

-RESEARCH ARTICLE-

EXPLORING THE ROLE OF INFORMATION SYSTEMS IN DOCUMENTING TACIT KNOWLEDGE AND DRIVING TRANSFORMATION IN TRADITIONAL HANDICRAFTS

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—Abstract—

The preservation of tacit knowledge within traditional handicrafts has increasingly become a critical concern due to the effects of globalisation, the declining number of artisans, and the erosion of master-apprentice learning frameworks. This study examines how information systems can be employed to document and transmit tacit knowledge, thereby supporting the sustainability and evolution of artisanal craftsmanship. Through a systematic literature review, the research identifies significant strategies, including AI-driven pattern recognition, IoT-enabled smart tools, cloud-based knowledge repositories, digital storytelling, and blockchain-facilitated provenance tracking. The findings reveal that digital documentation contributes to the preservation of knowledge, enhances the transfer of skills through virtual training, and expands market opportunities for artisans via e-commerce platforms and digital branding initiatives. Nonetheless, persistent challenges such as cultural appropriation, intellectual property rights, and artisans' reluctance to adopt technological solutions remain prevalent. The study concludes that achieving a balance between technological innovation and cultural sensitivity is essential to ensuring that information systems serve as effective mechanisms for the preservation of traditional crafts and the promotion of sustainable industry development.

Keywords: Tacit Knowledge, Information Systems, Digital Documentation, Traditional Handicrafts, Knowledge Preservation

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INTRODUCTION

Handicrafts embody essential cultural expressions that preserve artistic creativity and protect traditional heritage. Historically, the survival of such crafts has relied on master-apprentice training, through which tacit knowledge has been transmitted as an embedded system dependent on sensory skills, physical memory, and creative innovation (Wang et al., 2024). However, contemporary globalisation, industrial advancement, and the decline in apprenticeship opportunities threaten the continuity of these traditional crafts (Ismail, 2019). While explicit knowledge can be systematically recorded with relative ease, capturing tacit knowledge remains challenging, as experiential knowledge is inherently difficult to translate into documented forms (Liu et al., 2023).

Emerging digital technologies, including Artificial Intelligence (AI), the Internet of Things (IoT), blockchain, cloud storage, and immersive tools such as Virtual and Augmented Reality (VR/AR), are increasingly explored as potential solutions for documenting, analysing, and transmitting artisanal skills (Lyu et al., 2024). AI-driven pattern recognition and IoT-enabled smart tools facilitate the recreation of designs and provide artisans with real-time feedback on their movements, thereby ensuring that the precision inherent to traditional craftsmanship is maintained (Jeyasri et al., 2024). Additionally, blockchain technology offers mechanisms for protecting intellectual property by authenticating handmade products and preventing cultural misappropriation (Zhang & He, 2023).

Nevertheless, artisans in rural and marginalised communities often display resistance towards adopting digital technologies due to unfamiliarity and concerns over compromising the authenticity of their crafts (Luo et al., 2023). Furthermore, unresolved ethical dilemmas persist concerning the commodification of culture and issues of digital ownership (Fergus et al., 2003). This study conducts a systematic literature review to examine digital strategies aimed at safeguarding handicrafts, identifying both opportunities and challenges, as well as best practices. The research seeks to promote a balanced integration of modern technology with cultural preservation, ensuring that traditional arts can be sustained and transmitted across generations.

Problem Statement

The preservation of traditional handicrafts faces increasing threats from globalisation, urbanisation, and the erosion of master-apprentice training frameworks. Central to this issue is the difficulty of capturing and transmitting tacit knowledge—non-verbal, experiential expertise inherent in artisanal craftsmanship. Unlike explicit knowledge, which can be easily codified, tacit knowledge encompasses sensory perceptions, skilled hand movements, and adaptive problem-solving abilities that are challenging to

document through conventional methods (Tianying, 2023). Although emerging technologies such as Artificial Intelligence (AI), the Internet of Things (IoT), blockchain, and cloud-based platforms present promising avenues for addressing this issue, their adoption within most craft sectors remains limited. This reluctance is largely due to artisans' lack of technological familiarity, concerns over cultural appropriation, and fears of compromising authenticity (Zhang & He, 2023). Moreover, ethical challenges related to ownership rights and the commercialisation of cultural heritage pose additional barriers to the digitisation of craft knowledge. This study investigates how information systems can effectively document, preserve, and transmit tacit knowledge in traditional handicrafts, while addressing the intertwined challenges of technological adoption, authenticity, and ethical considerations in the practice of craftsmanship.

Research Objectives

The purpose of this study is to accomplish the following objectives:

1. To examine how AI, the IoT, and cloud storage contribute to the documentation and preservation of tacit knowledge in traditional handicrafts by capturing artisans' experiential and intuitive expertise.
2. To explore the role of AI, IoT, and cloud-based knowledge management systems in reshaping traditional craft practices, fostering innovation, facilitating intergenerational skill transmission, and expanding market accessibility for artisans.

Research Questions

To answer these objectives, the study will focus on the following questions of the research in the research field:

1. In what ways do information systems contribute to the documentation and preservation of tacit knowledge in traditional handicrafts, particularly in capturing non-verbal, experience-based expertise?
2. How does digital documentation influence the innovation, sustainability, and intergenerational transmission of traditional craft practices within contemporary and technological contexts?

LITERATURE REVIEW

Introduction to Tacit Knowledge in Traditional Handicrafts

Tacit knowledge, as initially emphasised by Jakubowska (2019), refers to experiential, non-conceptual understanding that is difficult to articulate or codify. The process of documenting explicit knowledge through written practices contrasts with tacit understanding, as the latter relies on human intuition, sensory perception, and embodied knowledge derived from lived experiences (Othman et al., 2024). In the context of handicrafts, tacit knowledge plays a critical role, encompassing skilled hand

movements, material sensitivity, and adaptive problem-solving abilities honed over years of practice (Seiler et al., 2021). Artisans typically acquire such knowledge through apprenticeship, active participation, and experiential immersion rather than formal instruction, highlighting its dependence on human interaction for transmission.

A key distinction between tacit and explicit knowledge in handicrafts lies in their methods of transfer and preservation. Explicit knowledge can be codified into written formats, such as books, manuals, or digital databases (Endow, 2024). However, tacit knowledge—such as the precise pressure applied during weaving, the ability to judge clay consistency in pottery, or the intuitive understanding of how natural dyes interact with fabrics—cannot be fully conveyed through textual descriptions alone (Othman et al., 2024). This poses a significant challenge for the preservation of crafts, as traditional master-apprenticeship models are increasingly threatened by globalisation, urbanisation, and declining interest among younger generations.

The significance of tacit knowledge in safeguarding cultural heritage cannot be overstated. Traditional crafts are not merely economic activities but also represent cultural heritage, artistic expression, historical narratives, and national identity (Guo & Ahn, 2023). Neglecting tacit knowledge risks eroding cultural uniqueness, as the specialised skills and techniques integral to artisanal practices may degrade or disappear entirely. Conventional documentation methods, which primarily focus on explicit knowledge, are insufficient to fully preserve the technical expertise embedded in artisanal traditions (Squassina, 2022). In response to these challenges, digital technologies have emerged as potential solutions for capturing and retaining tacit knowledge. Innovations such as artificial intelligence-driven pattern recognition, motion capture for gesture analysis, IoT-enabled smart tools, and immersive technologies like VR and augmented reality (AR) offer promising avenues for communicating tacit knowledge. These tools aim to document both the intellectual and material dimensions of craftsmanship, opening new possibilities for preserving artisanal traditions in an ever-changing world.

Information Systems for Documenting and Preserving Tacit Knowledge

The inherently experimental nature of artisanal expertise presents significant challenges to the documentation and preservation of tacit knowledge in handicrafts, as such knowledge is largely intuitive, non-verbal, and difficult to convey through conventional documentation approaches. The advancement of technology, coupled with the forces of globalisation, economic pressures, and declining interest in handmade products, has contributed to the erosion of traditional master-apprentice systems that historically facilitated the transmission of craft knowledge (Othman et al., 2024). In response to the decline of these traditional knowledge transfer mechanisms, information systems have emerged as potential solutions for capturing and transmitting the specialised knowledge embedded within craftsmanship. Contemporary digital technologies, including AI, the

IoT, VR, and blockchain, offer innovative approaches to safeguarding various elements of traditional craftsmanship, encompassing sensory experiences, cognitive processes, and technical skills. These advanced technological tools enable the creation of systematic and structured preservation methods, ensuring that tacit knowledge endures and is passed on to future generations of artisans.

Digital Tools for Tacit Knowledge Documentation

In recent years, the tacit knowledge embedded in handicrafts has been increasingly captured through technological advancements for purposes of analysis, documentation, and dissemination. Technologies such as AI-powered pattern recognition, motion capture, IoT-enabled smart tools, and virtual immersive environments have emerged as pivotal in preserving and transmitting artisanal expertise (Yu & Dai, 2024). By offering accurate, scalable, and interactive methods for capturing craft knowledge, these innovations contribute significantly to reducing the risk of traditional knowledge loss and facilitating its transmission to future generations. Among the most notable applications of digital technologies in craft documentation is AI and machine learning, which have proven instrumental in identifying, analysing, and replicating traditional motifs and artistic styles. AI tools, leveraging computer vision and deep learning, are capable of analysing vast datasets of handicrafts to detect intricate motifs, weaving patterns, ceramic glazes, and wood-carving techniques (Stefanidi et al., 2020). This capability enables AI to decode and recreate historical craft patterns, a crucial function as the number of skilled artisans continues to decline. Furthermore, AI-driven predictive models support the restoration of partially damaged artworks, thus contributing to cultural heritage preservation (Stefanidi et al., 2020). Nevertheless, despite AI's capacity to replicate classical designs with high precision, it lacks the cognitive depth and emotional resonance intrinsic to human craftsmanship, raising concerns regarding authenticity, creative ownership, and cultural integrity. Therefore, AI should be regarded as a supportive tool rather than a replacement for traditional craftsmanship.

Gesture and motion-capture technologies represent another significant innovation, facilitating the real-time recording of hand movements, pressure application, and material interaction throughout craft production. These systems generate high-fidelity digital representations of artisanal skills, thereby enhancing the accuracy of skill transfer and replication (Veldhuijzen et al., 2024). For instance, in pottery, motion sensors embedded within a potter's wheel can capture nuanced hand movements, spin velocity, and clay pressure, enabling apprentices to replicate these actions with precision (Akman & Sönmez, 2021). Similarly, sensor-integrated tools used in wood carving and metalwork measure grip force, carving depth, and stroke accuracy, creating comprehensive digital repositories for training purposes. However, while motion-capture technology excels in documenting the mechanical aspects of craft, it falls short in capturing the contextual, intuitive, and creative dimensions that define expert

artisanship (Caroline et al., 2024). Additionally, access to such advanced facilities remains limited, particularly among rural artisans lacking the necessary infrastructure.

The IoT has introduced intelligent tools and sensors that enable real-time monitoring and analysis of artisanal processes. IoT-based platforms are especially valuable in precision crafts such as textile weaving, embroidery, and jewellery-making, where minute variations in hand movements, material handling, and tool pressure significantly influence outcomes (Khan et al., 2023). IoT-enabled equipment, including sensor-embedded looms, embroidery machines, and metalworking devices, capture critical data—such as pressure, temperature, and motion speed—thus facilitating performative skill assessments and precise documentation. These tools not only enhance traditional craftsmanship by providing artisans with real-time feedback but also help maintain consistency and quality control (Sofronova & Angelova, 2021). Nonetheless, the adoption of IoT in traditional crafts faces significant hurdles, including high costs, limited accessibility, and insufficient technical knowledge among artisans. Given that many rural craftsmen form the backbone of the handicraft sector, overcoming these barriers requires the development of affordable, locally adapted, and user-friendly IoT solutions that cater to those with minimal digital literacy (Luo et al., 2023).

Moreover, VR and AR offer immersive environments for skill documentation and digital apprenticeship models. These technologies facilitate interactive and experiential learning by enabling artisans to record their techniques and pass them on within simulated workshop settings (Luo et al., 2023). VR-based modules allow learners to practise engaging with tools, materials, and processes in a controlled virtual environment, supporting remote craft education. Meanwhile, AR applications provide step-by-step visual overlays, enabling apprentices to view projected instructions on their work surfaces for activities such as stitching, carving, or glazing (Wallace et al., 2024). By bridging the geographical and generational gaps in traditional apprenticeship systems, VR and AR hold the potential to transform craft education. However, challenges including high implementation costs, limited technological access, and resistance to digital integration remain obstacles to their widespread adoption, particularly in rural contexts. In conclusion, digital technologies offer crucial pathways for documenting, preserving, and transmitting tacit knowledge within the handicraft sector. AI, motion capture, IoT, and immersive VR/AR environments present promising solutions for preserving artisanal skills; however, their successful implementation depends on addressing issues of accessibility, affordability, and authenticity. By effectively leveraging these technologies, the handicraft industry can sustain traditional expertise while meeting contemporary market and educational demands.

Cloud-Based Knowledge Management Systems

Cloud repositories function as effective tools for the preservation and management of knowledge, offering centralised storage for multimedia content that aids in safeguarding

traditional indigenous skills. These platforms enable artisans to maintain digital access to their expertise, which can be readily accessed by researchers and future generations across the globe (Noor et al., 2019). Cloud-based systems utilise integrated solutions to record knowledge through diverse media formats, including written text, visual materials, and animations, providing more comprehensive documentation capabilities compared to traditional, fragmented record-keeping methods (Tapfuma & Hoskins, 2017). By storing artisanal techniques on cloud platforms, cultural institutions, artisans, and researchers can share knowledge beyond geographical boundaries, thereby contributing to the preservation of traditional crafts.

Digital storytelling emerges as a particularly effective cloud-based approach, offering an interactive medium to document traditional crafts alongside their associated narratives. Platforms such as Google Arts and Culture, as well as UNESCO Digital Heritage Initiatives, allow artisans to document and showcase their craft processes while sharing cultural heritage through engaging, interactive features (Lyu et al., 2024). These platforms provide users with access to oral histories, video demonstrations, and 3D modelling tools, which serve as invaluable resources for both practitioners and researchers (Balogun, 2023). By combining technical skill documentation with cultural context and historical background, digital storytelling ensures that craft knowledge is preserved in its full contextual depth.

The integration of blockchain technology into cloud systems marks a significant advancement in knowledge management, offering dual benefits of intellectual property protection and authentication of artisanal handicrafts. Blockchain's tamper-proof, transparent ledger system allows traditional arts and crafts to be securely linked to their origins, ensuring authenticity and traceability (Zhang et al., 2023). This technology enables artisans to obtain digital certificates for their creations, granting them ownership rights and protecting their craft processes from unauthorised use or exploitation. Blockchain technology also serves as a robust mechanism to prevent the commercial exploitation of indigenous and heritage crafts while preserving their cultural authenticity. When combined with cloud storage systems, blockchain enhances transparency in the global craft market, ensuring secure documentation management and empowering artisans to maintain control over their intellectual property.

Challenges in Digitizing Tacit Knowledge

Technological advancements, despite their potential, have not fully resolved the challenges inherent in the digitalisation of tacit knowledge, thus impeding its effective preservation and transfer. A primary obstacle lies in the difficulty of converting experiential, non-verbal knowledge into digital formats. Tacit knowledge is inherently intuitive, context-specific, and nonlinear, making it resistant to traditional knowledge management systems (Maymir-Ducharme & Angelelli, 2014). Unlike explicit knowledge, which can be systematically codified and stored in databases, tacit

knowledge encompasses sensory perceptions such as skilled hand movements, the tactile experience of materials, and adaptive decision-making—dimensions that elude purely textual or static documentation methods. Additionally, significant ethical concerns surrounding ownership, authenticity, and cultural appropriation complicate the digitisation process. Digital platforms often risk appropriating indigenous craft techniques and designs without appropriate acknowledgment or compensation to the original artisans (Talarico et al., 2024). This raises critical questions about the rightful ownership and governance of digitised craft knowledge—whether it should belong to the artisans, be regulated by cultural institutions, or controlled by commercial entities (Arruda et al., 2024). In the absence of clear intellectual property protections, traditional artisans are vulnerable to exploitation, as their cultural heritage may be commodified without their consent or benefit.

Furthermore, widespread resistance among artisans to the adoption of digital tools presents another significant barrier. Many artisans, particularly those from rural or marginalised communities, lack digital literacy and access to the necessary technological infrastructure (Owens, 2023). There is also an ingrained scepticism towards digital systems, with artisans fearing that technology may supplant rather than support traditional craftsmanship (Nipo et al., 2024). Such reluctance is deeply rooted in concerns that the use of technology may erode the uniqueness, human touch, and individual creativity that define handcrafted products. Therefore, addressing these issues requires the development of inclusive, community-led approaches that prioritise artisans' perspectives and ensure that technological interventions act as supportive rather than intrusive mechanisms for craft preservation.

While information systems offer promising avenues for recording and safeguarding tacit knowledge, their success depends on balancing technological capabilities with sensitivity to cultural, ethical, and accessibility concerns. Although AI, IoT, motion capture, and blockchain technologies enhance the precision and scope of craft knowledge documentation, challenges of authenticity, ethical governance, and equitable access remain to be addressed. Future research should focus on designing inclusive, community-driven digital documentation models that embed artisans at the core of technological innovation, thereby ensuring that the preservation of traditional crafts respects both the artisans' rights and the cultural significance of their work.

Impact of Digital Documentation on Craft Innovation, Skill Transmission, and Market Accessibility

The digitalisation of handicrafts has significantly reshaped how artisans innovate, share knowledge, and access markets. By utilising technologies such as AI, IoT, blockchain, and online learning platforms, digital documentation has created opportunities for creative innovation, intergenerational knowledge transfer, and global market expansion.

While these technologies offer considerable benefits, they also introduce challenges related to economic accessibility, intellectual property rights, and cultural sustainability. The integration of digital tools must carefully balance preserving the authenticity of crafts with fostering technological innovation, ensuring artisans maintain control over their cultural heritage while reaping the benefits of digital advancements.

Digital Documentation as a Driver of Craft Innovation

Arguably, one of the most transformative roles of digital documentation in handicrafts is its capacity to foster creative innovation. Emerging models of hybrid craftsmanship that blend traditional artisanal methods with advanced digital technologies have enabled artisans to evolve their crafts while safeguarding cultural heritage (Shiwen & Zahari, 2024). The integration of AI-generated design recommendations has opened new horizons for craft production by analysing historical designs, material combinations, and regional styles to generate adaptive and contemporary design variations. This approach has been particularly impactful in textile sectors such as weaving and embroidery, where AI-driven pattern recognition assists artisans in both preserving intricate motifs and developing innovative adaptations.

Alongside AI, technologies such as 3D printing and digital prototyping have been instrumental in maintaining and updating traditional artworks (Liu et al., 2023). By digitising craft templates, artisans can create bespoke designs, replicate rare or endangered motifs, and experiment with hybrid production techniques. For example, in pottery, 3D modelling allows for the precise reconstruction of fragile or damaged ceramic pieces, ensuring the preservation of traditional forms while facilitating accurate reproductions (Agelada et al., 2022). Furthermore, digital fabrication supports sustainable practices by enabling the use of reclaimed or biodegradable materials, all while preserving the structural and aesthetic integrity of the craft (Elran & Zoran, 2024). Nevertheless, a critical debate persists over whether digital fabrication undermines the authenticity of handcrafted work. While some view digitally enhanced craftsmanship as a natural evolution that revitalises tradition, others argue that it dilutes the uniqueness and artisanal value by merging commercial reproduction with individual creativity. The expansion of immersive technologies such as VR and AR has also contributed to the digital reinvention of traditional crafts. VR facilitates the comprehensive documentation of craft techniques, allowing the creation of interactive and immersive learning environments for the next generation of artisans, while AR provides real-time, step-by-step visual guidance during the crafting process (Garcia & Verlinden, 2024). These tools bridge the gap between older generations of craftsmen and modern apprentices, broadening access to high-quality craft training beyond geographical constraints. However, the widespread adoption of VR and AR remains limited by significant challenges, including high costs, technical limitations, and resistance from artisans unfamiliar with digital media.

In summary, while digital documentation and emerging technologies offer powerful avenues for creative innovation and knowledge preservation within handicrafts, their implementation continues to raise critical questions around authenticity, accessibility, and cultural integrity. Thus, a balanced approach is required to ensure that such technologies complement rather than compromise traditional craftsmanship.

Intergenerational Knowledge Transmission Through Digital Platforms

The decline of master-apprentice systems has posed a significant threat to the survival of many traditional crafts. Digital documentation has emerged as a vital tool to ensure the transmission of artisanal knowledge across generations. E-learning platforms such as Coursera, Udemy, and the UNESCO Creative Cities Network have expanded the reach of craft education to a global audience through video tutorials, structured courses, and interactive workshops (Partarakis et al., 2022). These platforms enable artisans to share knowledge remotely, reducing the risk of knowledge loss and preserving unique techniques beyond their local communities.

Online craft communities and social media platforms have also become influential informal networks for knowledge exchange and networking (Al-Shihi et al., 2018). Platforms like Instagram, Pinterest, YouTube, and Facebook provide artisans with tools to showcase their techniques and display their work to a global audience. This democratisation of craft education fosters cultural collaboration, as designers from diverse backgrounds blend traditional methods with contemporary design concepts (Martins et al., 2021). However, challenges such as intellectual property rights violations, cultural misrepresentation, and the exploitation of traditional patterns remain prevalent. Many artisans lack legal protection against the unauthorised reproduction of their craft designs by commercial entities.

Additionally, e-learning modules and virtual apprenticeships have revolutionised the way craft skills are passed down through generations (Heffer, 2023). Unlike traditional models requiring physical presence, virtual mentorship programmes allow aspiring artisans to receive guidance from experienced craftspeople, regardless of geographical distance. Virtual reality (VR)-based learning tools have further enhanced this process by simulating real-world crafting environments, enabling learners to practise traditional techniques and receive digital feedback (Heffer, 2023). Nevertheless, barriers such as limited digital access, high costs, and language differences continue to hinder the widespread adoption of online craft education, particularly among rural and marginalised communities.

Market Expansion and Digital Branding for Artisans

Perhaps the greatest impact of digital documentation has been its role in expanding market access for traditional craftspeople. The rise of e-commerce platforms such as

Etsy, Novica, and Amazon Handmade has enabled artisans to reach global consumers directly, bypassing intermediaries and increasing profit margins (Jeyasri et al., 2024). These platforms allow artisans to sell handmade products internationally, fostering craft entrepreneurship and reducing dependence on local markets. Additionally, e-commerce helps artisans tap into the growing demand for ethically produced, fair-trade, and handmade goods, positioning their work within a sustainable and ethical consumer framework.

Social media promotion has further enhanced artisans' ability to build personal brands and connect with niche audiences (Revathi et al., 2023). Platforms like Instagram and Pinterest enable artisans to create compelling visual narratives that showcase their creative processes, cultural heritage, and aesthetic inspirations. Live videos and interactive storytelling have proven particularly effective, fostering emotional connections between artisans and buyers. However, success in digital marketing requires technical skills, content planning, and advertising budgets, posing challenges for artisans lacking digital literacy or financial resources.

Blockchain technology has also emerged as a critical tool for ensuring authenticity and responsible sourcing in artisan markets (Martins et al., 2021). Blockchain-based traceability systems provide auditable records of a product's origin, production chain, and ownership history, reducing the risk of forgery and commercial exploitation. By integrating blockchain into craft documentation, artisans can protect their intellectual property and offer consumers transparency regarding product authenticity. Despite its potential, blockchain remains costly and technologically complex, limiting its widespread adoption among artisans.

Research Gaps

The application of information systems in the recording and preservation of tacit knowledge has significantly contributed to sustaining traditional handicrafts. Advanced technologies, including AI, IoT, motion-capture systems, VR, and blockchain, have introduced innovative methods that allow artisans to record, disseminate, and evolve their crafts. These technologies facilitate the documentation of experiential and non-verbal knowledge, which has historically been difficult to capture, ensuring that such knowledge becomes accessible to future generations. Consequently, the practices of traditional crafts have undergone transformation, enabling the development of hybrid craftsmanship, improved intergenerational knowledge transfer, and expanded access to global markets.

Nevertheless, various research gaps remain within current studies on these technological interventions. Further investigation is required to assess the long-term effectiveness of digital apprenticeships and virtual learning environments in transmitting craft knowledge while preserving its authenticity. Moreover, the use of

blockchain technology to authenticate craft traditions encounters notable obstacles in ensuring ethical sourcing, fair remuneration, and the protection of artisans' intellectual property. Additionally, there is a need for deeper scholarly inquiry into how AI and deep learning algorithms can fully realise their potential in documenting and emulating manual craft techniques without compromising cultural heritage. Addressing these gaps is essential for integrating digital documentation as a robust preservation tool for traditional handicrafts. Ultimately, resolving these challenges will enable technology to serve not as a threat to cultural heritage but as a powerful mechanism for its protection and revitalisation.

METHODOLOGY

The present investigation adopts a Systematic Literature Review (SLR) methodology to examine how information systems facilitate the documentation and preservation of tacit knowledge within indigenous handicrafts. A qualitative research approach is deemed most appropriate for this inquiry, as tacit knowledge is inherently non-verbal and emerges from embodied artisanal practices. The SLR method offers a structured and transparent framework for conducting a comprehensive and critical assessment of existing literature, enabling the synthesis of insights into best practices, key challenges, and contemporary developments in the digital documentation of traditional crafts. Furthermore, the research aligns its methodological design with the principal themes addressed in the Findings and Discussion sections to ensure coherence and analytical depth. This alignment guarantees that the reviewed studies contribute meaningfully to core areas such as documentation strategies, the implementation of digital tools, mechanisms of knowledge transfer, and ethical considerations in the digital preservation of craftsmanship. Through this approach, the study aims to provide a consolidated understanding of how modern information systems can support the safeguarding and continuation of intangible cultural heritage embodied in indigenous crafts.

Research Approach

Justification for Qualitative Research

The study adopted a qualitative research approach as it is most suitable for examining non-quantifiable knowledge grounded in lived experiences (Bearman et al., 2012). In the context of traditional handicrafts, the transmission, preservation, and evolution of tacit knowledge are intrinsically tied to hands-on practice, where such knowledge is conveyed exclusively through embodied action. Consequently, qualitative methods are essential to effectively capture and explore this form of knowledge. Unlike quantitative approaches that rely on statistical analysis and numerical data, qualitative research prioritises the in-depth exploration of subjectivity, contextual meaning, and experiential insight that characterise artisanal craftsmanship. To identify, evaluate, and synthesise the role of digital knowledge management in handicrafts, the study employed a

qualitative SLR of existing scholarly and industry-based literature. This method ensures a transparent, structured, and replicable process for assessing relevant research, offering a comprehensive synthesis of academic contributions, practical applications, and technological advancements.

The SLR methodology was selected for its capacity to deliver a robust and holistic analysis of contemporary research on the documentation and preservation of tacit knowledge in traditional crafts. By systematically identifying recurrent themes, gaps, and emerging trends, the SLR provides a rigorous synthesis that enhances the reliability and depth of the study's outcomes. This approach enables a critical examination of how information systems—including AI, IoT, and blockchain—support the retention and dissemination of artisanal know-how, while also addressing the best practices and key challenges associated with digital craft documentation. Ultimately, by building on a broad and diverse range of empirical studies rather than isolated case analyses, the SLR methodology reinforces the credibility, validity, and applicability of the research findings.

Data Collection and Selection Criteria

The study adopts a systematic selection process to ensure the inclusion of high-quality and relevant literature aligned with the research objectives. To achieve a comprehensive and multidisciplinary understanding of the topic, the literature search was conducted across five major academic databases:

1. Scopus – selected for its extensive collection of high-impact, peer-reviewed studies on digital knowledge management and innovation in handicrafts.
3. Web of Science – utilised to capture interdisciplinary perspectives on the adoption of technology in the preservation of cultural heritage, offering access to well-cited, cross-disciplinary research.
4. Google Scholar – included to identify grey literature, industry reports, and case studies that provide practical insights and contemporary developments beyond purely academic discourse.
5. IEEE Xplore – chosen for its focus on advanced technological applications, particularly research on AI, IoT, and blockchain as they relate to the documentation and preservation of craft knowledge.
6. SpringerLink – consulted for scholarly work addressing cultural sustainability, digital heritage preservation, and the socio-cultural implications of technological integration in traditional crafts.

Inclusion and Exclusion Criteria

The inclusion and exclusion criteria for the literature were defined in advance to ensure that only relevant and credible sources were analysed. As shown in [Table 1](#), these inclusion and exclusion criteria ensure a focused, credible, and methodologically sound

review, effectively aligning the selected literature with the research objectives.

Table 1: Inclusion and Exclusion Criteria

Criteria	Inclusion	Exclusion	Justification
Publication Type	Peer-reviewed journal articles, conference papers, industry reports, case studies	Non-peer-reviewed blogs, opinion articles, unverified sources	Ensures credibility and reliability by including only rigorously reviewed and academically recognized sources.
Time Frame	Studies published between 2010–2024	Studies before 2010 (unless foundational)	Focuses on recent advancements and technological developments while including foundational studies where necessary.
Language	English publications	Non-English publications without translation	Ensures accessibility and consistency in analysis while acknowledging the limitation of excluding non-English research.
Relevance	Research on digital documentation, tacit knowledge, handicrafts	Studies unrelated to craft documentation or digital knowledge management	Ensures alignment with the research objectives by including studies directly related to the intersection of digital technology and craft preservation.
Methodology	Empirical research, qualitative studies, systematic reviews	Theoretical papers without application	Prioritizes studies that provide practical insights, case studies, and data-driven conclusions, ensuring applicability to real-world craft documentation efforts.

Sources of Data

This selection process ensures the inclusion of only empirical studies and systematic reviews, thereby enhancing the reliability, credibility, and applicability of the research findings. Additional sources of information were drawn from industry reports published by UNESCO, the World Intellectual Property Organization (WIPO), and other cultural heritage agencies to incorporate perspectives and insights grounded in real-world contexts. The details of sources of data used in current research given in [Table 2](#).

Table 2: Data Sources

Database	Reason for Selection
Scopus	High-impact journals in knowledge management and digital innovation
Web of Science	Multidisciplinary coverage, ensuring diverse insights
Google Scholar	Access to grey literature and case studies
IEEE Xplore	Studies related to digital technologies and AI applications
SpringerLink	Research on cultural heritage and knowledge preservation

PRISMA Flow Diagram for Literature Selection

The literature screening process adhered to the PRISMA (Preferred Reporting Items for

Systematic Reviews and Meta-Analyses) guidelines which is shown in Figure 1. The PRISMA flow diagram presented below illustrates the systematic process of identifying, screening, assessing, and including studies, along with the number of records at each stage of the review. The PRISMA framework outlines the systematic approach employed for selecting articles in this study. The total screening process led to the identification of 37 records, of which 15 were excluded based on relevance and quality. Subsequently, 22 full-text articles were assessed for eligibility, resulting in the exclusion of 10 studies that did not meet the inclusion criteria. This rigorous selection process concluded with 12 studies that were retained for in-depth thematic analysis. These final studies formed the foundation for synthesising key insights related to the documentation and preservation of tacit knowledge in traditional handicrafts.

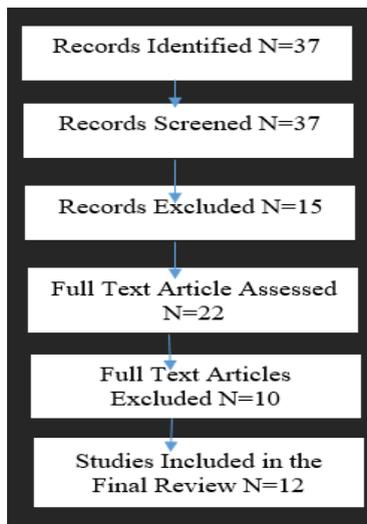


Figure 1: PRISMA Framework

Analytical Framework

To synthesise findings from the reviewed literature, a thematic analysis was conducted. This qualitative research method is suitable for identifying recurring patterns, organising research findings, and establishing connections between digital technologies and the preservation of tacit knowledge. The thematic analysis in this study was carried out through the following structured steps:

1. Exposure to Data – Engaging with and summarising the selected literature to comprehend recurring concepts and emerging themes.
2. Initial Coding – Systematically coding the data to identify common themes related to digital documentation and tacit knowledge.
3. Theme Development – Grouping codes into broader thematic categories, such as technology integration, knowledge transmission, and market transformation.

4. Refining Categories – Refining and clarifying categories to ensure their alignment with the literature findings and accurately reflect key insights. The [Table 3](#) presents the themes identified through this analysis.

Table 3: Themes Identified

Theme	Description	Corresponding Findings
Strategies for Documenting Tacit Knowledge	Use of high-resolution video recording, AI, motion capture, and 3D modelling to capture artisanal techniques	Strategies used in documenting tacit knowledge through information systems
Digital Tools for Handicraft Preservation	Application of IoT, cloud-based repositories, and blockchain technology for knowledge storage and authentication	Digital tools and platforms for handicraft preservation
Best Practices in Digital Documentation	Use of AI, IoT, and cloud storage for managing craft knowledge	Integration of AI, IoT, and cloud storage in knowledge management
Impact on Craftsmanship and Innovation	Emergence of hybrid craftsmanship models, e-learning platforms, and digital apprenticeships	Digital learning environments and hybrid craft models
Challenges and Future Directions	Ethical concerns, risk of cultural appropriation, and lack of IP protections	Challenges and policy recommendations for digital craft preservation

By organising the analysis around these themes, the study ensures that the Findings and Discussion section presents a cohesive and structured summary of insights, effectively capturing the broader trends in digital craft preservation. This thematic organisation allows for a comprehensive examination of how various digital tools and systems contribute to the recording, transmission, and evolution of tacit knowledge while addressing associated challenges and opportunities. Through this approach, the study aligns its analytical focus with its research objectives, ensuring that the discussion reflects a balanced perspective on both technological advancements and the cultural-ethical dimensions of traditional craft preservation.

RESULTS

This investigation explores the role of information systems in creating digital documentation aimed at preserving tacit knowledge related to traditional crafts in the era of digital transformation. Technologies such as AI, IoT, cloud storage, blockchain, VR, and AR introduce innovative approaches to knowledge sharing and open new market opportunities. Through a SLR, the study analyses both methods of documenting and digitising craft knowledge and the mechanisms of digital preservation. It also examines barriers to innovation adoption and strategies for safeguarding intellectual property, with the overarching goal of developing sustainable craft practices and ensuring the protection of artisans' rights.

Table 4: Comprehensive Studies Selected from Systematic literature Review SLR

	Author(s)	Year	Title	Objective	Keywords	Methodology	Findings
1	Guo & Ahn	2023	Tacit Knowledge Sharing for Enhancing the Sustainability of Intangible Cultural Heritage (ICH) Crafts	To examine how tacit knowledge sharing influences the sustainability of cultural heritage in handicrafts	Tacit knowledge, handicrafts, sustainability, cultural heritage	Qualitative study with artisan and academic perspectives	Tacit knowledge is crucial for craft sustainability. Digital documentation aids knowledge transfer but must balance tradition and innovation.
2	Hsu & Wu	2020	Developing a Knowledge Management System for Supporting Learning Activity in Ceramics Craft Education	To create a digital knowledge management system for craft education	Knowledge management, ceramics, AI, digital learning	Experimental study using AI and digital learning models	Digital systems improve skill transmission but may lack experiential depth.
3	Zhang & He	2023	Inheritance and Innovation of Traditional Handicraft Skills Based on Artificial Intelligence	To analyse the role of AI in the innovation and preservation of handicrafts	Artificial Intelligence, handicrafts, innovation, preservation	Case study on AI-enhanced craft production	AI enables pattern recognition and preservation but raises authenticity concerns.
4	Shiwen & Zahari	2024	A Systematic Literature Review of Handicraft Heritage Co-Design Towards Sustainable Development	To review how digital tools, contribute to the co-design of handicrafts	Handicrafts, co-design, sustainability, digital tools	Systematic Literature Review (SLR)	Digital tools help preserve heritage, but artisans' participation is vital.
5	Noor et al.	2019	A Review of Cloud-Based Knowledge Management in Higher Education Institutions	To evaluate cloud-based knowledge repositories for cultural documentation	Cloud storage, knowledge management, digital preservation	Empirical study on cloud repositories	Cloud storage enhances accessibility, but IP protection remains an issue.
6	Ojha & Yammiyavar	2019	A Fuzzy-Based Approach to Identify Tacit Knowledge in Craft Objects	To explore AI-driven approaches to categorizing tacit craft knowledge	Fuzzy logic, AI, tacit knowledge, craft classification	Experimental approach using fuzzy logic algorithms	AI-driven models improve craft classification but require expert validation.

7	Revathi et al.	2023	E-Commerce for Artisans in Web Application Using Communication and Growth Technology	To examine digital commerce for traditional crafts	E-commerce, artisans, AI, blockchain	Case study on digital marketing platforms	E-commerce expands market reach, but blockchain for authenticity is underutilized.
8	Lyu et al.	2024	From Handicraft to Cultural Heritage: Redefining the Role of Traditional Handicraft in Shanxi's Cultural Expression	To analyse how digital storytelling influences craft preservation	Handicrafts, digital storytelling, cultural heritage	Cultural analysis and case studies	Digital narratives enhance craft visibility, but cultural ownership concerns persist.
9	Liu et al.	2023	Digital Making for Inheritance and Enlivening Intangible Cultural Heritage: A Case of Hairy Monkey Handicrafts	To examine how digital modelling contributes to handicraft replication	3D modelling, handicrafts, cultural heritage, digital tools	Experimental study on 3D modelling and AI applications	3D modelling aids in craft replication but lacks artisan engagement.
10	Aounzou et al.	2024	A Blockchain of Things System for Managing Handcrafted Products in a Cultural Industry	To review how blockchain technology ensures IP protection for artisans	Blockchain, intellectual property, craft authentication	Systematic review of blockchain and provenance tracking	Blockchain enhances IP security, but adoption barriers remain.
11	Stefanidi et al.	2020	An Approach for the Visualization of Crafts and Machine Usage in Virtual Environments	To explore how immersive VR environments support craft preservation	Virtual reality, handicrafts, craft visualization	Experimental study on VR-based visualization	VR aids in preserving craft techniques but requires high-cost implementation.
12	Zabulis et al.	2022	Digitisation of Traditional Craft Processes	To evaluate digital solutions for craft documentation and sustainability	Digital documentation, craft processes, sustainability	Journal review and empirical study	Digital tools improve craft preservation but raise ethical concerns over commercialization.

Table 4 presents the final set of reviewed research papers from which the key themes of this study were derived. These papers form the basis for identifying five principal themes: strategies for documenting tacit knowledge, digital tools employed for the preservation of handicrafts, best practices in digital documentation, the influence of digitalisation on craftsmanship and innovation, and the challenges encountered in the digital transformation of crafts. Collectively, these themes offer a comprehensive analysis of how technologies such as AI, IoT, blockchain, and cloud storage contribute to the preservation and continuation of traditional craft knowledge.

Theme 1: Strategies for Documenting Tacit Knowledge

The documentation of tacit knowledge in traditional handicrafts necessitates effective solutions due to its inherently intuitive, experiential, and non-verbal characteristics, which complicate conventional documentation methods. Unlike explicit knowledge, which can be systematically recorded in databases, tacit knowledge is embedded within artisans' manual techniques, material manipulation, and creative intuition (Zhang & He, 2023).

Various digital tools and methodologies have been introduced to address these technical challenges, including high-definition video recording, AI-driven pattern recognition, motion capture technologies, and 3D modelling (Shiwen & Zahari, 2024). These digital innovations offer precise and sustainable means of preserving craftsmanship, ensuring that such knowledge remains accessible to future generations.

Video Documentation and Motion Capture Technologies

High-definition video recording has proven highly effective for documenting traditional craft techniques, particularly in capturing hand movements and tool-handling processes (Guo & Ahn, 2023). Many digital archives utilise this method to help artisans recreate techniques at risk of being lost. Motion capture technology further enhances documentation accuracy by precisely recording measurements of hand orientations, tool pressure, and movement patterns (Stefanidi et al., 2020). For instance, pottery wheel systems integrated with motion sensors can measure clay pressure, spinning speeds, and shaping techniques, creating precise digital records of traditional pottery practices (Hsu & Wu, 2020).

Artificial Intelligence (AI) in Craft Documentation

AI powered by machine learning algorithms has transformed documentation by enabling pattern analysis and the replication of traditional designs. These technologies allow artisans to preserve intricate motifs, analyse material choices, and reconstruct missing elements in historical artefacts (Zhang & He, 2023). However, the lack of cultural understanding and cognitive intuition in AI raises concerns about authenticity and creative freedom in traditional crafts (Lyu et al., 2024).

3D Modelling and Digital Craft Replication

Three-dimensional (3D) modelling has emerged as a vital digital approach for preserving intricate design processes and manufacturing techniques. Through the application of scanning technologies, artisans are able to safeguard their designs, reproduce them accurately, and refine their work prior to physical production (Liu et al., 2023). This method also enables researchers and designers to recreate historically accurate artefacts, including pottery, jewellery, and sculptures, thereby contributing to both preservation and innovation in traditional crafts.

Theme 2: Digital Tools for Handicraft Preservation

Digital technologies have significantly contributed to the preservation of handicrafts through the integration of IoT applications, blockchain authentication, and cloud storage systems (Noor et al., 2019). The synergy of IoT, cloud storage, and blockchain tools facilitates real-time monitoring, protection of knowledge assets, and traceability of origins, thereby ensuring the safeguarding of traditional techniques in the face of globalisation and the decline of apprenticeship models (Guo & Ahn, 2023). However, the success of these advanced systems is contingent upon the accessibility of technology, associated costs, and the active engagement of artisans (Lyu et al., 2024).

IoT-Enabled Smart Tools for Monitoring and Skill Preservation

IoT-based tracking tools offer real-time insights into artisans' hand movements, manufacturing materials, and operational tools (Ojha & Yammiyavar, 2019). In textile weaving, sensor-driven looms function as embedded sensors that monitor weaving patterns and fabric tension, enabling the storage of such data for future replication (Stefanidi et al., 2020). Moreover, IoT devices facilitate the analysis of metalworking and pottery processes by capturing data on shaping techniques, heat application, and pressure, thereby contributing to the preservation of rare traditional knowledge (Hsu & Wu, 2020). Nevertheless, the documentation potential of IoT is limited by high implementation costs, which hinder its broader adoption, particularly among rural and marginalised artisan communities (Revathi et al., 2023).

Cloud-Based Knowledge Repositories for Global Access

Cloud storage platforms facilitate the transition of craft knowledge into digital formats by offering centralised multimedia repositories that host video tutorials, 3D scans, and digital blueprints (Noor et al., 2019). UNESCO's Digital Heritage Platforms have successfully documented endangered crafts, enabling experts worldwide to access, study, and develop innovative approaches to traditional arts (Guo & Ahn, 2023). However, virtual repositories often remain inaccessible to artisans in remote regions due to limited internet connectivity and insufficient digital literacy (Zabulis et al., 2022). Furthermore, significant concerns persist regarding the security of craft knowledge and

the risk of cultural appropriation, as digitised traditional techniques may be exploited without appropriate financial compensation or recognition (Lyu et al., 2024).

Blockchain for Provenance Tracking and IP Protection

The secure, tamper-proof blockchain system facilitates the authentication and tracking of genuine crafts, offering protection for intellectual property and ensuring fair compensation for artisans (Aounzou et al., 2024). Organisations that implement decentralised ledger registration help safeguard both the origin of materials and trademarks, preventing counterfeiting and unauthorised replication (Zhang & He, 2023). Provenance remains a critical determinant of market value, particularly for heritage textiles, handcrafted jewellery, and ceramics (Lyu et al., 2024). Nonetheless, significant obstacles hinder blockchain adoption within traditional craft communities, primarily due to high implementation costs and the limited digital proficiency of artisans (Revathi et al., 2023).

Theme 3: Best Practices in Digital Documentation

The documentation of traditional handicraft knowledge has been substantially enhanced through the integration of AI, IoT, and cloud storage technologies. These modern technologies facilitate not only the documentation but also the preservation and dissemination of artisanal techniques, ensuring the retention of cultural significance while promoting economic sustainability (Guo & Ahn, 2023). The synergy of AI-driven analysis, IoT-enabled smart tools, and cloud-based repositories within digital documentation frameworks establishes a comprehensive system that enables future generations to preserve and access traditional craft knowledge effectively (Noor et al., 2019).

AI, IoT, and Cloud Storage for Craft Knowledge Management

Through AI technology, professionals can identify patterns, make predictions, and optimise materials, enabling artisans to adapt traditional techniques into modern styles with authenticity (Zhang & He, 2023). AI also restores old motifs and processes, helping artisans align ancient aesthetics with modern markets (Lyu et al., 2024). The IoT allows smart tools to monitor artisanal production by tracking movements, material usage, and tool pressure (Ojha & Yammiyavar, 2019). Smart looms and sensor-equipped pottery wheels create precise digital records to improve skill transfer and training (Hsu & Wu, 2020). Secure online storage holds design patterns, 3D models, and videos (Noor et al., 2019), while UNESCO Digital Heritage Initiatives document crafts for educational use (Lyu et al., 2024). However, internet access and digital skill gaps hinder rural artisans' participation (Zabulis et al., 2022).

Theme 4: Impact on Craftsmanship and Innovation

Traditional craftsmanship is transforming through digitalisation, connecting ancient

heritage skills with contemporary creative innovation (Zhang & He, 2023). Digital fabrication, virtual learning, and online craft communities enhance skill teaching and market expansion while fostering new creative potential (Guo & Ahn, 2023). However, maintaining a balance between technological advancement and cultural authenticity remains a challenge (Lyu et al., 2024).

Hybrid Craftsmanship Models: Merging Tradition with Digital Fabrication

Artisans adopt hybrid craftsmanship approaches that combine traditional manual work with AI-based tools, 3D printing, and digital prototyping systems (Aounzou et al., 2024). AI tools help artisans recognise patterns and analyse motifs, enabling the transformation of historical designs without losing cultural value (Zhang & He, 2023). Digital carving and 3D modelling enhance complex design production, improving efficiency while preserving authenticity (Lyu et al., 2024). Although digital fabrication allows for greater precision and large-scale production, some artisans argue it undermines the unique quality of handcrafted work (Revathi et al., 2023).

E-Learning Platforms and Virtual Apprenticeships for Skill Transmission

Traditional master-apprentice training has declined, making digital platforms vital for craft education (Guo & Ahn, 2023). Online courses, video tutorials, and VR-based apprenticeships enable global learners to access endangered craft techniques (Liu et al., 2023). Structured e-learning models on platforms like UNESCO Creative Cities and digital craft schools have proven effective in preserving and transmitting skills (Zabulis et al., 2022). However, limited digital literacy among rural artisans remains a significant barrier to accessing these technological resources (Noor et al., 2019).

Social Media and Online Craft Communities

Social media platforms like Instagram, YouTube, and Pinterest act as influential marketing and educational tools for artisans (Lyu et al., 2024). Through video tutorials, real-time demonstrations, and digital storytelling, artisans preserve creative freedom while engaging with global audiences (Zabulis et al., 2022). However, the online environment continues to encounter intellectual property challenges related to unauthorised content reproduction (Aounzou et al., 2024).

Balancing Digital Innovation and Cultural Authenticity

The digital tools that enhance innovation and accessibility must ensure that handcrafted authenticity is preserved (Zhang & He, 2023). Digital transformation compels artisans to combine technology with traditional techniques to maintain the cultural identity of their craftsmanship (Guo & Ahn, 2023).

Theme 5: Challenges and Future Directions

Modern digital documentation continues to encounter significant challenges, including

cultural appropriation, intellectual property issues, economic constraints, and technological barriers (Guo & Ahn, 2023). Industrial actors remain a major concern as they monetise traditional designs from indigenous communities without proper compensation or recognition (Aounzou et al., 2024; Lyu et al., 2024). In the absence of robust legal protections, artisans face heightened risks of intellectual property infringements, allowing mass production and theft of traditional designs (Zabulis et al., 2022). Additionally, the high cost and complex setup of blockchain technology hinder its widespread use as a provenance tracking tool (Revathi et al., 2023).

The expense of implementing AI, IoT, and cloud-based documentation systems creates further obstacles to their adoption (Noor et al., 2019). Artisans in rural regions often lack both the financial resources and digital skills necessary to engage with advanced technologies (Guo & Ahn, 2023). Moreover, many artisans fear that digital tools may undermine traditional craftsmanship, leading to diminished cultural authenticity and erosion of essential manufacturing skills. Addressing these challenges requires policymakers to promote blockchain authentication to enhance intellectual property protections, while also offering financial support to improve digital accessibility and tailored digital literacy programmes for artisans (Zabulis et al., 2022). Ensuring artisan involvement in decision-making processes is essential to guarantee that digital documentation empowers rather than exploits them (Guo & Ahn, 2023; Liu et al., 2023).

DISCUSSION

Research findings indicate that digital tools play a critical role in preserving and transmitting implicit knowledge of traditional handicrafts. Technologies such as AI, the IoT, cloud storage, and blockchain contribute to protecting artisanal knowledge through systematic documentation that enhances both accessibility and authentication (Guo & Ahn, 2023; Zhang & He, 2023). Nevertheless, traditional craft preservation continues to face persistent challenges, including intellectual property concerns, financial limitations, and artisans' hesitation due to fears of cultural erosion and over-commercialisation (Lyu et al., 2024; Zabulis et al., 2022). Therefore, technological solutions require careful integration to maintain authenticity while supporting preservation efforts, as these barriers highlight the complex relationship between technology and craftsmanship.

Strategies for Documenting Tacit Knowledge

The challenge of preserving experiential and non-verbal artisanal knowledge remains considerable, as such knowledge relies on intuitive understanding and sensory perception. Modern technological tools have transformed the craft documentation process by enabling precise pattern detection, real-time tracking, and photographic recording (Zabulis et al., 2022). AI-powered systems contribute significantly to motif analysis, fabrication technique explanation, and design reproduction, safeguarding

complex knowledge from being lost (Chai-Arayalert et al., 2023). Moreover, IoT-enabled monitoring and smart tools equipped with motion sensors allow artisans and trainees to accurately record hand movements and material interactions, thereby supporting remote learning opportunities. High-resolution video documentation has become a prevalent method, capturing the full sequence of craft production for archival and instructional purposes (Hanzel et al., 2024). In addition, 3D modelling and digital archiving have proven effective for replicating historical crafts, while offering artisans interactive design tools for market innovation. Nevertheless, digital solutions in craft production remain limited, as they cannot replicate the sensory experiences, intuitive creative processes, and tactile dimensions of skilled work (Akman & Sönmez, 2021). Thus, empirical training through hands-on practice remains irreplaceable, with digital documentation serving primarily to enhance accessibility rather than substitute traditional methods.

Challenges and Ethical Considerations in Digital Craft Preservation

Artisans face serious concerns regarding intellectual property (IP) protection and the risk of exploitative use of their traditional craft knowledge, despite the benefits offered by digitalisation. Once their designs are documented and shared online, they become vulnerable to unauthorised commercial use and cultural appropriation (Maymir-Ducharme & Angelelli, 2014). Indigenous and heritage crafts require particular care, as their ancient artistic elements should not be commercially reproduced without artisan consent. Blockchain technology offers potential solutions for provenance tracking and authenticity verification through tamper-proof digital records that support design registration and origin monitoring. However, blockchain adoption remains low in rural craft communities due to technical complexities and high costs, limiting its effectiveness in counterfeiting prevention. Protection systems for artisanal knowledge must become more accessible through simplified structures to ensure widespread adoption. Artisans in economically disadvantaged areas face significant barriers, including limited access to digital technologies, lack of technical skills, financial constraints, and inadequate infrastructure. Many artisans also view digitalisation as a threat to their traditional production processes and handcrafted authenticity (Arruda et al., 2024). Therefore, integrating technology requires educational initiatives, financial support, and ethical oversight to ensure digital tools enhance, rather than replace, traditional preservation practices.

FUTURE DIRECTIONS FOR SUSTAINABLE CRAFT DIGITIZATION

Digital craft documentation requires sustainable approaches that combine cultural protection, fair compensation, and inclusive technology access. Safeguarding artisans' intellectual property rights demands partnerships among government bodies, industry leaders, and craft organisations to develop supportive policies (Owens, 2023). Digital literacy and responsible technology integration training will empower artisans to

navigate digital preservation while staying faithful to traditional methods. When technological innovation aligns with cultural sensitivity, digital documentation becomes a tool that not only preserves heritage but also generates value for artisans and future creators.

CONCLUSION

The study explores how AI, IoT, cloud storage, and blockchain protect traditional handicraft tacit knowledge. Modern digital methods transform the recording and sharing of artisanal expertise, ensuring knowledge passes to future generations. AI, IoT, and cloud tools offer new ways to document and exchange skills, while blockchain secures intellectual property and tracks product authenticity. However, weak IP protections, financial limits, digital illiteracy, and poor access to technology hinder artisans, especially in rural areas. Mass production without ethical safeguards also threatens craft authenticity. Bridging traditional skills and technology needs institutional support and policies. Blockchain can secure IP, and government funding with targeted training can build digital skills. Ethical and sustainable digital practices can preserve heritage and create new economic opportunities. Future research should advance AI-driven apprenticeships, blockchain IP protection, and improved digital tools to balance technology with tradition.

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