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Mapping Beijing with Data: An AI Travel Companion for Personalized Dining and Sightseeing

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Abstract

As Beijing's cultural tourism market continues to expand and Generation Z becomes a major force in tourism consumption, conventional travel services have revealed clear limitations in information integration, personalized itinerary planning, and real-time responsiveness. Taking "Mapping Beijing with Data," an undergraduate innovation and entrepreneurship project, as its subject, this paper systematically examines the feasibility and implementation pathway of an AI-powered travel service platform from four perspectives: product functionality, core technical architecture, market-oriented business model, and potential risks. The analysis suggests that a technical solution built on a Beijing cultural-tourism knowledge graph and a dynamic-planning engine offers advantages in information-integration efficiency and the relevance of personalized recommendations. However, it also faces practical challenges involving data quality assurance, intensifying market competition, limited team experience, and data security and regulatory compliance. The project has promising implementation prospects, supported by both favorable policies and market demand. Sustained investment in technological iteration, resource integration, and compliance management will nevertheless be necessary for it to establish a foothold in the competitive cultural-tourism technology sector.

Keywords: Artificial Intelligence; Cultural-Tourism Integration; Knowledge Graph; Itinerary Planning; Business Model

1. Introduction

"Mapping Beijing with Data" is grounded in the realities of Beijing's cultural-tourism market. According to official statistics, Beijing received approximately 371.5 million tourist visits in 2024, including approximately 201.7 million visits by tourists from other provinces, and total tourism revenue reached RMB 672.24 billion (Beijing Municipal Bureau of Statistics & Beijing Survey Team of the National Bureau of Statistics, 2025). Despite this substantial market, visitors may still encounter notable service deficiencies. The project team's preliminary visitor survey reportedly

found that more than 68% of respondents identified three major pain points: fragmented cultural-tourism information that is difficult to integrate, the time and effort required for itinerary planning, and insufficiently personalized travel options. When preparing a trip to Beijing, visitors often have to gather information from multiple tourism platforms, social media channels, and businesses before assembling an itinerary themselves. After arriving, they may also encounter reservation restrictions at attractions, discrepancies between business recommendations and actual experiences, and traffic congestion between destinations. Conventional travel recommendation systems have long faced challenges involving information overload, context awareness, and the integration of user preferences into coherent itineraries (Gavalas et al., 2014; Chen et al., 2020). Many mainstream platforms provide basic information, such as opening hours and public-transit routes, but may be less capable of dynamically optimizing itineraries in response to variables such as current weather, visitor volume, and users' mobility needs. Niche local resources—including distinctive hutong businesses and intangible cultural heritage workshops—may also be less visible in generalized recommendation systems.

Artificial intelligence offers a potential way to address these problems. By combining large language models with knowledge graphs, an intelligent system can interpret compound requests such as "traveling with older adults and children," "minimizing walking," and "preferring mild food," rather than relying solely on keyword searches. Such a system could function as an around-the-clock local guide, identify distinctive local resources, and adjust itineraries in response to real-time traffic and queue conditions. Research on smart tourism has emphasized the value of integrating destination data and personalized services, while recent studies have examined the use of generative AI in tourist information search and decision-making (Gretzel et al., 2015; Jiang & Han, 2025; Stergiou & Nella, 2024). Policy support also facilitates implementation. In March 2023, the Ministry of Culture and Tourism of the People's Republic of China issued the Opinions on Promoting High-Quality Development of the Online Tourism Market, which encourages online tourism platforms to integrate tourism-related resources and apply technologies such as 5G, artificial intelligence, big data, cloud computing, and blockchain to improve services (Ministry of Culture and Tourism of the People's Republic of China, 2023). Against this backdrop, the "Mapping Beijing with Data" project, developed by the "Jingyun Zhichuang" undergraduate team at Beijing City University, aligns with broader policy priorities concerning digital innovation and the development of smart tourism.

The project identifies Generation Z as a priority consumer segment because its proposed services emphasize personalized, immersive, and digitally mediated travel planning. Previous research on smart tourism has highlighted personalization as an important way to improve the visitor experience, while recent studies have examined how travelers evaluate AI-generated recommendations in trip-planning contexts (Buhalis & Amaranggana, 2015; Kim et al., 2024; Stergiou & Nella, 2024). The project team's preliminary market assessment estimates that approximately 80% of its target users prefer personalized and immersive travel experiences and that demand for intelligent cultural-tourism services may grow by 35% annually. The team further estimates that China's intelligent cultural-tourism service market could exceed RMB 80 billion by 2027, with Beijing accounting for approximately 15%, equivalent to a potential market of RMB 12 billion. These figures should be

understood as preliminary project estimates rather than independently verified industry statistics and should be substantiated with transparent market data before being used as external market-wide claims. Subject to that validation, the market may offer opportunities for university entrepreneurship teams.

2. Product Design and Technological Innovation

"Mapping Beijing with Data" is positioned as an "AI travel companion for Beijing." Although this positioning is straightforward and accessible, the product architecture and technical solution have been developed systematically. Its principal features are outlined below.

2.1. Intelligent Itinerary Planning: from Manual Information Gathering to One-Click Generation

A major limitation of conventional travel preparation is the time and effort required to collect and verify information in advance. Travel guides published through different channels may contain conflicting details, and information such as business opening hours and waiting times can be difficult to verify. Research on tourism recommender systems has addressed these challenges through mobile, context-aware, and personalized recommendation methods (Gavalas et al., 2014; Chen et al., 2020; Chen et al., 2024). The project allows users to enter basic parameters—including travel dates, group size, interests, and budget—and generates a customized itinerary within three seconds. The output includes daily routes, transportation options, recommended durations at destinations, and dining and accommodation suggestions. Users can also revise the itinerary and have it dynamically optimized. For example, a university student planning a weekend trip to Beijing with a budget of RMB 800 and an interest in history and local cuisine could receive an itinerary that includes the Palace Museum and Jingshan Park on Saturday, followed by distinctive dining experiences in Nanluoguxiang; on Sunday, the itinerary could include the Temple of Heaven, Qianmen Street, and time-honored businesses in Dashilan. Transport guidance and dining recommendations would be provided, and the plan could be updated in response to real-time traffic. Recent work on smart-tourism itinerary recommendation also emphasizes the need to account for tourist preferences, points of interest, and contextual constraints when generating travel routes (Esper et al., 2025).

2.2. Aggregation of Cultural-Tourism Resources: Systematic Integration of Fragmented Information

Beijing's cultural-tourism resources are geographically dispersed and span a wide range of business types. Information about major attractions, such as the Palace Museum and the Great Wall, is relatively accessible, whereas information about distinctive hutong businesses, intangible cultural heritage experiences, and cultural-creative shops is more fragmented. The integration of information from multiple tourism stakeholders is a central feature of smart-tourism ecosystems and online tourism platforms (Gretzel et al., 2015; Ministry of Culture and Tourism of the People's Republic of China, 2023). The project team reports that it has aggregated resources from more than 8,000 service providers across attractions, dining, accommodation, intangible cultural heritage workshops, and cultural-creative retail. The database also records customer reviews, operating

status, reservation links, and promotional offers, enabling users to filter results by distance, rating, and popularity. The database is not based solely on online data collection; it is supported by field research. The team visited 20 major attractions and 50 distinctive businesses in Beijing, collected 500 valid questionnaires, and conducted in-depth interviews with 100 visitors.

2.3. Core Technology: a Knowledge-Graph Algorithm For Beijing's Cultural-Tourism Sector

The project's core technical component is a knowledge-graph algorithm tailored to Beijing's cultural-tourism resources. The workflow begins with web-crawling tools to collect publicly available data on tourism, businesses, and transportation. Natural language processing is then used to extract entities and relationships, followed by manual annotation to align and integrate the data. A four-dimensional knowledge graph covering attractions, businesses, transportation, and users is constructed, after which graph neural networks support reasoning and intelligent recommendations. Recent tourism research has explored knowledge-graph-based attraction recommendation, including models that represent tourists' long- and short-term interests (Jiang & Han, 2025). Other studies have examined personalized itinerary recommendation using textual information and preference-learning methods (Chen et al., 2020; Chen et al., 2024; Esper et al., 2025). Compared with conventional recommendation models, the project team's internal tests reportedly show an eightfold improvement in information-integration efficiency, itinerary-planning accuracy of 95%, a 40% increase in the relevance of personalized recommendations, coverage of more than 90% of the high-quality cultural-tourism resources identified by the team, and real-time data-feedback latency of less than one second. These figures are results from internal model testing; actual performance in deployment remains to be verified through operational data.

2.4. Value-Added Services: an Integrated Portal for Cultural-Tourism Needs

The product extends beyond itinerary planning and resource search by incorporating several supporting functions. It provides multilingual intelligent audio guides for more than 40 major attractions, including the Palace Museum and the Temple of Heaven; recommends less-visited destinations and distinctive dining options based on user profiles; and integrates services such as ticket reservations, accommodation booking, navigation, and emergency assistance. Mobile tourism recommender systems have long explored context-aware information and location-based services, while smart-tourism research emphasizes the integration of digital services across the visitor journey (Gavalas et al., 2014; Gretzel et al., 2015). Recent work has also identified travel services and destination management as important areas for generative-AI applications in tourism (Sigala et al., 2024). The aim is to bring the full travel journey into a single platform and reduce the need to switch between applications.

3. Market Prospects and Business Model

The project divides its intended market into three segments. Based on the team's target-market segmentation estimates, the core segment consists of travelers aged 18–35 and accounts for 60% of the intended market. These users are expected to be receptive to internet-based products, prefer differentiated travel experiences, and be comfortable using intelligent services while balancing value for money with distinctive experiences. Families traveling with children form an important

segment, estimated at 25%; they often travel in larger groups, face more itinerary constraints, and place a high priority on safety and convenience. Middle-aged and older travelers represent a potential segment of 15%. Although they may have considerable purchasing power, they may have different levels of familiarity with smart devices, so the product should offer a simplified interface. The project's preliminary estimates suggest that the conversion rate for paid personalized add-on services may reach 30% among younger travelers, while more than 40% of family travelers may be willing to pay for integrated services. These proportions are planning assumptions for the project, not observed shares of Beijing's tourism market. They suggest that a model combining free basic services with paid value-added services may be worth testing in Beijing's cultural-tourism market.

The project's revenue model combines four channels. First, merchant commissions: the platform would charge a commission of 5%–15% on transactions completed through it; the project team reports that 40 merchants have expressed an intention to cooperate. Second, the platform would offer paid value-added services, including premium customized itineraries at RMB 99 each, dedicated audio guides at RMB 29 per person, priority reservation access at RMB 19 per use, and an annual membership package at RMB 199. Third, it would generate revenue from targeted advertising through placements on the home page and within itinerary recommendations. Fourth, it would provide commissioned services for government and business clients, including digital service solutions and data-analysis outputs for cultural-tourism authorities and relevant enterprises. Diversified revenue streams may reduce dependence on any single business line, but operating across multiple channels requires sustained resources. For a student-led venture, whether its staffing and funding can meet operational needs is a key implementation consideration.

Coordinated online and offline promotion forms the main marketing strategy. Online channels include Douyin, Xiaohongshu, and Bilibili, supplemented by collaborations with key opinion leaders specializing in cultural tourism, targeted advertising on comparable travel platforms, and original travel-guide content. Offline promotion would involve promotional stations at pilot attractions, outreach events at universities, and cross-sector partnerships with service points at high-speed rail stations and airports. The product also includes an older-adult mode, featuring larger text and simplified functions to accommodate the usage habits of middle-aged and older users. This design addresses practical user needs and reduces the burden of navigating a complex product independently.

Financial projections envisage a transition toward profitability. According to the project's estimates, revenue is expected to reach RMB 400,000 and net profit RMB 100,000 in 2026; revenue is projected at RMB 800,000 and net profit at RMB 700,000 in 2027; and revenue is projected at RMB 1.2 million and net profit at RMB 1.05 million in 2028. Based on these figures, the implied net profit margins are 25.0% in 2026, 87.5% in 2027, and 87.5% in 2028. These projections indicate positive growth, but they remain forecasts and actual performance is uncertain. In particular, the projected net profit margins for 2027 and 2028 are unusually high for a cultural-tourism service business and require detailed validation against operating costs, customer-acquisition expenses, technology maintenance, and merchant commission arrangements.

4. Challenges and Risks

4.1. Technical Risks

Algorithmic performance depends heavily on the quality, coverage, and timeliness of its data sources, which are important considerations in tourism recommendation systems (Chen et al., 2020; Jiang & Han, 2025; Esper et al., 2025). Outdated or inaccurate information about cultural-tourism resources can directly undermine itinerary reliability. For example, if a business closure is not reflected in the database, the system may continue recommending that business and thereby create a negative user experience. The project proposes a data-maintenance mechanism combining manual review with automated validation. Nevertheless, continuously maintaining accurate information for more than 8,000 providers will be difficult in practice. In addition, growth in the user base will increase server demand. The project plans to rely on Alibaba Cloud's elastic cloud services, but short-term traffic surges during peak periods such as the National Day holiday will test the system's ability to handle concurrent requests under real-world conditions.

4.2. Market Competition

Although intelligent cultural tourism is an emerging field, major platforms have already entered the market. Leading travel and local-service platforms such as Ctrip, Meituan, and Dianping have established large user bases, extensive merchant networks, or both. If comparable AI itinerary-planning functions are introduced by these established platforms, the sustainability of the project's differentiation based on its proprietary knowledge graph will remain uncertain. Research on smart tourism highlights the importance of interconnected platform ecosystems, data integration, and collaboration among destination stakeholders (Gretzel et al., 2015; Sigala et al., 2024). The project has adopted a localization strategy focused on Beijing's cultural-tourism resources and is exploring exclusive partnerships with major attractions and distinctive businesses to build resource-based barriers to entry. This approach may help a smaller team differentiate its offering. However, exclusive partnership opportunities with high-quality attractions and merchants are limited. The project's ability to secure a stable niche alongside major platforms will depend on the quality of subsequent execution.

4.3. Constraints Arising from the Team's Practical Experience

The core team members are second-year finance undergraduates at Beijing City University. They have foundational knowledge of AI and software development, as well as some related practical experience, but their hands-on experience in commercial operations is relatively limited. Cultural tourism is closely tied to offline settings. If the operating team cannot accurately understand merchants' business needs and visitors' actual expectations, product design may become self-referential and fail to meet market demand. At the same time, the team's entry into AI-enabled cultural tourism from a finance background offers a distinctive interdisciplinary perspective. Although this may appear unconventional, it may provide advantages: technology professionals may lack sector-specific knowledge of cultural tourism, while cultural-tourism practitioners may have limited familiarity with digital business models. A finance background may help the team develop distinctive approaches to business-model design and resource coordination. The priority is

to address talent gaps through external collaboration and complementary expertise rather than attempting to manage the entire development and operation process independently.

4.4. Data Compliance and Information Security

A cultural-tourism service platform may collect and store personal information about users' identities, travel activities, and consumption patterns. Under China's Data Security Law and Personal Information Protection Law, data security and the lawful processing of personal information are critical compliance requirements (National People's Congress of the People's Republic of China, 2021a, 2021b). Research on smart-tourism destinations has also identified privacy concerns, perceived risk, and users' control over personal information as important factors in the use of digital tourism services (Afolabi et al., 2021). A data breach could expose the project operator to legal liability and cause lasting damage to its reputation. The project plans to establish data-security controls, but it remains to be demonstrated whether a student-led venture can mobilize the expertise and resources needed to implement a comprehensive security architecture.

5. Conclusion and Outlook

The foregoing analysis supports an overall assessment of the "Mapping Beijing with Data" project. Although it is not yet a fully mature solution, it addresses identifiable pain points in Beijing's cultural-tourism market: fragmented information, static itineraries, and insufficient personalization of service provision. Its use of a knowledge graph and dynamic-planning engine provides a plausible technical foundation, while its diversified revenue streams offer a clear business-model framework. The team's relatively young composition is partly offset by its interdisciplinary background and substantial field research. Nevertheless, several challenges remain: the algorithmic system requires continuous iteration, competition is likely to intensify, commercial operating experience must be developed, and data security and compliance must be implemented effectively. These risks are not insurmountable, but their management will ultimately depend on execution and resource coordination.

Looking ahead, as AI continues to advance and the cultural-tourism sector deepens its digital transformation, "AI + cultural tourism" service models may be replicated in other regions, using major destinations such as Beijing as initial cases. Travel planning may become increasingly streamlined, allowing users to submit preferences and receive integrated itineraries. "Mapping Beijing with Data" remains at an early stage and requires further product refinement. If the project maintains a consistent strategic direction and continues iterating, it may be able to establish a viable position in the expanding intelligent cultural-tourism market.

Author Contributions:

Conceptualization, Y.F and H.P; methodology, Y.F and H.P; formal analysis, Y.F and Z.Y; investigation, Y.F, Z.Y ang and Y.L; data curation, Z.Y and Y.L; writing—original draft preparation, Y.F; writing—review and editing, Y.F, H.P, Z.Y and Y.L; visualization, Y.L; project administration, Y.F. All authors have read and agreed to the published version of the manuscript.

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Institutional Review Board Statement:

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Informed Consent Statement:

Informed consent was obtained from all participants involved in the questionnaire surveys and interviews.

Data Availability Statement:

Summary findings are presented in this article. Requests concerning access to the underlying questionnaire, interview and project data should be directed to the corresponding author, Hai Pan (3622039991@qq.com). Any disclosure must comply with participant consent, privacy requirements and applicable third-party restrictions.

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Conflict of Interest:

The authors declare no conflict of interest.

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