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Research on Practical Pathways for Empowering Cultural Heritage Preservation in Traditional Ancient Villages through Digital Intelligence Technologies

-- Taking Luling Ancient Villages as an Example

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Abstract

The rapid evolution of digital and intelligent technologies is profoundly transforming the preservation models for cultural heritage in traditional ancient villages. These technologies provide powerful momentum for such preservation efforts, enabling not only the high-precision documentation of cultural assets and the virtual recreation of cultural scenes, but also the provision of technical support for reshaping cultural value, expanding technological value, enhancing governance efficiency, and extending social value. At the practical level, the application of digital and intelligent technologies in heritage preservation follows an operational logic centered on enhancing perception capabilities, expanding dissemination channels, establishing multi-stakeholder collaboration platforms, and advancing intelligent governance. To enhance the effectiveness of digital and intelligent technologies in empowering the protection of cultural heritage in traditional ancient villages, efforts should be directed toward continuously improving the cultural perception system and consolidating digital archiving and risk early warning mechanisms; optimizing the content integration matrix and strengthening immersive expression and multi-channel communication; establishing a collaborative governance platform and activating the co-governance dynamics of multiple stakeholders; and refining the institutional operation mechanism while improving the allocation of powers and responsibilities as well as compliance evaluation systems.

Keywords

Digital and Intelligent Technologies; Traditional Ancient Villages; Cultural Heritage; Practical Pathways.

1. Problem Statement

The report of the 20th CPC National Congress explicitly states: "Strengthen the protection of cultural relics and heritage, and enhance the preservation and transmission of historical and cultural elements in urban and rural development." This significant directive establishes the protection of historical and cultural heritage, including traditional villages, as a strategic imperative for national cultural security and the transmission of civilization. With the rapid advancement of digital and intelligent technologies represented by AR, VR, and AI, "digital and intelligent empowerment" has become a crucial pathway for the digital preservation and revitalization of cultural heritage. However, as urbanization accelerates, the preservation of cultural heritage in ancient villages faces severe challenges. On the material level, the loss of traditional construction techniques renders damaged structures irreparable, while the poor integration of modern infrastructure with historical environments leads to the decline of ancient villages' residential functions. On the socio-economic level, the outflow of young and

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middle-aged populations for work causes traditional industrial systems to gradually deteriorate and economic vitality to decline. On the cultural continuity level, the generational gap among intangible cultural heritage inheritors disrupts the transmission of traditional knowledge systems, and the alienation of ritual spaces leads to the disappearance of cultural memory carriers. As Wei Fengqun et al. noted: "The core obstacle to revitalizing traditional villages lies not in technological gaps, but in the compounding effects of governance failure and the absence of key stakeholders."[1]

Taking the Luling Ancient Village Cluster (including Diaoyuan and Mibei) as a representative case, this study focuses on its digital and intelligent conservation practices. It explores the value implications, practical logic, and pathways of empowering ancient village cultural heritage conservation through digital and intelligent technologies. The research reveals the internal mechanisms driving the revitalization of cultural genes and value transformation, enriching existing theoretical frameworks and providing a theoretical analytical framework for the digital and intelligent conservation of traditional ancient village cultures. Simultaneously, by establishing digital archiving systems, immersive exhibition platforms, cultural-tourism industry integration, and decision-support frameworks, this approach achieves the living transmission of cultural heritage alongside endogenous rural economic development, forging replicable pathways for coordinated conservation and revitalization.

2. The Value Implications of Empowering Cultural Heritage Protection in Traditional Ancient Villages Through Digital Intelligence Technologies

Constrained by existing conservation philosophies, methodologies, and institutional arrangements, traditional approaches to ancient village heritage preservation tend to freeze cultural assets into "gazing others" [2], struggling to address practical challenges such as diverse value orientations, insufficient stakeholder participation, and the establishment of sustainable operational mechanisms. The rapid advancement of digital and intelligent technologies offers potential solutions to this dilemma: these technologies not only enable high-precision documentation of cultural heritage and virtual recreation of cultural scenarios but also provide technical support for reshaping cultural value, expanding technological value, enhancing governance efficiency, and extending social value.

2.1. Reshaping Cultural Value: Revitalizing Local Memory and Cultural Identity

Empowering traditional ancient village cultural preservation through digital and intelligent technologies fundamentally drives a revolutionary shift in preservation paradigms-from preserving physical entities to reconstructing cultural memory. Its core lies in leveraging these technologies to transcend temporal and spatial constraints, enabling the digital reconstruction, contextual reenactment, and living transmission of cultural resources. In revitalizing local memory, ancient villages serve as repositories of collective memory, with their value embedded in intangible cultural elements like rituals, dialects, and traditional crafts. Digital and intelligent technologies employ VR/AR reconstruction and AI voice reproduction to recreate endangered ceremonial and festive scenes, bridging past and present. This allows orally transmitted cultural practices to persist in virtual spaces, mitigating memory loss caused by transmission gaps. In reconstructing cultural spaces, ancient villages embody the fusion of history and regional culture. Through 3D laser scanning and spatial modeling, these technologies not only create millimeter-accurate digital archives of ancient structures—providing precise guidance for restoration—but also reconstruct the historical fabric of villages based on documented records. This significantly enhances the scientific rigor of preservation efforts, ensuring the complete retention and recreation of the very spaces where culture originated.

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Expanding perceptual dimensions, digital-intelligent media transforms linear, static cultural records into multidimensional, dynamic immersive experiences. Technological methods shift cultural presentation from static physical displays to interactive, participatory cultural experiences, thereby activating audience cultural identity and achieving a fundamental transition from museum-style exhibitions to participatory cultural inheritance. The Taizhou Ancient Village Digital Memory Project employs millimeter-level 3D laser scanning to document ancient architectural elements like beam frameworks and carvings, substantially enhancing conservation science [3]. In Jiangxi's Liukeng Ancient Village, centered on Nuo culture, AR technology enables visitors to virtually experience the entire Nuo dance ritual online, transforming cultural presentation from museum displays into immersive scenarios [4]. These cases demonstrate that the core value of digital intelligence lies not in replicating cultural appearances, but in reconstructing cultural lifecycles-making ancient villages living civilizational bridges connecting history and the future, tangible and intangible heritage.

2.2. Expanding Technological Value: Activating Digital Archives and Restoration Closed-Loops

The application of digital twin technology has revolutionized the paradigm of cultural preservation in ancient villages. Through high-precision sensing and real-time data collection, it enables continuous monitoring and intelligent early warning systems for microenvironments and structural ailments within historic buildings. For instance, Jinhua City in Zhejiang Province employs BIM (Building Information Modeling) and GIS (Geographic Information System) technologies to create 3D visualizations of ancient villages' topography, architectural structures, and utility layouts, providing decision support for conservation planning [5]. The application of digital and intelligent technologies not only enhances the precision of conservation efforts and breaks through temporal and spatial constraints but also supports online preservation, cloud-based exhibitions, and remote interactions. This fosters an intelligent governance framework that integrates cultural heritage with big data.

In terms of monitoring, the Huizhou Ancient Village in Meihua Town employs sensor-based temperature and humidity detection points alongside crack monitoring instruments for 24-hour early warning. This data is utilized to establish a cultural heritage vulnerability assessment model, enabling proactive prevention to replace reactive conservation [6]. Intelligent sensing technology enables dynamic monitoring and timely alerts for the architectural environment of ancient villages, enhancing the efficiency of cultural preservation. Furthermore, artificial intelligence algorithms reduce risk factors, while big data technology facilitates data-driven decision-making to identify solutions, transitioning from manual prevention to technological prevention. Digital and intelligent technological innovations address the challenges of restoration difficulties and scattered documentation in traditional conservation efforts, providing technical safeguards for the long-term preservation of ancient villages.

Digital archiving technology addresses the challenge of permanent preservation for cultural heritage. For instance, Foshan City in Guangdong Province launched a digital technology-driven cultural inheritance project for ancient villages. It employs GIS to establish holographic models of ancient villages and utilizes digital archiving to preserve information on architectural structures and spatial layouts, providing references for restoration[7]. The application of digital and intelligent technologies not only preserves the physical form of ancient villages but also safeguards their cultural DNA, advancing the intelligent transformation of cultural preservation methods.

ISSN: 2688-8653

2.3. Enhancing Governance Efficiency: Multi-stakeholder Collaboration and Data-Driven Governance

Embedding digital intelligence technology platforms into the "cultural governance network" fundamentally establishes a new data-driven collaborative governance model. Its core lies in leveraging technological platforms to reshape the interactive relationships and allocation of responsibilities among diverse stakeholders-including government, communities, enterprises, and the public. By ensuring seamless information flow, this approach reduces coordination costs and enhances the agility of governance responses. This paradigm shift transforms governance from traditional linear bureaucratic management to a networked, interactive co-governance framework, aiming for a profound transition from management to governance. Nannan Village in Doumen District, Zhuhai, has established a digital management system featuring "government leadership, enterprise operation, and villager participation."It employs blockchain technology to visualize fund flows and utilizes big data analysis of tourist information to optimize business layout. [8]

At the multi-stakeholder collaboration level, digital intelligence technologies play a pivotal role by providing institutionalized operational platforms for co-construction, co-governance, and shared benefits. By designing digital participation interfaces and procedural rules, the rights, responsibilities, and benefit distribution among stakeholders are institutionalized within the system, incentivizing and ensuring effective multi-stakeholder engagement. This represents not only technological application but also an optimization of governance structures, aiming to unleash the vitality of social forces and forge a cohesive governance synergy. For instance, Hongcun Village in Anhui launched a "Village Resident App" where residents can share personal stories, ancestral crafts, or scenic spots, participate in designing local tourism routes, and receive dividends based on their preferences [9]. This participatory model not only enhances residents' sense of fulfillment but also ensures the authenticity and vitality of ancient village preservation.

In the realm of community empowerment and capacity building, the profound value of digital and intelligent technologies lies in fostering endogenous momentum for cultural inheritance. By lowering technical barriers and spatial constraints to participation, residents gain stronger voices, actionable tools, and enhanced capabilities. Through engaging in digital archiving, online dissemination, VR workshops, and similar practices, community members simultaneously elevate their digital literacy and cultural awareness, thereby solidifying their central role in preservation and transmission. For instance, Foshan, Guangdong's ancient village conservation initiative, launched the "Digital Village Elders" program, guiding migrant workers to participate in their hometown's development through VR technology[10]. This approach not only expands villagers' voice in village construction but also reinforces their central role in preserving and transmitting ancient village culture.

The ultimate value of digital intelligence-driven cultural governance lies in catalyzing a virtuous cycle ecosystem for ancient village cultural preservation and development. Effective governance enhances community identity and cultural confidence, attracting human and capital resources back to the area and transforming cultural assets into developmental momentum.

2.4. Extending Social Value: Deep Integration of Culture and Tourism with Endogenous Social Development

Digital and intelligent technologies facilitate the transformation of cultural resources in ancient villages from assets into content, injecting new momentum into cultural creativity. By developing and selling cultural and creative products using these technologies, cultural value is converted into economic returns, providing fresh financial support for the continuous innovation and development of culture, thereby extending its social value. For instance,

ISSN: 2688-8653

Shandong's Qilu ancient villages have extracted key elements like Confucian culture and intangible heritage crafts to develop online products such as virtual Hanfu experiences and ancient ritual study tours. Promoted and sold on short-video platforms, these initiatives have achieved remarkable results[11]. This transformation not only enriches cultural expression but also generates economic value, providing sustainable financial support for ancient village preservation.

Digital technologies promote the socialization of cultural inheritance, keeping traditions alive in the present. They extend channels for cultural transmission, enabling heritage to be passed down through digital means while preserving traditional skills. In Jinxi, Jiangxi, 3ds Max is used to digitally preserve local wood carvings, stone carvings, and brick carvings. These works are housed in a cloud-based virtual museum, where videos are produced and materials collected. Information about folk craft inheritors and related techniques is published online, forming a dynamic skills inheritance database [12]. This approach not only safeguards intangible cultural heritage techniques but also opens new channels for dissemination and sales, enabling traditional crafts to survive and thrive in modern society.

Digital and intelligent technologies attract young people to return, addressing the issue of rural depopulation. Youth entrepreneurship and community revitalization have become important extensions of social value. The plight of ancient villages often stems from young people leaving while the elderly remain, leaving the culture with no one to carry on the traditions. However, new avenues like "online cultural creativity and cloud-based services" pioneered by digital technologies require young people proficient in digital skills-such as creating short videos, designing digital collectibles, or operating online platforms. These emerging opportunities attract young people to return to their hometowns for entrepreneurship and employment. They integrate modern aesthetics and communication logic into traditional culture, making cultural content more appealing to younger generations while simultaneously addressing the issue of cultural succession.

Digital intelligence technology transforms the static culture of ancient villages into interactive, dynamic experiences, attracting young people to contribute to village development. It converts the cultural value of creative products into economic value, providing the human and financial resources needed for ancient village preservation. This, in turn, broadens cultural transmission channels, preserves traditional culture, and deepens cultural identity. This three-pronged approach creates a virtuous cycle of cultural protection, increased villager income, community revitalization, and cultural confidence-a win-win for all.

3. The Practical Logic of Digital Intelligence Empowering Cultural Heritage Protection in Traditional Ancient Villages

The application of digital and intelligent technologies in safeguarding ancient village cultural heritage is undergoing a profound transformation-shifting from supplementary tools to fundamental systemic restructuring. This transition is not merely a simple layering of technologies but follows a four-tiered practical logic: perception, dissemination, collaboration, and governance. Together, these elements drive the upgrade of the traditional cultural heritage protection paradigm for ancient villages.

3.1. Strengthening Perception Capabilities: Digital Collection and Dynamic Identification of Heritage through Digital Intelligence Technologies

First, digital and intelligent technologies deepen the breadth and depth of cultural perception in ancient villages. Traditionally, information was primarily obtained through paper records or newspapers, relying on two-dimensional media like text and images to understand ancient village culture. This approach limited viewers' imagination and resulted in a lack of

ISSN: 2688-8653

multidimensionality and depth in perception. However, digital and intelligent technologies significantly expand the dimensions and depth of perception, enhancing modern audiences' ability to comprehend traditional ancient village culture. Utilizing digital technologies like 3D laser scanning, drone oblique photography, and remote sensing surveying, millimeter-level precision modeling can be achieved for ancient architectural complexes, stele inscriptions, spatial layouts, and intangible cultural forms. This creates digital archives that offer a more comprehensive perception of the subjects than books or newspapers.

Second, digital intelligence technologies drive a transformation in how ancient village culture is perceived, shifting audiences from passive reception to active understanding. Traditionally, perception relied on information from books, newspapers, television, and other media. However, these channels often kept audiences in a passive information-receiving phase, lacking interaction and hindering deeper understanding. The advancement of digital and intelligent technologies has transformed the relationship between audiences and culture. Through AR virtual technology, historical scenes and cultural information can be overlaid onto real physical spaces. Constructing virtual cultural craftsmanship scenes in ancient villages creates deeply interactive narrative experiences for audiences, enhancing their cultural comprehension.

Digital and intelligent technologies have profoundly revolutionized the perception of ancient village culture. Traditional methods, reliant on two-dimensional media like paper and television, suffer from limitations in imagination, lack depth, and are predominantly passive. Digital intelligence technology, on the one hand, employs methods like 3D laser scanning and drone surveying to achieve millimeter-level modeling of cultural forms such as ancient architecture and intangible cultural heritage, constructing more comprehensive digital archives that significantly expand the depth and breadth of perception. On the other hand, it leverages technologies like AR to create virtual interactive scenes, transforming audiences from passive information recipients to active participants in the experience, effectively deepening their understanding and perception of ancient village culture.

3.2. Expanding Communication Channels: Extending Content Expression and Dissemination Boundaries Through Platform Media

Digital intelligence technologies empower the expansion of cultural dissemination channels for ancient villages, transcending mere tool integration. They adhere to deeper communication logic-symbolic translation, algorithmic adaptation, and contextual integration-propelling cultural transmission from one-way information delivery toward co-creation and shared meaning. Digital and intelligent technologies achieve creative transformation of cultural symbols through multi-modal, multi-state translation. By leveraging short videos, digital exhibition halls, VR/AR, and other technologies, immovable physical spaces and intangible craft processes within ancient villages are transformed into immersive, perceptible, and interactive digital symbol systems. For instance, the Southern Song Imperial Kiln site developed a "Virtual Ceramic Workshop" using AR technology, allowing visitors to personally experience processes like wheel-throwing and glazing, thereby internalizing an understanding of the craft's essence through hands-on engagement[13]. This symbolic translation alters the form of cultural narratives, activating users' emotional experiences through contextual participation and deepening dissemination from mere observation to experiential comprehension.

Digital intelligence technologies utilize algorithm-driven approaches to reconstruct pathways for cultural identity formation. Intelligent recommendation systems analyze user profiles to transition cultural content delivery from broad dissemination to precision targeting. Emotion computing technology identifies users' dwell time and interaction preferences with specific cultural content, progressively pushing related material-such as transitioning from scenic imagery to artisan narratives-to guide users toward deeper cultural cognition. Simultaneously, AIGC tools lower creative barriers, empowering villagers to evolve from objects of cultural

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representation by outsiders into cultural subjects capable of self-narration.For example, Huangling Village in Wuyuan, Jiangxi Province, transformed the traditional “autumn sun-drying” agricultural custom into a digital IP. By precisely targeting audiences through social media and short-video platforms, it resonated emotionally with netizens [14]. Algorithms not only accurately target interest groups but also foster community identity based on emotional resonance within compatible audiences. This enables local knowledge to transcend geographical boundaries, generating broad cultural influence.

The elevation of this communication logic lies in its ability to transform cultural resources from regional assets into global cultural capital. This logic forms a closed-loop pathway where algorithm-driven content reconstruction ultimately enhances dissemination efficiency, significantly boosting the external visibility and cognitive reach of ancient village culture.

3.3. Building Collaborative Platforms: Enabling Multi-Stakeholder Collaboration Through Digital-Intelligent Platform Integration

The essence of digital-intelligence technology-driven stakeholder collaboration lies in reshaping the relationships of authority and responsibility, resource flows, and cooperative mechanisms among diverse actors through platform-based tools. This enables the collaborative governance of ancient village cultural heritage preservation through the integration of digital intelligence platforms.

First, the collaborative logic clarifies the responsibilities of each stakeholder through platform-based interfaces. Specifically, it stipulates that the government must adhere to relevant policies to ensure the smooth progress of protection efforts during the conservation and development of ancient villages. Villagers are required to take ownership and actively participate in safeguarding these heritage sites. Meanwhile, society is encouraged to contribute through fundraising, public awareness campaigns, and offering conservation recommendations to support the preservation and development of ancient village culture. By pooling these forces, collaborative costs are effectively reduced. In essence, digital governance platforms standardize processes like policy approvals, villager applications, and expert evaluations, creating an interconnected data-driven framework that unites multiple stakeholders. For instance, Beijing's Mentougou District Traditional Village Restoration Incentive Platform achieves "one-stop" collaborative management [15]by integrating government approvals, designer proposal access, and online villager applications, significantly boosting operational efficiency. This design not only resolves traditional governance issues like ambiguous responsibilities and slow responses but also embeds diverse stakeholder actions into a unified governance framework through algorithmic rules, establishing institutionalized collaborative pathways.

Second, collaborative logic activates villagers' agency through data flow. Digital intelligence technologies can stimulate public enthusiasm for participating in ancient village preservation and development. Using digital tools like apps and mini-programs, villagers can provide real-time feedback, engage in decision-making, and even achieve transparent benefit distribution through blockchain technology. Through digital training and platform usage, villagers enhance their digital literacy and master basic operational skills, transforming from "bystanders" in cultural preservation to "co-creators." Expert teams serve as third-party evaluators, providing academic support and refinement suggestions for the governance mechanism.

Ultimately, the sustainability of collaborative logic relies on dynamic optimization mechanisms. Digital platforms continuously assess collaborative outcomes through real-time data feedback and intelligent algorithms, dynamically adjusting resource allocation and participation rules. This data-driven iterative capability transforms collaboration from temporary projects into a sustainable governance ecosystem. The collaborative logic of digital intelligence technology empowering cultural heritage preservation in ancient villages fundamentally builds an open,

ISSN: 2688-8653

adaptable, and sustainable governance community through data-driven approaches and embedded rules.

3.4. Advancing Intelligent Governance: Transforming Ancient Village Conservation Models Through Smart Governance

The deeper logic of digital intelligence technologies empowering cultural heritage preservation in ancient villages lies in achieving a fundamental leap from static preservation to dynamic governance through data-driven approaches, algorithmic embedding, and process reconstruction. This reconfiguration manifests primarily across three dimensions: the synergy among governance actors (detailed earlier and thus not elaborated here), the scientific rigor of governance processes, and the sustainability of governance effectiveness. Ultimately, it propels ancient village conservation from experience-dependent approaches toward data-driven intelligence and from fragmented management toward systematic governance.

Regarding the scientific nature of the governance process, digital intelligence technologies-through data visualization, AI analysis, and digital twin models-provide valuable decision-making references for ancient village preservation and development. This shifts governance away from relying primarily on experience that may not align with local realities, promoting a transition from subjective experience to objective data-driven approaches. Data visualization transforms disorganized data into intuitive charts, while AI big data analysis enables rapid decision-making, significantly enhancing the scientific rigor of governance. Digital twin models simulate neighborhood renovation plans to support planning decisions, effectively mitigating conflicts between preservation and development.

In terms of governance sustainability, digital intelligence technologies establish dynamic optimization mechanisms to mobilize all stakeholders in collaborative governance. This ensures scientifically sound, continuous governance methods and autonomous villager participation, guaranteeing long-term viability. Concurrently, blockchain technology shifts cultural memory from individual custodianship to immutable permanent archives, providing dual legal and technical safeguards for governance and advancing sustainability.

4. Practical Pathways for Empowering Cultural Heritage Protection in Traditional Ancient Villages through Digital Intelligence Technologies

Digital and intelligent technologies provide systematic solutions for preserving cultural heritage in traditional ancient villages through a four-dimensional framework: data governance, content production, collaborative participation, and institutional safeguards. As a quintessential representative of Jiangyou culture, Luling Ancient Village requires a practice path that balances digital-intelligence empowerment with humanistic value, tailored to its architectural forms, folk crafts, and cultural lineage.

4.1. Enhancing the Cultural Perception System by Strengthening Digital Archiving and Risk Early Warning

First, establish a foundational digital repository for traditional ancient village cultural heritage, encompassing physical relics, intangible cultural heritage skills, village narratives, and genealogical archives. While Ji'an's Diaoyuan Ancient Village and Mibei Ancient Village have developed relatively systematic digital databases, their coverage dimensions require expansion. Many village stories and skills have been lost due to inadequate preservation. For ancient building conservation and restoration, promote digital-intelligent methods like 3D laser scanning, Geographic Information Systems (GIS), and drone surveying to achieve digital archiving of village structures. Leverage digital-intelligent technologies to digitally preserve, restore, and reconstruct the original appearance of ancient villages. Concurrently, Luling Ancient Village conservation should integrate IoT technology by establishing "Cultural Asset

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Monitoring Points." Implemented through IoT systems, these points utilize high-precision sensors and real-time data collection to dynamically assess structural stability and environmental changes, enabling risk warnings and establishing an intelligent governance framework that combines cultural heritage with big data. Regarding the dynamic transformation of cultural resources, Luling Ancient Villages should actively implement a "Visual Cultural Resource Map" project to provide interactive spatial support for government management and public awareness. This initiative will convert Luling's tangible and intangible cultural heritage into visual resources through digital and intelligent technologies, transforming "static relics" into "dynamic narratives" to enhance the visibility and influence of Luling Ancient Villages.

4.2. Enhancing Content Integration Matrix: Strengthening Immersive Expression and Multi-Channel Dissemination

To address the need for enhanced cultural influence in Luling Ancient Villages, conservation efforts should leverage digital and intelligent technologies to build a cultural dissemination matrix centered on short videos, digital exhibition halls, and virtual tour systems. This approach enables multi-channel, multi-scenario content reproduction, recreating Luling's folk customs such as wedding rituals and ancestor worship. For instance, Liukeng Ancient Village in Jiangxi employs AR technology to recreate Nuo dance rituals, allowing visitors to deepen their understanding of village culture and strengthen cultural identity through virtual experiences. In terms of cultural-tourism integration, Luling Ancient Villages can leverage AI-assisted content generation for voice narrations, dialect transcription, and image restoration, enhancing the accuracy and richness of cultural reenactments while boosting cultural-tourism appeal. Simultaneously, local creators and intangible cultural heritage inheritors should be encouraged to collaborate on scriptwriting and video production. Leveraging digital intelligence technologies to build dissemination platforms enables "co-creation and co-transmission" of cultural content, expanding the public influence of Luling Ancient Villages.

As a quintessential representative of Jiangyou culture, Luling Ancient Villages can leverage the influence of Jiangyou culture to guide local media, schools, and platform accounts in establishing a "Jiangyou Culture Co-creation Community" and conducting targeted dissemination activities.

4.3. Establishing Collaborative Governance Platforms: Activating Multi-stakeholder Governance Momentum

The preservation and development of Luling Ancient Village requires not only the driving force of digital and intelligent technologies but also the concerted efforts of diverse stakeholders. Establishing a collaborative governance platform for multiple stakeholders will activate the momentum of co-governance mechanisms. Luling Ancient Village should establish a joint digital governance mechanism for ancient village culture, with members including the village committee, cultural bureau, intangible cultural heritage association, and digital enterprises. This mechanism should create a digital middle platform for cultural governance, integrating government oversight, data sharing, content review, and public feedback. It should facilitate smooth channels for multi-stakeholder co-governance and protection, mobilizing diverse forces for the preservation of the ancient village. Simultaneously, Luling Ancient Village should intensify digital literacy training for villagers. Through such training, villagers can enhance their capabilities to apply simple, user-friendly digital and intelligent technologies in safeguarding the village's tangible and intangible cultural heritage. This enables them to proactively engage in foundational conservation activities like managing cultural resources via platforms, uploading family memories, and participating in interactive storytelling. However, relying solely on villagers is insufficient; professional expertise must also be integrated. This can be achieved by engaging teams specializing in digital and intelligent technologies from

ISSN: 2688-8653

Jinggangshan University to serve as a cultural governance think tank, facilitating third-party evaluations and mechanism refinements. By integrating government oversight, villager self-management, and professional assessments for adjustments, a collaborative governance platform can be established to effectively advance the preservation and development of ancient villages.

4.4. Improving Institutional Mechanisms: Refining Authority-Responsibility Allocation and Compliance Evaluation

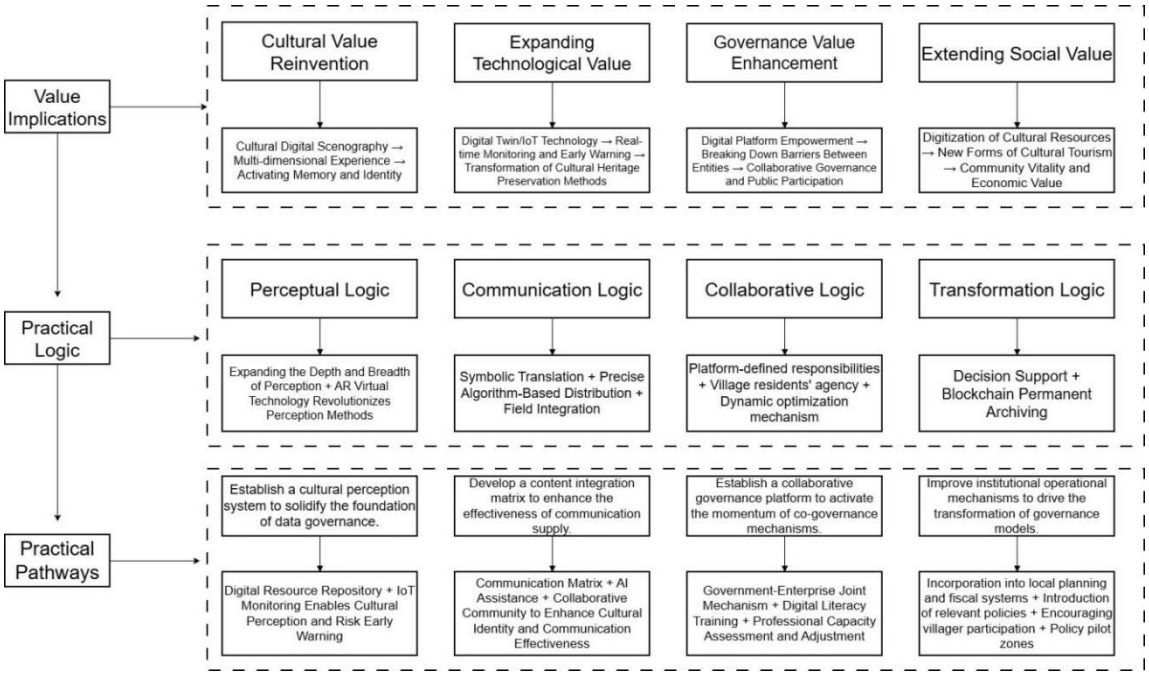

Figure 1. Value Implications, Practical Logic, and Implementation Pathways of Digital Intelligence Technologies Empowering Cultural Heritage Protection in Traditional Ancient Villages

The preservation and development pathway for Luling Ancient Villages requires robust institutional mechanisms to ensure rational allocation of responsibilities for traditional cultural protection and compliant evaluation of conservation effectiveness. When leveraging digital and intelligent technologies to empower cultural preservation in Luling Ancient Villages, emphasis must be placed on protecting and evaluating digital cultural resources. Digital cultural heritage preservation should be integrated into local "Smart Village" planning and fiscal budgeting systems. Establish systems for managing intellectual property rights of ancient village digital cultural resources, data access authorization, and content review, prioritizing the protection and management of these digital assets. Concurrently, Luling Ancient Villages should explore mechanisms for registering digital cultural rights, encouraging villagers to participate in cultural dividend sharing and digital transactions using cultural data assets. This approach will stimulate villagers' enthusiasm for actively engaging in the protection and governance of ancient villages. Establishing digital trading platforms to promote the marketization of data assets will transform cultural resources into economic drivers for the protection and development of ancient villages, propelling the advancement of Luling Ancient Villages. Moreover, amid the digital and intelligent transformation wave, Luling Ancient Villages should proactively establish a collaborative policy pilot zone integrating culture and technology to advance governance, providing an institutional template for exploring a Chinese-specific path of cultural digital governance. For instance, establishing a Luling Cultural Preservation Digital

ISSN: 2688-8653

Pilot Zone and testing policies in villages like Diaoyuan, Mibei, and Jishui Yanfang could create a replicable "Jiangxi Model."

5. Conclusion

The empowerment of digital and intelligent technologies in the protection of cultural heritage in traditional ancient villages encompasses four dimensions of value implications: in terms of cultural value, it revitalizes local memories and cultural identity; in terms of technological value, it facilitates the development of digital archives and a closed-loop restoration system; in terms of governance value, it realizes multi-stakeholder collaboration and data-driven governance; and in terms of social value, it promotes the in-depth integration of cultural and tourism industries and endogenous social development. The practical logic of empowering the protection of cultural heritage in traditional ancient villages through digital and intelligent technologies consists of: utilizing digital and intelligent technologies to realize the digital collection and dynamic identification of heritage, thereby enhancing audiences' perceptual capacity of traditional ancient village culture; leveraging media platforms to expand the boundaries of content expression and dissemination, broadening the dissemination channels for traditional ancient village culture; integrating digital and intelligent platforms to achieve multi-stakeholder collaboration, establishing a collaborative platform for the protection of such cultural heritage; and adopting intelligent governance to drive the transformation of ancient village protection models, advancing the smart governance of traditional ancient village cultural heritage.To effectively enhance the efficacy of cultural heritage preservation in ancient villages under digital intelligence empowerment, efforts should focus on: Continuously refining cultural perception systems while strengthening digital archiving and risk early warning; Implementing a full-content integration matrix to enhance immersive expression and multi-channel dissemination; Establishing collaborative governance platforms to activate multi-stakeholder co-governance momentum; and Improving institutional operational mechanisms to refine authority-responsibility allocation and compliance evaluation.

Due to data limitations regarding Luling Ancient Villages, some have already disappeared, confining the study's primary conclusions to theoretical levels while practical implementation requires further strengthening. In the future, as technologies like artificial intelligence and the metaverse mature, Luling Ancient Villages will showcase richer achievements in digital and intelligent preservation and development. This will transform villages like Luling's into living carriers of civilization where "mountains are visible, waters are seen, and nostalgia is remembered," offering a Jiangxi model for rural cultural heritage preservation.

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