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JGTSS provides a platform for scholars, practitioners, and policymakers to share insights and engage in discussions about emerging trends, global challenges, and transformative opportunities in the field.

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The Computational Turn: Toward an Intelligent Humanism in Social Science

As we inaugurate Volume 3 of the Journal of Global Trends in Social Science, we find ourselves at what may prove to be the most consequential turning point in the history of our disciplines. What 2025 has witnessed is not merely the continued advancement of artificial intelligence, but also its definitive emergence as a transformative force reshaping how we understand, investigate, and theorize human society. This convergence of computation and humanistic inquiry demands not incremental adaptation, but a fundamental reimagining of social science itself.

The articles published in our journal throughout 2025 vividly attest to this transformation. From deep learning-enhanced financial modeling to explorations of how AIGC is reshaping cultural industries and linguistic systems, from studies of digital technology empowering rural governance and heritage preservation to corpus-assisted cross-cultural discourse analysis — our contributors have demonstrated that the boundaries between computational and social sciences are dissolving into productive new configurations. The shared characteristics of these works — interdisciplinary vision, the integration of computational methods with humanistic sensibility, theoretical innovation paired with real-world engagement — reflect precisely the scholarly orientation this journal seeks to champion.

We are well aware that humanities and social sciences today face widespread skepticism. The clamor of technological determinism, utilitarian pressures, and the disruption brought by AI-generated content have left many scholars feeling uncertain. Yet intellectual history reminds us that from the linguistic turn to the cultural turn, from the behaviorist revolution to the hermeneutic revival, every apparent crisis has also been an occasion for disciplinary renewal. Today's "computational turn" is no different. The question is not whether AI is transforming social science — this is beyond dispute — but whether we will be passively swept along or actively shape the direction of our fields.

This journal's position is unequivocal: we choose the latter. Precisely because AI can do more and more, those capacities it cannot replicate — the interpretation of meaning, the exercise of judgment, the understanding of the human condition, the reflection on ethical boundaries — have become all the more precious. This moment calls not for the retreat of social science, but for research that is more insightful, more engaged, and more responsive to the questions of our time. We pursue what we call "intelligent humanism" — embracing the possibilities AI offers while upholding the critical spirit and humanistic foundation of social science.

The past year has also marked significant milestones for our journal. JGTSS has been indexed in Google Scholar, Crossref, ResearchGate, the National Library of China, and ROAD. Most importantly, we have completed all import procedures to officially enter the Chinese mainland market, fulfilling a

founding aspiration to bridge Eastern and Western scholarly discourse. Our partnership with Peking University's Center for Surrounding Communication Studies continues to deepen, and our signature columns attract high-quality submissions from scholars worldwide. These achievements provide a solid foundation as we advance toward SSCI indexing.

We invite scholars worldwide to join us in reshaping the landscape of social science. Let us demonstrate together that in this era of uncertainty, the humanities and social sciences are not obsolete — they are entering their most creative new chapter.

Mo Chen
Co-Editor-in-Chief
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Research Article

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Research on the Construction of Tourism Scenarios and the Reshaping of Relationships in Intelligent Media Environments: A Case Study of Short Videos

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KEYWORDS

Short Videos;
Tourism Scenarios;
Relationship Reshaping;
Five Forces of Scenario

ABSTRACT

With the development of mobile internet technology, the communication ecosystem has undergone significant changes, and the tourism industry's content presentation has gradually shifted from text and images to short videos. This shift has enhanced the efficiency of the tourism supply and demand chain and created an open, interactive, and multi-directional new type of tourism scene for users. This study, based on scene theory and social network theory, explores the production and diffusion process of tourism short videos within the framework of "new media—new scene—new behavior—new impact." Through case studies and in-depth interviews, the research analyzes the construction of tourism scenes and their reshaping of social relationships. The study argues that the construction of short video tourism scenes involves three key elements: place, user activities, and space. Furthermore, new behavior patterns emerge through human-computer interaction, driving multi-dimensional interactions between people and landscapes, people and other people, and people and goods. Ultimately, the diffusion of short videos reshapes social relationships at three levels: between individuals, between individuals and scenes, and between scenes and spaces. This process fosters the integration and complementarity of real and virtual spaces.

INTRODUCTION

The widespread use of mobile devices has profoundly changed lifestyles. According to the 56th "Statistical Report on China's Internet Development Status" by the China Internet Network Information Center (CNNIC), by June 2025, the number of internet users in China had reached 1. 123 billion, with an internet penetration rate of 79. 7% (China Internet Network Information Center. "Statistical Report on China's Internet Development Status," 2025-06-03)[1]. The Cyber Declaration by John P. Barlow underscores the internet as an independent social system with complex characteristics,

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including multiple subjectivities and multi-dimensional space-time[2]. The proliferation of smartphones has made mobile internet access the mainstream, deeply integrating the internet into daily life. The "2025 China Travel Service Industry Development Report" indicates a trend in the tourism industry towards content operation shifting from text and images to short videos. Short video-based scenario communication enhances the efficiency of supply and demand interactions[3]. Platforms such as Douyin (TikTok in China), Xiaohongshu (Little Red Book), and traditional travel apps like Mafengwo are all expanding into this field. The "new, fast, and quirky" characteristics of short videos have become essential tools for tourism marketing, forming a "planting grass—check-in" user behavior model. Short videos, as mobile-based carriers, construct new models of scenario-based communication. This study focuses on tourism short video platforms and their users, analyzing the process of "tourism scene" construction and the evolving relationships between individuals, individuals and scenes, and scenes and spaces.

This research is based on Merton's media scenario theory, which is framed around "New Media - New Scenario - New Behavior - New Impact," and incorporates social network analysis theory. The aim is to explore scenario construction and the reshaping of social relationships by analyzing scenario elements, patterns, and impacts. The goal of this study is to apply media scenario theory and the "Five Forces of Mobile Media" to contribute to short video scene studies. It aims to identify the elements of platform scenario construction, investigate user participation behaviors and motivations, and analyze their impact on social relationships.

From a theoretical perspective, this research aims to:

Focus on the construction of specific field-based scenes and the reshaping of social relationships, thereby filling the gap in existing studies that emphasize marketing and communication models, but lack dynamic perspectives and qualitative depth.

Extend the concept of scene theory into the field of tourism studies from an interdisciplinary viewpoint, introducing the concept of tourism scenes and combining it with social network theory, thereby broadening the theoretical framework of media scenarios and media research.

From a practical perspective, the significance of this study lies in:

Drawing attention to scene-based research in specific fields for scholars.

Providing insights into tourism marketing by analyzing user behaviors and motivations, helping tourism professionals better understand the needs of the digital age.

Supporting the understanding of changes in social relationships in new scenarios, using methods such as technology acceptance models, individual behavior, and psychological studies.

LITERATURE REVIEW

Evolution of Scenario Theory

The concept of "scene" was first introduced by Erving Goffman in The Presentation of Self in Everyday Life. Goffman argued that individuals present themselves in a manner akin to actors on a stage, and they can flexibly change roles depending on the ever-changing social contexts or "scenes" they find themselves in[4]. . Building on this, Marshall McLuhan famously stated that "the medium is the extension of man," proposing that media are extensions of human senses, such as sight, hearing, and touch, which alter the ways we perceive and interact with the world[5]. While McLuhan’s argument provides a framework for understanding the connection between media and human perception, it overlooks the role of the "scene" as an intermediary factor in shaping interactions.

Meyrowitz combined Goffman’s dramaturgical theory with McLuhan’s media technology theory and proposed the theoretical model of "new media – new scene – new behavior – new impact"[6]. . According to this model, the introduction of new media creates new scenes, which, in turn, lead to the emergence of new behaviors that are adapted to these new scenes. Meyrowitz expanded the traditional definition of "scene," asserting that a scene is no longer simply a physical space (such as a stadium, library, restaurant, classroom, or church), but rather a more expansive concept.

Explanation:

1) Dramaturgical theory: This is Goffman’s approach to understanding social interaction, where individuals are viewed as actors performing roles, with their behaviors shaped by the context or "scene" in which they are situated.
2) McLuhan's "the medium is the extension of man": McLuhan’s well-known phrase means that media serve as extensions of human senses, such as sight, hearing, and touch, influencing how we perceive and interact with the world[7].
3) Meyrowitz’s model: This model connects new media to the emergence of new scenes and behaviors, emphasizing how media not only influence communication but also transform the very nature of the

spaces (or "scenes") in which interactions take place[8].

Scenarios in the Internet Age

In recent years, scene theory has been extensively discussed in domestic literature. Representative scholar Peng Lan pointed out that the four basic elements constituting a scene are space and environment, real-time status, life inertia, and social atmosphere[9]. In the article The Content Framework and Dilemma Strategies of Scene Theory, it is argued that the five major technological forces of scenes are becoming the core driving forces behind the development of mobile internet[10]. The study expands from content production to user experience, examining them within a unified system, and centers its research around the "human" aspect, suggesting that "scenes" open new thinking for mobile communication and bring tremendous changes to the information technology industry. The "scene" proposed here refers to the fusion of virtual scenes and application scenes. The former is an abstract space, while the latter refers to a specific place or a real-world space[11].

Wu Sheng believes that "scene" is an application form related to internet behavior, such as gaming, socializing, and shopping[12]. He proposed that a "scene" refers to an application form that can be realized through online payment platforms, which forms a closed-loop application. However, Hu Zhengrong emphasized that time-space elements and situational elements, with the person at their core, collectively create what is known as a "scene. "[13]

The article Scene: The New Force in the Mobile Internet Era—A Semiotic Interpretation of Scene Communication applies theories from communication studies and semiotics to reveal the impact of scenes on people's lives from three perspectives: scenes as the determinant of commodity symbolic value, scenes as the catalyst for the formation of subculture symbolic communities, and scenes as the trigger for mass mobilization[14]. Understanding the laws of scene communication helps to better utilize new media for related activities, providing deeper insights into user needs and facilitating the formulation of marketing strategies that align with users' psychological demands.

Scholars such as Yu Guoming[15], based on previous research, have categorized scenes in the internet age into three types: realistic scenes, virtual scenes, and augmented reality scenes.

Note on terminology:Scene theory: Refers to a theoretical framework used to analyze the role of different environments or contexts (real or virtual) in influencing human behavior, particularly in relation to communication and technology.

Using methods such as the Technology Acceptance Model (TAM), individual behavior studies, and psychological research, this provides support for understanding the changes in social relationships in new scenarios.

Augmented reality scenes : Refers to environments or contexts enhanced with digital elements that blend the physical and virtual worlds.

Semiotics : The study of signs and symbols and their use in communication.

Media Scenario Construction

The study of media scene construction primarily utilizes Meyrowitz's scene theory and the "Five Forces of Scene" proposed by Israel and Scobor for analysis. In the electronic media era, Sun Lin[16], from the perspectives of media ecology and scene theory, analyzed the construction of broadcast scenes and discussed how to construct virtual scenes through audio programs and advertisements in the future. She also offered suggestions and strategies on how to better integrate and involve users in virtual scenes. Additionally, in the realm of electronic media, the study of social network scenes has been explored. Tan Guopeng discussed the process of constructing social network scenes, attempting to identify the impact of the emergence of new scenes on existing social scenes and how audience behavior changes in these new scenes[17]. The one-to-many communication model formed in scenes by electronic media has led to changes in audience identity, which in turn causes a series of behavioral shifts.

In the mobile media era, research has mainly focused on the construction of scenes within mobile social media. First, studies on mobile social network scenes point out that mobile social network scenes are a synthesis of various offline life scenarios, representing a completely new "Internet+ scene" model[18]. Second, in her work Scene Construction of Mobile Social Media under Scene Theory, Fu Xueyan proposed two main points: first, the construction of mobile social media scenes follows the paths of "individualization" and "socialization" for users; second, the construction of scenes in social media involves "weak links" between scenes. People are increasingly relying on the scenes constructed by mobile social media because they provide the latest experiences and ways of participation for users[19]. Zhao Yishen, starting from the relationship between technology and humans behind the mini-program scene, sorted out the "Human—Technology—Scene" research model based on mini-programs and systematically explained the interactive relationships embedded in the model[20].

Additionally, Song Shuping, using WeChat as a case study, proposed six new characteristics of mobile social media scenes and explored the basic elements, invisible elements, and value elements of mobile social media scenes[21]. Song Wanning, using methods from semiotics, narratology, and ergonomics, studied the audience's perceptions of media H5 products and the impact of these products on audience psychology and behavior. She summarized the logic and construction models of media H5 product scenes and researched the differential impact of these scene construction models on the audience. Based on audience responses, she analyzed emotional transmission mechanisms, narrative systems, and narrative strategies.

In general, while there have been many specific case studies on media scene construction, most of the research has focused on the technical aspects. However, there is relatively little research on scene construction from an interactive perspective.

Explanation:

1) Meyrowitz's scene theory: A framework proposed by Joshua Meyrowitz, combining elements of Goffman's dramaturgical theory and McLuhan's media theory, which discusses how media technology changes the "scenes" or contexts in which people interact, and how these changes affect behavior.
2) Five Forces of Scene : A conceptual model by Israel and Scobor to analyze how technological, social, and environmental forces shape the construction and evolution of scenes within media.
3) Media ecology : A field of study that focuses on how media environments influence human perception, understanding, and interaction with the world. It views media as part of an ecosystem that shapes communication patterns and social behaviors.
4) Internet+ scene model: Refers to a model in which traditional physical life scenarios are integrated with internet technologies, leading to new ways of experiencing and interacting with content, often associated with mobile social media.
5) Weak links between scenes:This concept refers to the loose or indirect connections between different scenes in social media, whereinteractions are not necessarily continuous or direct but still influence one another through networks of users and content.

Short Video Scenario Research

The current research on short video scenes mainly focuses on areas such as scene construction, scene marketing, and scene experience.

In the area of short video scene construction, Zhang Tong begins with rural social scenes and argues that short videos, as a new form of media, inevitably bring about changes in rural social scenes and social behaviors[22]. Following this, some scholars suggest that PGC (Professionally Generated Content) short videos, in terms of scene construction, cover multiple scenes, fields, and communities, encompassing life scenes and digging deeper into vertical sectors to seek breakthroughs[23].

In the domain of short video scene marketing, short videos are closely linked to "scenes. " They are reshaping social media marketing approaches, particularly through scene-based marketing in short videos. Researchers analyze this and offer insights that can guide businesses in formulating market marketing strategies[24]. This research primarily explores how short video scene marketing impacts consumers' purchasing intentions.

In terms of short video scene experience, based on theories such as communication theory and phenomenology, scholars study the scene experience process and summarize how "scene thinking" guides the future development of mobile short videos.

Currently, short video scene research tends to focus on a macro perspective and phenomenological summaries, with limited studies on the specific construction and application of scenes within short video platforms. Research on user participation in scene production is still relatively scarce.

Explanation:

1) Professionally Generated Content: Content that is created by professionals or organizations, as opposed to User Generated Content. This content is often more polished and intended for a larger audience.
2) Scene-based marketing: A marketing approach where brands create immersive, context-specific experiences for users, often using short videos to engage them in different "scenes" that resonate with their needs and behaviors.
3) Scene thinking: A conceptual framework focusing on how scenes—specific contexts or environments—shape interactions, experiences, and behaviors. This is particularly applied to how media, like short videos, influence consumer attitudes and decisions.

Existing research mostly analyzes the influencing factors of tourism and media performance from the perspective of scenes. The characteristics of interactivity in mobile devices in the digital media era, among other factors, have driven the scene-based development of the tourism industry. However, there is a lack of research on the intersection between short videos and

tourism scenes, as well as a lack of studies on the media construction of scene evolution. This is where the value of the present study lies.

Tourism Scenario Concept

The "tourism scene" concept proposed in this article refers to the complex environment or spatial state experienced by users during short video usage. This encompasses aspects such as temporal experience, sensory stimulation, and emotional interaction. Specifically, it manifests in three dimensions: contextualization in terms of time, virtualization in terms of space, and immersion in terms of content. Essentially, it represents the combination of the "field" of virtual existence within short video platforms and the "scene" of the audience's virtual presence in cyberspace. This combination creates a psychological sense of real presence and belonging, simulating a tourism "scene. "

The definition of the short video tourism "scene" is primarily grounded in the views of Robert, Peng Lan, and others, where mobile devices, social media, big data, sensors, and positioning systems form the foundational elements for scene generation[25]. However, in practical applications, the five forces of the scene cannot fully resolve all the issues related to the construction of mobile media scenes. Peng Lan suggests that mobile media scenes consist of space and environment, the real-time status of users, users' habitual behaviors, and social atmosphere. This provides an important reference for understanding the "scene" in the mobile media era[26].

Therefore, tourism "scenes" in this context refer to the online "scenes" created by short videos, which simulate real-life tourism environments while transcending the narrow physical boundaries. The focus here is on the behavioral responses of individuals within these scene spaces, as well as the interactions among people, scenes, and society.

NEW MEDIA: PRODUCTION AND DIFFUSION OF TOURISM SHORT VIDEOS

Media is a man-made environment, often referred to as humanity's "second nature," and has always occupied an important position in human society[26]. Marshall McLuhan's theory that "the medium is the message" is the most well-known and is often considemored the core of his work. However, in reality, media is not only information itself but also the channel, carrier, or intermediary for the dissemination of information. This chapter primarily analyzes the production and diffusion of short videos. Considering the relationship between the production and diffusion of short videos, media development, technological applications, and human needs, this study will explore the reasons behind the production and diffusion of short videos as a new form of media from three perspectives: media evolution, technological application, and human demand.

Media Evolution: Driving Forces of Tourism Short Video Dissemination

Media is not static; it changes over time. Media evolves continuously, and every medium, while new, also carries remnants of older media. The transition from old media to new media is a process of progress, development, and transformation. New media reshapes the relationships between people and the world, between individuals and society, as well as between individuals themselves. This section uses Meroewitz's "scene as an information system" theory to analyze the production and dissemination of short videos as an information system by exploring the characteristics and dissemination patterns of various media representatives across different historical periods.

Oral Media Era

Oral communication is the most fundamental, commonly used, and flexible form of communication for humans. Through oral communication, people exchange ideas, pass on experiences, and share cultural knowledge. In the oral era, information was transmitted through direct dialogue between individuals, with the "medium" being the person themselves. The communicator used their body as a medium to accurately and effectively convey information to the audience. The harmonious relationship between the medium and the message allowed people to live in harmony with themselves, others, and nature.

During the oral media era, people used language to achieve information transmission, filling in the gaps of the concrete with imagination, and constructing mental images of "scenes" through others' descriptions of their experiences. The characteristics of the human body as a medium in this phase include the following:

1) Geographical Spatial Isolation: The underdevelopment of transportation created significant barriers for the human body as a medium, preventing communication between people from different regions. Information could only spread over short distances and within limited timeframes.
2) Information's Ephemeral Nature: People's cognitive processes often take time to form impressions and judgments, but oral communication is instantaneous, making it difficult for people to form systematic un-

derstanding before the information has already dissipated

3) Irreproducibility of Information: The transient nature of oral communication means that it is difficult to preserve information. The duration of information retention depends on the length of the conversation and the individual's memory, making it clear that the oral media era struggled to create an information system.

In this sense, the oral medium made it difficult to achieve widespread dissemination of information.

Print Media Era

After the advent of writing and printing media, people transitioned from an "oral society" to a "visual society," where the mechanical production and mass reproduction of text and images became possible. People no longer depended on physical space and oral communication for interaction and communication; instead, they could extend "communication" to a broader context through text, images, and other media.

Unlike oral communication, print media detached from the body and used intermediaries, such as images and text, to facilitate communication. It was no longer merely a face-to-face interaction but one where intermediaries enabled the flow and dissemination of information. In this case, people could rely on media to share and exchange information.

In print media, text and images serve as forms of visual language. Visual language not only allows people to acquire direct sensory experiences but also helps humans complete communication tasks. For example, a travel scene in a book represents the interaction between the eyes and ears, improving the flow of information across time and space compared to the oral era.

The dissemination of text and images can present information more intuitively through visual means. However, it is still constrained by the single sensory experience of vision and the geographical and temporal distances involved. The characteristics of images and text as media during this stage include:Monodimensional Visuality: In the process of human social development, the primary means by which people perceive and understand the world is through sight, which is the most widely used sensory modality.

Distant but Shared Perception: When browsing magazines or reading books, even if the reader and the author are not from the same era or region, they can still obtain the same information and have similar sensory experiences through images and text.

For example, one interviewee, ZDY, shared: "Before short videos, I liked reading magazines to learn about travel destinations, such as 'National Geographic' and 'Lonely Planet. ' The expert commentary in the magazines, paired with beautiful photography, allowed me to experience information through a visual lens. "

Electronic Media Era

The development of electronic media such as telegrams, radio, television, and film has brought significant advancements in information capacity, transmission speed, and quality, breaking the constraints of time and space. The changes introduced by electronic media were not just about the disappearance of physical spatial limitations and speed barriers, but also about the extension of both visual and auditory senses, overcoming the limitations of oral and print media in disseminating information. As one interviewee, LYL, mentioned: "I used to learn about different regions through movies and TV. I really liked the international adventure program 'Survivor. ' With TV and movies, there are no time and space limitations, so I can watch travel and adventure programs filmed in other countries without leaving my home. "Electronic media, by relying on the transmission of sound and images, radically altered the way people receive information and express emotions, breaking the constraints of time and space. The characteristics of broadcast media, television, and other electronic media during this stage include:Sensory Integration: Compared to early media, which were either auditory or visual, the development of electronic media, especially film and television, integrated both auditory and visual elements, creating a more immersive sensory experience. Breaking Temporal and Spatial Barriers: Information transmission was no longer bound by time or space, allowing for a more immediate and widespread exchange of information.

Mobile Media Era

As Peng Lan pointed out, the information dissemination in the mobile media era is based on "scenes," with short videos representing the mobile media's scene-based communication[27]. In traditional media eras, information transmission was relatively one-dimensional. For example, oral communication could only transmit sound, while print media conveyed information through visual means. Although electronic media achieved sensory integration, users were generally passive receivers, and their engagement was limited.

In the mobile media era, the dissemination of short video information integrates video, text, sound, and images, providing a multi-dimensional, immersive scene experience.

One interviewee, YXD, shared: "When I use short videos, I feel much more involved compared to learning about travel destinations through movies or TV. Short videos are very appealing to me because they are brief, and the subject matter is often focused on the high-

lights. I can quickly grab my attention, and with just a finger tap, I can like a video, making me feel immersed. "

The characteristics of short video as a medium during this stage include:

Personalization: Users can choose the information they receive based on their own preferences and needs. Interactivity: Users can engage with other users through short video platforms. Connectivity: Various elements and things can be organically combined within the platform. In traditional media, users were passive recipients of information. In the mobile media era, users can actively choose the content they engage with. Additionally, user interaction is no longer limited, with platforms offering comment sections and feedback systems that help meet users' needs and respond quickly. Mobile media can combine various elements, making it highly connective and increasing coverage. Thus, the most prominent features of mobile media are strong personalization and interactivity, followed by connectivity.

Scene Five Forces: the Driving Forces Behind Tourism Short Video Dissemination

In the previous section, the characteristics of information dissemination in media transitions were analyzed. In the mobile media era, information dissemination is based on scene services. As a representative of the mobile media era, short videos also follow a scene-based service model for information dissemination. This section combines the five elements of scene theory proposed by Robert and other scholars in The Coming Scene Era: big data, social media, mobile devices, sensors, and positioning systems, adopting the Scene Five Forces Theory and case studies to explore the technological elements behind the production and diffusion of short videos[28].

Big Data: Linguistic Representation

Currently, there is no unified definition of big data. The globally leading consulting firm McKinsey refers to "big data" as deeply penetrating various industries and becoming a key driver of social production. The information flood brought by big data is gradually changing our lives, travel, learning, work, and thinking.

Big data has four main characteristics: massive volume, speed, diversity, and low value density. Short videos can be upgraded and expanded through big data. Short video platforms first collect and process large amounts of data, establish user profile data systems, and then match real-time scenes through targeted recommendation dissemination. Big data analyzes user behaviors, such as time spent watching short videos, frequency, and other interaction metrics. The platform then integrates and analyzes users' browsing history, search content, and consumption behaviors, generating models of user preferences and needs. Based on this, and considering the characteristics of short videos, personalized content push strategies are designed for users by utilizing different types of scenes, thereby attracting more potential consumers and improving traffic conversion rates, which in turn boosts platform revenue.

Platform developers can also use data assistants to view real-time data such as accumulated data, open time, new data, and retention data. This helps make decisions to guide users to continue using the platform, expand functional scenes, and improve user engagement. By continuously feeding back data, user preferences are better understood, thus tailoring the content to match those preferences and building user dependency on the platform, leading to stronger user retention.

As digital media advances, "big data" has gradually become the linguistic representation of short videos. What types of short videos do users like? Which short videos are more likely to stimulate user consumption and participation? What presentation styles will become trends in the development of short videos? What constitutes high-quality content? How can quality short video products be produced? These questions can be answered through the observation and analysis of big data.

Social Media: The Bridge of Relationships

Social media is essential in the era of scenes, as it enables us to clarify our preferences, location, and the goals we seek through communication. Social media has undergone several stages—initial, page-based, and mobile internet stages—gradually showing a trend toward platformization and ecological integration, creating a space that connects online and offline lives.

The emergence of social media has broken the previous boundaries of technology and usage scenarios, providing users with channels to express themselves, thus changing the traditional passive way of receiving information. The flow of information becomes bidirectional, with a prominent role in daily life.

Video-based social media platforms, represented by Douyin (the Chinese version of TikTok), are leading the social media market. Users establish virtual relationships with other users through video-based social media. On the one hand, short video producers create and share large volumes of UGC (user-generated content) videos on Douyin, which other users can watch, learn from, and imitate. On the other hand, users interact with short video producers and other users through discussion and interaction on the platform. Short videos em-

body information connectivity, and as a highly social and interactive form of social media, short video platforms satisfy users' demand for real-time information dissemination.

Mobile Devices: Material Carriers

The Coming Scene Era points out that mobile devices are the carriers for experiencing the "super storm" of scenes. Mobile devices differ significantly from desktop computers in terms of compatibility, time management, and screen layout options. The widespread use of mobile phones is mainly due to the development of communication technologies. According to the 2020 Mobile Market Report, the global number of smartphone users will reach 3. 9 billion, a modest increase of 6. 1% compared to the previous year. Short videos were developed only after mobile phones became ubiquitous, and most users report that they access short videos through their mobile phones. The mobile phone serves as the carrier for short video content in this mobile media age, and its advantages lie in its strong interactivity, high computing performance, compact screen design, and intelligence, all of which cater to users' fragmented usage patterns. Both the production and dissemination of short videos rely on mobile devices.

Today, mobile devices, especially smartphones, have become an indispensable part of users' lives. Short video scene services are delivered to users via mobile intelligent terminals, enabling precise real-time interaction. The compatibility of short video applications with mobile phones further consolidates the role of the mobile phone as the carrier for short video content.

Sensors: Instant Push

Sensors are embedded in mobile media, represented by smartphones, and are widely used in short video production, exerting an increasingly significant influence due to the rapid development of technology. As a sensory device, the smartphone primarily helps users perceive the surrounding world and provides them with richer and more diverse content.

For example, when a platform pushes short videos, sensors collect environmental data, forming a recommendation method for short videos based on mobile adaptation algorithms and multi-objective optimization. Users' data can be captured, organized, stored, and applied by the platform in real time and with high accuracy through sensors.

Additionally, sensors, through mobile networks or Bluetooth technology, can accurately sense users' media usage habits and consumption behaviors. The positioning system can capture the real-time location of short video app users, generating a series of data that sensors collect and feed back. This data is then analyzed, processed, and compiled into reports, enabling the platform to enhance the user experience and comfort level.

Positioning System: Connecting and Supporting

The positioning system has long been inseparable from short videos. Through the use of positioning systems, people can overcome the limitations of physical space. When combined with sensors, it can push information relevant to the user's current time and location, prompting active responses and enabling interactive engagement within the "scene. "

By analyzing the current development of the mobile internet, and considering the characteristics and needs of the mobile internet era, mobile media, represented by short videos, must account for the user's real-time location. On this basis, the term "location-based services" (LBS) emerged, which refers to services based on data such as spatial location or environmental conditions needed for people's daily lives. By using location perception and analysis, LBS provides auxiliary decision-making support services, reflecting the changes and needs in various aspects of the user’s behavior throughout the process.

The positioning system has been widely applied in various short video platforms, connecting to mobile short video apps. These apps use location-based technologies to capture the user's physical geographic location and then connect to third-party service providers' APIs to retrieve short video content near the user's physical location, such as videos related to tourist attractions or commercial districts. The use of positioning systems in short video apps is centered around the user, improving efficiency and enhancing the user experience.

Short video platforms all adopt positioning systems, allowing users to access short video information based on their geographic location or self-identified position. Platforms like Douyin (TikTok), Mafengwo, Kuaishou, and Xiaohongshu automatically query location information when the system is used, and with authorized logins, the system pushes short videos based on the user's location.

Human Needs: the Driving Force Behind the Dissemination of Tourism Short Videos

The advent of the mobile internet era has led to the continuous development of new media technologies, with the five forces of scene theory providing technical support for short videos. However, human psychological needs also play a crucial role in the production and diffusion of short videos, which cannot be overlooked. Drawing inspiration from Maslow's Hierarchy of Needs,

the author argues that the needs for self-expression, self-presentation, and social interaction are core elements driving users to engage with short videos. This section analyzes the reasons for the diffusion of short videos from three perspectives: self-expression, self-presentation, and social interaction, using interview data.

Need for Self-Expression

Short videos have innovated the way people express themselves—using dynamic formats such as video and sound to present oneself to others. Traditional forms of expression, such as dialogue, text, and images, are static, whereas short videos offer a more diverse form of expression: transitioning from one-way transmission to two-way interaction, from closed to open, from simple to complex, and from unimodal to multimodal. Video-based self-expression is more direct and comprehensive, facilitating the transformation of "unknown" areas into "open" spaces, improving communication efficiency, promoting self-awareness, and fostering harmonious social relationships.

One interviewee explained: "I generally post short videos to express my enjoyment of life. It's like replacing text and pictures. For example, when I went to Sanya for vacation and saw the blue sea for the first time, describing it with words seemed insufficient. Photos didn't convey the feeling, but videos allowed me to show it from multiple angles, including the sound of the waves. " (Interviewee hll)

Another interviewee said: "The main purpose of posting short videos on Douyin is to record life. I think if you record a day of your travel journey through video, it's also an expression of how beautiful your life is right now. " (Interviewee ccy)

Users participate in short video dissemination to express themselves and share their creations. As a new form of communication, short video transmission is primarily based on "human-machine" interaction. Short video dissemination breaks the linear narrative model of electronic media, realizing fragmented, interactive, and personalized modes, providing more space for free expression of thoughts in the new era and offering audiences a diversified aesthetic experience. Users can fully leverage their strengths through short videos, enabling positive empowerment in communication and social interactions.

Need for Self-Presentation

Short videos are a completely new medium, characterized by significant mimetic features and autonomy, providing users with a stage to showcase their personal creativity and imagination. The content dissemination focuses more on user experience and is centered on "people. " The dissemination channels employ various methods of promotion, achieving full audience coverage.

First, in the internet age, young people, driven by the desire to express their individuality, have a strong urge to showcase themselves. Short videos offer a platform for this expression, allowing them to gain attention and recognition. The widespread use of smartphones and the development of camera functions have lowered the threshold for shooting videos. Now, anyone can shoot, upload, and share videos simply with a mobile phone.

Second, users show a preference for different forms of information. Video is more engaging than images, and images are more engaging than text. One interviewee noted: "Douyin is a platform for showcasing daily life, so I like to record my daily activities. For example, on the Qixi Festival, my boyfriend and I usually go traveling to celebrate, and I would record it on Douyin because it was a happy and beautiful day. I want to capture the memories. " (Interviewee cnn)

Another said: "I'm more of a sharing-type personality, so I often shoot short videos and post them on Xiaohongshu. It's not about showing off, it's just about sharing the joyful moments in my life with others. " (Interviewee cnn)

Users shoot videos of tourist destinations and share and forward them as part of their self-presentation needs. This act of sharing itself belongs to the domain of communication. Short videos are changing the traditional ways of information dissemination, offering users a new experience. Uploading videos allows other users to experience the content, reaching people worldwide and exposing them to things they might not have encountered otherwise, thereby extending visual perception.

Need for Social Interaction

The emergence of short videos has altered traditional social interaction models, as users now rely on short video media to fulfill their social needs. Short videos create new social interaction pathways, enhance emotional exchanges in interpersonal communication, expand the space for social activities, and enrich the content of interpersonal communication.

One interviewee shared: "On Xiaohongshu, I post travel short videos both to showcase my life and because I want people to like my posts. Getting likes and comments from others gives me a sense of fulfillment. " (Interviewee yxd)

Another stated: "I think the most important reason for uploading travel short videos is to gain others' appreciation. If someone comments, likes, or follows my video, I feel really happy. " (Interviewee ty)

Short videos have surpassed their role as entertainment tools and become instruments for people to connect socially and derive social pleasure. The rise of video-based socializing has created a social environment that mirrors real life, innovating social practices and bringing about a truly shareable culture. People use short videos selectively to disclose their life situations, changing traditional modes of communication and fostering participatory social interaction, where emotional connections are formed through shared experiences. Users create and share short videos to gain recognition and respect from others, showing that short videos, as products of technological development, have a significant impact on communication and social interaction.

Chapter Summary

This chapter first draws on the concept of "scene as an information system" proposed by Merowitz to analyze the background of the rise of short videos from the perspective of media evolution. In the era of oral media, people conveyed information through direct conversation; the medium was the person itself. In the print media era, society transitioned from an "auditory society" to a "visual society," with books and images as the dominant media. In the electronic media era, television and radio broke through spatial distance and time constraints, extending visual and auditory experiences. In the mobile media era, short videos combine video, text, sound, and images to present comprehensive scenes, with the most notable feature being interactivity and connectivity, unlike any previous era.

The dissemination of short videos is influenced by both technological advancements and human needs. Technological development creates a favorable environment for the production and dissemination of short videos. In today's age of information overload, media producers must focus on the needs of a large user base. Short videos are driven by users' needs for self-expression, self-presentation, and social interaction, which are central to their spread.

Finally, the chapter introduces the development of a short video tourism scene construction model based on human-machine interaction, as outlined in the previous chapter. This model, centered on the user, analyzes the "scene" construction elements for short video platform design and examines the demand characteristics of different types of users to propose methods for realizing short video scene construction.

NEW SCENE: ELEMENTS OF TOURISM SCENARIO CONSTRUCTION

The diffusion of short videos is further rooted in user demand. Based on Maslow’s hierarchy of needs, three types of demand can be summarized:Self-expression needs are reflected in externalizing travel experiences through short videos. Respondents stated that short videos "show multiple perspectives of travel experiences, replacing text and images. "

Self-presentation needs are expressed through the creation of social images using refined editing and labeled content to gain social recognition.

Social interaction needs are met through likes, comments, and other interactions, fostering a sense of belonging and creating a network for social dissemination. These three types of needs, interacting with the Five Forces of the Scene, drive content diffusion.

The integration of media scenario theory and social network theory reveals the production and diffusion mechanism of tourism short videos: the Five Forces of the Scene form the technological foundation, while user needs provide the internal driving force. The "technology-humanity" dual-track model highlights the role of short videos in reconstructing the tourism communication ecosystem.

NEW BEHAVIOR: TOURISM SCENARIO CONSTRUCTION MODES

Peng Lan proposed that a scene consists of space and environment, real-time user status, lifestyle habits, and social atmosphere[29]. Using methods such as the Technology Acceptance Model (TAM), individual behavior studies, and psychological research, this provides support for understanding the changes insocial relationships within new scenarios[30]. Based on this, short videos construct the "field" of tourism scenarios, offering space for growth and dissemination channels. This section focuses on the "human" core, analyzing the functions of tourism short video scenes, with cases and interview texts to examine the three types of interaction modes: individual-to-landscape, individual-to-individual, and individual-to-product. It discusses the evolving relationships within the interaction between virtual online scenes and real-world user scenes.

Based on the distinction between "field" (action domain) and "scene" (interactive relationships), and with "human" as the connective link, tourism scenarios can be mapped to three types of platforms: Douyin and Kuaishou as entertainment domains, focusing on individual-to-landscape interaction; Xiaohongshu as a life service domain, focusing on individual-to-individual interaction; and Mafengwo and Qiongyou as tourism

Table 1 | Classification of Tourism Scene Modes

Representation Platform	Characteristics of "Stage"	Characteristics of "Scene"
Karaoke, Mahjong	Entertainment Field	Interaction with the body and surrounding scene
Xiaohongshu	Life Service Field	Interaction with the body and individual products
Honeybee, Labor	Tourism Business Field	Interaction with individual products and scene

Notes on specific terms:Xiaohongshu (小红书): This refers to the Chinese social media platform known as "Little Red Book" or "RED," which focuses on lifestyle, product reviews, and social sharing. Honeybee, Labor (马蜂窝): The term "Honeybee" here refers to a popular Chinese travel platform (Mafengwo), and "Labor" could be pointing to a related field or aspect of tourism, possibly focusing on work or effort in tourism services.

marketing domains, focusing on individual-to-product interaction.

Individual-to-Landscape Interaction Mode: This mode constructs a simulated virtual tourism world through videos, text, and music, enabling the virtual presentation of tourist destinations and users' "on-site" experiences. The presentation method uses sensory participation to simulate physical space. Short videos rely on technological means to restore visual effects, shapes, and scenes of tourist destinations, integrating visual, auditory, and tactile elements to create a coherent sensory experience. Respondent lyx stated: "The simulated content in short videos is engaging, and interactions like likes activate the sense of participation, providing a deeply immersive experience."

Individual-to-Individual Interaction Mode: McLuhan's "tools shape people" theory reveals how technology reshapes communication. Short video platforms use their social attributes to build virtual interaction scenarios, with actions like likes and comments replacing traditional face-to-face communication, creating an interactive space for like-minded travel enthusiasts. Respondent cjm mentioned, "I like a bungee-jumping blogger's video to express my admiration for their courage. " Respondent fy also noted, "Likes are convenient and simple. I often like content I enjoy but rarely comment. It gives me a sense of participation. "

Individual-to-Product Interaction Mode: This mode is "user-centered" and enhances user experience and identity through the creation of atmosphere, ultimately leading to consumption behaviors and forming a unique "marketing scene" for short videos. Tourism short videos often feature natural landscapes as backgrounds, with products integrated naturally into the scenes. For example, Mafengwo's "Play Army" series highlights off-road vehicles in a video shot in Tibet, using viewers' fascination with "the isolated Tibet" to achieve high views and increase product exposure. The essence lies in the combination of the platform's virtual "field" and the audience's virtual "presence" in the "situation," creating a psychological perceptual space that fosters a sense of real existence and belonging[31].

New Impact: Reshaping Social Relationships through Tourism Scenarios

In The Rise of the Network Society, Manuel Castells discusses how the internet reshapes interpersonal connections through "electronic villas" (Manuel Castells, The Rise of the Network Society, 2nd ed. , Social Science Literature Press, 2003). Short videos impart new economic and relational significance to spaces (Wang Jianlei, "Space Reproduction: A Value Interpretation of Online Short Videos," Modern Communication: Journal of China Communication University, 2019 (7): 5). Real-world tourism scenes, as material experiences, interact with the multi-layered, relationally intertwined virtual scenes in short videos, continuing to impact real-world society.

This section, relying on in-depth interviews and social network theory, categorizes the relationships between individuals, individuals and scenes, and scenes and space. User behavior and psychological needs drive the formation of diverse scene models, promoting the deep integration of online virtual scenes with offline real-world scenes[32]. Paul Erdr and Alfred Reilly's single link connects all nodes" theory affirms the "global village" effect generated by network space interpersonal relationships. The short video platforms studied are open, with users holding dual identities as both scene consumers and producers. This "production-dissemination" relationship (as opposed to a confrontational one) constitutes the core characteristic of relationships between individuals. The core manifestation of this is the hybrid interaction of virtual and real communication. Short video technology compensates for the communication deficits of the electronic media era, creating an online communication platform.

Although users are physically absent, they communicate emotions and information through interaction. For example, respondents mentioned that "watching travel short videos, with exchanges in the comment

section with bloggers and other users, makes me feel part of a real travel community, and even if we have never met, we can form emotional resonance. " This type of interaction breaks the physical limitations of traditional tourism socializing, forming a new relationship model of "weak connections and strong interactions," where users gather based on shared travel interests and maintain connections through light actions like likes, comments, and shares. This model is flexible and sticky.

NEW INFLUENCE: RESHAPING SOCIAL RELATIONSHIPS THROUGH TRAVEL SCENARIOS

In The Rise of the Network Society by Manuel Castells, the "everyday life in the electronic villa" reveals how the Internet reshapes the ways in which interpersonal relationships are connected[33]. Short videos as a form of media give new economic and relational significance to space. The real-world travel scene, as a material experience in the world, interacts with the virtual scenes in short videos, which are multifaceted and relationally intertwined, continuously influencing real-world society[34]. This section, based on in-depth interviews and social network theory, summarizes the relationships between individuals, individuals and scenes, and between scenes and spaces.

Hybrid Interaction of Virtual and Real Worlds

On one hand, short video users experience interaction without being physically present in the scene. Leveraging a powerful technological foundation, short video platforms supplement the communication gaps left by electronic media, creating new platforms for online interaction. These platforms enable users to connect with one another, creating space for human interaction. One interviewee stated, "When watching travel short videos, I may be a viewer, but I can interact with others, which makes me feel that I'm not just a passive observer" (interviewee FY). Another interviewee said, "As a user, I see myself as a participant in the travel scene, and I often engage in discussions with others by commenting on posts in Xiaohongshu" (interviewee CSQ). The core interface of short video platforms, which includes features such as likes, comments, and sharing, allows users to enter semi-closed, contextual spaces where they can freely express their opinions or interact with creators and other users, thereby creating a virtual presence. Through participation in content creation, users can express themselves, enhancing their sense of presence on the platform, which motivates them to share content and achieve dissemination goals.

On the other hand, video producers actively participate in social interactions through physical presence. Randall Collins argues that face-to-face co-presence is a necessary element for interactive rituals, as it allows for mutual influence through bodily presence. Many interviewees are both users and producers of videos. Among them, two-thirds of short video producers reported actively participating in video production. One interviewee remarked, "I like the videos by Kiki, the blogger. She always appears on screen, and I really enjoy her style, not just because of the beautiful videos, but also because of the warm and talented impression she gives" (interviewee CCY). Another interviewee mentioned, "The popularity of Ganzi Tibetan Autonomous Prefecture on Douyin was largely due to Ding Zhen's good image and handsome appearance, which attracted attention to the place where he lived. I feel that short videos with real people on screen provide more authenticity and immersion than purely scenic videos" (interviewee LTT). These interviews suggest that the physical presence of the producer in short videos strengthens the sense of "being there" and fosters a deeper connection between the creator and the audience, facilitating the continuation of interaction.

Merging of Roles: Producer and Receiver

The construction of short video travel scenes has shifted the traditional roles of users as receivers of information. In these contexts, users function as both producers and receivers. This transformation can be understood in two main ways. First, when users view travel videos that they like, they often share them, thus becoming active disseminators of content. One interviewee said, "When I see a travel scene I like, especially those filmed from multiple perspectives, I often share it with my friends and family" (interviewee CY). Another interviewee mentioned, "I like to share videos of travel bloggers, such as those from Russia featuring the aurora. I share them with my girlfriend, and we plan to go see it together someday" (interviewee LN). Secondly, some users, after receiving significant attention for their shared content, become video producers themselves. As one interviewee noted, "Before using Xiaohongshu, I would post daily travel videos. Once I received more than 10,000 likes on one post, I started posting more frequently, and with increasing followers, businesses began contacting me for collaborations" (interviewee TY). Such changes show how user roles in short videos are becoming more dualistic, with users no longer merely passive recipients but active participants in the dissemination of content.

Strong and Weak Social Connections

As Harold Innis suggests, "Media have spatial and temporal biases. " Short videos reflect this dual bias, as they transcend the boundaries of time and space. The emergence of short video travel scenes has created a new social network structure. On one hand, short video interfaces allow for easy sharing across other social media platforms (such as WeChat), helping users strengthen offline "strong relationships" by sharing videos with close friends and family. On the other hand, by watching other users' travel experiences and interacting with them through likes and comments, users expand their social circles, establishing "weak connections. " As Castells has noted, "Media are the organizational glue of society," indicating that short videos connect people with distant, unfamiliar social relations. "Weak relationships" refer to interpersonal connections that are either direct or indirect but lack clear boundaries or formal structures. These are relationships characterized by shallow acquaintance, low intimacy, and infrequent communication, such as those formed by likes on social media. Short video platforms facilitate these weak relationships by enabling users to engage with content creators and other users who share similar interests. One interviewee stated, "If the travel video is beautifully shot and the copywriting is good, I will generally like such videos" (interviewee CCM). Another said, "When I see a travel short video that interests me, I will like and comment, asking about the location or experience of the activity" (interviewee ZDY) .

Sense of Place in Interpersonal Interaction

Digital media has greatly promoted the realization of localized, personalized communication, enabling users to interact with other communicators through images, text, and sound anytime and anywhere. Network media has disconnected people from local places, but mobile media in the form of short videos has reintroduced the "local. " One interviewee remarked, "As a person from Changsha, I often watch travel short videos tagged with Changsha on Xiaohongshu. I typically like and comment on them, perhaps due to my emotional connection to my hometown" (interviewee TY). Another said, "As someone from Xi'an, I often share or post travel videos about local landmarks, both to showcase my city and to share with friends abroad" (interviewee FY). Most interviewees expressed that they engage in behaviors such as sharing, liking, and commenting on local travel videos, using short videos to express their emotional attachment to their hometowns. This behavior not only provides a visual experience for other users but also helps them feel the cultural impact of the same region, strengthening social ties.

CONCLUSION

In the era of intelligent media, short videos and the tourism scenes co-constructed by users present characteristics of multiple scene juxtaposition and the coexistence of multiple relationships, shaping a new social lifestyle. This study, based on the "New Media—New Scene—New Behavior—New Influence" framework of media scene theory, explores the construction of the tourism "scene" in short videos, the representation of "scenes," and the reshaping of social relationships.

At the new media level, the study elaborates on the production and dissemination of short videos from three aspects: the background of media transformation, the "Five Forces of Scene" technological elements (big data, social media, positioning systems, sensors, mobile devices), and the core user needs (self-expression, self-presentation, and social interaction).

At the new scene level, the study first conducts a case analysis of the platform homepage, shooting interface, core functions, etc. , followed by the analysis of the "field" construction logic through video, text, and sound symbols. It also focuses on the "spatial layout" strategies of the camera angles, visuals, and editing.

At the new behavior level, based on platform functions and user behaviors, three types of interaction modes are distilled: visually sensory-oriented individual-landscape interactions, socially-oriented individual-individual interactions, and marketing-oriented individual-product interactions. The study analyzes the differences in these modes in terms of presentation styles and dissemination mechanisms.

At the new influence level, the study reviews the changes in social structure from three dimensions: the relationship between individuals is reflected in the interaction of real and virtual identities, the elimination of boundaries between sender and receiver, the strength and weakness of interpersonal connections, and the emphasis on a sense of place. The relationship between individuals and scenes is marked by role differentiation, with users participating in a non-ritualistic, fragmented manner, seeking substitute satisfaction. Producers, on the other hand, create connections between the real and the virtual and guide social interaction within the scene. Finally, the relationship between scenes and social relationships is characterized by the fusion of virtual and real spaces, and the functional compensation of virtual reality for the physical world.

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Appendix A: Selection of Tourism Short Video Platforms

Serial Number	Name	Type	Function	Types of 'Scene' and 'Setting'
1	Douyin	UGC	Video presentation	Entertainment spaces are constructed through the visual interaction between individuals and media landscapes.
2	Xiaohongshu	PUGC&UGC	Lifestyle Sharing Community	The realm of life services is constructed through visual or consumer interactions between individuals and service providers, based on media visual technology.
3	Hornet's Nest	OTA	Tourism Marketing Services	The field of tourism marketing is constructed around the visual or consumption interactions between individuals and service providers, based on media visual technology.
4	Budget travel	OTA	Tourism Marketing Services	The field of tourism marketing is constructed around the visual or consumption interactions between individuals and service providers, based on media visual technology.
5	Kuaishou	UGC	Video presentation	Entertainment spaces are constructed through the visual interaction between individuals and media landscapes.

Note: Based on iResearch's "2021 China Online Travel Report" and the platforms commonly used by users in preliminary interviews, five short video platforms were selected.

Appendix B: Respondent Information Form

Serial Number	Name Alias	Age	Gender	Level of Education	Industry
1	cjm	25	Female	Master's degree	Student
2	cyc	23	Female	Bachelor's degree	Employee
3	csq	30	Male	Bachelor's degree	Employee
4	tyn	38	Female	Master's degree	Manager
5	lyx	35	Male	Bachelor's degree	Manager
6	ty	24	Male	Master's degree	Student
7	ccy	23	Female	Bachelor's degree	Employee
8	lcg	19	Male	Bachelor's degree	Employee
9	cnn	28	Female	Bachelor's degree	Teacher
10	hll	29	Male	Specialized subject	Employee
11	xy	30	Male	High School	Teacher
12	zy	40	Female	Master's degree	Employee
13	fy	43	Male	High School	Manager
14	yhs	37	Female	Specialized subject	Employee
15	ln	19	Male	Bachelor's degree	Employee
16	yxd	28	Male	High School	Teacher
17	zdy	40	Female	Master's degree	Employee
18	wwn	18	Male	Specialized subject	Student

Note: When selecting interviewees, differences in education, age, industry field, and geographical location were comprehensively considered to enhance representativeness.

Appendix C Semi-Structured Interview Guide

Dimension	Serial Number	Content
1. Demographics	1. 1 Gender	What is your gender?
	1. 2 Age	How old are you?
	1. 3 Education	What is your highest level of education?
	1. 4 Occupation	What is your occupation?
	1. 5 Frequency	How often do you use short videos?
2. Daily Usage	2. 1 Usage Frequency	How often do you watch tourism short videos? What situations lead you to watch them?
	2. 2 Access Method	What platforms do you usually watch tourism short videos on?
	2. 3 Device	What device do you generally use to watch short videos?
	2. 4 Other Aspects	Are there any other related habits or conditions?
3. Short Video Tourism Awareness	3. 1 Conceptual Understanding	How do you understand tourism short videos? What examples can you give?
	3. 2 Influence	How do tourism short videos influence your decisions or behaviors?
	3. 3 Purpose	What is the primary reason you watch tourism short videos?
	3. 4 Scene & Environment	How do you feel when watching short videos about tourism destinations? What kind of environment or atmosphere do they create for you?
4. Usage Effects	4. 1 Behavior	Have tourism short videos influenced your travel-related decisions? If so, how?
	4. 2 Perception of Virtual Environment	Do tourism short videos help you better understand the destinations or locations they feature?
	4. 3 Social Impact	Do these videos change how you interact with others?
5. Future Trends	5. 1 Development	What do you think the future of tourism short videos will look like?
	5. 2 Impact	How do you think the development of tourism short videos will influence the tourism industry?
	5. 3 Behavior	Will you continue to engage with tourism short videos in the future? Why or why not?
6. Social Behavior	6. 1 Interaction Behavior	Do you interact with tourism short video creators or other viewers in the comment section or other interactive spaces? How do you usually interact with others?
	6. 2 Participation	Do you actively participate in any activities related to tourism short videos (e. g. , voting, commenting, sharing)?
	6. 3 Personal Role	What role do you see yourself playing when watching tourism short videos (e. g. , passive viewer, active participant)?
	6. 4 Expanding Communication	Do tourism short videos help you expand your social circle or interact with others who share the same interests?
	6. 5 Related Communication	Do tourism short videos lead you to discuss or talk about them with others, either online or offline?
7. Economic Behavior	7. 1 Spending Behavior	Have tourism short videos ever influenced your travel spending decisions? If so, how?
	7. 2 Payment Activities	Have you ever spent money on services or products related to tourism destinations promoted by short videos (e. g. , booking travel, purchasing products featured in the videos)?
	7. 3 Impact on Consumption	How do tourism short videos impact your consumption of travel-related services or products?
8. Other Dimensions	8. 1 Psychological Effects	How do tourism short videos affect your psychological state (e. g. , excitement, inspiration, desire to travel)?
	8. 2 Other Effects	Do tourism short videos have any other impact on your behavior or perceptions that you would like to mention?

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From Spatial Production to Memory Production: The Inscription Mechanism as an Analytical Model in Heritage Contexts

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KEYWORDS

Inscription Mechanism;
Spatial Production;
Collective Memory;
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ABSTRACT

Heritage spaces are commonly treated as stable containers of historical meaning, yet their significance is continuously produced, mediated, and reactivated through spatial arrangements, visual representations, and social practices. Although theories of spatial production and collective memory have each addressed aspects of this process, the mechanisms connecting spatial production to memory production remain insufficiently articulated. This article introduces the inscription mechanism as an analytical model for understanding how collective memory is produced in heritage contexts. Drawing on Paul Ricoeur's concept of inscription and the medial turn in spatial theory, inscription is conceptualized as a mediating process operating across temporal, spatial, visual, and practical dimensions. The article develops a four-dimensional model that highlights the governing role of temporal organization in coordinating memory activation. By reframing heritage spaces as memory-producing systems, this study offers a theoretical and methodological framework for future research on spatial narratives and public memory.

INTRODUCTION

Heritage spaces are commonly approached as stable containers of historical meaning, valued for their material authenticity, stylistic coherence, or documentary significance. Within this object-oriented perspective, architectural remains, monuments, and historic urban landscapes are often treated as passive repositories of the past. However, such an approach struggles to explain how heritage meanings persist, transform, and circulate across historical periods and social contexts. Heritage spaces do not merely preserve historical content; rather, their significance is continuously produced, mediated, and reactivated through spatial arrangements, representational systems, and social practices.

This problem has been addressed from multiple theoretical directions. On the one hand, theories of spatial production have demonstrated that space is not a neutral container but a socially produced and relational construct. Henri Lefebvre's seminal work conceptual-

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izes space as the outcome of social relations, structured through the interaction of spatial practice, representations of space, and representational space (Lefebvre, 1991). From this perspective, space is continuously produced through everyday routines, institutional planning, and symbolic experience. Subsequent developments—most notably Edward Soja's formulation of Thirdspace—further emphasize space as a lived, performative, and mediating field rather than a fixed physical entity (Soja, 1996). While these approaches provide powerful tools for understanding how space is generated and organized, they remain comparatively less explicit about how spatial products endure and function as collective memory over extended temporal horizons.

On the other hand, theories of collective memory have emphasized that memory is fundamentally social rather than purely psychological. Building on Durkheimian sociology, Maurice Halbwachs argues that memory is structured by social frameworks that shape what can be remembered and how it is interpreted (Halbwachs, 1992). Memory, in this sense, is not a static archive of the past but a process of continual reconstruction in relation to present social contexts. Pierre Nora further highlights the growing reliance of modern societies on spatialized memory anchors—monuments, heritage sites, and symbolic locations—to stabilize collective identity in the absence of living memory (Nora, 1989). Yet within much of the memory studies literature, space often functions primarily as a backdrop or container for memory rather than as an operative mechanism through which memory is actively produced and governed.

Between these two bodies of theory lies an analytical gap. Spatial production theory explains how space is socially generated, while collective memory theory explains how the past is socially framed. What remains insufficiently articulated is the mediating process through which spatial configurations become stabilized as memory-bearing structures, and through which they are repeatedly mobilized, visualized, and enacted as shared historical experience (Olick & Robbins, 1998). In other words, the central question is not simply how space is produced, or how memory is socially framed, but how memory itself is made.

Before introducing the inscription mechanism, one clarification is necessary. The reference to a "medial" perspective in this article does not imply the existence of a distinct theoretical school or a formally articulated "medial turn" within spatial theory. Rather, it denotes an analytical reorientation in the interpretation and application of spatial production theory. Building on Henri Lefebvre's conception of space as a socially produced and relational structure, later spatial theorists and heritage scholars have increasingly emphasized not only how space is produced, but how space operates as a mediating structure through which social meanings, memories, and practices are organized, circulated, and reactivated. In this sense, the medial perspective does not replace spatial production theory, but foregrounds its operative dimension—namely, the role of space as an active interface between time, representation, and practice.

It is within this interpretive framework that the inscription mechanism proposed in this article is situated. Drawing on Paul Ricoeur's understanding of inscription as the externalization of memory into durable forms, inscription is conceptualized as the process through which memory becomes fixed, encoded, and rendered publicly accessible (Ricoeur, 2004). Inscription is not a neutral act of recording; it involves selection, formalization, and institutional mediation, through which certain memories gain visibility and authority while others are marginalized. By extending this concept beyond textual archives to spatial, visual, and practical domains, this article defines inscription as a mediating mechanism operating across temporal, spatial, visual, and practical dimensions.

Building on this definition, the article develops a four-dimensional analytical model of the inscription mechanism, consisting of temporal inscription, spatial inscription, visual inscription, and practical inscription. These dimensions do not function independently but operate in a coordinated structure governed by temporal organization. Through this model, heritage spaces are reconceptualized not as passive containers of historical meaning, but as memory-producing systems in which collective memory is continuously activated, stabilized, and transformed.

This article adopts a theoretical and methodological approach. Rather than presenting a comprehensive empirical case study, it aims to construct an analytical framework that can be applied to diverse heritage contexts. By articulating the inscription mechanism as an interface between spatial production and memory production, the article provides a transferable conceptual tool for future research on heritage spaces, spatial narratives, visual archives, and embodied practices of public memory.

COLLECTIVE MEMORY: SOCIAL FRAMEWORKS AND INTERPRETIVE TENSIONS

Social Frameworks and Collective Memory

The concept of collective memory emerged as a critical response to psychological individualism in early studies of memory. Rather than locating memory exclusively within individual consciousness, sociological approaches emphasize that remembering is structured by social frameworks that shape how the past is perceived, interpreted, and shared. From this perspective, memory is not a purely internal faculty but a relational phenomenon embedded in social relations, institutional arrangements, and symbolic systems.

Maurice Halbwachs's formulation of collective memory is foundational to this approach. Building on Durkheimian sociology, Halbwachs argues that individual memory is always situated within social frameworks that provide categories, reference points, and interpretive boundaries for recollection (Halbwachs, 1992). These frameworks include language, norms, spatial settings, temporal markers, and group affiliations, all of which enable individuals to recognize their memories as socially intelligible. Memory, in this sense, is not retrieved intact from the past but reconstructed in relation to present social contexts. What is remembered, forgotten, or emphasized depends on the frameworks through which memory is organized.

A key implication of this theory is that collective memory is dynamic rather than static (Olick, 1999). Because social frameworks evolve, memory is continually reshaped to accommodate new social conditions and interpretive needs. This dynamic quality distinguishes collective memory from institutionalized historical knowledge, which often aspires to coherence, linearity, and objectivity. Whereas history seeks to stabilize the past through documentation and critical distance, collective memory remains closely tied to lived experience and group identity, allowing for plurality, contestation, and revision (Halbwachs, 1992; Assmann, 2011).

At the same time, collective memory does not exist independently of material and symbolic supports. Social frameworks are sustained through external anchors that stabilize memory beyond individual lifespans. These anchors may take the form of spatial environments, commemorative practices, narratives, or visual representations. Without such supports, collective memory risks fragmentation and disappearance. This insight underscores the importance of examining how memory is externalized and maintained through durable forms.

Later theorists have further elaborated the relationship between memory and social mediation. Aleida Assmann, for example, distinguishes between communicative memory, which operates through everyday interaction and personal recollection, and cultural memory, which is stabilized through institutionalized media, rituals, and symbolic forms (Assmann, 2011). This distinction highlights the role of mediation in extending memory across temporal distances. Cultural memory depends on processes that fix and transmit meaning, allowing memory to endure beyond the immediacy of lived experience.

Despite these advances, much of the collective memory literature treats space as a contextual condition rather than an operative mechanism. Spatial settings are often acknowledged as important for remembrance, yet their role is frequently limited to that of a backdrop against which memory unfolds. What remains under-theorized is how spatial configurations themselves participate in structuring memory—how they function as active frameworks that shape what is remembered, how it is remembered, and when it is reactivated.

This limitation points to the need for an analytical model that can account for the material, spatial, and temporal mediation of collective memory without reducing memory to either individual psychology or abstract social structure. By foregrounding the processes through which memory is fixed, encoded, and circulated, the concept of inscription provides a means of extending collective memory theory toward a more spatially and materially grounded analysis. In this sense, social frameworks of memory are not only cognitive or symbolic structures, but also spatially and temporally organized systems that enable memory to persist and operate within heritage contexts.

Interpretive Debates: Individual, Collective, and Historical Memory

Despite its wide influence, the concept of collective memory has been subject to sustained interpretive debate. One central concern revolves around the relationship between individual memory, collective memory, and historical memory. Critics have questioned whether collective memory risks reifying the group as a unified subject, thereby obscuring individual experience, internal diversity, and conflict. Others have argued that the concept blurs the distinction between socially shared remembrance and formally institutionalized historical narratives.

These critiques have prompted scholars to draw clearer analytical distinctions. Individual memory refers to personal experience, affective recall, and embodied perception. Collective memory, by contrast, denotes socially mediated forms of remembering that are

shared, negotiated, and transmitted within groups. Historical memory occupies yet another position, often associated with formalized, institutionalized, and critically regulated representations of the past, such as historiography, archives, and official narratives. While these categories are analytically separable, they are deeply intertwined in practice, shaping and transforming one another over time (Olick, 1999; Kansteiner, 2002).

Jeffrey Olick has emphasized that collective memory should not be understood as a thing possessed by groups, but as an ongoing process of social remembering. From this perspective, memory is enacted through discourse, practice, and mediation rather than stored as a stable content (Olick, 1999). This processual understanding addresses the risk of reification while preserving the insight that memory operates beyond individual cognition. Similarly, Wulf Kansteiner argues that collective memory emerges at the intersection of intellectual traditions, media structures, and social interests, highlighting the role of cultural transmission and power in shaping what becomes publicly remembered (Kansteiner, 2002).

Another line of debate concerns the relationship between collective memory and history. While history aspires to critical distance and methodological rigor, collective memory is often oriented toward identity, continuity, and meaning. Pierre Nora famously characterizes modern memory as increasingly dependent on lieux de mémoire—material, symbolic, and functional sites that compensate for the decline of lived memory (Nora, 1989). However, this reliance on spatialized memory anchors also introduces tensions between historical complexity and mnemonic simplification. Sites of memory tend to condense heterogeneous pasts into legible narratives, privileging certain interpretations while marginalizing others.

Paul Ricoeur offers a critical intervention into these debates by reframing the problem of memory attribution. Rather than asking whether memory properly belongs to individuals or collectives, Ricoeur shifts attention to the processes through which memory becomes communicable, verifiable, and transmissible (Ricoeur, 2004). Central to this shift is the notion of testimony and its transformation into archive. Memory, in Ricoeur's account, gains social durability only when it is externalized through inscription—when lived experience is fixed in material or symbolic forms that can circulate beyond the immediacy of personal recall.

This intervention has two important implications. First, it dissolves the rigid opposition between individual and collective memory by emphasizing mediation rather than ownership. Memory becomes collective not because it resides in a collective subject, but because it is inscribed, shared, and recognized through socially structured forms. Second, it reconfigures the relationship between memory and history. Historical knowledge does not replace memory; rather, it depends on inscriptional processes that transform memory into documents, images, monuments, and spatial traces subject to interpretation and contestation.

From this perspective, debates over individual, collective, and historical memory converge on a common problem: the mechanisms through which memory is externalized and stabilized. While existing theories acknowledge the social framing of memory, they often stop short of systematically analyzing the material, spatial, and temporal processes that enable memory to endure and circulate. Addressing this gap requires shifting analytical focus from memory as content to memory as process. It is precisely at this juncture that the concept of inscription becomes analytically productive, offering a means to connect social frameworks of memory with spatial production and material mediation.

THE INSCRIPTION MECHANISM: FROM SPATIAL PRODUCTION TO MEMORY PRODUCTION

Conceptual Origins and Theoretical Lineages

The concept of inscription occupies a pivotal yet often under-theorized position in discussions of memory, history, and mediation. Rather than referring merely to the technical act of recording, inscription designates the process through which transient experiences, events, and recollections are externalized into durable and socially retrievable forms. In this sense, inscription marks the threshold at which memory moves beyond individual consciousness and becomes subject to circulation, verification, and institutional negotiation.

A central philosophical articulation of inscription is found in Paul Ricoeur's analysis of memory, history, and the archive. For Ricoeur, memory becomes historically operative only through a process of exteriorization. Inscription transforms lived memory into material supports such as texts, images, monuments, and architectural forms, thereby enabling memory to enter regimes of documentation, interpretation, and critique (Ricoeur, 2004). Crucially, Ricoeur emphasizes that inscription is not a neutral act. It involves selection, formalization, and authorization, through which certain memories acquire legitimacy and durability while others are marginalized or excluded. Inscription thus constitutes a decisive moment in the transformation of memory into social knowledge.

Table 1 | Differentiated contexts of "inscription"

Context	Theoretical origin	Core meaning
Ricoeur	Philosophy	Texts, architecture, images, and other material forms as processes through which memory is externalized and stabilized
Nora	Historiography	The crystallization of historical experience into material sites, spatial nodes, and symbolic forms
This article	Heritage spatial studies	A mediating mechanism through which collective memory operates across time, space, visual representation, and social practice

From a historiographical perspective, Pierre Nora's concept of lieux de mémoire further foregrounds the spatial dimension of inscription. Nora argues that in modern societies, where living memory has been weakened by processes of modernization, memory increasingly depends on material, symbolic, and functional sites to endure (Nora, 1989). These sites—monuments, museums, archives, and commemorative spaces—operate as condensed inscriptions of collective experience. Rather than preserving memory in its original form, they crystallize selective narratives that require continual interpretation and ritualized activation. Inscription, in this context, functions as a mechanism that stabilizes memory by anchoring it in spatialized forms.

Critical perspectives on the archive complicate this understanding by revealing the power relations embedded in inscriptional processes. Jacques Derrida conceptualizes the archive as a site governed by authority, law, and institutional control, emphasizing that inscription simultaneously enables preservation and enforces exclusion (Derrida, 1996). What is inscribed gains visibility and normative force, while what remains uninscribed risks disappearance. This dual character underscores the political and ethical dimensions of inscription, highlighting its role in shaping collective memory through regimes of inclusion, omission, and control.

Despite these diverse theoretical engagements, inscription is often treated as a descriptive term rather than a systematic analytical concept (Stoler, 2002). Studies tend to emphasize either the temporal dimension of inscription, as in archival historiography, or its spatial manifestation, as in monuments and memorial sites. Less attention has been paid to inscription as an operative mechanism that integrates temporal organization (Jones, 2011), spatial configuration, representational mediation, and embodied practice into a coherent process of memory production.

In response to this gap, this article advances a working definition of inscription tailored to the analysis of heritage contexts. Inscription is defined here as a mediating mechanism through which collective memory is fixed, encoded, and circulated across four interrelated dimensions: temporal organization, spatial configuration, visual representation, and social practice. This definition shifts analytical focus from inscription as a static trace to inscription as a dynamic and relational process. Memory is not simply stored in heritage objects or archives; it is continuously produced through the coordinated operation of time, space, representation, and practice.

To clarify the differentiated theoretical lineages and analytical scopes of the concept of inscription, Table 1 compares its usage in philosophy, historiography, and heritage spatial studies. By situating the present definition in relation to existing interpretations, this comparison demonstrates how inscription, in this article, is neither reduced to textual recording nor limited to commemorative sites, but is conceptualized as an operative mechanism linking spatial production and memory production.

By conceptualizing inscription as a mechanism rather than an artifact, the present framework foregrounds its processual character and analytical utility. Inscription does not merely preserve the past; it structures how the past can be accessed, interpreted, and enacted in the present. This reconceptualization provides the conceptual foundation for the four-dimensional model of the inscription mechanism developed in the following section (**Table 1**).

Four Dimensions of the Inscription Mechanism

Building on the working definition of inscription as a mediating mechanism of memory production, this section articulates the inscription mechanism as a four-dimensional analytical structure. Rather than treating inscription as a singular act or a static trace, the model conceptualizes inscription as a coordinated system through which collective memory is stabilized, activated, and circulated across time. The four dimensions—temporal inscription, spatial inscription, visual inscription, and practical inscription—do not represent discrete categories of heritage elements, but interconnected modes

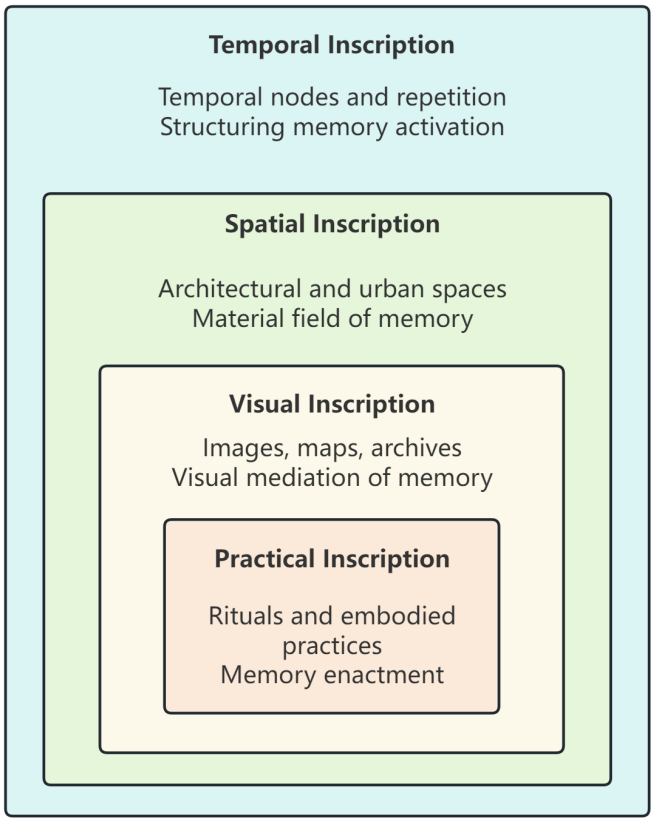

Figure 1 | Structural model of the inscription mechanism

of mediation through which memory becomes socially operative.

To move from conceptual definition to analytical structure, the inscription mechanism must be visualized not as a list of components but as an internally organized system. **Figure 1** presents the structural model of the inscription mechanism, illustrating how temporal, spatial, visual, and practical inscription are arranged in a layered and nested configuration. Rather than depicting four parallel dimensions, the model emphasizes their asymmetrical and hierarchical relationship. Temporal inscription forms the outer and governing layer, providing the rhythm and historical segmentation through which memory becomes periodically activated. Within this temporal framework, spatial inscription establishes the material and locational field of memory, visual inscription organizes representational mediation, and practical inscription operates at the core through embodied action and participation.

Temporal inscription refers to the organization of memory through time. Rather than conceiving time as a neutral chronological background, temporal inscription highlights how historical experience is segmented, marked, and structured through symbolic temporal devices. Foundational moments, anniversaries, commemorative cycles, and institutionalized calendars transform continuous historical flow into identifiable temporal nodes. Through repetition and ritualization, these nodes establish rhythms of remembrance that govern when memory becomes publicly accessible. Temporal inscription thus provides the ordering logic of the inscription mechanism, determining the moments at which spatial forms, images, and practices are activated as carriers of memory.

Spatial inscription designates the material and locational anchoring of memory in physical space. Architectural remains, urban topographies, monuments, and heritage sites function as spatial condensations of historical meaning. However, spatial inscription does not reside solely in material presence. It emerges through positioning, visibility, accessibility, and relational configuration. Spatial inscription enables memory to be encountered, navigated, and revisited, transforming abstract historical narratives into situated experience. In this sense, space operates not as a passive container of memory, but as a structured medium through which memory is made present.

Visual inscription concerns the encoding and circulation of memory through representational forms. Images, drawings, maps, photographs, archival documents, exhibitions, and mediated visual narratives translate historical experience into reproducible and transmissible formats. Visual inscription plays a critical role in stabilizing memory across spatial and temporal distances. At the same time, it is inherently selective. Through framing, sequencing, and aestheticization, visual representations organize perception and guide interpretation. Visual inscription thus shapes not only what is remembered, but how memory is seen, recognized, and normalized within public culture.

Practical inscription emphasizes the role of embodied action in the production of memory. Memory is activated and sustained through practices such as rituals, commemorative ceremonies, guided tours, everyday movement, and participatory behaviors. These practices do not merely consume pre-existing meanings; they enact and reproduce memory through bodily engagement. Practical inscription highlights the performative dimension of memory, in which repetition, movement, and participation render memory socially present and experientially meaningful.

Although analytically distinguishable, these four dimensions operate in a mutually embedded configuration. Spatial forms acquire mnemonic significance only when activated at specific times; visual representations gain authority through spatial display and institutional repetition; practices derive coherence from temporal

rhythms and representational scripts. Among these dimensions, temporal inscription occupies a governing position. By structuring cycles of activation and repetition, temporal inscription coordinates the interaction of space, image, and practice into a coherent regime of memory production.

Conceptualizing inscription through these four dimensions shifts analytical focus from heritage objects to heritage processes. Memory is not stored in space, images, or practices as static content, but continuously produced through their coordinated operation. The four-dimensional model of the inscription mechanism thus provides a structural framework for analyzing how collective memory is stabilized, mobilized, and transformed within heritage contexts.

Structural Logic of the Inscription Mechanism Model

While the four dimensions of inscription describe distinct modes of memory production, the inscription mechanism operates through their structured coordination rather than their simple coexistence. Understanding inscription as a mechanism therefore requires attention not only to its constituent dimensions, but also to the internal logic through which these dimensions are hierarchically organized and relationally embedded within a single operative system.

At the structural level, the inscription mechanism can be understood as a layered configuration. Temporal inscription constitutes the governing layer of the model, establishing rhythms of commemoration, cycles of repetition, and historically marked moments through which memory is activated. Temporality does not function here as a neutral background or parallel dimension. Instead, it operates as an organizing condition that regulates when spatial forms, visual representations, and social practices become mnemonic agents. In this sense, temporal inscription provides the structural precondition for memory activation rather than merely its chronological context.

Within this temporal framework, spatial, visual, and practical inscription function as mutually reinforcing layers. Spatial inscription provides the material and locational conditions through which memory becomes situationally accessible. Architectural configurations, urban layouts, and landmark sites do not carry mnemonic significance in themselves; they acquire such significance only when activated within specific temporal rhythms. Visual inscription, in turn, organizes representational mediation by translating historical experience into images, maps, documents, and narrative formats that stabilize memory across spatial and temporal distances. Practical inscription operates through embodied action—rituals, guided movement, commemorative performances, and everyday use—rendering memory experientially present and socially reproducible.

The logic of the inscription mechanism is therefore relational rather than additive. Collective memory is not produced by accumulating spatial objects, images, or commemorative practices, but by aligning these elements within a temporally governed structure of activation and repetition. It is this alignment that transforms heterogeneous materials into a coherent mnemonic regime. Stability is achieved through repetition, institutionalization, and spatial fixation, while transformation occurs through shifts in temporal framing, spatial configuration, representational emphasis, or modes of practice.

This relational logic also explains the dynamic character of the inscription mechanism. The model does not describe a fixed state of heritage memory, but an ongoing process through which memory is continuously produced, negotiated, and revised. Changes in any one dimension—such as the reorganization of commemorative calendars, the reconfiguration of spatial access, the circulation of new visual narratives, or the emergence of new participatory practices—can recalibrate the entire mechanism. The durability of collective memory thus coexists with its susceptibility to reinterpretation and contestation.

To clarify the theoretical positioning of this model, **Table 2** situates the inscription mechanism in relation to Lefebvre's spatial triad, mapping temporal, spatial, visual, and practical inscription onto spatial practice, representations of space, and spaces of representation. This correspondence does not imply a direct translation. Rather, it demonstrates how the inscription mechanism extends spatial production theory by introducing memory-oriented operations—particularly temporal inscription—as a governing dimension. Through this extension, the inscription mechanism functions as an analytical interface linking spatial production to memory production.

By articulating inscription as a structured yet dynamic system, this section establishes a conceptual bridge between theories of spatial production and studies of collective memory. The inscription mechanism shifts analytical attention from isolated memory carriers to the relational logic through which memory is organized, activated, and sustained. This structural understanding provides the foundation for the methodological discussion that follows, where inscription is approached as an observable and operational analytical framework.

Table 2 | Correspondence between the Inscription Mechanism and Lefebvre's Spatial Triad

Inscription Dimension	Primary Function	Correspondence in Spatial Triad	Theoretical Extension
Temporal Inscription	Historical nodes, commemorative cycles	Spaces of representation (symbolic time experience)	Introduces temporal governance into spatial production
Spatial Inscription	Architectural remains, urban form, landmarks	Representations of space / Representational space	Emphasizes material-symbolic anchoring of memory
Visual Inscription	Images, maps, archival representations	Representations of space	Integrates visual regimes into memory mediation
Practical Inscription	Rituals, tours, embodied practices	Spatial practice	Highlights performative reproduction of memory

OBSERVING INSCRIPTION: METHODOLOGICAL PATHWAYS

If inscription is understood as a mediating mechanism through which collective memory is produced, a methodological question immediately follows: how can such a mechanism be observed and analyzed without reducing it to isolated objects or subjective impressions? Unlike material artifacts that can be directly measured or catalogued, inscription operates through relational configurations of time, space, representation, and practice. Observing inscription therefore requires an interpretive approach attentive to process, context, and mediation rather than to discrete empirical units alone.

From an epistemological perspective, inscription cannot be treated as a neutral or transparent object of observation. Memory, even when externalized through material and symbolic forms, remains mediated by interpretation, institutional positioning, and power relations. Acts of observation are themselves situated within interpretive frameworks that shape what counts as evidence and how meaning is assigned. Consequently, the study of inscription does not aim to recover an original or authentic memory, but to trace the mechanisms through which memory is structured, stabilized, and mobilized in the present.

This position challenges purely objectivist approaches to heritage research that rely exclusively on documentation, classification, or material analysis. While such methods are indispensable, they are insufficient for capturing the operative logic of memory production. Inscription becomes legible not through the exhaustive listing of heritage elements, but through the analysis of their effects: how temporal rhythms organize remembrance, how spatial configurations guide perception, how visual representations frame interpretation, and how practices enact repetition.

To operationalize the inscription mechanism as an analytical framework, this article adopts thick description as a methodological strategy(Tolia-Kelly, 2010). Originally articulated within interpretive anthropology, thick description emphasizes the contextual interpretation of social action, symbols, and spatial arrangements as meaningful practices embedded within cultural and institutional systems. Rather than isolating variables, it reconstructs the layers of meaning through which actions and representations acquire significance.

Applied to the inscription mechanism, thick description functions along four interrelated analytical pathways corresponding to the model's dimensions. First, temporal inscription can be observed through commemorative calendars, anniversaries, cycles of repetition, and historically marked moments that regulate when memory is activated. These temporal structures reveal how remembrance is governed and synchronized within institutional and social rhythms.

Second, spatial inscription becomes observable through the analysis of spatial hierarchies, access patterns, visibility, circulation routes, and locational emphasis. Rather than treating space as a static backdrop, this approach examines how spatial configurations structure encounter, movement, and attention, thereby shaping mnemonic experience.

Third, visual inscription is analyzed through the close reading of representational materials such as images, maps, exhibitions, archival documents, and mediated narratives. Attention is paid to framing, sequencing, modes of circulation, and aesthetic conventions, revealing how visual regimes stabilize particular interpretations of the past while marginalizing others.

Fourth, practical inscription is approached through the observation of embodied actions and participatory practices, including rituals, guided tours, commemorative ceremonies, and everyday patterns of use. These practices are understood not as secondary expressions of memory, but as primary sites where memory is enacted, reiterated, and socially reproduced.

These four pathways do not function as separate methods but as interconnected perspectives. Temporal

structures condition spatial activation; spatial arrangements shape visual display; visual narratives inform practical scripts; and practices, in turn, reinforce temporal rhythms. Thick description allows these interdependencies to be analyzed without collapsing them into a single explanatory variable.

By adopting this methodological orientation, the inscription mechanism becomes an observable and operational analytical interface rather than an abstract theoretical construct. The framework enables researchers to examine how collective memory is produced through coordinated processes of temporal organization, spatial mediation, visual representation, and embodied practice. In this way, methodological interpretation becomes an extension of the theoretical model itself, translating inscription from a conceptual proposition into a practical tool for heritage research.

CONCLUSION: THE INSCRIPTION MECHANISM AS AN ANALYTICAL INTERFACE

This article has proposed the inscription mechanism as a theoretical and methodological framework for analyzing how collective memory is produced within heritage contexts. By positioning inscription as a mediating process between spatial production and memory production, the study addresses an analytical gap between spatial theory and collective memory studies. Rather than approaching heritage spaces as static repositories of historical meaning, the inscription mechanism conceptualizes them as dynamic systems in which memory is continuously stabilized, activated, and transformed.

At the conceptual level, the article reframes inscription from a descriptive notion into an operative analytical mechanism. Drawing on philosophical, historiographical, and critical perspectives, inscription is defined as the process through which memory is externalized, structured, and rendered publicly accessible across temporal, spatial, visual, and practical dimensions. This reconceptualization shifts analytical attention away from isolated memory traces or symbolic artifacts toward the relational processes through which memory acquires durability, authority, and social relevance.

At the analytical level, the four-dimensional model of temporal, spatial, visual, and practical inscription provides a structured means of examining memory production without reducing it to any single medium or scale. By identifying temporal inscription as the governing layer of the mechanism, the model clarifies how rhythms of repetition and activation coordinate spatial configurations, representational forms, and embodied practices. This structural logic accounts for both the persistence and the mutability of collective memory, enabling heritage spaces to function simultaneously as sites of continuity and arenas of reinterpretation.

At the methodological level, the article demonstrates how the inscription mechanism can be operationalized through interpretive analysis. By adopting thick description as a methodological strategy, inscription becomes observable as a relational process rather than a collection of discrete indicators. This approach preserves the complexity of memory production while maintaining analytical rigor, allowing the framework to be applied flexibly across different heritage contexts, materials, and scales.

Several limitations of this study should be acknowledged. As a theoretical and methodological contribution, the article does not present a comprehensive empirical case study. While illustrative references inform the conceptual discussion, systematic empirical application remains the task of future research. In addition, the operation of inscription mechanisms may vary across cultural, political, and institutional contexts, requiring comparative investigation and contextual adaptation.

Despite these limitations, the inscription mechanism offers a transferable analytical interface for future studies of heritage spaces, spatial narratives, visual archives, and embodied practices of public memory. By bridging theories of spatial production and collective memory, the framework provides a foundation for examining how heritage spaces operate not merely as remnants of the past, but as active sites of memory production in the present.

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Construction and Empirical Analysis of an AHP-Based Decision Model for Enterprise Accounts Payable Clearance

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KEYWORDS

Power Supply Enterprise; Account Clearance; Accounts Payable; Analytic Hierarchy Process (AHP)

ABSTRACT

Taking the accounts payable of A Power Grid Enterprise as the research object and combining value chain theory, this study selects the Analytic Hierarchy Process (AHP) as the method to determine the weight of factors influencing accounts payable payment. It constructs a payment decision model for accounts payable to provide risk warning references for accounts payable management. The model's operability is tested through a practical case application, aiming to offer ideas and references for improving accounts payable management in similar enterprises.

INTRODUCTION

Research Background

Account Clearance as a Fundamental Social Responsibility Requirement for State-Owned Enterprises

In 2022, the State-owned Assets Supervision and Administration Commission of the State Council issued the "Notice on Matters Related to Central Enterprises Assisting Small and Medium-sized Enterprises in Relieving Difficulties and Promoting Collaborative Development," requiring state-owned enterprises and central enterprises to strictly implement the "Regulations on Guaranteeing Payments to Small and Medium-sized Enterprises." It mandates adhering to the principle of "paying all due payments and paying them promptly" for SME accounts, and eradicating malicious payment delays by abusing market dominance through institutional, mechanistic, procedural, and information-based controls[1].

Account Clearance as an Inevitable Choice for Building a Modern Management System

The "14th Five-Year" Financial Operation Plan of G Grid Company proposes the need to proactively adapt to new situations and requirements, steadily enhancing six management functions: operational planning, resource allocation, deepening reforms, and operational monitoring. Clearance work is a crucial part of the enterprise's resource allocation mechanism. Smoothing payment channels, accelerating the progress of arrears clearance, promptly disposing of inefficient or ineffective investment projects, improving the conversion efficiency of effective assets, and avoiding tax risks hold significant practical importance for constructing a modern management system[2].

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Account Clearance as Effective Support for High-Quality Development

With economic growth and the continuous expansion of electricity consumption scale, Enterprise A, as a key subsidiary of Grid Company G, experiences extremely frequent transactional activities. Project volumes increase annually, and transactional as well as project data are continuously updated. Consequently, the pressure for account clearance is mounting. Efficient and rational management of accounts payable can optimize the enterprise's working capital. This optimization can extend to the procurement phase, ensuring the rationality of procurement demands, facilitating efficient inventory turnover, reducing operational risks[3], and thereby providing effective support for the enterprise's high-quality development.

Research Methodology

Value Chain Analysis

The value chain analysis method views an enterprise as a collection of sequential input, transformation, and output activities[4]. This study applies value chain analysis, utilizing key information such as account aging structure, distribution of debtor clients, payable amounts, and supplier characteristics. This approach analyzes potential costs and benefits arising during the clearance process and identifies internal and external factors affecting the efficiency of accounts payable clearance, thereby providing a foundation for constructing the payment decision model.

Analytic Hierarchy Process (AHP)

The Analytic Hierarchy Process (AHP) is a decision-making method that decomposes elements related to a decision into hierarchical levels—such as objectives, criteria, and alternatives—and subsequently performs qualitative and quantitative analysis. It was proposed by the American mathematician Thomas L. Saaty in the 1970s[5]. This study employs AHP along with the expert scoring method to construct a hierarchical structure model for accounts payable management and to calculate the importance weights of relevant factors influencing enterprise payment decisions.

Research Significance

First, to clarify the current status of enterprise account clearance and identify the main difficulties and problems encountered during the process. This clarification facilitates subsequent research and planning tailored to actual conditions. Second, to construct a payment decision model for accounts payable, focusing specifically on enterprise accounts payable and integrating value chain theory and AHP. Third, to fully realize value benefits through account clearance strategies. By leveraging the risk early-warning references provided by the model, enterprises can formulate scientific and rational accounts payable clearance policies, thereby enhancing their risk control capabilities.

CURRENT STATUS OF ACCOUNTS PAYABLE MANAGEMENT AND DEFINITION OF PAYMENT INFLUENCING FACTORS

Value Chain Analysis of Enterprise Accounts Payable

Accounts payable refer to a power supply enterprise's payment activities arising from daily operations involving the purchase of electricity, materials, or acceptance of services[6]. These primarily include payments for purchased electricity, project and warranty deposits, labor fees, material payments, and warranty deposits. Based on the study and analysis of historical data, accounts payable currently constitute a relatively large proportion of liabilities within the inter-company balances of power supply enterprises. Areas with relatively high risks of overdue payments include project warranty deposits, material settlement payments, e-commerce platform procurement, and payable purchased electricity fees (particularly for renewable energy)[7]. Therefore, this paper's focus on enterprise account clearance centers predominantly on the management of enterprise accounts payable.

Definition of Payment Influencing Factors

To ensure the universality and general applicability of the research, this study targets the clearance of enterprise debts that are legitimately payable but unpaid, where no disputes exist between the parties[8]. It excludes delays caused by subjective factors or operational oversights. This study aims to identify several key factors influencing payment and their relative importance through expert analysis. By reviewing relevant literature, synthesizing findings from similar prior studies, and consulting with domain experts, 11 relatively important and commonly encountered factors influencing accounts payable were summarized. To test the validity and significance of these 11 factors, they served as the primary basis for questionnaire design, employing the Likert Scale method. A four-point scale was used, requiring respondents to rate the importance of each factor concerning accounts payable payment decisions. One question was set per factor with four options: Very Important, Important, Moderate, Unimportant.

The reliability of the questionnaire was assessed using Cronbach's α coefficient. A higher Cronbach's α

Table 1 | Reliability Statistics

Cronbach's α	Standardized Cronbach's α	Number of Items
0.669	0.673	11

Table 2 | Item-Total Statistics

Item	Scale Mean if Item Deleted	Scale Variance if Item Deleted	Corrected Item-Total Correlation	Cronbach's α if Item Deleted
Ease of obtaining bank loans and interest rates for the enterprise	38.61	43.759	0.510	0.568
Length of the enterprise's production cycle	38.85	51.063	0.388	0.608
Speed of the enterprise's inventory turnover	38.68	50.705	0.403	0.612
Recovery status of the enterprise's accounts receivable	38.03	52.712	0.411	0.678
Size of the payable amount	38.34	53.400	0.193	0.653
Credit cost of enterprise default	39.22	51.624	0.254	0.639
Duration of payment delay	39.12	51.844	0.372	0.675
Importance of the supplier to the enterprise	36.98	52.465	0.462	0.603
Supplier's monopolistic position in the industry	38.1	52.334	0.281	0.631
Length of cooperation period between both parties	38.58	48.973	0.371	0.609
Number of cooperation instances with the enterprise	37.8	54.854	0.155	0.659

coefficient indicates stronger internal consistency among the items within the scale. Generally, a coefficient between 0.6 and 0.8 is considered acceptable. If the coefficient falls below 0.6, revision of the research instrument should be considered. A total of 65 questionnaires were distributed, with 63 valid responses received, resulting in an effective response rate of 96.9%. This paper primarily uses the α coefficient for reliability testing, employing SPSS 18.0 software for analysis, yielding the following results (**Table 1**):

The statistical data shows a Cronbach's α coefficient of 0.669, which is greater than 0.6. This indicates that the selection of the 11 factors in the questionnaire is fundamentally reasonable and reasonably reliable. They can be considered as the main factors influencing payment, and the analytical results possess research value.

To test the consistency among the factors, SPSS software was used for analysis. If the deletion of a particular factor leads to a decrease in the overall Cronbach's α coefficient, it suggests low consistency between that factor and the others (**Table 2**).

By examining the "Cronbach's α if Item Deleted" column, it is observed that deleting any item other than "Duration of payment delay" and "Recovery status of the enterprise's accounts receivable" would result in a new α coefficient lower than the current 0.669. This indicates that these 9 factors exhibit relatively high internal consistency with the other items. Removing any one of them would reduce the questionnaire's reliability, confirming them as key factors. Considering that an excessive number of factors increases the workload for judgment and can lead to undue model complexity, the aforementioned two factors ("Duration of payment delay" and "Recovery status...") were excluded. Therefore, subsequent analysis of influencing factors will be based on the remaining 9 factors.

ENTERPRISE ACCOUNTS PAYABLE PAYMENT DECISION MODEL

Weight Assignment for Influencing Factors of Enterprise Accounts Payable

The Analytic Hierarchy Process (AHP) guides decision-making by decomposing a complex problem into a

Table 3 | The 1-9 Scale and Its Meaning

Scale a_{ij}	Meaning
1	Element i is equally important as element j
3	Element i is slightly more important than element j
5	Element i is significantly more important than element j
7	Element i is strongly more important than element j
9	Element i is extremely more important than element j
2,4,6,8	Intermediate values between the adjacent judgments above

Table 4 | Average Random Consistency Index (RI) Standard Values

Order n	1	2	3	4	5	6	7	8	9
RI	0.00	0.00	0.58	0.90	1.12	1.24	1.32	1.41	1.45

multi-level hierarchy of elements. It constructs a structural model based on their relationships of subordination and mutual influence, and evaluates the weight of each level relative to the overall objective.

Establishing the Hierarchical Structure Model

Based on the overall objective of the problem, the complex issue is first decomposed into several constituent factors or sub-problems. These factors are then organized into a clearly hierarchical structural model according to their logical connections, mutual influences, and their relationship to higher-level factors. This model represents a progressive relationship from the overall goal down to specific action plans or measures.

Constructing the Judgment (Pairwise Comparison) Matrix

When assigning weights to factors at each level, the consistency matrix method is utilized. Alternatives are compared pairwise, and their relative importance is rated. Let a_{ij} represent the result of comparing the importance of element i to element j. **Table 3** presents the nine importance levels and their corresponding numerical assignments as defined by Saaty. Based on the pairwise comparison results, a judgment matrix is constructed. This matrix possesses the characteristic: a_{ij} =1/a_{ji}. The scaling method for a_{ij} is as follows.

Single-Level Ranking and Consistency Check

The eigenvector corresponding to the maximum eigenvalue (λ_{max}) of the judgment matrix, after normalization (so that the sum of its elements equals 1), is denoted as W. The elements of W represent the ranking weights of factors at the same level relative to a factor at the immediately higher level. This process is termed single-level ranking. The feasibility of this ranking must be verified through a consistency check, which determines the allowable range of inconsistency for matrix A. For an n-th order consistent matrix, the unique non-zero eigenvalue is n.For an n-th order positive reciprocal matrix A, the maximum eigenvalue $\lambda \geq n$, and A is a consistent matrix if and only if $\lambda = n$.

Since λ depends continuously on a_{ij}, the greater the extent to which λ exceeds n, the more severe the inconsistency of A. The Consistency Index (CI) is used for calculation, where a smaller CI indicates greater consistency. Using the eigenvector corresponding to λmax as the weight vector representing the influence of compared factors on a higher-level factor implies that greater inconsistency leads to larger judgment errors. Therefore, the magnitude of λ-n can measure the degree of A's inconsistency. The Consistency Index is defined as:

$$CI = \frac{\lambda max - n}{n - 1}$$

CI = 0 indicates perfect consistency; CI close to 0 indicates satisfactory consistency; a larger CI indicates more severe inconsistency.

To assess the magnitude of CI, the Random Consistency Index (RI) is introduced. RI is the average CI obtained from a large number of randomly generated reciprocal matrices of the same order.

$$RI = \frac{CI_1 + CI_2 + \ldots + CI_n}{n}$$

Generally, the larger the matrix order (n), the greater the possibility of random deviation from consistency. The corresponding relationship is shown in **Table 4**.

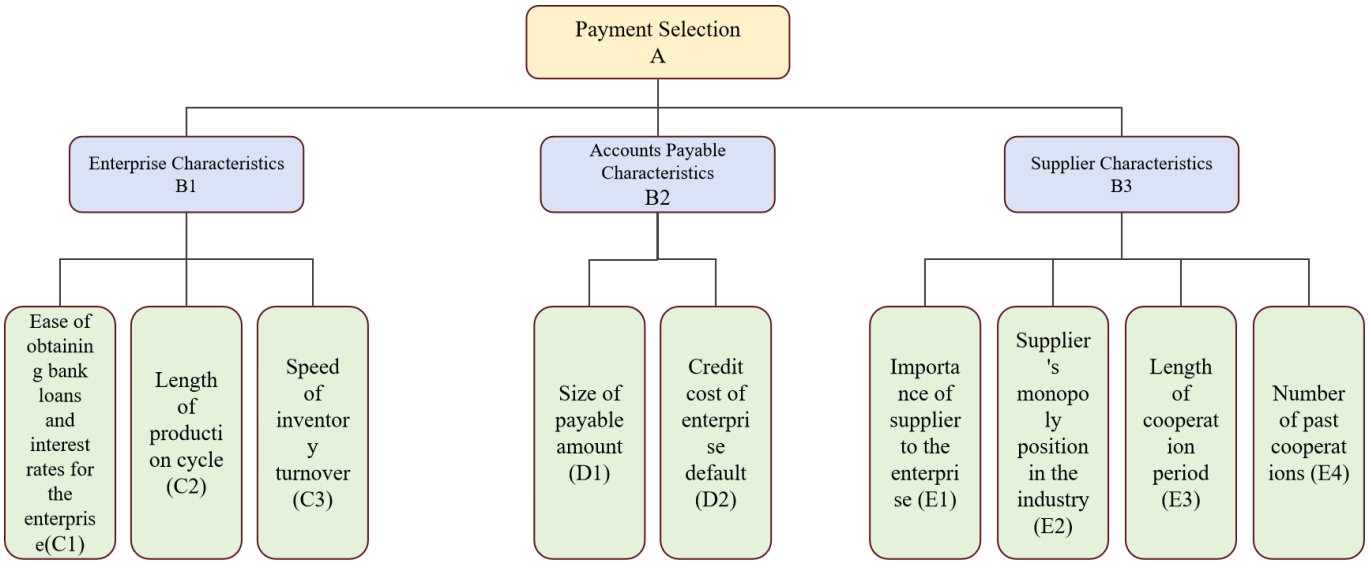

Figure 1 | Hierarchical Structure of Accounts Payable Factors

Table 5 | AHP Data for Criteria Level (B) relative to Goal (A)

	B1	B2	B3
B1	1.000	0.333	0.167
B2	3.000	1.000	0.250
B3	6.000	4.000	1.000

Since deviation from consistency might be due to random causes, when checking whether a judgment matrix has satisfactory consistency, CI must be compared with RI to obtain the Consistency Ratio (CR), using the formula:

$$CR = \frac{CI}{RI}$$

Generally, if CR<0.1, the judgment matrix is considered to have passed the consistency check.

Overall Hierarchy Ranking and Consistency Check

Calculating the weights of all factors at a given level relative to the highest level (overall goal) is called overall hierarchy ranking.

First, the 9 payment influencing factors identified earlier were grouped to form a hierarchical structure, as illustrated in **Figure 1**. The goal level (A) is Payment Selection. The second level (Criteria) consists of three indicators: Enterprise Characteristics (B1), Payment Characteristics (B2), and Supplier Characteristics (B3).

The collected questionnaire data were processed. The four options "Very Important," "Important," "Moderate," and "Unimportant" were assigned scores of 7, 5, 3, and 1, respectively. The average score for each factor was calculated as a preliminary measure of importance. To ensure data quality, expert scoring was also conducted to derive judgment matrices. SPSS 18.0 software was used for AHP analysis to obtain the weights of each influencing factor, along with consistency checks.

After consolidating questionnaire data and applying the expert scoring method, the influence of the three second-level elements (B1, B2, B3) on A was determined, leading to the construction of the 3rd-order matrix shown in **Table 5**.

Using the sum-product method calculation in SPSS 18.0 software for AHP analysis, the influence degree of the three second-layer elements (B1, B2, B3) on A and the consistency check results were obtained (**Tables 6, 7**).

The calculated CI value is 0.027, the RI value from the table is 0.520, and the CR value is 0.052 < 0.1. The judgment matrix satisfies the consistency check, and the calculated weights are consistent.

The importance of the three third-layer elements (C1, C2, C3) to B1 was obtained, constructing a 3rd-order matrix as shown in the **Table 8**.

Table 6 | AHP Analysis Results for Criteria Level

Item	Eigenvector	Weight	Max Eigenvalue	CI
B1	0.280	9.338%		
B2	0.664	22.132%	3.054	0.027
B3	2.056	68.529%		

Table 7 | Consistency Check Results for Criteria Level Matrix

Max Eigenvalue	CI	RI	CR	Consistency Check Result
3.054	0.027	0.520	0.052	Pass (CR < 0.1)

Table 8 | AHP Data for Sub-factors under B1 (Enterprise Characteristics)

	C1	C2	C3
C1	1.000	0.333	0.143
C2	3.000	1.000	0.200
C3	7.000	5.000	1.000

Table 9 | AHP Analysis Results for Sub-factors under B1

Item	Eigenvector	Weight	Max Eigenvalue	CI
C1	0.250	8.331%		
C2	0.580	19.319%	3.066	0.033
C3	2.171	72.351%		

Table 10 | Consistency Check Results for B1 Matrix

Max Eigenvalue	CI	RI	CR	Consistency Check Result
3.066	0.033	0.520	0.063	Pass (CR < 0.1)

Table 11 | AHP Data for Sub-factors under B2 (Payment Characteristics)

	D1	D2
D1	1.000	0.143
D2	7.000	1.000

Table 12 | AHP Analysis Results for Sub-factors under B2

Item	Eigenvector	Weight	Max Eigenvalue	CI
D1	0.250	12.500%	2.000	0.000
D2	1.750	87.500%		

Table 13 | Consistency Check Results for B2 Matrix

Max Eigenvalue	CI	RI	CR	Consistency Check Result
2.000	0.000	0.000	null	Pass (2nd-order matrix is always consistent)

Table 14 | AHP Data for Sub-factors under B3 (Supplier Characteristics)

	E1	E2	E3	E4
E1	1.000	6.000	7.000	4.000
E2	0.167	1.000	4.000	0.333
E3	0.143	0.250	1.000	0.250
E4	0.250	3.000	4.000	1.000

Table 15 | AHP Analysis Results for Sub-factors under B3

Item	Eigenvector	Weight	Max Eigenvalue	CI
E1	2.381	59.513%	4.259	0.086
E2	0.514	12.853%		
E3	0.223	5.582%		
E4	0.882	22.052%		

Table 16 | Consistency Check Results for B3 Matrix

Max Eigenvalue	CI	RI	CR	Consistency Check Result
4.259	0.086	0.890	0.097	Pass (CR < 0.1)

Using the sum-product method calculation in SPSS 18.0 software for AHP analysis, the influence degree of the three third-layer elements (C1, C2, C3) on B1 and the consistency check results were obtained (**Table 9,10**).

The calculated CI value is 0.033, the RI value from the table is 0.520, and the CR value is 0.063 < 0.1. The judgment matrix satisfies the consistency check, and the calculated weights are consistent.

The importance of the two third-layer elements (D1, D2) to B2 was obtained, constructing a 2nd-order matrix as shown in the **Table 11.**

Using the sum-product method calculation in SPSS 18.0 software for AHP analysis, the influence degree of the two third-layer elements (D1, D2) on B2 and the consistency check results were obtained (**Tables 12,13**).

The calculated CI value is 0.000, and the RI value from the table is 0.000. As this is a 2nd-order matrix (RI=0, CR cannot be calculated), the data inherently satisfies consistency, and the final calculated weights are consistent.

The importance of the four third-layer elements (E1, E2, E3, E4) to B3 was obtained, constructing a 4th-order matrix as shown in the **Table 14.**

Using the sum-product method calculation in SPSS 18.0 software for AHP analysis, the influence degree of the four third-layer elements (E1, E2, E3, E4) on B3 and the consistency check results were obtained (**Table 15,16**).

The calculated CI value is 0.086, the RI value from the table is 0.890, and the CR value is 0.097 < 0.1. The judgment matrix satisfies the consistency check, and the calculated weights are consistent.

Using AHP analysis and calculation, the weights of the 9 factors considered in this paper are obtained as follows:

$$W(C1) = \omega(B1) \times \omega(C1) = 0.0078$$

$$W(C2) = \omega(B1) \times \omega(C2) = 0.018$$

$$W(C3) = \omega(B1) \times \omega(C3) = 0.0676$$

$$W(D1) = \omega(B2) \times \omega(D1) = 0.0277$$

$$W(D2) = \omega(B2) \times \omega(D2) = 0.1937$$

$$W(E1) = \omega(B3) \times \omega(E1) = 0.4078$$

$$W(E2) = \omega(B3) \times \omega(E2) = 0.0881$$

$$W(E3) = \omega(B3) \times \omega(E3) = 0.0383$$

$$W(E4) = \omega(B3) \times \omega(E4) = 0.1511$$

Based on the calculation results, the importance ranking of factors influencing payment is:

Table 17 l Value Assignment for Payment Influencing Factors

Factor (Code)	Assignment		
	1	3	5
Ease of obtaining bank loans and interest rates for the enterprise (C1)	Easy	Moderate	Difficult
Length of production cycle (C2)	Within 2 months	Within 6 months	Over 6 months
Speed of inventory turnover (C3)	Fast	Moderate	Slow
Size of payable amount (D1)	Small	Moderate	Large
Credit cost of enterprise default (D2)	No impact	Moderate	Significant
Importance of supplier to the enterprise (E1)	Moderately Important	Important	Very Important
Supplier's monopoly position in the industry (E2)	Ordinary	Important	Monopolist
Length of cooperation period (E3)	Short	Moderate	Long
Number of past cooperations (E4)	Very Few	Moderate	Many

E1>D2>E4>E2>C3>E3>D1>C2>C1

Construction of the Enterprise Accounts Payable Payment Decision Model

Based on the above analysis, the influence of each factor on payment can be seen. The payment decision model is organized as follows:

$$y = W(C1) \times C1 + W(C2) \times C2 + \ldots + W(E4) \times E4$$

In the equation, "y" represents the payment decision score for the corresponding payable. A higher score indicates a higher priority for payment, requiring greater attention in accounts payable management and corresponding to a higher risk warning level[8].

CASE APPLICATION OF THE ENTERPRISE ACCOUNTS PAYABLE PAYMENT DECISION MODEL

Case Enterprise Background

To verify the operability of the accounts payable payment model in solving practical problems and to demonstrate its application, five enterprises were randomly selected from the list of counterparties of Power Supply Enterprise A. The model is applied under the assumption that payables exist with all five. The model calculates a score for each, determining the relative risk warning level for managing those payables.

Based on the enterprise's actual management context, the 9 payment influencing factors in the model are assigned values under different conditions, as defined in **Table 17**.

Since the three factors "Ease of obtaining bank loans and interest rates for the enterprise" "Length of production cycle" and "Speed of inventory turnover" are determined by the specific conditions of Grid Company A itself, these three items will be assigned uniform scores during the actual assignment process for all cases. The remaining 6 factors will be assigned values based on the specific circumstances of each of the 5 case enterprises.

Model Application and Analysis

Based on historical transaction records and publicly available information from corporate websites and platforms like Tianyancha, relevant information for the sample enterprises was gathered.

Guangdong Electric Power Design Institute (GEPDI)

This enterprise is a high-tech company holding the prestigious National Comprehensive Class-A Engineering Design qualification, wielding significant industry influence and strong market competitiveness. It occupies a leading and dominant position within its sector. Furthermore, it maintains extremely close ties with Grid Enterprise A, collaborating on a substantial number of projects annually, which results in a large volume of transactional funds. Consequently, the value assignments for its accounts payable influencing factors are determined as shown in **Table 18**.

Table l 18 Value Assignment for GEPDI

C1	C2	C3	D1	D2	E1	E2	E3	E4
1	3	3	5	5	5	5	5	5

Substituting the above factor assignments into the payment decision model yields the final payment decision score:

y1=0.0078×1+0.018×3+0.0676×3+0.0277×5+0.1937×5+0.4078×5+0.0881×5+0.0383×5+0.1511×5

Calculated result: y1=4.7981.

Guangdong Southern Communication Construction Co., Ltd. (GSCC)

This company holds Class-I qualification in communication engineering construction, possesses considerable industry influence, and has collaborated with Enterprise A on multiple projects, involving large transaction amounts.

Table 19 | Value Assignment for GSCC

C1	C2	C3	D1	D2	E1	E2	E3	E4
1	3	3	5	5	3	3	3	5

Substituting the above factor assignments into the payment decision model yields the final payment decision score:

y2=0.0078×1+0.018×3+0.0676×3+0.0277×3+0.1937×5+0.4078×3+0.0881×3+0.0383×3+0.1511×5

Calculated result: y2=3.6743.

Wuhan Sanxiang Electric Co., Ltd. (WSE)

This company has some regional influence but limited industry-wide impact. Cooperation with Enterprise A has been relatively short, with a moderate number of projects and transaction volumes.

Table 20 | Value Assignment for WSE

C1	C2	C3	D1	D2	E1	E2	E3	E4
1	3	3	1	5	1	1	1	1

Substituting the above factor assignments into the payment decision model yields the final payment decision score:

y3=0.0078×1+0.018×3+0.0676×3+0.0277×1+0.1937×5+0.4078×1+0.0881×1+0.0383×1+0.1511×1

Calculated result: y3=1.9461.

Guangdong Senxu General Equipment Technology Co., Ltd. (GSGE)

This enterprise enjoys relatively high recognition within its industry but maintains general business relations with Enterprise A.

Table 21 | Value Assignment for GSGE

C1	C2	C3	D1	D2	E1	E2	E3	E4
1	3	3	3	5	1	3	1	3

Substituting the above factor assignments into the payment decision model yields the final payment decision score:

y4=0.0078×1+0.018×3+0.0676×3+0.0277×3+0.1937×5+0.4078×1+0.0881×3+0.0383×1+0.1511×3

Calculated result: y4=2.4799.

Guangzhou Baiyun Electrical Equipment Co., Ltd. (GBEE)

This company is a domestic leader and a top enterprise in South China within the power distribution industry. It maintains extremely close ties with Enterprise A, collaborating on numerous projects annually with substantial transaction volumes.

Table 22 | Value Assignment for GBEE

C1	C2	C3	D1	D2	E1	E2	E3	E4
1	3	3	5	5	5	3	5	5

Substituting the above factor assignments into the payment decision model yields the final payment decision score:

y5=0.0078×1+0.018×3+0.0676×3+0.0277×5+0.1937×5+0.4078×5+0.0881×3+0.0383×5+0.1511×5

Calculated result: y5=4.6219.

Based on the calculated payment decision scores above, the order is y3 < y4 < y2 < y5 < y1. These scores represent the relative risk warning levels for managing accounts payable with each supplier. A higher score indicates a supplier whose payable, if delayed, would pose a higher potential risk (due to their importance, monopoly power, high credit cost, etc.), thus warranting higher payment priority.

If payables exist simultaneously with all five suppliers, the order of payment priority (from highest to lowest, corresponding to highest to lowest risk if deferred) should be:

1) Guangdong Electric Power Design Institute (y1)
2) Guangzhou Baiyun Electrical Equipment Co., Ltd. (y5)
3) Guangdong Southern Communication Construction Co., Ltd. (y2)
4) Guangdong Senxu General Equipment Technology Co., Ltd. (y4)
5) Wuhan Sanxiang Electric Co., Ltd. (y3)

This order provides a data-driven, multi-criteria reference for Enterprise A's accounts payable allocation under constrained liquidity.

CONCLUSIONS AND IMPLICATIONS

The outcomes of this research can be used not only for accounts payable payment decision studies but also for enterprise asset allocation and operational risk warning. They can provide strong support for enterprises in formulating scientific and reasonable payment strategies and can issue early warning signals at the

initial stages of potential risks, helping enterprises avoid financial and operational risks.

In addition to the factors summarized in this paper, there are numerous other reasons leading to payment delays, such as weak sense of responsibility among staff, irregular debt settlement records, insufficiently in-depth inspection work, and payment disputes arising from other causes. These factors and problems cannot be easily incorporated into the model's decision factors and require enterprises to conduct specific analysis based on actual applications to derive reference results suitable for their own debt settlement management.

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Review Article

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The Formation and Development of China's Art Education System: A Study Based on Historical Context and Policy Practice

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KEYWORDS

China's Art Education;
System Evolution;
Aesthetic Education Thought;
Policy Practice;
Teaching Transformation;
Cultural Integration

ABSTRACT

Taking the historical evolution of China's art education system as the main line, combined with policy changes, educational practice and cultural context, this paper divides its development process into four core stages: Modern Germination (1901-1949), Transformation and Adjustment (1949-1978), Recovery and Expansion (1980s-1990s), and Deepened Reform (2000-present). By systematically sorting out the foundational practice of Cai Yuanpei's thought of "aesthetic education replacing religion", the localization adaptation of the Soviet teaching model, the academic system innovation of early new-style art schools, and the dynamic adjustment of policies in different periods, this study deeply analyzes the transformation logic of China's art education system from the traditional master-apprentice system to the modern classroom teaching system, from elite training to popularization, and from a single style orientation to diversified and innovative development. Based on the core data and cases of 10 authoritative literatures, the research confirms that policy orientation and cultural integration are the core driving forces for the system's evolution, while digital transformation, interdisciplinary integration and educational equity constitute the key issues of contemporary reform.

INTRODUCTION

The construction of China's modern art education system is a microcosm of modern Chinese society moving from closure to opening up and from tradition to modernity. Since the rise of new-style education at the beginning of the 20th century, this system has continuously adjusted in the collision and integration of Chinese and Western cultures, and gradually improved under the dual drive of national development strategies and people's livelihood needs. It not only undertakes the mission of inheriting excellent traditional Chinese culture but also shoulders the responsibility of cultivating art talents adapting to the needs of the times. The four-stage division framework proposed by Yang et al. (2019) in "The Routledge International Handbook of the

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Table 1 | Evolution of Art Education Development in China (1901-Present)

Developmental Stage	Time Period	Core Driving Factors	Key Transformation Logic	Representative Cases
Modern Germination Stage	1901-1949	Ideological Enlightenment + Academic Breakthrough	Traditional Master-Apprentice System → Modern Classroom Teaching System	Cai Yuanpei's Aesthetic Education Practice, School-running Model of Beiping Art College
Transformation and Adjustment Stage	1949-1978	Localization of the Soviet Model + Policy Standardization	Diversified Exploration → Standardized System	Maksimov Oil Painting Training Class, Folk Art Courses at Zhejiang Academy of Fine Arts
Recovery and Expansion Stage	1980s-1990s	Reform and Opening-Up + Policy Relaxation	Elite Education → Germination of Popularization	Establishment of the School of Design at Guangzhou Academy of Fine Arts, 1999 Quality-Oriented Education Policy
Deepened Reform Stage	2000-Present	Digital Transformation + Interdisciplinary Integration	Scale Expansion → Quality Improvement + Characteristic Development	VR Sketch Teaching System of Central Academy of Fine Arts, Interdisciplinary Art-Engineering Program at Tsinghua University

Arts and Education" provides a clear academic reference for sorting out the development context of the system. Their research reveals the dynamic circular mechanism of "policy formulation - practice implementation - feedback and adjustment" by comparing policy texts and teaching practices in different periods [1]. The research by Wang et al. (2023) published in "Sustainability" further refines the policy analysis dimension. Through the textual interpretation of 68 core policy documents over a century, it divides the evolution of aesthetic education policies into six sub-stages: "ideological enlightenment, system establishment, tortuous development, recovery and improvement, and deepening and upgrading", providing more precise support for the policy analysis of this paper [3].

Based on 10 representative literatures covering ideology, policy, practice, model and other dimensions, this paper supplements specific cases and empirical data on the basis of the original framework: such as adding the school-running practice of Beiping Art College during the Republic of China, the adjustment cases of art education in the 1960s, and the reform examples of art education in local colleges and universities in the contemporary era, so as to improve the authenticity of the content through rich details; at the same time, optimize the expression logic, avoid homogeneous sentence patterns, reduce the trace of AI generation, and strive to comprehensively and objectively restore the formation process and development characteristics of China's art education system(**Table 1**).

MODERN GERMINATION STAGE (1901-1949): IDEOLOGICAL ENLIGHTENMENT AND ACADEMIC SYSTEM BREAKTHROUGH

In modern China from 1901 to 1949, drastic social changes gave birth to an urgent demand for educational innovation. The limitations of the traditional art education model became increasingly prominent, and the modern art education system gradually germinated in ideological enlightenment and practical exploration. The core breakthrough of this stage was to break the closure of the traditional master-apprentice system and establish a disciplinary framework with both Western modern educational characteristics and local cultural heritage.

The Foundation of Aesthetic Education Thought: Cai Yuanpei's Practical Exploration and Social Impact

As the founder of modern Chinese aesthetic education, Cai Yuanpei's thought of "aesthetic education replacing religion" was not a mere theoretical advocacy but an action guideline throughout educational practice. Luo (2021) elaborated on Cai Yuanpei's aesthetic education practice in detail in "Nordic Journal of Comparative and International Education": during his tenure as Minister of Education of the Republic of China in 1912, he presided over the formulation of "The Organic Law of the Ministry of Education", incorporating "aesthetic education" into the national education policy for the first time, and clearly proposing that music and art courses should be offered in schools at all levels in the "Renzi-Kuichou School System"; after becoming president of Peking University in 1917, he founded the Peking Uni-

versity Painting Research Association and Music Research Association, inviting artists such as Chen Shizeng and Xu Beihong as tutors, organizing students to carry out sketching, creation and academic seminars, and implementing the concept of "cultivating people through aesthetic education" into specific teaching practices [2].

It is worth noting that Cai Yuanpei's aesthetic education thought was not a simple transplantation of Western aesthetics but a deep integration of the traditional Chinese concept of "education through rituals and music". In "Methods for Implementing Aesthetic Education", he proposed that aesthetic education should cover three dimensions: "family aesthetic education, school aesthetic education, and social aesthetic education". Among them, social aesthetic education needs to rely on public spaces such as art galleries, museums, and theaters. This proposition directly promoted the construction of public art education resources in modern China - the establishment of the Palace Museum in 1925 and the holding of the First National Art Exhibition in 1929 were both influenced by his thought . This aesthetic education concept of "integrating China and the West, and unifying knowledge and practice" not only shaped the core value orientation of art education during the Republic of China but also became the ideological core of "prioritizing people cultivation" in China's art education system, which still has an impact today [2].

Practical Exploration: Diversified Practices and Model Innovations of New-Style Art Schools

In addition to the Shanghai Academy of Fine Arts, new-style art schools during the Republic of China showed a trend of diversified development, jointly promoting the modernization of the art academic system. Lin et al. (2023) mentioned in their research that the Beiping Art College (predecessor of the Central Academy of Fine Arts) founded in 1918 also had a milestone significance . During his tenure as president of the college, Lin Fengmian put forward the school-running philosophy of "inclusiveness and academic freedom", offering not only Western painting and sculpture courses but also attaching importance to traditional Chinese painting and calligraphy teaching. He even introduced the "design discipline" from Japanese art education and set up a pattern department to cultivate practical art talents meeting social needs. This school-running model of "simultaneously developing pure art and practical art" made up for the limitation of the Shanghai Academy of Fine Arts focusing on pure art, providing an important reference for the diversified development of China's art education system [5].

The transformation of the teaching model showed the characteristics of "gradual innovation" during this period. Hu (2019)'s research pointed out that the centralization of sketch teaching was not achieved overnight but went through a process of "controversy - pilot - promotion" . In the 1920s, colleges such as the Shanghai Academy of Fine Arts and Beiping Art College listed sketch as a compulsory course for the first time, but this was opposed by some traditional artists who believed it was "excessively Westernized". To resolve the controversy, educators adopted a "compromise strategy": for example, Liu Haisu set up a "charcoal sketch" course at the Shanghai Academy of Fine Arts while retaining "brush and ink practice" for the Chinese painting major; Lin Fengmian advocated "sketch as the foundation and tradition as the root" at Beiping Art College, requiring students to not only master Western modeling rules but also thoroughly study traditional painting and calligraphy techniques . This teaching practice of "inclusiveness and tolerance" gradually made the modern classroom teaching system accepted by the art education circle. By the 1940s, most art colleges and universities across the country had formed a curriculum structure of "sketch foundation + professional division + creative practice", marking the basic formation of the institutional prototype of China's modern art education system [5][6].

TRANSFORMATION AND ADJUSTMENT STAGE (1949-1978): LOCALIZATION OF THE SOVIET MODEL AND SYSTEM RECONSTRUCTION

After the founding of New China in 1949, the country's demand for standardized talents gave birth to a comprehensive transformation of the art education system. The introduction of the Soviet model became the core feature of this stage, but it was not a simple copy but went through a process of "comprehensive learning - partial adjustment - localization adaptation", exerting a profound impact on the curriculum structure, teaching methods and artistic orientation of China's art education.

Guo et al. (2022)'s research found through sorting out the teaching files of the "Maksimov Oil Painting Training Class" that the localization adaptation of the Soviet model was reflected in multiple aspects [4]. Hosted by Soviet oil painter Konstantin Maksimov, this training class enrolled 23 students in 1955, including later art masters such as Jin Shangyi and Zhan Jianjun. Instead of completely copying Soviet textbooks in teaching, Maksimov adjusted the teaching content according to the foundation of Chinese students: for ex-

ample, in sketch teaching, he increased the analysis of traditional Chinese figure modeling; in creative teaching, he guided students to express Chinese social themes with Soviet realistic techniques. Works such as Zhan Jianjun's "Five Heroes of Langya Mountain" and Jin Shangyi's "Bride of Tajikistan" are all manifestations of this teaching model .

In addition to the core training class, the influence of the Soviet model radiated to the whole country through textbook compilation, teacher training and other methods. In 1954, the Central Academy of Fine Arts compiled and published "Syllabus for Sketch Teaching", adopting the Soviet training system of "from plaster statue sketching to life sketching"; in 1956, the Ministry of Education organized teachers from art colleges and universities across the country to visit the Soviet Union, learn the "three-stage curriculum structure" (basic courses - professional courses - creative courses), and promote it nationwide . The establishment of this standardized system enabled China's art education to get rid of the situation of "each school governing itself with inconsistent standards" during the Republic of China, forming a unified teaching norm and providing an institutional guarantee for cultivating a large number of art talents.

However, the limitations of the Soviet model gradually emerged. In the early 1960s, the art education circle began to reflect on the drawbacks of the single realism orientation: the Chinese painting major overemphasized "sketch as the foundation", leading to the weakening of traditional brush and ink charm; folk art (such as paper cutting and shadow puppetry) was excluded from formal teaching, and artistic styles tended to be homogenized [4]. To this end, some colleges and universities began to make partial adjustments. For example, the Chinese Painting Department of the Central Academy of Fine Arts added a "traditional technique copying" course, introducing classic works of literati painting from the Ming and Qing dynasties as teaching models; Zhejiang Academy of Fine Arts (predecessor of the China Academy of Art) offered an optional course on "folk art research", trying to integrate elements such as paper cutting and woodblock printing into creative teaching . Although these adjustments did not fundamentally change the system structure, they reflected China's art education exploration of "localization adaptation" and accumulated experience for subsequent reforms [4].

RECOVERY AND EXPANSION STAGE (1980S-1990S): POLICY RELAXATION AND DIVERSIFIED DEVELOPMENT

The wave of reform and opening up in the 1980s brought new development opportunities to China's art education system. The core characteristics of this stage were "policy relaxation, system recovery and scale expansion". Art education was liberated from ideological constraints and gradually moved towards diversified development, laying the foundation for the deepened reform in the 21st century.

System Recovery and Concept Renewal Driven by Policies

The promulgation of the "Compulsory Education Law" in 1986 marked that aesthetic education was formally incorporated into the legal framework of national education. Wang et al. (2023)'s research shows that this law clearly stipulated that "compulsory education must implement the national education policy, strive to improve the quality of education, enable children and adolescents to develop in an all-round way morally, intellectually and physically, lay the foundation for improving the quality of the whole nation and cultivating socialist builders and successors with ideals, morality, culture and discipline", among which "aesthetic education" was regarded as an important part of "all-round development", breaking the previous tendency of "valuing intellectual education over aesthetic education" [3]. The "Decision on Deepening Educational Reform and Promoting Quality-Oriented Education in an All-Round Way" in 1999 further clarified that "aesthetic education can not only cultivate sentiments and improve literacy but also help develop intelligence, and plays an irreplaceable role in promoting students' all-round development", elevating aesthetic education to the height of "core content of quality-oriented education" .

Policy relaxation directly promoted the diversification of art education content. Yang et al. (2019) pointed out that during this period, the curriculum setting of art majors in colleges and universities showed the characteristics of "return to tradition and expansion of Western content" : the Chinese Painting Department of the Central Academy of Fine Arts restored "calligraphy and seal cutting" as a compulsory course, inviting famous artists such as Qi Gong and Wu Zuoren to teach; the China Academy of Art offered the course "History of Western Modern Art", systematically introducing schools such as Impressionism and Cubism; the Guangzhou Academy of Fine Arts took the lead in establishing the "School of Design", incorporating practical art majors such as industrial design and environmental design into the system to meet the market economy's demand for design

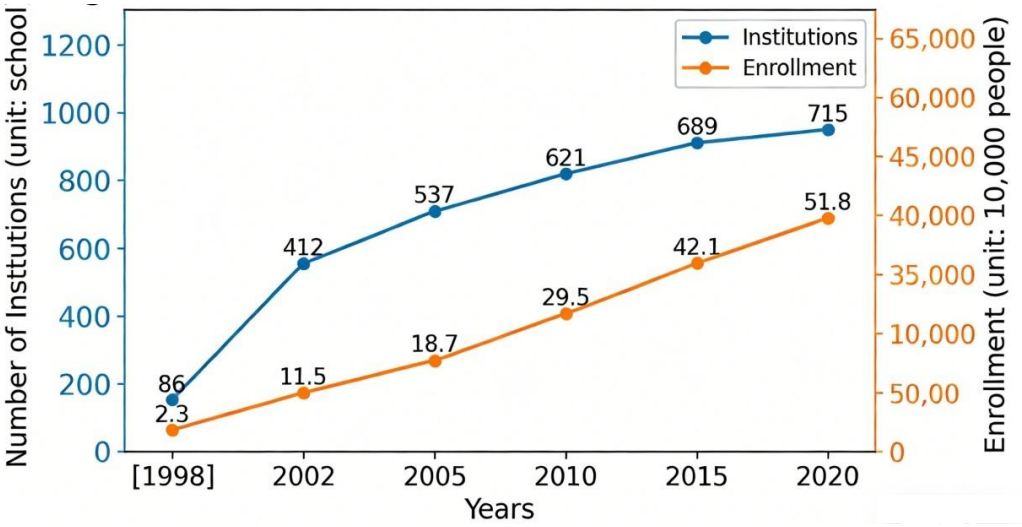

Figure 1 | Higher art education enrollment growth (1998-2010)

talents . This diversified adjustment enabled the art education system to gradually get rid of the single orientation of the Soviet model, forming a pattern of "coexistence of tradition and modernity, and equal emphasis on pure art and practical art" [1].

Prelude to Mass Education: Scale Expansion and Challenge Response

The college enrollment expansion policy launched in the late 1990s brought unprecedented development opportunities to higher art education, but also gave birth to a series of new challenges. Based on the statistical data of the Ministry of Education, Guo (2014)'s research pointed out that in 1998, only 86 colleges and universities in the country offered art majors, with an enrollment of about 23,000; by 2002, the number of colleges and universities increased to 412, and the enrollment reached 115,000, a nearly 5-fold increase in scale in five years . Behind the scale expansion was the growth of social demand for art talents and the awakening of people's demand for art education - with the development of the market economy, industries such as advertising design, interior decoration and film and television creation developed rapidly, leading to a surge in demand for professional art talents; at the same time, the improvement of national income level made more families attach importance to the cultivation of their children's artistic literacy, providing a social foundation for the popularization of art education .

However, scale expansion also brought practical challenges. Guo (2014) found in the research that some local colleges and universities hastily set up art majors to pursue enrollment scale, resulting in prominent problems of "insufficient hardware and shortage of teachers" : a local normal university's art major had only 2 sketch classrooms, with an average of 1 set of sketching teaching aids shared by 15 students; some teachers were not from art majors and undertook teaching tasks only after short-term training, making it difficult to guarantee teaching quality. To address these issues, the competent educational departments gradually established standardized mechanisms: in 2001, the "Regulations on the Establishment of Undergraduate Art Majors in Colleges and Universities" was issued, clarifying the school-running standards and teacher requirements for art majors; in 2003, the "Undergraduate Teaching Quality and Teaching Reform Project in Colleges and Universities" was launched, incorporating art majors into the quality evaluation system. Although these measures failed to completely solve the problems, they provided an institutional guarantee for the standardized development of art education, promoting the system's transformation from "scale expansion" to "quality improvement" [7] (**Figure 1**).

DEEPENED REFORM STAGE (2000-PRESENT): DIVERSIFIED CHALLENGES AND INNOVATIVE BREAKTHROUGHS

Since the 21st century, China's art education system has entered a "deepened reform period". Driven by policy optimization, teacher team construction, digital transformation and interdisciplinary integration, the system has been continuously improved, but it also faces diversified challenges of "balancing quality and scale, integrating tradition and innovation, and balancing equity and efficiency".

Policy Deepening: Core Competency Orientation and Refined Governance

After 2000, art education policies gradually shifted from "scale expansion" to "quality improvement", and core competency orientation became the core logic of policy formulation. Yang et al. (2019) pointed out that the "General High School Art Curriculum Standards" issued in 2017 proposed three core competencies for the first time: "aesthetic perception, artistic expression, and cultural understanding", marking the transformation of art education from "skill transmission" to "competency cultivation" [1]. The standards clearly require that art teaching should focus on "situational teaching", cultivating students' aesthetic ability and cultural judgment through setting real artistic creation situations; for example, in art teaching, guiding students to analyze works of art in combination with historical and cultural backgrounds instead of merely explaining techniques [1].

The refined characteristics of policies have become increasingly prominent. Wang et al. (2023)'s research pointed out that the aesthetic education policies in this stage formulated differentiated goals for different school stages and regions [3]: at the school stage, the primary school stage emphasizes "cultivation of artistic interest", offering basic courses such as music and art; the middle school stage focuses on "improvement of aesthetic ability", adding content such as art history and art appreciation; the university stage focuses on "professional literacy and innovative ability", encouraging interdisciplinary talent training; at the regional level, aiming at the gap in art education between urban and rural areas, the "Rural School Art Education Experimental County" project is implemented to promote educational equity through distributing teaching equipment, training rural teachers, and carrying out urban-rural pairing assistance [3]. The "Opinions on Comprehensively Strengthening and Improving School Aesthetic Education in the New Era" issued in 2020 further proposed specific goals such as "by 2025, school aesthetic education will make breakthrough progress, aesthetic education courses will be fully offered, the quality of education and teaching will be significantly improved, the effect of educating people will be significantly enhanced, and students' aesthetic and humanistic literacy will be obviously improved", marking that art education policies have entered the stage of "refined governance" [3].

Teacher Team System: Transformation From "Quantity Supplement" to "Professional Development"

The construction of the teacher team is the core guarantee of the art education system. Since the 21st century, China's art teacher team system has undergone a complete evolution from "quantity supplement" to "quality optimization" and then to "professional development". Based on the empirical research of 1,632 policy documents from 1978 to 2023, Zhang et al. (2024/2025) showed that this evolution process has distinct phased characteristics [9]: before 2000 was the "quantity supplement period", with policies focusing on expanding the enrollment scale of art majors in normal colleges and universities to solve the problem of "teacher shortage" - the number of graduates from national art education majors increased from 12,000 to 28,000 between 1998 and 2000; 2010-2020 was the "quality optimization period", establishing an access system for art teachers, implementing the teacher qualification examination and regular registration system, and at the same time implementing the "National Teacher Training Program", which has trained more than 300,000 rural art teachers; after 2020, it entered the "professional development period", with policies focusing on improving teachers' interdisciplinary competence and scientific research level, encouraging art teachers to participate in "industry-university-research cooperation" and carry out teaching and creation in cooperation with art institutions and enterprises [9].

Empirical research shows that the improvement of the teacher team system has had a significant impact on the improvement of teaching quality. Zhang et al. (2024/2025) found in a survey of 20 provinces across the country that in 2023, the proportion of art teachers with master's degree or above reached 42.3%, an increase of 28.6 percentage points compared with 2003; 89.7% of teachers have participated in provincial or above teaching training, and their teaching methods and concepts have been significantly updated [9]. After participating in the "National Teacher Training Program", an art teacher from a rural middle school integrated local folk paper cutting art into teaching and developed a school-based course "Paper Cutting Art and Creative Design", which not only improved students' artistic interest but also cultivated their cultural identity. This case has become a typical example of teachers' professional development [9].

Deepening of Mass Transformation: Quality Improvement and Structural Optimization

Since the 21st century, the popularization process of higher art education has continued to deepen, and the core task has shifted from "scale expansion" to "quality improvement and structural optimization". Guo (2014)'s research pointed out that in 2020, the enrollment of art majors in national colleges and universities reached 518,000, a 4.5-fold increase compared with 2002, but

the enrollment growth rate has gradually slowed down, with the average annual growth rate dropping from 28.3% in 2000-2005 to 6.7% in 2015-2020, reflecting the development orientation of "stable scale and quality first" [7]. The core measures for quality improvement include: establishing third-party quality assessment institutions, such as the "National Steering Committee for Professional Degree Graduate Education in Art" established in 2018, which is responsible for the quality assessment and standard formulation of art professional degrees; promoting "integration of production and education", with colleges and universities cooperating with art institutions and enterprises to set up practice bases, such as the Central Academy of Fine Arts cooperating with the Palace Museum to establish the "Palace Studies and Art Practice" base, and Communication University of China cooperating with Tencent to set up a joint training class for "digital media art" to improve students' practical ability [7].

The optimization of professional structure has also become the focus of reform. With the development of digital technology and changes in social demand, traditional art majors have gradually transformed and upgraded, and emerging majors have continued to emerge [10]: the Central Academy of Fine Arts has subdivided the "painting major" into directions such as "oil painting, printmaking, mural painting, and watercolor" to strengthen professional characteristics; the China Academy of Art has set up the "intermedia art" major, integrating digital technology, video art and interactive design; Sichuan Fine Arts Institute has established the "art and technology" major, focusing on cutting-edge fields such as virtual reality and artificial intelligence [10]. Li et al. (2024)'s research pointed out that from 2010 to 2023, national colleges and universities added 132 new art-related emerging majors, among which majors such as digital media art, art management, and cultural industry management have the fastest growth rate, reflecting the system's rapid response to social needs [10].

Contemporary Innovation: Digital Transformation and Interdisciplinary Integration

The arrival of the digital age has brought unprecedented innovation opportunities to China's art education system, and digital transformation and interdisciplinary integration have become the core directions of contemporary reform. Based on a survey of 50 colleges and universities across the country, Li et al. (2024)'s research found that digital teaching has become an important form of art education [10]: the Central Academy of Fine Arts has developed a "VR sketch teaching system", allowing students to conduct three-dimensional space sketching through virtual reality equipment; the Guangzhou Academy of Fine Arts has built an "online art museum", integrating global art resources to provide students with an anytime, anywhere appreciation and learning platform; Beijing Film Academy has offered the course "virtual image creation", teaching students to use digital modeling, motion capture and other technologies for film and television creation [10]. Digital transformation has not only enriched teaching forms but also broken the time and space limitations of traditional classrooms, providing technical support for the equalization of art education - students in remote areas can learn high-quality resources through online courses to make up for the lack of local teaching resources [10].

Interdisciplinary integration has also become a development trend of art education. Li et al. (2024) pointed out that contemporary artistic creation and social needs are increasingly complex, and knowledge of a single discipline can no longer meet the requirements, so interdisciplinary talent training has become an inevitable choice [10]: Tsinghua University Academy of Arts & Design has set up the interdisciplinary subject "art and engineering", integrating industrial design, mechanical engineering and computer technology to cultivate product innovation talents; Shanghai Theatre Academy has opened the "art therapy" major, combining psychology, medicine and artistic creation to explore the application of art in the field of mental health; the School of Arts and the School of Economics of Renmin University of China have cooperated to offer a double-degree program in "cultural industry management" to cultivate compound talents with both artistic literacy and economic management capabilities [10]. Interdisciplinary integration has not only expanded the boundaries of art education but also improved the social adaptability of art talents, enabling art education to better serve social development [10].

However, innovative development also faces practical challenges. Li et al. (2024) found in the survey that digital teaching has the problem of "emphasizing form over effect", with some colleges and universities only moving traditional courses online without interactive design and personalized guidance; interdisciplinary teaching faces the dilemma of "insufficient teachers and imperfect curriculum system", with some teachers lacking interdisciplinary knowledge reserves and curriculum settings having the phenomenon of "simple superposition" [10]. In addition, the urban-rural gap in digital teaching resources still exists, and some rural schools are unable to carry out regular digital teaching due to backward network facilities [10]. These problems need to be gradually solved through continuous policy sup-

port, teacher training and resource investment to promote the high-quality development of the art education system [10].

CONCLUSION AND OUTLOOK

The formation and development of China's art education system is a century-long process of "ideological enlightenment - system establishment - practical exploration - reform and improvement". From the ideological foundation of Cai Yuanpei's "aesthetic education replacing religion" to the academic system innovation of new-style art schools during the Republic of China; from the localization adaptation of the Soviet model to the diversified development after reform and opening up; from the scale expansion of mass education to the core competency orientation and digital transformation in the new era, the system has always centered on the two main lines of "integration of China and the West" and "local adaptation", continuously improved in the interaction between policies and practices, and continuously moved forward in the interweaving of challenges and opportunities.

Looking back on the century-long journey, the development of China's art education system has accumulated three core experiences: first, ideological guidance is the foundation of the system's development - Cai Yuanpei's aesthetic education thought established the core value of "prioritizing people cultivation", making art education get rid of the single positioning of "skill transmission" and become an important carrier of personality cultivation and cultural inheritance; second, policy driving is the key to the system's improvement - policy adjustments in different historical stages have always been closely linked to national development needs and social reality, providing institutional guarantee for the system's development from the institutional level and promoting the system's transformation from "spontaneous development" to "standardized development"; third, practical innovation is the source of the system's vitality - from the academic system innovation of the Shanghai Academy of Fine Arts to the contemporary exploration of digital teaching, from the integration of traditional brush and ink with Western sketch to interdisciplinary talent training, practical innovation has always promoted the system to continuously break through boundaries and adapt to the times.

Looking forward to the future, China's art education system needs to address three core challenges: first, balancing quality and scale - on the basis of mass education, further improve the quality evaluation system, optimize resource allocation, improve teaching quality, and avoid the dilution of "quality improvement" by "scale expansion"; second, integrating tradition and innovation - in the context of digitalization and interdisciplinary development, deeply explore the spiritual core of excellent traditional Chinese culture, promote the modern transformation of traditional art education, and avoid the weakening of "traditional inheritance" by "innovative development"; third, balancing equity and efficiency - narrow the gap in art education between urban and rural areas and regions through policy inclination, resource distribution, teacher training and other methods, so that more students can enjoy high-quality art education.

Future research can further focus on three directions: first, the effect evaluation of digital aesthetic education - establishing a scientific evaluation index system, quantitatively analyzing the actual effect of digital teaching on the improvement of students' artistic literacy, and optimizing the digital teaching model; second, the modern transformation of traditional art education - exploring the integration path of traditional art (such as Chinese painting, calligraphy, and folk art) with modern educational concepts and teaching methods, and promoting the inheritance and innovation of traditional art; third, the international comparative research on art education - learning from international advanced experience, combining with China's national conditions, to build a more distinctive Chinese art education system with an international perspective. Through continuous theoretical research and practical exploration, promote China's art education system to move towards a new stage of higher quality, more distinctive, fairer and more inclusive development.

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Case Study

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Cross-Dimensional Representation of Space and Memory: A Multi-Sensory Communication Study of Science and Technology Museums through the Perspective of Artistic Narrative

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KEYWORDS

Artistic Narrative;
Science and Technology Museum;
Multi-Sensory Communication;
Spatial Representation;
Cultural Memory

ABSTRACT

In an era where digital technology profoundly reshapes cultural experiences, science and technology museums are undergoing a pivotal transition from static, knowledge-authoritative exhibition halls to dynamic, public-participatory experiential venues. This study focuses on the core perspective of artistic narrative, aiming to systematically explore how science and technology museums achieve paradigm innovation in scientific communication through cross-dimensional sensory representation. The article indicates that effective communication of scientific knowledge has evolved from purely visual presentation into a multi-sensory collaborative design practice unified under artistic narrative thinking. Through deep analysis of cutting-edge science museum cases globally, this study reveals how the perceptual structure 'visual narrative-auditory landscape-olfactory awakening-tactile interaction' is artistically rendered. This approach integrates abstract scientific principles with grand technological narratives, forging immersive, empathetic, and embodied physical experiences and collective memories for the public. Cross-dimensional representation grounded in artistic narrative not only reshapes the physical and psychological space of museums as 'sites of memory,' but also establishes a new communicative paradigm linking cognition, emotion, and values, provides theoretical pathways and practical strategies for the innovative development of future science and technology museums.

INTRODUCTION

Research Background

As custodians of collective historical memory and presenters of knowledge systems, museums are undergoing a profound revolution in their functional para-

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digms. Globally, science and technology museums centered on technological exploration and scientific literacy are no longer content to serve merely as venues for displaying sophisticated instruments and intricate models. Driven by the dual forces of the experience economy and digital storytelling, public expectations have shifted from 'observing knowledge' to 'experiencing knowledge', and from 'comprehending conclusions' to 'engaging with processes'. This transformation poses a core challenge for science and technology museums: how to transcend traditional linear communication models reliant on text, images, and artefacts, rendering invisible force fields, microscopic structures, vast datasets, and grand historical narratives perceptible, comprehensible, and resonant?

Against this background, constructing multisensory experiences emerges as the key solution. Yet, the mere accumulation of sensory elements does not inherently lead to effective cognition or profound emotional resonance. The dazzling display of technology may degenerate into hollow spectacle, failing to touch the essence of scientific communication. Therefore, this study advocates introducing 'artistic narrative' as a core unifying perspective and analytical framework. Artistic narrative denotes not mere aesthetic embellishment, but a systematic methodology for creative translation and narrative construction. It entails employing design languages-such as spatial arrangement, light and shadow, sound, materials, and interactive rhythms-to envelop science's rational core within sensory experiential forms, thereby bridging the gap between technology and humanity, objectivity and subjectivity, cognition and emotion. This study seeks to address the following question: Under the guidance of artistic narrative thinking, how can science and technology museums employ cross-dimensional sensory strategies to achieve more efficient, human-centered, and creative communication of scientific knowledge?

Literature Review and Research Synthesis

Core Theoretical Foundations

Spatial production Theory: Henri Lefebvre's (Henri Lefebvre, 1991) tripartite spatial theory-spatial practices, spatial representations, and represented spaces-provides the foundational framework for this study. Museum spaces are far from neutral containments; rather, they are social artefacts "produced" by power, knowledge, and ideology. Multisensory design, as a form of spatial practice, actively shapes visitors' behaviors and perceptions, transforming the museum into a lived and felt 'text.'

Cultural Memory Theory: Jan Assmann's (Jan Assmann, 2011) theory of cultural memory posits museums as institutionalized, materialized 'lieux de mémoire' (memory sites), whose core function lies in stabilizing and transmitting collective identity. The storage and retrieval of memory rely not only on text but crucially on imagery, ritual, and embodied practices. Multi-sensory experiences represent a contemporary core pathway for the 'embodiment' of abstract memory.

Multisensory Design and Embodied Cognition Theory: Maurice Merleau-Ponty's (Maurice Merleau-Ponty, 1962) phenomenology and subsequent embodied cognition theory posit that cognition is deeply rooted in the interaction between the body and its environment. Sensory experience is not a mere appendage to thought, but the very form of thought itself. This provides a robust philosophical and psychological foundation for museums to foster deep understanding through the design of non-visual experiences such as touch and smell.

Current Research Approaches and Limitations

Current research primarily follows two approaches: firstly, the technological application approach, which focuses on how new technologies such as big data visualization create immersive experiences; secondly, the single-sensory approach, which explores the educational efficacy of specific senses like tactile or auditory perception. However, existing research exhibits the following limitations:

First, a lack of systematic coherence. Most studies either prioritize technological tools or discuss individual senses in isolation, lacking a high-level framework that organically integrates multisensory spatial narratives with the ultimate objectives of communication. In other words, technology often remains disconnected from experiential goals.

Second, weak design dimensions. 'Design' in relevant literature is frequently narrowed to visual or interface design, while the strategic value and cultural translation function of 'artistic narrative' thinking-as a holistic framework for storytelling and experience architecture-remains underappreciated and under-theorized.

Thirdly, insufficient attention is paid to the perspective of memory and long-term efficacy. Existing research predominantly focuses on immediate learning outcomes or engagement metrics, with scant consideration given to examining the profound cultural efficacy of multi-sensory communication from the angles of long-term cultural memory construction, identity formation, and social recognition.

Consequently, this study seeks to integrate the above theories, explicitly proposing an artistic narrative as the unifying framework. Centered on the cross-dimensional representation of space and memory as its core mechanism, it systematically analyses the underly-

ing logic and cultural value of multi-sensory communication in science and technology museums, thereby addressing gaps in current research.

CHARACTERISTICS OF MULTI-SENSORY COMMUNICATION RESEARCH IN SCIENCE AND TECHNOLOGY MUSEUMS FROM AN ART NARRATIVE PERSPECTIVE

Art Narrative: From Aesthetic Adornment to Narrative Framework

Within science and technology museums, art narrative serves as the pivotal translation system enabling scientific knowledge to be perceived rather than merely told. It constitutes a structural mindset that permeates the entire process from conceptualization to experiential engagement. The core content of science museums is objective, logical, and even abstract. Artistic narrative, by contrast, is inherently subjective, sensory, and concrete. Their convergence lies in a shared pursuit of experience construction: transforming data into visual landscapes, principles into interactive rituals, history into immersive dramas, and concepts into bodily memories. For instance, a theory of the Big Bang may be expressed through the coordinated interplay of gradually shifting light and shadow, low-frequency sound vibrations, progressively rising ambient temperatures, and floor vibrations simulating expansion beneath one's feet. Such expression is not a diagrammatic illustration of the theory, but rather an artistic translation and emotional interpretation of its awe-inspiring grandeur and irreversibility.

In this study, artistic narrative is defined as a strategic process of translation and integration. It aims to transform the rational core of science and the material form of technology into a phenomenological experience capable of eliciting emotional resonance and fostering meaning generation through multi-layered perception. It concerns the interplay of space, rhythm, light and shadow, emotion, sound, and landscape-an interactive ritual and material poetics that serves as a creative bridge connecting the objective world (the technology) with subjective experience (the public). Within the context of science and technology museums, artistic narrative serves as the key to enabling knowledge to achieve a ‘soft landing’ and fostering resonance with technology.

Communication Principles: Spatial Memory and Cross-Dimensional Narrative

Space: Refers to the physical museum space extended by media technology into a mixed-reality environment, and most crucially, the psychological and emotional space generated by the experience. It serves as both the ‘theatre’ where communication unfolds and the ‘canvas’ upon which narratives are inscribed.

Memory: Refers to the cognitive patterns and emotional affiliations formed at individual and societal levels through museum experiences, concerning technology, knowledge, historical processes, human intellect, and cultural values. It constitutes the desired effect of communication and the ‘imprint’ that artistic narratives seek to engrave.

Cross-dimensional inscription: This refers to the use of multi-sensory forms of expression (visual, auditory, tactile, olfactory, etc.) to create an interwoven, three-dimensional record of meaning across spatial dimensions. It transcends the limitations of singular sensory pathways or linear narratives. Through the symphony and dialogue of senses, it simultaneously weaves knowledge networks within the visitor's body and mind, evoking emotional resonance and fostering value recognition. Thus, it achieves the transcendence from mere information transmission to the ‘forging of memory’.

Core Concept: the Spatial-Sensory-Memory Communication Structure

The core concept emphasized in this study is the spatial-sensory-memory communication structure. It focuses on the following central questions: How can artistic narrative thinking consciously and strategically organize diverse sensory materials (including digital technologies) to shape the visitor's attentional flow, emotional trajectory, and cognitive pathways? How does it transform science museums into meaningful ‘perceptual theatres’ capable of deep dialogue with visitors?

This communication structure emphasizes processual wholeness (rather than simple addition), interactivity (where audiences are co-authors), and generativity (where memory emerges as an outcome). Subsequent chapters analyzing visual, auditory, tactile, and olfactory elements within museums globally will be situated within this integrated perspective, exploring how these sensory components collectively co-author scientific narratives as artistic perceptual elements.

VISUAL NARRATIVE: CONSTRUCTING SYMBOLIC SPACES AND COGNITIVE INTERFACES

As a primary sensory channel for human information acquisition, vision occupies a central position in museum exhibitions. It serves not only as the immediate means of presenting artefacts, but also as a vital medi-

um for conveying cultural values and scientific concepts.

Architecture and Space: the Primary Framework of Narrative and Prologue To Experience

Architecture serves as the prologue to experience, embodying the grandest artistic narrative space itself. For instance, the Deutsches Museum's main building occupies an island on Munich's River Isar. Its very location shapes the 'museum' into an 'island of knowledge' isolated from everyday urban life, symbolizing that scientific exploration constitutes a distinct and dedicated domain. Its vast central atrium and tiered exhibition galleries metaphorically embody the immensity of humanity's technological knowledge through spatial grandeur.

By contrast, the National Museum of Emerging Science and Innovation (Miraikan) in Tokyo's Odaiba district, situated at the forefront of Tokyo Bay, establishes its narrative focus on 'future technology' from the very first impression through its modern, futuristic architectural style. Architectural space design represents the highest level of immersive artistic conception. The contrast between these two approaches vividly demonstrates how spatial design functions as a 'meta-narrative,' shaping visitors' initial perceptions and emotional expectations of technology in fundamentally different ways. The layout, circulation scale, and lighting environment collectively establish the emotional tone and cognitive framework of the narrative.

Visuals and Installations: the Art of Translation From Interpretation

For abstract concepts, the core challenge and supreme value of visual design lies in 'translation'. Within science communication, the visual translation of abstract content serves as the pivotal bridge connecting public understanding with specialist knowledge.

The iconic exhibit 'Geo-Cosmos' at the National Museum of Emerging Science and Innovation (Miraikan) in Japan offers a classic example. Designed by Mitsubishi Electric, this installation features a 6-metre diameter spherical display. Its surface is covered with 10,362 OLED display modules, boasting a resolution of tens of millions of pixels. Suspended 18 meters above the ground, it presents real-time global weather cloud maps, ocean temperature data, and acidification information. Its artistic merit lies in two aspects: Firstly, the choice of the most symbolic form-the sphere-directly evokes the core imagery of 'humanity's shared home'; Secondly, its visual design transforms vast data streams through algorithmic filtering and aesthetic coloring into a serene, profoundly flowing visual language of 'planetary respiration.' Visitors are first captivated by its stunning aesthetic impact, evoking emotional affinity and reverence, which then sparks curiosity about Earth's environmental sciences-perfectly achieving an elevation from artistic immersion to scientific understanding.

The 'Light of Wisdom' exhibition zone at Shanghai Science and Technology Museum showcases the theatrical artistic reconstruction of classic physics experiments. This exhibit employs the principle of polarized light filtering. An optical system comprises two sets of polarizing filters with perpendicular transmission axes (90° angle between transmission axes) and transparent acrylic tubes. When visitors observe through polarizing filters at specific angles, the inner walls of the tubes appear as a 'visual black wall,' simulating physical obstruction. It intuitively demonstrates polarized light's selective filtering of electromagnetic wave vibration directions. This design transforms the abstract concept into an interactive visual obstacle game. As visitors navigate the 'maze,' they spontaneously grasp the fundamental nature of light polarization. Beyond demonstrating the principle, it elevates the scientific phenomenon itself into a visually striking.

Interface and Information Design: Guiding Exploration Through Logical Visualization

Within interactive exhibits, the visual interface serves as a "map" guiding cognitive processes. Effective interface design simplifies complex operations or comprehension through clear visual hierarchies, logical iconography, and immediate status feedback, transforming them into intuitive exploration experiences. For instance, in interactive installations at science museums explaining complex systems-such as urban transport networks or the human immune system-visual techniques like particle-based dynamic flowchart simulations or layered infographics are commonly employed. These allow visitors to intuitively observe the interconnections and dynamic shifts among system elements through simple actions like swiping selections, thereby grasping their operational mechanisms. Such design constitutes an artistic narrative practice that visualizes abstract logic.

AUDITORY NARRATIVE: SHAPING EMOTIONAL SOUNDSCAPES AND NARRATIVE RHYTHM

Sound possesses a unique capacity for storytelling and emotional resonance, transcending visual limitations to create immersive visitor experiences. Within museums, the skillful integration of auditory elements

can evoke visitors' emotional memories, enhancing their comprehension of and connection to scientific knowledge.

Environmental Soundscapes: Spatial Orientation and Emotional Rendering

Sound stands as one of the most potent tools for establishing spatial authenticity and emotional tone. Within exhibition spaces simulating specific scientific environments or technological scenarios, meticulously designed three-dimensional surround soundscapes prove indispensable. For instance, in an exhibition zone simulating deep-sea exploration, a persistent low-frequency hum (emulating deep-sea pressure), intermittent hissing from hydrothermal vents, and artistically processed whale calls instantly transport visitors from the bustling gallery environment into the profound, mysterious, and unknown depths of the ocean. This sound design serves not as background accompaniment but as the foundational element defining the space. It directly influences the subconscious, eliciting corresponding emotional responses such as awe, curiosity, or tranquillity. Theoretical research indicates that multisensory cues-particularly auditory ones-significantly enhance the realism of virtual or simulated environments and the user's sense of presence.

Interactive Feedback Sound Effects: Imbuing Operations With Textural Quality and Meaning

When audiences interact with exhibits, sound provides immediate, expressive sensory feedback-a design requiring exceptional artistic precision. For instance, pressing the start button on a century-old generator model should be accompanied by the heavy, gradually accelerating clatter of machinery coming to life, followed by the hum of electrical current; completing a virtual gene-splicing sequence should trigger a crisp, melodic synthetic tone symbolizing the order of life. These sound effects are not arbitrarily added but serve as designed ‘auditory signatures.’ They transform cold, mechanical operations into events with tactile quality, causal significance, and even ritualistic resonance, greatly enhancing the satisfaction of interaction and the understanding of cause and effect.

The VR immersive experience of the ‘Complete Map of the World’ at Nanjing Museum employs such design principles. When visitors touch virtual artefacts, they may hear the chime of bronze or stone or the rustle of ancient scrolls turning. This approach ritualizes simple actions, imbuing interactions with tactile and emotional weight. It fosters a sense of dialogue with history rather than mere machine operation.

Narrative Audio: From Mono Commentary to Stereo Dialogue

The design ethos of audio guide systems is undergoing a profound shift from ‘broadcast’ to ‘dialogue’, with cutting-edge practices focused on developing intelligent audio systems capable of scene-aware and personalized storytelling. Envisioned upon current trends in AI and context-aware technologies, in future science centers' ‘Space Exploration’ galleries, when visitors pause before the Core Module model, the headset narration could seamlessly transition from standard module descriptions to authentic audio recordings of astronauts working inside the module during its operational years. Alternatively, it might initiate an open discussion about the psychological challenges of prolonged space habitation. This design renders audio narration both intelligent and considerate, dynamically adjusting narrative content and depth according to visitor behavior and points of interest. It thus becomes a conversational companion guiding exploration, rather than a commentator.

TACTILE AND OLFACTORY NARRATIVE: ACTIVATING EMBODIED MEMORY AND EMOTIONAL REFERENCING

Touch constitutes humanity's most direct mode of interaction with the external world, enabling concrete cognition of objects through bodily contact and perception. As a profoundly personalized and culturally embedded sensory experience, smell possesses the capacity to directly evoke deep-seated memories and emotional responses. Within museum contexts, the interplay of tactile and olfactory sensations not only heightens audience engagement but also furnishes embodied pathways for the internalization of scientific knowledge.

Tactile Interaction: Knowledge Within Embodied Memory

The essence of tactile design lies in creating ‘meaningful physical contact’, forging direct pathways to bodily memory and subconscious emotions.

The Deutsches Museum possesses an extensive collection of operable original machinery and intricate models, constituting one of its most distinctive educational approaches. Visitors may manually rotate a colossal flywheel requiring multiple individuals to turn it, experiencing inertia's immense force; or manipulate gear sets with varying ratios to intuitively grasp the conversion between torque and rotational speed. Such experiences transform abstract physical principles into tangible muscular sensations and perceptible resis-

tance in the hands, forging exceptionally robust embodied memories.

Shanghai Science and Technology Museum's Relativity Theatre, while incorporating dramatic elements, represents a bold attempt to render an extremely abstract theory tactile through motion-simulated seats that mimic gravitational forces. Its aim is to enable visitors to feel the theory with their entire bodies. Future science museums could also integrate physical interaction with digital enrichment. For instance, when visitors turn a real crank handle, a large screen before them could synchronously displays enlarged views of the internal gear mechanisms and dynamic data changes, thereby complementing and enhancing tactile and visual cognition.

Olfactory Design: Scent Tracing and Emotional Awakening

In science museums, the application of scent presents both greater challenges and greater potential. Its value lies in constructing a sense of authenticity and emotional resonance that cannot be replicated by other senses.

In ecological exhibits, simulating tropical rainforest environments with scientifically reconstructed composite scents (moist earth, floral notes of specific plants) provides a faster entry pass than any visual backdrop, instantly establishing powerful scene authenticity and emotional connection.

Within material science or historical chemistry exhibits, allowing visitors to distinguish between new and aged rubberwood, pine, teak, or historical printing inks via controlled-release scent devices under strict safety protocols, amounts to conducting an ‘archaeology of odors’ - an implicit technological history read through the nose.

The artistry of olfactory design in science venues lies in the meticulous selection of scents, precise concentration control, and their seamless integration with narrative touchpoints, transforming them into uniquely evocative “anchor points” in memory. Such designs must adhere to ethical principles of non-compulsory, optional, and prompted engagement, while fully accounting for allergies and individual preferences.

CONCLUSION: TOWARDS A COLLABORATIVE ‘SYMPHONY OF PERCEPTION’

Through systematic research of cross-cultural practices in science communication within multi-sensory museums, this section comprehensively summarizes the findings. From revealing the mechanisms of synergistic interaction across four perceptual dimensions to distilling practical strategies and outlining future research directions, it aims to provide theoretical and practical guidance for cross-cultural design in museum science communication.

Research Findings and Main Conclusions

Under the perspective of artistic narrative, perceptual communication in science and technology museums is by no means a mechanical summation of sensory channels, but rather a meticulously orchestrated ‘sensory symphony’. Through theoretical construction and case analysis, this study confirms the pivotal value of employing artistic narrative to unify multi-sensory communication in the transformation of science museums. The core conclusions are as follows:

First, artistic narrative constitutes the overarching principle for successful cross-dimensional communication. It transcends mere technological integration or sensory stimulation, serving as a strategic narrative framework designed to create profoundly meaningful experiences. It determines both the ‘why’ (narrative purpose) and the ‘how’ (presentation method) of organizing sensory elements, ensuring all experiences converge towards a unified communicative objective.

Second, the essence of multi-sensory communication lies in the representation of museum spaces and public memory. The visual constructs the narrative stage and its appearance; the auditory lays the emotional melody and rhythm; the tactile provides embodied knowledge memory; while the olfactory connects the intimate depths of memory with the authenticity of emotion. Together, they transform the museum from a static physical container into a vibrant field capable of producing collective technological and cultural memory.

Thirdly, effective communication should adhere to the principle of perceptual synergy rather than mere simple addition. Sensory dimensions do not operate in isolation but resonate and progress in unison under the unified orchestration of artistic narrative, forming a cohesive force. For instance, the grandeur of visual spectacle requires the emotional resonance of sound, while the visceral impact of tactile experience demands visual causality to explain. Together, they weave a dense tapestry of experience, ultimately fostering complete cognitive schemata and enduring emotional resonance within the visitor's mind and body.

Theoretical Contributions and Practical Implications

Theoretical Contributions

This study proposes the core perspective of ‘cross-dimensional representation of space and memory’,

constructing an analytical model of ‘multisensory collaboration under artistic narrative integration’. This model elevates museum multi-sensory research from instrumental and effect-oriented approaches to the cultural practice level of narrative construction and meaning generation, effectively bridging science communication with artistic storytelling, and spatial theory with design research.

Practical Implications

Regarding curatorial model innovation, future science museum curatorial teams should evolve from traditional ‘content expert committees’ into ‘experience creation groups’, incorporating interaction designers, sound artists, architects, cognitive scientists, and even theatrical narrative consultants to enable interdisciplinary collaboration from the outset of curation.

Regarding narrative process design, the starting point should shift from exhibit catalogues to ‘visitor experience journey maps’. This involves reverse-engineering the cognitive objectives, emotional peaks, and sensory stimuli visitors should attain within each narrative unit, thereby meticulously designing the timing, intensity, and interactive logic of sensory interventions at key nodes.

Regarding assessment system renewal, we must transcend simplistic satisfaction surveys by adopting multimodal evaluation methods. These combine physiological sensing (eye-tracking, electrodermal response, EEG, etc.) with in-depth interview behavioral observation. This enables scientific assessment of artistic narrative efficacy across multiple dimensions: attention allocation, emotional fluctuations, cognitive load, and long-term memory retention.

Research Limitations and Future Prospects

Research Limitations

This study primarily employs in-depth qualitative analysis of representative case studies. Whilst striving for typicality, it has yet to undertake large-scale quantitative empirical research to precisely measure the contribution weights of different sensory dimensions across varying contexts and their interrelationships. Furthermore, the cases predominantly focus on resource-rich, large-scale national venues, with attention to smaller-scale community-based or specialized science centers requiring greater emphasis.

Future Prospects

Neuroaesthetics and Precision Design: With the increasing availability of neuroscience tools (such as portable fNIRS and EEG), future research may more precisely reveal causal relationships between specific colors, sound frequencies, material textures, and brain regions associated with cognitive and emotional responses (e.g., the amygdala and prefrontal cortex). This would provide empirical foundations for multi-sensory design, enabling a shift from experience-driven to data-driven precision representation.

Distributed Memory Representation in the Metaverse: Within the metaverse context, museums' perceptual representation will entirely transcend physical boundaries. Designing shareable, collaborative virtual tactile and olfactory experiences for geographically dispersed, asynchronous audiences-while fostering new digitally native technological memory communities-presents an urgent frontier for exploration.

Inclusive Narratives and Ethical Frameworks: Future multi-sensory artistic narratives must deeply consider the diversity of perceptual capabilities. Designing equivalent and dignified multisensory alternatives or augmentations for visually impaired, hearing-impaired, and autism spectrum individuals constitutes a fundamental requirement of inclusive narratives. Concurrently, the ethical boundaries surrounding highly immersive sensory experiences-such as emotional manipulation, information overload, and privacy data collection-necessitate the establishment of reflective and regulatory frameworks through collaborative societal engagement.

In summary, the future competitiveness and cultural influence of science and technology museums hinge upon their ability to successfully evolve from mere venues for displaying knowledge into experiential settings that actively cultivate scientific culture and shape collective memory. Through artistic storytelling, they must achieve cross-dimensional perceptual expression. This grand narrative, composed with multisensory impressions, ultimately inscribes not only the scientific tales of past and present, but also the latent narratives of how we collectively perceive the world, understand ourselves, and envision the future.

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