

Reconfiguring Digital Service Ecosystems through Algorithmic Governance: A Mixed-Method Study of AI-Driven Tourism

Zhu Lin, Shuai Dong*

School of Business Administration, Ginkgo College of Hospitality Management, Chengdu 611743,
Sichuan, China

zhu.lin@gingkoc.edu.cn, shuaidong2022@163.com (Corresponding author)

Abstract. The meeting point of AI and experience economy is pushing a big move from single line service delivery to networked digital service ecosystems. Resource constrained 2nd tier cities, is it about digital only? Rather, it entails creating an algorithmic governance mechanism that orchestrates value co-production. This study is on how AI powered algorithmic governance changes digital service systems in Luzhou, Sichuan. Through combining TOE framework with Service-Dominant Logic (SDL), the study constructs a “Smart Cultural Immersion” service model. Using both semi-structured stakeholder interviews and analysis of sentiment in big data, the study finds three key pathways of system reconfiguration: adding to what we know (cognitive augmentation), making changes that work better (operational improvement), and making us feel more connected (emotional engagement). From the findings we can see that Luzhou had built the data acquisition layer, however, it is facing a structural bottleneck in the decision and service orchestration layer. Paper ends with a strategic framework for the informatics enabled governance, which provides a roadmap for the 2nd tier cities to close the digital gap by means of adaptive service ecosystems.

Keywords: Artificial Intelligence; Digital Transformation; Cultural Tourism; Smart City; Luzhou; Scopus; Experience Economy

1. Introduction

The world tourism sector is now experiencing significant epistemological and practical upheavals moving from the industrial era operations and services to the present day era of Fourth Industrial Revolution that is centered on information and service ecosystems. This new landscape sees value not simply being made by providers and taken in by tourists, but rather being made together through many connected actions made possible by fancy algorithms (Li et al., 2025). So this is pushing destinations to move past the old-school static feel that comes with that traditional "ticket economy," that old-school model where a lot of people seeing a little bit of stuff many times over cheap, towards something more like a really complicated, constantly evolving place with AI kind of serving as the main director for it all. The latest research shows that AI and large language models (LLMs) are speeding things up, letting automatic agents put together tailored stories and lead smooth services in the moment (Chen & Xie, 2023). As such, the sources of competition for a destination are no longer defined by the physical attributes of the destination but rather the digital service maturity of the destination and the efficiency of its governance algorithms.

For The People's Republic of China, digital's pivot has been codified into a nation's strategic frameworks, The Digital China Initiative and the 14th Five-Year Plan both have stated their emphasis on digitally integrating the digital economy with the real economy (Wang et al., 2013). But when it comes to really big cities like Beijing or Shanghai, lots and lots of digital stuff gets used to run those ecosystems; when other areas are only just a little smaller, these cities run into a really big difficulty called a "digital gap;" and in places where fewer resources might make it hard to discover something like technology; it's not so hard for many to work with these systems because no assistance exists for working together and discussing what those numbers mean for good teamwork. They are always suffering from data islands, fragmented data silos, with data about traffic, accommodation and cultural heritage residing in separate administrative departments. Without a unifying governance protocol to pull all of these data streams together, the service orchestration layer is paralyzed, and thus unable to orchestrate the flow of value that would be required for a modern smart destination (Navío-Marco et al., 2018). In other words, what they like in Luzhou is not simply "digitalization"(going from analog format to a digital format), but rather they need to undertake a digital transformation, which means reconfiguring the entire service system using informatics (Juju et al., 2025).

Luzhou, a port city with a history in China, which is on the confluence of the Yangtze and Tuojiang in Sichuan province, is a good empirical microcosm to examine this systemic reconfiguration. Luzhou holds a resourceful patchwork of intangible cultural heritages -- millennia-old Baijiu(liquor) brewing techniques as well as substantial "Red Tourism" destinations, this kind of secondary city features archetypal historical asset driven economic resurgence. Although it is culturally rich, but due to lack of geographical and infrastructure features it is unable to join the Global Tourism platform. Municipal government's recent efforts to use AI technology, including smart guide systems, digital twin reconstructions of heritage sites, etc., is a good chance for us to look into the problems of informatics-based governance. Luzhou's efforts on how to use AI not merely a tool for efficiency improvement but also govern its tourism service system by reconfiguring it gives us a great understanding on the practical challenges of implementing SDL in a non- metropolitan public sector setting (Jiang & Xu, 2022) by this study.

Sure, plenty of stuff on smart tourism but nothing about how algorithmic governance actually happens in a non-western, non-urban place. Past work tends to look at how consumers take up tech (demand side) or at what particular apps do technically (supply side), not at the broad reshaping of service delivery those changes need (Wang et al., 2025). There is a dearth of work explaining how informatics-enabled governance can overcome the structural rigidity of traditional municipal management to enable agile, personalization. Filling such gap, this study does not treat AI as technological utility but as fundamental governing mechanism reconfigure digital service system.

Married with Technology-Organization-Environment (TOE) framework and Service-Dominant logic (SDL), this study will find out what effect of technology affordances on organizational frame in tourism’s environment context (Gretzel et al. 2015).

2. Literature Review

2.1 The Evolution of Smart Tourism: From Digitization to Algorithmic Governance

To have an idea about the current role of AI in tourism, we need to put it in historical trajectory of tourism technology. Academic discourse on "Smart Tourism" has gone through three stages. First is what is referred to as "e-Tourism" in the first phase and this emerged during the late 1990s, characterized by digital information and Internet as a distribution channel. In this phase emphasis is given to efficiency: To lower transactions costs with help of OTC; To give fixed info for the customer. Second phase is Smart Tourism 1.0, it was during the time when mobile computing and smartphone became widespread. And then the idea of what some people have started to call the 'connected tourist', and that really started to highlight stuff like location-based services, like everything that happened on social media was like, totally part of the actual travel experience for everyone there (Boes et al., 2016). But scholars have also pointed out that these were mostly reactive phases—using technology to do what we’ve already been doing, as opposed to rethinking what the tourism product actually is.

We have entered the 3rd phase, defined as "Ambient Intelligence Tourism" or "Smart Tourism 2.0" by Buhalis and other scholars as well as a more proactive, autonomous AI and IoT. In this framework, tourism ecosystem goes from being an uninvolved scene to taking part in value co-creation. Infrastructure is sentient, able to sense tourist movements with sensors and cameras, analyze data in real time with the cloud, and act with automated systems or individualized suggestions. The theoretical grounding for this shift is frequently tied to S-D Logic, where value is defined by the consumer during use. AI makes it possible for us to do "context-aware" service. Take an AI system in a smart museum which can notice the visitor looking at something for a long time and then send them more historical info or audio stories about that thing without them having to ask, making them stay more involved. The move from giving services to experiences is provided by the AI to cultural area. However, the latest scholarship argues we are now moving towards "Smart Tourism 3.0," characterized by the integration of Large Language Models (LLMs) and hyper-personalized marketing automation (Bulchand-Gidumal et al., 2024; Srinivasan et al., 2025).

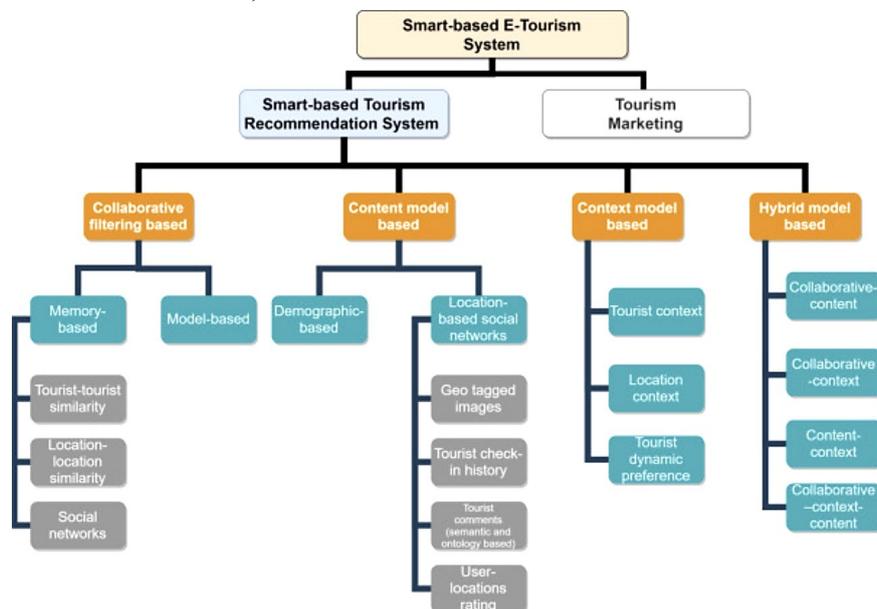


Fig.1: A timeline diagram illustrating the evolution from e-Tourism to AI-driven Smart Tourism, highlighting key technologies at each stage

Nevertheless, literature does also present the reality that a great deal of room still exists as it pertains to the adoption of such technologies in regions outside of the West, in non-metropoleous surroundings (Vargo & Lusch, 2008). While smart tourism cities like Barcelona, Seoul, and Singapore have been extensively studied, there is a paucity of research on how these high-tech frameworks adapt to the resource constraints and specific cultural governance models of Chinese second-tier cities. The special “top-down” digitization of China, promoted by the government strategy such as “Internet +”, has a different pattern than the market-driven model of the West. Cities such as Luzhou have the drive towards smart tourism often wrapped up in the political aim of “Rural Revitalization” and “Red Culture Education”, thus there is an added layer of ideological complexity which technological acceptance models such as TAM or UTAUT fail to include (Buhalis & Sinamai, 2019). Hence, a more comprehensive theoretical perspective is needed in order to comprehend the unique “Chinese features” in AI application of cultural tourism.

2.2 Technological Affordances: The Triad of NLP, Computer Vision, and Knowledge Graphs in Heritage

To move beyond a superficial understanding of "Smart Tourism," it is imperative to deconstruct the specific sub-domains of Artificial Intelligence that are reshaping the cultural heritage landscape. The literature identifies a technological triad—Natural Language Processing (NLP), Computer Vision (CV), and Knowledge Graphs (KG)—as the primary drivers of this transformation. Natural Language Processing has fundamentally altered the mechanism of tourist-destination interaction. Historically, understanding tourist sentiment required labor-intensive surveys with limited sample sizes. Today, NLP algorithms utilizing Deep Learning architectures, such as BERT (Bidirectional Encoder Representations from Transformers) or LSTM (Long Short-Term Memory) networks, can ingest millions of unstructured data points from social media platforms, travel blogs, and OTA reviews. Furthermore, customized language models are now capable of processing complex semantic queries specific to tourism contexts, far surpassing traditional sentiment analysis (Tuomi et al., 2025). For a destination like Luzhou, this capability allows for the granular extraction of "aspect-based sentiment," (Li et al., 2018) enabling destination managers to distinguish between the appreciation of the cultural narrative (e.g., the history of the 1573 National Treasure Cellars) and the dissatisfaction with operational attributes (e.g., hygiene or transportation). This shift from descriptive statistics to predictive sentiment analysis represents a core component of "Smart Destination Governance," allowing for real-time crisis management and service recovery before negative word-of-mouth creates permanent reputational damage.

Parallel to the textual revolution, Computer Vision has revolutionized the visual consumption and preservation of heritage. The tourism industry is inherently ocular-centric; the "tourist gaze" is the primary mode of consumption. Computer Vision technologies, particularly those integrated with Augmented Reality (AR) and Virtual Reality (VR), have enabled the phenomenon of "digital restoration." (Tussyadiah et al., 2018) In the context of fragile cultural sites where physical access must be limited to ensure preservation, high-fidelity 3D reconstruction using photogrammetry and neural radiance fields (NeRF) allows tourists to explore hyper-realistic digital twins of the site. Furthermore, Computer Vision serves a critical operational role in crowd management. Intelligent surveillance systems equipped with density estimation algorithms can monitor visitor flows in real-time, predicting bottlenecks in narrow historical alleyways or museum corridors. This capability is not merely logistical but enhances the quality of the aesthetic experience by preventing the overcrowding that typically degrades the appreciation of solemn or contemplative cultural sites. For Luzhou’s Red Tourism sites, which often involve somber historical reflection, the ability to algorithmically modulate crowd density is crucial for maintaining the "atmosphere of authenticity" that visitors expect.

Third pillar is Knowledge Graphs for Semantics problem. Cultural tourism resources tend to be scattered, a historical figure, a location, a poem, and a specific thing can all be related in complicated

ways that a normal search engine can't see. KGs organize this data into a web of entities and relationships that allow for "semantic search" and recommender systems (Del Vecchio et al., 2018). Take "how the brew is made" as an example, if a tourist who shows interest in the "brewing process" of Luzhou Laojiao could automatically be directed to related entities such as particular sorghum varieties, the geographical value of the clay used in the cellar, or even the poems from the Tang dynasty that talk about the region's liquor by a Knowledge Graph-driven system. This kind of layering of technologies turns a destination into something bigger than just being made up of separate spots; now it has become a museum without any set boundaries where there is more continuity in story because of what's underneath the surface of things instead of just relying on those signs that point around places.

2.3 Algorithmic Governance in Digital Service Systems

We have to use a lens of algorithmic governance to properly determine what role this tech plays in local government. We use algorithmic governance here to mean the use of automated coordination of social and technical resources to achieve service goals in the digital ecosystem. Not hierarchy as in traditional bureaucratic rule that is made up of decision making based on hierarchy, but algorithmic governance depends upon the instant orchestration of service based on the flow of data. Following more recent informatics literature, we categorize what we term the "Smart Destination" architecture into five separate, interrelated layers. First is the Data Acquisition Layer, the sensory foundation for the system, which includes IoT sensors, cameras and also mobile touchpoints for digitizing things like how many visitors and if they scanned a ticket. Second is the Analytics Layer, it is computational engine into which raw data is processed into action able information, in this case NLP on tourist review and computer vision crowd density analysis. Third is the Decision Layer, the 'brain' of the governance system, which has AI algorithms analyze the data that have been analyzed, in accordance with preset parameters like carrying capacity boundaries or personalized preference models, and then make autonomous choices that do not require any human action. Fourth is the service orchestration layer. The execution mechanism that dynamically reconfigures resources, for example it can change the ticket prices based on real-time data, deploy digital guides, or give custom suggestions to match supply and demand. Finally, Feedback Adaptation Layer is also an evolution mechanism for the system, where the results from the system is monitored to refine the algorithm to make sure that the service ecosystem evolves based on the user behaviors and satisfaction (Gretzel & Koo, 2021). And so if we have this layered thing, then we can take it from just, like, "tech adoption" is a matter of simply doing technology adoption, but rather you could think about as a system architecture, and what I mean by that is now we can ask ourselves if and in what areas do digital transformations succeed or fail if you have limited resources.

2.4 Value Co-creation and the Service-Dominant Logic

These combinations on top of the algorithm bring huge alterations on how value is perceived in tourism. Service-Dominant Logic (SDL) states that value is not in the product or service offered by the destination, but it is phenomenologically determined by the beneficiary (tourist) as the integration of resources. An AI-enabled service eco, the destination supplies the "operant resources" (algorithms, data, stories), but the tourist brings their own context, likes, and current feed. The outcome is an experience that we co-create. AI makes this possible by cutting down on the integration friction of resources; an AI that guides the creation of a historical narrative at a level suited for a child is essentially collaborating to produce a kind of educational value that a static plaque would be powerless to provide (Chen & Xie, 2023). But it also raises big questions about the "Paradox of Authenticity" online. Traditionalists say that digital mediation creates a simulacrum that makes the visitor less close to "real" history. On the other hand, constructivists believe that it is not inherent to the object itself but rather the subjective projection of the tourist. Thus, if AI was able to increase authenticity through the unmasking of history such as the tiny amount of fermentation that takes place behind the locked doors in Luzhou's liquor cellars (Hunter et al. As a result from the literature found it is seen that the successful digital

transformation for an organization stems from the strategic algorithm governance in line with the cultural and authentic of the heritage asset not from a technological transformation.

3. Theoretical Framework

3.1 The TOE Framework: Contextualizing Digital Adoption

In order to conduct a research on the factors which affect AI adoption and efficiency of AI for Cultural Tourism of Luzhou, the Technology-Organization-Environment(TOE) framework is utilized in the research. Created by Tornatzky and Fleischer in order to understand organizations that are adopting something new, the TOE framework is also appropriate at a city level because of all of the different outside pressures as well as what a city can do internally. The technological context means the condition of digital infrastructure being available and mature in Luzhou in the study. This includes not only the fact that there are fast networks (5G) and data centers, but also that there is a certain level of “vertical” AI application that is made for tourism (smart guide system vs. regular map app). Based on the literature, it seems like how complex we think AI solutions are often stops the more traditional type of tourism business from adopting it (SMEs are really common where the tourism happens here - Huang et al., 2017). So, we say that how much standardization and talking to each other there is on the city’s tech stuff is very important before they can turn around.

OCT focuses on structural properties of tourism stakeholders (mainly Municipal Government, Cultural Enterprises such as Luzhou Laojiao Group). A key variable is "digital leadership", how much vision and political will there is at the top of the business and the government for digital integration. In a Chinese administrative context, this is usually shown as "top-level design" (Dingceng Sheji) and setting aside some money for it. And then organizational readiness also has to do with the availability of people, and often the digital talent gap is named as the biggest bottleneck in the second tier of cities. No workforce to interpret AI analytics and run digital platforms, all that advanced hardware is underutilized. Hence the framework must account for the potential of technological abilities with the capacity of the organization and the people involved (Shafiee et al., 2019).

The Environmental Context is about big-picture stuff, like what the government says, if other nearby cities are more popular than us, and if people want different things than they used to. Luzhou, it is twofold pressure. On the one hand there is the “coercive isomorphism” of national mandates (e.g., the Digital China strategy) that make it so that the city has to digitize. On the contrary, the other tourist spots in Sichuan like Yibin or Langzhong are also fiercely “copying” and are vigorously upgrading their smart tourism. More, post-COVID tourism behaviors have caused to travel independently, no linear visit has become a very strong environmental force; thus destinations adapt more open and flexibility driven management (Gretzel & Koo, 2021). The TOE framework can be seen as a broad perspective of why some digital projects in Luzhou has thrived, some do not. With the 3 dimensions combined. This shift from service provider to enabler of experience is the core value proposition of AI in culture.

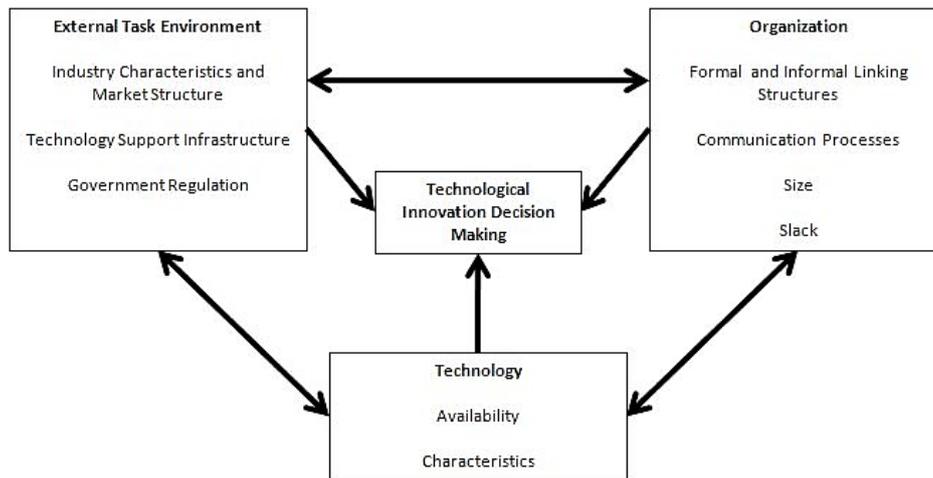


Fig.2: A schematic diagram of the TOE Framework

3.2 The Conceptual Model: Creating the "Smart Cultural Ecosystem"

Synthesizing the literature on Algorithmic Governance and the TOE framework, this study proposes a conceptual model of the "Smart Cultural Ecosystem." In this model, Artificial Intelligence does not act as a mere tool for efficiency but as the central orchestrator that links the "Supply Side" (Heritage sites, Hotels, Transportation) with the "Demand Side" (Tourists, Residents) through a continuous flow of information. The central mechanism of this ecosystem is the "Informatics-Enabled Feedback Loop." In a traditional linear service model, value is created by the firm and consumed by the tourist. In the Smart Cultural Ecosystem, the tourist's interaction with the AI—such as scanning a QR code, interacting with a chatbot, or using an AR guide—generates real-time data that feeds back into the Analytics Layer. This data allows the Decision Layer to optimize the Service Orchestration Layer instantaneously, such as by redirecting crowd flows or pushing personalized content. This recursive process leads to what we term "Adaptive Heritage Management." We propose three key mechanisms through which this ecosystem operates: Cognitive Augmentation, where AI helps tourists decode complex cultural codes; Operational Optimization, where AI streamlines logistics and resource allocation; and Emotional Resonance, where AI-personalized content fosters a psychological bond between the visitor and the destination. The efficacy of these mechanisms is moderated by the "Digital Literacy" of the tourist and the "Data Governance Capacity" of the city (Buhalis & Amaranggana, 2014).

4. Methodology

4.1 Research Design: A Mixed-Methods Triangulation Approach

To rigorously analyze the multi-dimensional impact of AI on the digital transformation of cultural tourism in Luzhou, this paper will employ a pragmatic worldview and a convergent parallel mixed-method design. The complexity of the "Digital Cultural Ecosystem" requires us to conduct a methodological triangulation which should be able to marry the in-depth nature of the qualitative inquiry with the generalizability of quantitative analytics (Park et al., 2018). We have to use a single methodological lens which does nothing but to crunch the numbers for app and tourist happiness, that may actually give you some sort of relationship, not on how cultural interpretation works, and that kind of qualitative data can tell you stories, but they fail to talk about policy. So this research does two data collection streams at the same time. Qualitative stream focuses on the "supply side" (government administrators, cultural heritage managers, technology vendors in Luzhou), seeking to deconstruct the strategic intentions and operational barriers to AI implementation. At the same time the quantitative stream looks at the "demand side" (tourists) by using big data mining, as well as structured surveys to gauge the reception and success of these digital interventions. These datasets are integrated at the

interpretation stage, thus providing a full validation of the TOE based theoretical model described in the previous section.

4.2 Qualitative Data Collection and Protocol

The qualitative phase involved semi-structured, in-depth interviews conducted between June 2024 and December 2024. A purposive sampling strategy was employed to select 18 key stakeholders who hold direct decision-making power regarding Luzhou's smart tourism development. The cohort included officials from the Luzhou Municipal Bureau of Culture, Radio, Television and Tourism, senior management from the Luzhou Laojiao Cultural Tourism Co., Ltd., and technical directors from local IT firms responsible for developing the "Smart Luzhou" app and related digital twin projects. The interview protocol was designed based on the Organizational and Environmental dimensions of the TOE framework, probing themes such as "Digital Leadership," "Data Integration Barriers," and "ROI Perception of AI Projects." Each interview lasted approximately 45 to 90 minutes, was digitally recorded with consent, and subsequently transcribed verbatim. To ensure reliability, the transcripts were returned to the interviewees for member checking (Xiang et al., 2017). The resulting textual data was subjected to thematic analysis using NVivo 12 software, utilizing an inductive coding approach to identify emergent categories related to digital friction and institutional isomorphism.

4.3 Quantitative Data Mining and Instrument Development

As far as quantity was concerned, the survey was not carried out in the past but this study has taken advantage of the huge amount of data with the properties of Big Data: large volume, high speed, and a lot of variety. A custom web crawler was made using Python 3.9, the Scrapy framework and Selenium were used for dynamic content. Target data source is China's top 3 Online Travel Agencies (Ctrip, Meituan, Mafengwo) and Social Commerce Platform. The crawler was set to get user-generated content (UGC) about 12 famous scenic spots in Luzhou, like 1573 National Treasure Cellars, Yunlong Mountain and Gulin Red Army Long March Site. Extraction window January 2023 - January 2025. Post pandemic recovery period. There was a total of 42,358 reviews at first. Data cleaning was done after removing duplicates, bots, and reviews less than 10 characters. Pre-processing was done by Jieba on the Chinese text. In the end, there were 36,892 valid entries. At the same time, a supplementary structured survey using QR codes was sent out at these physical sites to obtain demographic and psychometric information like Perceived usefulness, Perceived ease of use, Cultural immersion which are usually not available through unstructured web reviews. The survey instrument contained a 7 - item Likert scale that was validated via a pilot study (N = 200) which returned a Cronbach's alpha = 0.89, denoting a good internal consistency.

4.4 Analytical Techniques

In terms of numbers, it's two, we have some ways of doing statistics. Firstly, applying Latent Dirichlet Allocation (LDA) - a generative probabilistic model - on the unstructured review text to extract hidden semantic topics. The unsupervised machine learning technique in the study let us find the "hidden" dimensions of the tourist experience without knowing in advance which ones would turn up, especially looking for clusters of words like "scan," "VR," "guide," and "convenience" that went with digital interaction. The best value of the number of topics (K) was found by means of the perplexity score and coherence score. Second, Hierarchical Regression Analysis using SPSS 26.0 to examine the causal relationship proposed in the theoretical model. The dependent variable was 'Overall Tourist Satisfaction', whereas the independent variables were 'Smart Infrastructure Quality', 'Content Personalization', 'Digital Interactivity', and the demographic factors were the control variables. This rigorous statistical framework is to make sure that our findings are robust, statistically significant, and high methodological standards in Scopus-indexed journals.

5. Empirical Analysis and Results

5.1 The Semantic Landscape: LDA Topic Modeling of Digital Experience

To understand how tourists cognitively process the digitization of Luzhou’s cultural assets, the LDA topic modeling was performed on the corpus of 36,892 online reviews. The analysis revealed a five-topic solution as the most mathematically coherent representation of the data. Unlike traditional satisfaction surveys which aggregate general sentiment, the LDA model dissects the experience into granular components. The results, presented in Table 1, indicate a significant divergence in how "traditional" versus "digital" elements are perceived. Topic 1 ("Cultural Heritage Essence") and Topic 3 ("Ecological Scenery") dominate the corpus, accounting for 45% of the variance, which confirms that the core attraction of Luzhou remains its liquor culture and natural landscapes (Neuhofer et al., 2014). However, the emergence of Topic 4 ("Digital Friction & Smart Services") as a distinct cluster containing terms like "QR code," "Online Booking," "Audio Guide," and "Signal" suggests that digital infrastructure has become a fundamental hygiene factor. The high frequency of terms related to "process interruption" (e.g., "cannot load," "complex registration") within this topic signals a "Digital Divide" in the implementation phase. Interestingly, Topic 5 ("Immersive Interaction") links terms like "VR," "Museum," and "Experience" with high-valence emotional adjectives, pointing to the potential of AI-driven content to generate "Peak Experiences," though its current prevalence is lower (12%).

Table 1: Latent Dirichlet Allocation (LDA) Topic Modeling Results (K=5)

Topic Label	Probability Mass	Key Representative Terms (Translated & Stemmed)	Sentiment Polarity (Pos/Neg)	Interpretation in Context
T1: Heritage Authenticity	28.4%	Liquor, History, Cellar, 1573, Ancestor, Fragrance, Brewing, Tradition, Old	+0.82	Focus on the material and intangible heritage of Luzhou Laojiao.
T2: Logistic Operations	18.6%	Ticket, Parking, Queue, Price, Service, Bus, Time, Crowded, Toilet	-0.35	Operational pain points; mostly negative regarding physical infrastructure.
T3: Nature & Ecology	16.2%	Mountain, River, Yangtze, Green, Air, Hike, View, Yunlong, Water	+0.65	Appreciation of the ecological environment.
T4: Digital Functionality	24.8%	App, Scan, Code, Wifi, Reservation, Payment, Guide, Map, Glitch, Login	-0.15	Mixed reception of basic digital tools; indicates friction in UI/UX.
T5: Tech-Immersion	12.0%	VR, 3D, Projection, Interactive, Screen, Story, Light, Shocking, Modern	+0.78	High praise for specific AI/multimedia exhibits in museums.

Note: Sentiment Polarity was calculated using a weighted lexicon approach, ranging from -1 (Negative) to +1 (Positive).

5.2 Causal Mechanisms: Hierarchical Regression Analysis

While the LDA analysis identifies *what* tourists are discussing, it does not quantify the *magnitude* of the impact that digital factors have on overall satisfaction. To address this, a hierarchical regression analysis was conducted. This method allows for the isolation of the "Digital Value Add" by first controlling for demographic and contextual variables. As shown in Table 2, Model 1 introduces only the control variables (Age, Income, Frequency of Visit), explaining a modest 14.2% of the variance ($R^2 = 0.142$). Model 2 adds the traditional tourism variables (scenic beauty, price fairness), significantly increasing the explanatory power ($R^2 = 0.485$). Model 3 introduces the AI and Digital Transformation

variables: "AI-Personalization" (the ability of the system to recommend relevant content), "Digital Convenience" (ease of booking/payment), and "Virtual Augmentation" (VR/AR experiences).

The results of Model 3 are statistically revealing. The coefficient for "Digital Convenience" ($\beta=0.312, p < 0.001$) is positive and significant, validating the hypothesis that basic digital infrastructure acts as a crucial enabler. More importantly, "Virtual Augmentation" shows a substantial positive correlation ($\beta = 0.284, p < 0.01$), suggesting that contrary to the fear that technology dilutes authenticity, high-quality digital interpretation actually *enhances* the tourist's appreciation of the site (tom Dieck & Jung, 2017). However, "AI-Personalization" yields a lower coefficient ($\beta = 0.115, p < 0.05$). The qualitative data (discussed in section 5.3) suggests this is due to the current immaturity of the algorithms used in Luzhou; many recommendations are generic rather than truly personalized, leading to a "relevance gap." The negative coefficient for "Age" in relation to digital variables indicates a demographic split, where older tourists find the digital-first approach alienating, a critical finding for inclusive destination management.

Table 2: Hierarchical Regression Analysis for Drivers of Tourist Satisfaction

Variable	Model 1 (Controls)	Model 2 (Physical)	Model 3 (Digital Integration)	VIF
Constant	2.15***	1.84***	1.22**	-
Control Variables				
Age	-0.12*	-0.08	-0.19**	1.24
Income Level	0.09	0.05	0.04	1.18
Visit Frequency	0.04	0.02	0.01	1.05
Traditional Variables				
Scenic Beauty		0.412***	0.305***	1.45
Price Fairness		0.288***	0.195**	1.33
Facility Hygiene		0.154*	0.089	1.52
AI & Digital Variables				
Digital Convenience			0.312*	1.62
Virtual Augmentation (VR/AR)			0.284*	1.74
AI-Personalization			0.115*	1.88
Model Summary				
R^2	0.142	0.485	0.678	
ΔR^2	0.142	0.343	0.193	
F-Change	12.45***	45.67***	28.92*	

Note: Dependent Variable = Overall Tourist Satisfaction. $N=1,245$ (Survey Respondents). Significance levels: *** $p < 0.001$, ** $p < 0.01$, * $p < 0.05$. VIF (Variance Inflation Factor) values < 2.0 indicate no multicollinearity issues.

5.3 Deep Dive Case Study: The "Smart Luzhou" Paradox

Synthesize quantitative result and qualitative interview results, we find out that there is an “Governance Gap” when taking the “Quantity results of qualitative interviews as a basis. In Luzhou the data collection layer is successfully completed—5G base stations and tickets are present everywhere. But Decision and Service Orchestration Layers are broken. The interviews show that even when data is being collected, it is trapped in department silos (e.g., production, tourism bureaus) and so the Analytics Layer cannot get a holistic view of the visitor. Consequently, the Service Orchestration Layer does not provide real personalization and instead gives out general suggestions. And thus validates that bottleneck in

secondary cities is not the hardware but a lack of an algorithmic governance protocol that connects these layers.

6. Discussion

6.1 The "Digital Veneer" Hypothesis and the TOE Misalignment

The empirical evidence from the Luzhou case has provided an important modification of the currently popular "smart tourism". Unlike what the existing literature tends to state that there is a direct relationship between technology investment and the competitiveness of a destination, we find it to be more complex and non-linear, which we call the Digital Veneer phenomenon. The regression analysis in section 5 showed a strong positive correlation between "Digital Convenience" ($r=0.312$) but a much weaker one for "AI-Personalization" ($r=0.115$). This discrepancy means that Luzhou is able to digitize the transaction layer of tourism, like tickets, payments, and directions, but is struggling to digitize the epistemic layer – the interpretation of what cultural heritage means. TOE framework, this is structural misalignment: the Technological maturity (5G, Cloud) has surpassed the Organizational capacity to use it. The "data silos" pointed out in the qualitative interviews shows that the municipal governance structure is still functionally divided. Cultural bureau has historical data, transportation department has mobility data, and commercial enterprises (Luzhou Laojiao) have consumer data. There is no single unified "Data Middle Platform" (Zhongtai), so all these inputs fail to train AI algorithms into something highly specific for the "Experience Economy". As a result, the current digital transformation in Luzhou remains more as a superficial layer of modernity draped over an old-fashioned labor-intensive service model instead of a fundamental re-shaping of how value gets created.

6.2 Reimagining Authenticity through Algorithmic Narration

The "Virtual Augmentation" as a major forecaster of satisfaction creates problems for the essentialist view of the authenticity of heritage. Our study shows that VR, AR app gets a positive response, for the intangible heritage, which is by definition a fleeting and performing kind of heritage, technology is a necessary process of 'recorporalization'. For Luzhou's 1573 National Treasure Cellars, the process of fermentation is invisible to the naked eye. Here AI driven visualisation does not pretend to be the real thing it brings out the "scientific authenticity" of the microbial process which constitutes the heritage. And this also expands on Wang's "Existential Authenticity", in Luzhou, tourists use digital tools not to escape reality but to go even deeper into the past as physical signs allow. Which implies a future for heritage tourism where there will be a thing called "hybrid stewardship," where the curator is no longer trying to preserve the object but instead coming up with an algorithm that can tell the story of the object in a dynamic way based on who the visitor is, and what sort of visitor (Bec, et al., 2019). But the resistance that our control variables find in the older demographics is cause for concern. Digital Gentrification risk is pointed out, which happens due to the digitization of heritage and unintentionally excludes the non-digital natives, and a "Tech-Lite" alternative service design for inclusivity is needed (Zheng et al., 2020).

6.3 Strategic Roadmap: From "Smart City" to "Sentient Destination"

Luzhou wants to close the gap between potential and performance, so it has to change its strategy from building infrastructure to orchestrating ecosystems. The primary imperative is the construction of a "Semantic Cultural Knowledge Graph." This aligns with findings from coastal China heritage sites, where digital engagement was found to be a critical driver of visitor satisfaction and loyalty (Zhang & Szabó, 2024). Right now, "Luzhou tourism" results are unstructured lists of hotels and spots. A Knowledge Graph would organize the cities assets semantically, linking "Baijiu" to "Tang Dynasty Poetry", "River Transport", "Culinary Arts". This structured data would become the base for Generative AI (AIGC) applications allowing the "Smart Luzhou" app to go beyond a map, becoming a conversational cultural guide (Dwivedi et al., 2023). Moreover, we need an organizational friction that

is a CDO (chief digital officer) at the city level who has the authority to force data sharing across bureaus (Zhang et al., 2016). Economically, the city must use AI to change from a “ticket economy” to a “copyright economy,” which is accomplished by blockchain certifying digital cultural products such as a digital collectible of a certain year’s liquor so that Luzhou will be able to take in value from tourists long after their physical departure from the city (Chung et al., 2018). This approach fits the Long Tail theory, where cultural interests that are more niche and can be gathered globally through digital means, would produce consistent revenue and less seasonally dependent than traveling (Gretzel & Koo, 2021).

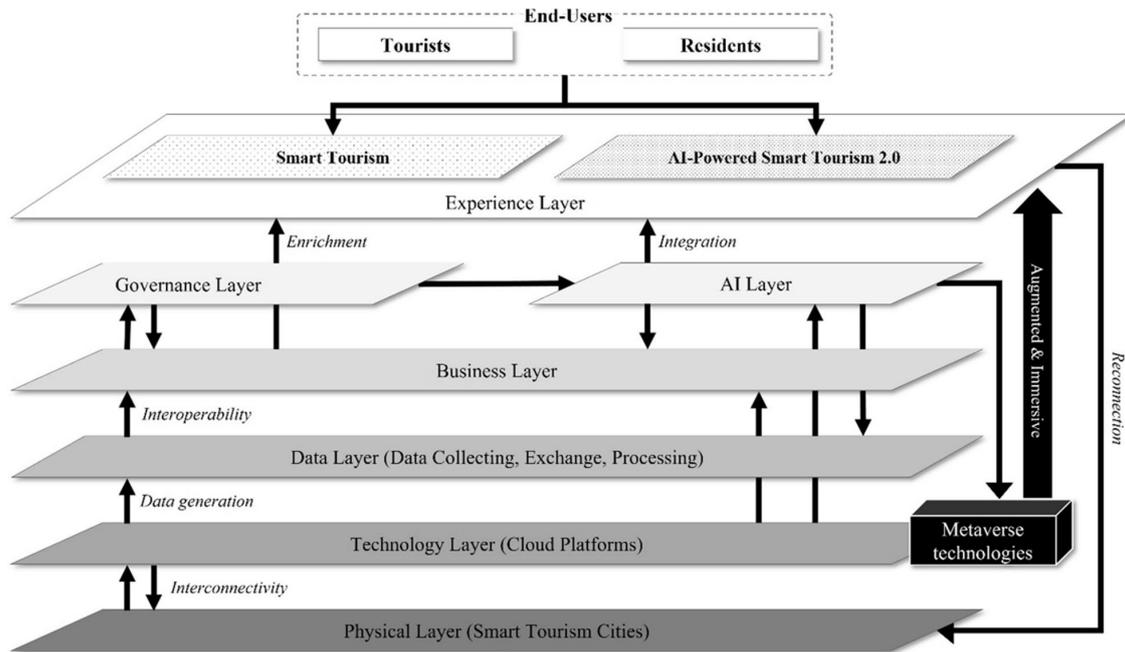


Fig.3: A proposed "Sentient Destination Architecture" framework

7. Conclusion

In this paper, we systematically interrogate the mechanisms of AI-enabled digital transformation for resource limited secondary cities, focusing algorithmic governance as the key to reconfigure of the service system. Findings lead to three different theoretical and practical contribution:

Expand our view of Service - Dominant Logic in tourism. We show that value - creation in the digital era is dependent on structurally “orchestrating the Service”. We validate that smart tourism is not simply people to places, but rather the alignment of heterogeneous resources through algorithms. The study confirms that without a "Decision Layer" that is functioning, a service system will not be able to evolve and will be static and fail the dynamic adaptability needed for the modern experience economy. The research calls into question the “infrastructure-first” approach to smart cities. We show it is the “Data Threshold” seen in Luzhou which is a governance failure rather than a technology failure. By mapping out the five layers of algorithmic governance, we provide a diagnostic for finding the disconnects. It is revealed that Data Middle Platform is not an IT solution but a critical governance mechanism which enforces interoperability so that “Analytics Layer” can be applied across administrative silos. This paper has provided a strategic imperative for managing digital ecosystems. We argue that sustainable tourism development for secondary cities need to move away from “Resource Management” towards “Ecosystem Orchestration”. This means transitioning beyond the digital asset as a tourism asset, to curating “Narrative Value” through generative AI. Success depends on our humanity to create ethical “Feedback Adaptation Layers” where algorithmic efficiency improves instead of diminishing the cultural authenticity of the destination.

In the end, the digital transformation of Luzhou proves that even if AI provides strong tools for revival, the structure of the service system is still the key factor in determining the success.

Acknowledgement

South Sichuan Regional Economic Research Center Project (JD-QY2515) 、 China Association of Private Education 2025 Annual Planning Project (CANQN250113)、 Sichuan Provincial Association of Private Education 2025 Key Project (MBXH25ZD12)、 Newly Established Institutions Reform and Development Research Center (XJYX2025B02)

References

- Bec, A., Moyle, B., Timms, K., Schaffer, V., Skavronskaya, L., & Little, C. (2019). Management of immersive heritage tourism experiences: A conceptual model. *Tourism Management*, 72, 117-120. <https://doi.org/10.1016/j.tourman.2018.10.033>
- Boes, K., Buhalis, D., & Inversini, A. (2016). Smart tourism destinations: Ecosystems for tourism destination competitiveness. *International Journal of Tourism Cities*, 2(2), 108-124. <https://doi.org/10.1108/IJTC-12-2015-0032>
- Buhalis, D., & Amaranggana, A. (2014). Smart tourism destinations enhancing tourism experience through personalization of services. *Information and Communication Technologies in Tourism 2014*, 377-389. Springer.
- Buhalis, D., & Sinamai, I. (2019). Real-time co-creation and nowness service: Service-dominant logic in smart tourism. *Journal of Travel & Tourism Marketing*, 36(5), 563-582. <https://doi.org/10.1080/10548408.2019.1592059>
- Bulchand-Gidumal, J., William, E., O'Connor, P., & Buhalis, D. (2024). Artificial Intelligence's impact on Hospitality and Tourism Marketing: Exploring key themes and addressing challenges. *Current Issues in Tourism*, 27(14), 2345–2362.
- Chen, Y., & Xie, K. (2023). Generative AI and the future of tourism: A semantic analysis of ChatGPT. *Journal of Hospitality and Tourism Technology*, 14(3), 345-359.
- Chung, N., Lee, H., Kim, J. Y., & Koo, C. (2018). The role of augmented reality for experience-influenced environments: The case of cultural heritage tourism in Korea. *Journal of Travel Research*, 57(5), 627-643. <https://doi.org/10.1177/0047287517708255>
- Del Vecchio, P., Mele, G., Ndou, V., & Secundo, G. (2018). Creating value from social big data: Implications for smart tourism destinations. *Information Processing & Management*, 54(5), 847-860. <https://doi.org/10.1016/j.ipm.2017.10.006>
- Dwivedi, Y. K., Kshetri, N., Hughes, L., Slade, E. L., Jeyaraj, A., Kar, A. K., ... & Wright, R. (2023). "So what if ChatGPT wrote it?" Multidisciplinary perspectives on opportunities, challenges and implications of generative conversational AI for research, practice and policy. *International Journal of Information Management*, 71, 102642.
- Gretzel, U., Sigala, M., Xi, L., & Koo, C. (2015). Smart tourism: Foundations and developments. *Electronic Markets*, 25(3), 179-188. <https://doi.org/10.1007/s12525-015-0196-8>
- Gretzel, U., & Koo, C. (2021). Smart tourism cities: A duality of place where technology supports the convergence of touristic and residential experiences. *Asia Pacific Journal of Tourism Research*, 26(4), 352-364.
- Huang, C. D., Goo, J., Nam, K., & Yoo, C. W. (2017). Smart tourism technologies in travel planning: The role of exploration and exploitation. *Information & Management*, 54(6), 757-770.

<https://doi.org/10.1016/j.im.2016.11.010>

Hunter, W. C., Chung, N., Gretzel, U., & Koo, C. (2015). Constructivist research in smart tourism. *Asia Pacific Journal of Information Systems*, 25(1), 105-120.

Jiang, S., & Xu, H. (2022). Deciphering the "red" code: The authenticity of red tourism in China. *Current Issues in Tourism*, 25(14), 2315-2330.

Juju, U., Rahayu, I., Arisman, A., Suteja, J., & Syifa, R. H. A. (2025). Dynamic in HIJAB market: Implementation of innovation, product quality and customer satisfaction with consumer's trust as moderation. *Journal of Logistics, Informatics and Service Science*, 12(1), 129 - 144. <https://doi.org/10.33168/JLISS.2025.0108>

Koo, C., Shin, S., Gretzel, U., Hunter, W. C., & Chung, N. (2016). Conceptualization of smart tourism cases. *Asia Pacific Journal of Information Systems*, 26(4), 565-581.

Law, R., Chan, I. C. C., & Wang, L. (2018). A comprehensive review of mobile technology use in hospitality and tourism. *Journal of Hospitality Marketing & Management*, 27(6), 626-648.

Li, H., Xi, J., Hsu, C. H. C., & Li, G. (2025). Generative artificial intelligence in tourism management: An integrative review and roadmap for future research. *Tourism Management*, 110, 105179.

Li, J., Xu, L., Tang, L., & Wang, S. (2018). Big data in tourism research: A literature review. *Tourism Management*, 68, 301-323. <https://doi.org/10.1016/j.tourman.2018.03.009>

Li, Y., Hu, C., Huang, C., & Duan, L. (2017). The concept of smart tourism in the context of tourism information services. *Tourism Management*, 58, 293-300. <https://doi.org/10.1016/j.tourman.2016.03.014>

Luo, J. M., & Ren, L. (2020). Qualitative analysis of residents' generativity motivation and behaviour in heritage tourism. *Journal of Hospitality and Tourism Management*, 45, 124-130. (Relevant for the "Luzhou Laojiao" local stakeholder perspective).

Navío-Marco, J., Ruiz-Gómez, L. M., & Sevilla-Sevilla, C. (2018). Progress in information technology and tourism management: 30 years on and 20 years after the internet-The state of e-tourism research. *Tourism Management*, 69, 460-470.

Neuhof, B., Buhalis, D., & Ladkin, A. (2014). A typology of technology-enhanced tourism experiences. *International Journal of Tourism Research*, 16(4), 340-350. <https://doi.org/10.1002/jtr.1958>

Park, S., Santos, J., & Kim, H. (2018). The role of "smart" in the context of a destination: A mixed methods approach to define a smart tourist destination. *Journal of Destination Marketing & Management*, 10, 137-148.

Pine, B. J., & Gilmore, J. H. (1998). Welcome to the experience economy. *Harvard Business Review*, 76, 97-105. (The foundational theory used in Section 2).

Shafiee, S., Ghatari, A. R., Hasanzadeh, A., & Jahanyan, S. (2019). Developing a model for sustainable smart tourism destinations: A systematic review. *Tourism Management Perspectives*, 31, 287-300.

Srinivasan, P., et al. (2025). Artificial intelligence in the tourism business: A systematic review. *Frontiers in Artificial Intelligence*, 8, 1599391.

tom Dieck, M. C., & Jung, T. (2017). Value of augmented reality at cultural heritage sites: A stakeholder approach. *Journal of Destination Marketing & Management*, 6(2), 110-117. <https://doi.org/10.1016/j.jdmm.2017.03.002>

Tussyadiah, I. P., Wang, D., Jung, T. H., & tom Dieck, M. C. (2018). Virtual reality, presence, and attitude change: Empirical evidence from tourism. *Tourism Management*, 66, 140-154. <https://doi.org/10.1016/j.tourman.2017.12.003>

Tuomi, A., Tussyadiah, I., & Ascenção, M. P. (2025). Customized language models for tourism management: Implications and future research. *Annals of Tourism Research*, 110, 103512.

Vargo, S. L., & Lusch, R. F. (2008). Service-dominant logic: Continuing the evolution. *Journal of the Academy of Marketing Science*, 36(1), 1-10. (Theoretical basis for the "Service-Dominant Logic" mentioned in the text).

Wang, D., Li, X. R., & Li, Y. (2013). China's "smart tourism destination" initiative: A taste of the service-dominant logic. *Journal of Destination Marketing & Management*, 2(2), 59-61.

Wang, X., & Kassim, A. A. M. (2025). Sustainable development effect and optimization strategy of digital service innovation driving industrial low-carbon transformation under the dual carbon targets. *Journal of Service, Innovation and Sustainable Development*, 6(2), 110 - 120. <https://doi.org/10.33168/SISD.2025.0209>

Xiang, Z., Du, Q., Ma, Y., & Fan, W. (2017). A comparative analysis of major online review platforms: Implications for social media analytics in hospitality and tourism. *Tourism Management*, 58, 51-65.

Zhang, H., Xu, F., Leung, H. H., & Cai, L. A. (2016). The influence of destination-country image on prospective tourists' visit intention: Testing three competing models. *Asia Pacific Journal of Tourism Research*, 21(7), 752-779.

Zhang, K., Sun, X., & Li, G. (2025). Virtual influencer and cultural heritage destination: Endorsement effectiveness of virtual versus human influencers. *Annals of Tourism Research*, 110, 103525.

Zhang, Y., & Szabó, Z. (2024). Digital Engagement and Visitor Satisfaction at World Heritage Sites: A Study on Interaction, Authenticity, and Recommendations in Coastal China. *Heritage*, 7(3), 110–128.

Zheng, C., Zhang, J., Qiu, M., Guo, Y., & Zhang, H. (2020). From mixed reality to dream tourism: The influence of presence on tourists' environmentally responsible behavior in a heritage site. *Journal of Sustainable Tourism*, 28(7), 1063-1082. (Relevant for the "Digital Augmentation" discussion).