



User Experience-driven Digital Transformation Strategy for High-speed Railway

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How to cite this paper: Bin Wei. (2023) User Experience-driven Digital Transformation Strategy for High-speed Railway. *Advance in Sustainability*, 3(1), 7-14.
DOI: 10.26855/as.2023.12.002

Received: August 18, 2023

Accepted: September 16, 2023

Published: October 9, 2023

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Abstract

This paper discusses the user experience-driven digital transformation strategy of high-speed railroads. The needs and behavioral habits of high-speed railroad users are studied by analyzing the importance and driving role of user experience in digital transformation, and the key elements and influencing factors of user experience are explored. This study proposes a user-centered digital transformation concept and strategic objectives. It puts forward a series of digital technology solutions and user participation and feedback mechanisms to enhance user experience. User experience is the core driving force of digital transformation in high-speed railroads. Through a user-centered digital transformation strategy, the high-speed rail industry can improve user satisfaction, enhance operational efficiency, strengthen competitiveness, and promote the industry's sustainable development. Digital technologies have great potential to enhance user experience, such as mobile applications, artificial intelligence, and extensive data analysis. Meanwhile, establishing user participation and feedback mechanisms is also crucial to continuously optimize services and improve user satisfaction.

Keywords

User experience, high-speed railroad, digital transformation, strategy evaluation, passenger service, sustainability

1. Introduction

1.1 Background and significance of the study

With the advancement of the global digitalization wave, all industries are actively exploring the path and strategy of digital transformation [1-3]. As an essential part of the modern transportation system, the digital transformation of high-speed railroads is not only related to the industry's own technological progress and service innovation, but also closely linked to the national transportation strategy, regional economic development, and people's travel convenience [4, 5]. In this context, a user experience-driven digital transformation strategy has become an important research direction in the high-speed railroad industry.

In recent years, Governments have introduced policies and measures to promote digital transformation to foster economic growth and social progress. All of them have put forward the strategic goal of accelerating digital transformation and emphasized the critical role of digitalization in promoting industrial upgrading and improving people's quality of life. Against this policy background, the digital transformation of the high-speed railroad industry is particularly urgent and essential [1, 4].

With the rapid development of mobile Internet, artificial intelligence, big data, and other emerging technologies, the digital transformation of high-speed railroads has provided unprecedented technical support and innovation space [2-4]. However, digital transformation is not an overnight process and requires careful consideration of various factors such as technology, economy, and society. Especially in today's increasingly diversified and personalized user needs, how to put user experience at the core of digital transformation has become a challenge common to the high-speed railway industry and many other industries [6].

1.2 Overview of the purpose and content of the study

With the growth of the Internet, there are now more than 4 billion Internet users worldwide, representing 53 percent of the global population. The development of network technology has dramatically changed the mode of communication among enterprises, organizations, communities, and individuals. Against this backdrop, the digital transformation of the HSR industry has become even more urgent [2, 3].

Digital transformation in the HSR industry involves the application of technology and the transformation of business processes. The main drivers of digital transformation include the Internet of Things (IoT), cloud computing, big data analytics (BDA), and automation and robotics. The application of these technologies can not only improve the operational efficiency of the HSR industry, enhance the user experience, and provide more thoughtful, more convenient, and personalized services to users [1, 4, 5].

2. User experience analysis

As an essential part of modern transportation, high-speed railroads serve many travelers. Understanding high-speed railroad users' needs and behavioral habits is the foundation for implementing user experience-driven digital transformation. In this section, we will delve into the needs and behavioral habits of high-speed railroad users to provide strong support for digital transformation.

2.1 Demand analysis

Explore the travel demand of high-speed railroad users through qualitative and quantitative survey and analysis methods. The survey analyzes the degree of users' demand for different travel services, such as the impact of comfort, punctuality, ticket price, and other factors on users' demand. The main factors affecting passenger experience include price, staff density, service process, and facility environment.

Price: Customers' decisions on services or products are usually based on price versus expected benefits. The type of seat is an essential determinant of the fare, such as second class, first class, business, VIP, soft sleeper, and hard sleeper. Second class seats are the most popular type and their fares are the lowest among all other seats on high-speed trains. Compared to economy class on airplanes, second-class seats have similar space. Business seats are more expensive but more comfortable, similar to airplane business class. Soft sleepers and hard sleepers are only available on high-speed trains at night and are an option for users traveling at night.

Personnel density: For example, overcrowding and peripheral traffic congestion at train stations can lead to negative emotional issues. High passenger densities also lead to critical safety issues. For example, many passengers are unsure if they have passed through the station, and passengers tend to seek help rather than read messages and signs, further contributing to congestion issues at the station.

Service Process: Customer satisfaction is relatively high when services run efficiently and smoothly. Congestion at train stations may prevent passengers from entering and leaving the station quickly and safely. For example, if the number of passengers is large, then the flow of passengers through the train station will be severely impeded, reducing the train station's average processing speed. Crowding can occur in many places, such as stairs, escalators, and waiting areas. In these train station environments, people have to wait to finish boarding the train and therefore waiting times play an essential role in a passenger's train journey. Longer waiting times may lead to passenger dissatisfaction with the service.

Facility Environment: The physical facility or service environment can positively or negatively affect the customer experience. Consumers will have greater confidence in the quality of a service provider if the environment is comfortable, clean, safe, and offers usable products. Technological amenities such as mobile devices, social media, and the proliferation of wireless networks and virtual systems have also changed passenger behavior and the passenger experience. With the development of mobile platforms, more and more applications are running on mobile devices.

2.2 Behavioral habit analysis

Using big data analysis technology, we mine high-speed railroad users' behavioral data, including ticketing channels, travel routes, seat selection, etc. Through in-depth analysis of user behavior, it reveals user preferences and habits and provides data support for digital transformation strategies. For example, about 13% of Shinkansen passengers in Japan are commuters, and their average commuting distance is about 90 kilometers, which is more than four times that of regular train passengers. If the ride time is about one hour or less, passengers will still choose to use the Shinkansen over regular trains, despite the higher extra fares on the Shinkansen. An in-depth analysis of user behavior reveals user preferences and habits, providing data to support digital transformation strategies.

3. User Experience Driven Digital Transformation Strategy

3.1 User-centered digital transformation concept and strategic objectives

User-experience-driven digital transformation is to put users' needs and experiences at the core of the transformation strategy. In the high-speed railroad industry, the concept of user-centric digital transformation aims to optimize user experience, improve service quality, and satisfy users' personalized needs to enhance user loyalty and attract new users. When developing a digital transformation strategy, the following points should be clarified:

User demand orientation: The core of digital transformation is the user. Successful digital transformation always prioritizes customer needs. This means that organizations must deeply understand their target audience, including their needs, expectations, and pain points. For example, high-speed rail users may care more about on-time performance, comfort, and price than other ancillary features. Therefore, digital transformation strategies should be built around these core needs.

Omni-channel service: build a multi-channel service platform to meet the diverse needs of users for ticketing, consultation, complaints, etc., and provide a seamless service experience. Digital transformation is not just about introducing new technologies, but also about considering how to provide customers with consistent and efficient services across various channels. This means users should receive the same high-quality experience whether interacting with the high-speed railroad through mobile apps, websites, or physical channels.

Personalization: Through digital technology, we can realize the customization of personalized services for users and provide them with travel plans and services that meet their preferences and habits. The importance of personalization in digital transformation. With the development of big data and artificial intelligence technologies, high-speed railroads now have the ability to provide customized services, such as recommending travel routes based on a user's past ticketing history.

Continuous Improvement: Digital transformation is a continuous process, and one should constantly listen to user feedback and continuously improve digital services, which requires constant collection of feedback, analysis of data, and iteration. Enterprises should practice the concept of user-centeredness and continuously innovate the user experience.

3.2 Digital technology solutions to enhance user experience

To achieve user experience-driven digital transformation, the high-speed rail industry should apply advanced digital technologies to enhance user experience and service quality. Here are some critical digital technology solutions:

Mobile applications and e-ticketing: With the popularization of mobile Internet, mobile applications have become the main channel for users to obtain information and services. The high-speed railroad industry can develop mobile applications to provide users with functions such as online ticketing, querying train information, and real-time train status. In addition, e-ticketing can simplify the process of purchasing and checking tickets, improve efficiency, reduce the waste of paper tickets, and provide users with a more convenient travel experience.

Self-service facilities: Self-service facilities such as self-service ticket machines and self-service check-in machines can significantly improve service efficiency and reduce user waiting time. In the peak period, self-service facilities can effectively ease the pressure of pedestrian flow and improve user satisfaction.

Artificial intelligence and big data analysis: Artificial intelligence and big data technology can help the high-speed railroad industry to more accurately predict user needs and push personalized information and services to users. For example, by analyzing users' ticketing records and behavioral data, it can recommend more appropriate travel plans and provide preferential information for users.

Virtual Reality and Augmented Reality: Virtual Reality and Augmented Reality technologies can provide users with a more immersive travel experience. For example, users can experience tourist attractions in advance through virtual reality technology, or navigate around the station and find their seats through augmented reality technology.

Driverless technology: Driverless technology can not only improve the operational efficiency of trains but also enhance the safety of passengers. Through advanced sensors and algorithms, driverless trains can perceive the environment in real-time, make accurate judgments and decisions, and ensure the safety of passengers.

Agile development: Agile development methods emphasize rapid response to user needs and continuous iteration and improvement. In the digital transformation of the high-speed rail industry, agile development methods can be used to quickly experiment and launch new digital services, iterating and optimizing based on user feedback. This not only accelerates the process of digital transformation but also ensures that the services provided truly meet user needs and improve user satisfaction.

The relationship between technology strategy and user experience is particularly critical in the process of digital transformation. While the technology strategy provides the tools and methods of digitization for high-speed rail, the user experience ensures that these tools and methods meet the real needs of travelers and provide better and more convenient services. To demonstrate more clearly the relationship between digitalization and technology strategy and user experience, the following is a detailed table listing the priorities, development foundations, and critical technologies of the digitalization and technology strategy, and how

they interact with user experience:

Table 1. Relationship between digital and technology strategies and user experience

Form	Descriptive	Relationship to user experience
Key tasks		
Data collection and analysis	Collecting data through devices and using tools for data processing and analysis	Data analytics can help understand user needs and thus provide services that better meet user expectations
Technology development and application	R&D and application of new technologies such as AI, IoT, etc.	New technologies can provide more efficient and convenient services, thus improving the user experience
Business Process Optimization	Optimization of business processes through technological means	Optimized processes provide faster, simpler service and increased user satisfaction
User experience improvements	Improving the user experience through technology	Directly affects user satisfaction and loyalty
The basis for development		
Hardware foundation	Including servers, storage devices, etc.	Stable and efficient hardware provides users with a smooth service experience
Software foundation	Including operating systems, databases, etc.	Software determines the functionality and efficiency of the service and directly affects the user experience
Database	Including business data, user data, etc.	Data provides personalized services to users and improves user satisfaction
Talent base	Including technology developers, data analysts, etc.	Experienced personnel to provide high quality services to users
Key technologies		
Artificial intelligence (AI)	Technologies that mimic human intelligence	Provide personalized recommendations to improve user satisfaction
Internet of Things (IoT)	Connecting objects through a network	Provides smart connectivity to improve user convenience
Big data	Analyzing large amounts of data	Provide precise marketing to increase user loyalty
Cloud computing	Provide elastic and scalable computing resources	Provision of stable and efficient services to enhance user satisfaction
Interaction with user experience		
Impact of digitalization and technology strategies on user experience	Improvement of service quality, efficiency and cost reduction through digitalization and technological means	Directly improve user experience
Impact of user experience on digitalization and technology strategy	A good or bad user experience affects the effectiveness of digitalization and technology strategies	A good user experience leads to more use of the service, increasing the effectiveness of the strategy; a poor user experience leads to less use, decreasing the effectiveness of the strategy

As shown in the table, digitalization and technology strategies not only provide technical support for high-speed railroads but also profoundly affect user experience. Therefore, when formulating and implementing digital transformation strategies, user experience must always be put first to ensure that technology strategies and user experience are closely integrated to jointly promote the development of high-speed railroads.

3.3 User participation and feedback mechanisms

User engagement and feedback are critical to the success of digital transformation. The high-speed rail industry must ensure that users have a voice throughout the digital transformation process to ensure that the services provided meet their real needs and expectations.

User research: Regular user research is an effective way to understand user needs and satisfaction. Through the study of user

demand analysis, it is found that users have high expectations for the digital services of high-speed railroads, especially in the areas of ticketing, inquiring about train information, and real-time understanding of train status. Therefore, the high-speed railroad industry should conduct regular user research to understand users' needs and expectations, so as to provide strong guidance for digital transformation.

Online feedback platform: Establishing an online feedback platform allows users to provide their feedback and suggestions at any time. This will not only help the high-speed rail industry to keep abreast of users' needs and problems but also enhance users' engagement and make them feel part of the digital transformation process.

Social media interaction: Social media is an important channel to interact with users. The high-speed railroad industry should actively participate in social media to interact with users and understand their concerns and needs. In addition, social media can be used as a platform to publicize and promote digital services and attract more users.

User experience evaluation: Regular evaluation of user experience is critical to ensuring the success of digital transformation. The high-speed rail industry should regularly invite users to participate in experience assessments to understand their feedback and suggestions on newly launched digital services, so that continuous optimization can be carried out.

In addition, in combination with agile development methods, user participation can be more profound and broader. For example, users can be invited to participate in early trials and testing of new services, and iterations and optimizations can be made based on their actual experience. This "user engagement" approach ensures that the new services developed are closer to users' needs, increasing user satisfaction and loyalty.

User experience-driven digital transformation strategy is an essential path for the high-speed railroad industry to develop in the direction of intelligence, convenience, and personalization. The user-centered digital transformation concept and strategic objectives, as well as digital technology solutions to enhance user experience and user participation and feedback mechanisms, will provide the high-speed railroad industry with better and more efficient services, enhance user satisfaction, and promote the sustainable development of the industry.

4. Successful case studies and lessons learned

4.1 The Case for Customer Experience-Driven Digital Transformation in Banking

In the financial industry, customer experience-driven digital transformation has become an essential strategy for central banks. China Merchants Bank, one of the leading banks in China, started its digital transformation journey at the beginning of the digital wave. Supported by digital technology, China Merchants Bank actively promotes service digitization, personalization, and intelligence to provide customers with more convenient, efficient, and personalized financial services.

China Merchants Bank has launched the "Palm Life" mobile banking application, which integrates a number of digital technologies, such as face recognition, fingerprint recognition, voice assistant, etc., and realizes multi-channel and all-weather financial services. Users can handle all kinds of financial services, including account inquiries, transfers and remittances, wealth management and investment, etc., anytime and anywhere via cell phones, which greatly improves the service experience of users.

In the process of digital transformation, China Merchants Bank fully draws on the concept of user experience design, and continuously optimizes the application interface and interaction process to make user operation simpler and clearer. At the same time, China Merchants Bank has established a strong customer service team to respond to and solve users' problems and needs in a timely manner, which has improved user satisfaction and loyalty.

4.2 A Case for Customer Experience-Driven Digital Transformation in Restaurants

In the restaurant industry, customer experience-driven digital transformation has also achieved remarkable results. HungryMall, a well-known online takeout platform in China, has provided users with convenient and efficient catering services through digital transformation.

HungryMan has launched a new mobile ordering app that allows users to book tables, browse menus, order online, and choose between pick-up or take-out services via their cell phones. Through digital technology, users do not have to wait in line, saving a lot of time and improving the convenience of dining.

In addition, HungryMall provides personalized services through digital transformation. Through the user's historical ordering records and preferences, the app recommends dishes that suit the user's tastes, increasing user satisfaction. Meanwhile, users can submit comments and ratings through the app to provide references for other users, which promotes user engagement and feedback.

4.3 Implications and Lessons Learned from Successful Cases for the High-Speed Railway Industry

These successful cases provide essential insights and reference value for the digital transformation of the high-speed railroad industry:

User-centeredness: Successful cases of digital transformation, whether in the banking or catering industries, have placed user experience at the core. The high-speed railroad industry should also recognize that users are the ultimate beneficiaries of its services, so it should always aim to improve user experience when carrying out digital transformation. For example, providing more convenient and personalized services based on users' travel habits and needs.

Multi-channel services: Successful digital transformation cases have provided multi-channel services, whether mobile apps, websites, or physical stores. The high-speed rail industry should also consider how to build a multi-channel service platform to provide users with a seamless travel experience when undergoing digital transformation.

Personalized customization: In the case of digital transformation in the catering industry, suitable dishes are recommended for users through their historical ordering records and preferences. The high-speed railroad industry can also consider how to use digital technology to provide users with personalized travel suggestions and services, such as recommending suitable seats and train trips for users based on their travel history and preferences. Through digital technology, the high-speed railway industry can realize the customization of personalized services for users and provide them with personalized travel plans and services.

User participation and feedback: Successful cases of digital transformation, whether in the banking or catering industry, emphasize timely collection of and response to user feedback. The high-speed railroad industry should also establish an effective user feedback mechanism to ensure that it understands users' opinions and needs in a timely manner, and makes continuous improvements based on the feedback.

Cross-industry cooperation: Digital transformation is not only the application of technology but also requires cross-industry cooperation and communication. The high-speed railroad industry can cooperate with other industries, such as finance, catering, tourism, etc., to jointly explore new service modes and business models and provide more prosperous and diversified services for users.

Data-driven decision-making: Successful cases of digital transformation, whether in the banking or restaurant industries, emphasize data-driven decision-making. The high-speed rail industry should also make full use of data for decision-making when undergoing digital transformation, to ensure that the services and solutions provided truly meet the needs of the market.

By studying and learning from the cases of customer experience-driven digital transformation of banks and digital transformation of restaurants, the high-speed railroad industry can better understand user needs and experience, use advanced digital technology to improve user service quality and enhance user satisfaction, and promote the sustainable development of the high-speed railway industry towards intelligence, convenience, and personalization.

In digital transformation, the high-speed railroad industry has already had some successful cases, the most typical of which is the application of the integrated management platform for passenger service travel service. This platform fully embodies the core idea of the digital transformation strategy, that is, to focus on user experience, through integrated management, to achieve efficient, intelligent, and personalized services. To more intuitively demonstrate the workflow of the integrated management platform for passenger services, the following is a detailed flow chart describing the process of information input, processing, and output:

It can be clearly seen how the integrated management platform for passenger service travel services integrates, processes, and outputs various information to provide passengers with more convenient and efficient services. This further proves the success of the digital transformation strategy in the practical application of the high-speed railroad industry.

5. Conclusion and outlook

This paper focuses on the "user experience-driven digital transformation strategy for high-speed railroads", and through the analysis of user experience, digital transformation cases, and related theoretical models, the following main findings were made:

User experience plays a vital role in the digital transformation of the high-speed rail industry. As a strategic orientation, user experience should be the core of digital transformation strategy. Through a deep understanding of user needs and behavioral habits, the high-speed rail industry can build a user-centric digital transformation strategy to enhance user satisfaction and loyalty.

Second, the successful cases have reference value for the digital transformation of the high-speed railroad industry. The cases of customer experience-driven digital transformation of banks and digital transformation of restaurants provide practical experience and inspiration for the high-speed railway industry. In the digital transformation process, the high-speed railway industry can learn from the successful experiences of other industries to optimize user experience and improve service quality.

Finally, comprehensive assessment and application is the key to digital transformation strategy. By establishing an applicable digital transformation maturity model, the HSR industry can evaluate the implementation and effectiveness of the strategy, identify problems, and make adjustments in a timely manner. Continuous improvement and optimization will ensure the successful implementation of the digital transformation strategy.

In future research, we believe the following directions are worth exploring in depth: Application of NPS in the high-speed railroad industry: NPS, as a customer satisfaction metric, has been widely used in many industries. Future research can explore the application of NPS in the high-speed rail industry and how to combine NPS and other evaluation metrics to

comprehensively assess the impact of digital transformation strategies on user experience.

Table 2. Flowchart of the Integrated Management Platform for Passenger Services Travel Service

Point	Importation	Deal with	Exports
Passenger Information Management	Traveler's basic information, travel history, preferences, etc.	Storing and managing travelers' personal information; analyzing travelers' behavioral data to provide travelers with more personalized services	Travelers' personal data, travel history and preference settings; traveler behavior analysis reports
Travel services management	Travelers' booking requests, change requests, refund requests, etc.	Handling travelers' requests for reservations, ticket changes, refunds, etc.; providing travel information inquiry services	Booking Confirmation, Change Confirmation, Refund Confirmation; Travel Information Inquiry Results
Intelligent Services	Travelers' preferences and historical data	Recommend appropriate travel solutions for travelers based on their preferences and historical data; provide voice assistant services	Travel recommendation results; voice assistant service results
Resource management and optimization	Real-time passenger demand and vehicle availability	Intelligent scheduling based on real-time passenger demand and vehicle conditions; assigning the best seats to passengers based on their needs and preferences	Vehicle scheduling results; seat allocation results
System safety and security	Travelers' personal information and transaction data	Encryption of travelers' personal information and transaction data; regular backup of data to ensure stable operation of the system	Encrypted data; system backup results
System administration and maintenance	System operational status, problem reports, etc.	Real-time monitoring of the system's operating status, timely detection and handling of problems; regular updating of the system, introduction of new features and optimization of the	System monitoring reports; results of system updates
Open interfaces and integration	Access requests for third-party applications and services	Provide open API interfaces to allow third-party applications and services to integrate with the platform	Open API interface documentation; integration results
User experience and interaction	User interface design, user comments, ratings, sharing, etc.	Provide an intuitive, easy-to-use user interface; offer interactive features such as user comments, ratings, sharing, etc.	User interface; results of user interaction functions
Data analysis and decision support	Travelers' needs and behavioral data	Analyzing passenger demand and behavioral data to optimize services and improve operational efficiency	Data analysis reports; decision support results

Application of MaaS (Mobility as a Service) in the high-speed railroad industry: MaaS is a mode of integrating multiple transportation services into a single platform to provide users with one-stop travel services. Future research can explore how MaaS can be applied to the high-speed rail industry to realize the seamless connection between high-speed rail and other modes of transportation, providing users with a more convenient and efficient travel experience. Through MaaS, the high-speed rail industry can better meet the diverse travel needs of users and improve user satisfaction and loyalty.

By continuously optimizing the digital transformation strategy, the high-speed rail industry will achieve brighter, more convenient, and personalized services to meet users' needs and drive the sustainable development of the industry.

Acknowledgements

First of all, I would like to express my deep gratitude to my supervising professor, Prof. Nguyen Kyu Hong. During the whole thesis writing process, Prof. Ruan not only provided me with valuable academic guidance, but also helped me a lot in research methodology, data collection, and thesis structure. Whenever I encountered doubts and difficulties, Prof. Ruan would patiently answer my questions and show me the way. His rigorous academic attitude, extensive knowledge, and selfless teaching have all deeply influenced me and benefited me greatly.

I would also like to thank all the faculty members of Wakamatsu University's Railroad Management Department. They provided me with a lot of valuable advice and guidance while I was conducting this research. I got a lot of new insights and inspirations from my communication with them, which made my research ideas clearer and the content of my thesis richer. Especially

during the process of data collection and field research, they provided me with great support and help, which enabled me to carry out the research in a more in-depth way.

In addition, I would like to thank all the interviewees and partners who participated in this study. Their honest feedback and valuable opinions have helped me a lot in my research. Through communication with them, I gained a deeper understanding of the actual situation of the high-speed railroad industry, which provided strong empirical support for my research.

In the process of thesis writing, I also got a lot of help from my classmates and friends. They provided me with a lot of valuable suggestions to help me improve the content and structure of my thesis. Here, I would like to express my heartfelt thanks to them.

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