

Towards Sustainable Heritage Craft Ecosystems: An Interactive Digital Framework for Raghurajpur

¹Darniya Roy, ²Dr.Sanjay Mohapatra, ³Dr.Goutam Saha

¹Assistant Professor, ²Domain Advisor and Professor, ³Associate Professor

¹Fashion Design Department,

¹National Institute of Fashion Technology, Kolkata, India

Abstract: In India, import taxes enacted after Independence significantly affected rural economies and traditional crafts. However, the Pattachitra artisans of Raghurajpur, Odisha, have maintained their culture, and the village was recognized by INTACH as a heritage village in 2000. Yet sustaining artisan livelihoods remains a growing concern. This paper proposes a new “Interactive Digital Framework (IDF)” that integrates digital technologies and AI-enabled interactivity into traditional craft practices to improve visibility, accessibility, market penetration, and cultural retention. This study adopted a mixed-methods research design to investigate the socio-economic conditions of artisans in Raghurajpur and to explore the potential of digitalization and AI to enhance sustainable livelihoods and cultural preservation. An exploratory qualitative and quantitative study was conducted to collect data from 20 artisans in Raghurajpur and 80 consumers in Bhubaneswar. Results suggest significant opportunities for digital initiatives to connect artisans and consumers with Pattachitra and increase its awareness. The proposed framework offers a sustainable model for craft revitalization and the protection of Raghurajpur’s intangible cultural heritage.

Index Terms - Co-creation, Digital Framework, Interactive, Raghurajpur, Sustainability

I. INTRODUCTION

Interaction and participation are central to co-creating meaning, especially in traditional crafts, where artisan-consumer engagement sustains practices (Ascott, 1997). Interactivity underpins marketing and forges stronger company-customer connections (Liu & Shrum, 2002). The evolution of crafts hinges on the interplay of heritage and creativity (Manzini, 2015; Kofler & Walder, 2024). AI and digital technology are projected to drive the creative industry, contributing up to 14% of global GDP by 2030 (PwC, 2017), and are increasingly important for cultural preservation and sustainable development (Magistretti et al., 2019).

This research examines the socioeconomic and marketing challenges Raghurajpur artisans of Odisha face in securing sustainable income. It introduces the Interactive Digital Framework (IDF), which integrates digital tools, AI-mediated interactivity, and human-centric methods with craft traditions to nurture culture, foster community, and improve livelihoods. Digital engagement enables participation, collaboration, co-creation, online storytelling, and artisan-consumer bonds (Throsby, 2021). Digital solutions will help Raghurajpur artisans market their products and reach buyers. Unlike previous digital initiatives focused on documentation or tourism, the Interactive Digital Framework (IDF) emphasizes participation and AI-powered engagement for real-time interaction, co-creation, product customization, and heritage storytelling. It integrates Interactivity Theory, Co-creation Theory, and the Sustainable Livelihood Framework into a unified model for preservation, engagement, innovation, and accountability (Liu & Shrum, 2002; Prahalad & Ramaswamy, 2004; DFID, 1999). Ultimately, digital and AI-enabled co-creation can strengthen artist-consumer bonds, preserve heritage, expand markets, and improve livelihoods for Raghurajpur artisans.

II. LITERATURE REVIEW

Raghurajpur, a heritage crafts village in Puri, Odisha, is renowned for Pattachitra painting, palm-leaf engraving, wood and stone carving, Tussar silk painting, and eco-friendly papier-mâché and cow-dung crafts (Kanungo et al., 2020). Rooted in Hindu mythology and the Jagannath tradition, Pattachitra originated around the twelfth century and remains associated with rituals such as Anasara Patti and Debasnan Purnima (Pathy, 1990; Kanungo et al., 2020). Its design practices integrate cultural heritage with sustainability, community participation, and indigenous craftsmanship by using natural pigments, handmade brushes, and locally sourced materials, thereby supporting both environmental conservation and the local economy. These eco-friendly practices contribute to cultural resilience and sustainable rural development. (Kanungo et al., 2020).

However, limited public awareness and the relative isolation of artisan communities continue to threaten both the economic sustainability of craft guilds and the preservation of this cultural heritage (Kolay, 2016). Due to the inability to match the demands of the current world with those of the past, many crafts are struggling to continue their traditional methods, but they never get the recognition they deserve and face the critical challenge of unsustainable livelihoods. (Dasgupta and Chandra 2016, Das 1982). The essential needs of local communities, such as infrastructure, employment opportunities, and a satisfactory standard of living, continue to go unmet for artisans (INTACH Report, 2000). This ought to serve as a reminder that maintaining the craft requires a clearly defined digital framework. Our cultural legacy can be revitalized, and rural India's craft guilds can be connected to the wider populace through intelligent technological intervention. (Kolay, 2015). The following sections provide a concise review of traditional and contemporary approaches to selling crafts, as well as the challenges faced by the artisans of Raghurajpur.

2.1 Raghurajpur as an Open-air museum: Traditional approach to craft sales

Raghurajpur functions as a living open-air museum, with homes serving as workshops, galleries, and retail spaces. Artisans create, display, and sell crafts directly to visitors, allowing them to witness the production process and engage through demonstrations and workshops. This experiential marketplace integrates production, storytelling, tourism, and commerce, enhancing the cultural value of Pattachitra while supporting household livelihoods (INTACH, 2000). Knowledge is transmitted through family-based apprenticeships, preserving traditional techniques, iconography, and Jagannath-related ritual symbolism across generations (Dasgupta & Chandra, 2016; Das, 2013). At the same time, artisans diversify their products and adopt sustainable packaging and tourism-oriented experiences to meet evolving consumer preferences while maintaining cultural authenticity (Kanungo et al., 2020).



Fig. 1. Making of Pattachitra Painting and Palm Leaf Engraving
Source: Author's fieldwork (2017)



Fig. 2. Pattachitra Painting, Tale of Radha-Krishna,
Artist: Shri.Bamadeb Das
Source: Author's field-work (2017)

2.2 Raghurajpur as a Digital platform: Contemporary approach to craft sales

Traditionally, Pattachitra paintings were produced on hand-prepared cloth (patta) using pigments derived from minerals, plants, lampblack, and conch shells. However, increasing commercialization and tourism have encouraged many artisans to adopt synthetic pigments, acrylic colours, and machine-prepared painting surfaces to reduce production time and meet market demand, raising concerns regarding the preservation of the craft's traditional material practices and ritual authenticity (Mohapatra, 1989; Mohanty, 2007; Coccari, 2010). Pattachitra artisans have increasingly adopted digital platforms, including Instagram, Etsy, and craft-based e-commerce portals such as Gaatha, to access national and international markets and diversify their product offerings. Contemporary studios and design initiatives have also reinterpreted traditional Pattachitra motifs for home décor, fashion, stationery, and lifestyle products, expanding the craft's commercial appeal. While digital marketing has created new income-generating opportunities, artisans continue to face challenges stemming from dependence on intermediaries, limited bargaining power, and unequal access to markets (Kanungo et al., 2021). Furthermore, inadequate digital literacy, limited infrastructure, and uneven adoption of digital technologies continue to constrain the full benefits of digital transformation despite Raghurajpur's recognition as India's Best Tourism Village in 2023 (Kanungo et al., 2021; Ministry of Tourism, 2023).

2.3 Socio-Economic Challenges

Raghurajpur's Pattachitra artisans face ongoing socioeconomic challenges: unstable incomes, poor infrastructure, and limited market access (INTACH, 2000; UNESCO, 2022; Kofler & Walder, 2024). These issues are exacerbated by shifting consumer preferences, competition from mass-produced goods, and reliance on seasonal tourism (Kanungo et al., 2020, pp. 114-135). The COVID-19 pandemic further disrupted artisan-consumer relations (Kolay, 2015, 2016; British Council, 2021; He & Wen, 2024). Persistent barriers include weak digital connectivity, limited welfare, intellectual property problems, and under-recognition of women artisans (Handique, 2010; Dash, 2011, 2016; Bendi & Pany, 2017; WIPO, 2023). Digital skill development and innovation are crucial for sustaining Pattachitra's heritage (Mishra & Pattanaik, 2024). Despite using sustainable materials, industrialization, globalization, and digital consumerism threaten the craft's competitiveness and authenticity (Hespanhol, 2023; He & Wen, 2024; Li et al., 2024; Buragohain et al., 2024). Intermediaries, monetary restrictions, and urban migration erode resilience, while cheap machine-made products challenge authenticity (Mehra et al., 2019; Dash, 2011). AI-enabled platforms, digital storytelling, and co-creation are recommended for improved access and sustainability (Jia et al., 2023; He & Wen, 2024; Qin & Zahari, 2024; Shi et al., 2026). Integrating economic viability, cultural conservation, inclusion, and innovation is vital for Pattachitra's future (Mourato & Mazzanti, 2002).

2.4 AI and Raghurajpur's heritage crafts

Artificial Intelligence (AI) is turning digital platforms into intelligent, interactive environments that foster self-presentation, community dialogue, and co-creation. AI tools, such as recommendation engines and conversational agents contribute to customization, cooperative design, and immersive experiences to support innovation and trust (Hollebeek et al., 2024; Suraña-Sánchez & Aramendia-Muneta, 2024; Jain et al., 2024). AI does not replace artisans; rather, it assists their creativity by preserving cultural knowledge and supporting collaborative design (Gierl et al., 2024; Vats & Bhattacharjee, 2026). Research on Raghurajpur

has been devoted significantly to the preservation of heritage, tourism, and livelihoods, but has hardly addressed AI-enabled digital transformation. The gap highlights the necessity for an AI-enabled Interactive Digital Framework (IDF) that features AI-supported digital storytelling, AI-augmented customization, and participatory artisan-consumer interaction to drive sustainable livelihoods and preserve cultural heritage.

2.5 Theoretical Foundation

This study is grounded in Interactivity Theory (Liu & Shrum, 2002), Co-creation Theory (Prahalad & Ramaswamy, 2004), and the Sustainable Livelihood Framework (DFID, 1999), which together underpin the proposed Interactive Digital Framework (IDF). Interactivity Theory explains how active user control, two-way communication, and responsiveness foster meaningful engagement between artisans and consumers on AI-enabled digital platforms. Accordingly, the IDF incorporates constructs such as real-time communication, digital storytelling, personalization, customization, virtual interaction, and immersive experiences to strengthen consumer engagement, trust, and appreciation of cultural heritage. Co-creation Theory positions consumers as active collaborators rather than passive buyers, informing the integration of AI-assisted co-creation, collaborative design, feedback mechanisms, customization, and shared value creation. These processes encourage innovation while preserving the cultural authenticity of traditional crafts. The Sustainable Livelihood Framework provides the socio-economic foundation by linking digital innovation to improved market access, income diversification, digital capability, entrepreneurship, community empowerment, and cultural preservation, thereby supporting resilient and sustainable artisan livelihoods. In a nutshell, Interactivity Theory explains the mechanisms of engagement, Co-creation Theory explains the value-creation processes that emerge from engagement, and the Sustainable Livelihood Framework explains the social, cultural, and economic outcomes of those processes. Drawing on these theoretical perspectives, the IDF addresses the interconnected economic, technological, market, and socio-cultural challenges faced by Pattachitra artisans in Raghurajpur. By integrating AI-enabled interactivity, collaborative value creation, and livelihood-oriented digital strategies, the framework provides a holistic approach to enhancing cultural preservation, market participation, community resilience, and the long-term sustainability of heritage crafts.

2.6 Research Gap and Objectives

Although previous studies have examined the socioeconomic and market-related challenges faced by Raghurajpur artisans, these issues have largely been studied in isolation, with limited attention to their inter-relationships or the integrated role of digital technologies in strengthening sustainable livelihoods. Consequently, a comprehensive Interactive Digital Framework (IDF) for the sustainability of heritage crafts remains underdeveloped. This study proposes an IDF that integrates technological, economic, socio-cultural, and market dimensions to promote cultural preservation and sustainable livelihoods among Raghurajpur Pattachitra artisans. It addresses the research question: How can such an integrated framework be designed?

III. METHODOLOGY

3.1 Research Design

This study adopted a mixed-methods design to examine the socio-economic conditions of Raghurajpur artisans and explore how digitalization and AI can support sustainable livelihoods and cultural preservation. A comprehensive literature review and pilot study were conducted to assess the current status of the craft ecosystem and identify factors contributing to livelihood unsustainability. These findings informed the research instruments and thematic focus. As an exploratory study, the aim was not statistical generalization but rather the development of a conceptual framework grounded in the perspectives of artisans and consumers. The literature review included peer-reviewed journals, books, conference proceedings, websites, and online publications on Raghurajpur's crafts, heritage, livelihoods, and digitalization. Previous research highlighted low public awareness, market isolation, declining tourism, artisan migration, and tensions between authenticity and market-driven innovation (Kolay, 2016; Becker, 2020; Dash, 2011). Together with pilot findings, these informed six key discussion themes guiding the study.

3.2 Sample and Participants

The study involved two participant groups: artisans and consumers. In the qualitative phase, 20 artisans from Raghurajpur, aged 14-60 years and including both men (15) and women (5), participated in semi-structured interviews. Participants represented diverse age groups, experience levels, and involvement in traditional crafts. The smaller number of women reflected their greater engagement in household responsibilities. In the quantitative phase, 80 educated, financially stable consumers with monthly incomes above INR 20,000 completed an online survey. Respondents from Bhubaneswar were selected through simple random sampling due to the city's higher purchasing power and greater exposure to handicrafts, thereby ensuring relevant consumer insights.

3.3 Data collection

Data collection was conducted in two phases. First, semi-structured interviews with artisans explored their livelihoods, production processes, tools, procurement practices, market access, consumer understanding, aspirations, livelihood challenges, and perceptions of digital technologies and emerging market opportunities. Second, an online questionnaire was administered to consumers to assess awareness of Raghurajpur crafts, purchasing behavior, pricing perceptions, preferred purchasing channels, willingness to buy directly from artisans, interest in customized products, and demographic characteristics. The survey aimed to understand consumer attitudes toward traditional crafts and identify opportunities to strengthen artisan-consumer engagement through digital platforms.

3.4 Data Analysis

Qualitative interview data were analyzed using thematic analysis. Interview transcripts were systematically reviewed to identify recurring patterns, themes, and relationships related to artisan livelihoods, market challenges, cultural preservation, and digital engagement. The six discussion themes identified through the literature review and pilot study served as the initial analytical

framework and were refined through iterative coding and thematic interpretation. Quantitative survey data were analyzed using descriptive statistics to examine consumer awareness, purchasing preferences, and attitudes toward traditional crafts. Findings from both phases were triangulated to provide a comprehensive understanding of the challenges and opportunities within the Raghurajpur craft ecosystem.

IV. RESULTS AND DISCUSSIONS

4.1 Findings from Artisan Interviews

Qualitative data from field visits, interviews, participant observation, and field notes were analyzed using Braun and Clarke's (2006) thematic analysis. Transcripts and notes were reviewed for familiarity, and initial codes were derived from recurring patterns in artisans' narratives. Similar codes were grouped into broader themes that captured socioeconomic, cultural, and marketing challenges, including seasonal sales, reliance on intermediaries, limited computer literacy, and restricted market access. These themes were then interpreted through the study's theoretical framework to guide the development of the Interactive Digital Framework (IDF).

4.1.1 Awareness of crafts among Consumers

Consumer awareness of crafts was an important theme affecting the sustainability of Pattachitra in Raghurajpur. According to the results, most artisans believed consumers knew little about the cultural significance, authenticity, and craftsmanship of handmade Pattachitra paintings. This ignorance, according to participants, only adds to the trend towards cheap printed imitations, thereby decreasing demand for authentic pieces and threatening artisans' way of life.

Bamdeb Das, a male artist and State Awardee, said, *"Many people admire the paintings when they visit, but outside Raghurajpur, very few understand what Pattachitra is or how much effort and craftsmanship are needed to make it. People often buy printed pattachitra because they don't know the difference between handmade and machine-made work. Also, the price of printed pattachitra is lower than that of hand-drawn pattachitra, thereby diminishing the craft's originality"*.

Table 1: Awareness of crafts among consumers

Do you think customers are unaware of the authenticity and cultural significance of Pattachitra paintings, leading them to purchase printed imitations instead of handmade artworks? Do you feel that not receiving a fair price for your work reduces your motivation to continue practicing the craft?		
TRANSCRIPTS	CODE/SUB THEMES	FREQUENCIES (n = 20)
<i>"Many people admire the paintings when they visit, but outside Odisha, very few understand what Pattachitra is"</i>	Limited public awareness	18
<i>"Pattachitra paintings are expensive as it takes lot of time, but customers don't want to pay the actual price."</i>	Low Pricing vs. Effort	16
<i>"Most buyers want cheaper work. They often tell me, 'Why should I pay 1500 when I can get something cheaper elsewhere?'"</i>	Preference for low-cost alternatives	17
<i>"People prefer machine-made items because they are cheaper."</i>	Competition from low-cost imitations	15

Analysis: Customers often prioritize price over the cultural and artistic value of Pattachitra. These perceptions incentivize the sale of printed copies and reduce the need for authentic handmade objects. The result is that craftspeople earn little in the way of money even though so much time and skill is expended for production. Dash (2011) and Kolay (2016) also report similar observations, noting that a lack of consumer awareness of traditional crafts results in declining market competitiveness. The consumer survey further revealed that 82% of respondents were interested in learning about artisans and the stories behind Pattachitra. 83% of respondents indicated willingness to participate in awareness-building initiatives that promote traditional crafts and sustainable artisan practices. These findings suggest that digital storytelling can enhance consumer awareness of authentic crafts, strengthen appreciation for traditional craftsmanship, and encourage informed purchasing decisions that support artisan livelihoods.

Implications: Based on the findings, campaigns to raise awareness of the craft, AI-enabled storytelling, authenticity certification, and interactive digital platforms can improve consumer awareness, increase willingness to pay for authentic products, and increase the likelihood of sustaining artisan livelihoods.

4.1.2 Seclusion from the Masses

Isolation from broader society constitutes a substantial barrier to the livelihoods of Raghurajpur artisans. Although the village is internationally recognized for its cultural heritage, participants reported that geographical remoteness and reduced tourist inflow have limited opportunities for direct customer engagement and sales. Additionally, artisans observed that dependence on tourism and restricted access to wider markets have increased economic vulnerability and impeded the growth of the traditional craft sector.

Progya Paromita Das, a female artist, said, *"Earlier, many tourists came to our village. Now, most of them go straight to Puri and don't stop here due to a lack of awareness and the highway bypass effect. If customers don't come to us, how will we reach the customers?"*

Table 2: Seclusion from the Masses

How has the number of tourist visits to Raghurajpur changed over the years, and how has this affected your sales?		
TRANSCRIPTS	CODE / SUB THEMES	FREQUENCIES (n = 20)
"Earlier, many tourists used to visit the village; now, the number has reduced, and our sales have gone down significantly."	Declining Tourism and Livelihood Insecurity	17
"We mostly depend on tourists for selling our paintings"	Dependence on Tourism and limited customer base	16
"After COVID-19, tourist visits dropped sharply. Even though visitors have started coming again, business is still not like it was before."	Post-Pandemic Livelihood Recovery	18
"Most of our income depends on people visiting Raghurajpur. If tourists do not come, we have very few opportunities to sell our work"	Livelihood Vulnerability due to Tourism Dependence	18

Analysis: The findings indicate that geographical isolation and dependence on tourism limit market access and make artisan livelihoods vulnerable to external disruptions such as COVID-19. The lack of direct contact with consumers has limited sales opportunities and increased dependence on seasonal demand, thus underscoring the need for alternative marketing channels that enable artisans to reach broader domestic and international markets. These results support earlier studies highlighting tourism decline and market isolation as key challenges (Kolay, 2016; Dash, 2011; Becker, 2020). Consumer survey findings further revealed that 98.9% of respondents expressed interest in interacting directly with artisans to customize products and buy directly from artisans through online platforms, demonstrating the potential of digital channels to overcome spatial barriers.

Implications: AI-enabled digital platforms, virtual exhibitions, digital storytelling, and direct artisan-consumer engagement can expand market access, strengthen livelihood resilience, reduce dependence on tourism, and sustain Raghurajpur's cultural heritage.

4.1.3 Job Relocation and Migration

Job relocation and migration emerged as a major challenge to the continuity of Pattachitra in Raghurajpur. Although younger generations value their cultural heritage, financial insecurity and unstable incomes encourage them to seek employment in government or private sectors, reducing participation in traditional crafts and threatening the intergenerational transmission of knowledge and skills

Bapuji Maharana, State Awardee: "Young people want government jobs or private jobs because craft work cannot guarantee a stable income. My son is a painter, but he prefers to work in Bhubaneswar. Earlier, every family wanted their children to become artisans. Now, many parents themselves encourage their children to study and find better-paying jobs."

Table 3: Job Relocation and Migration

Do you think the younger generation is interested in continuing the Pattachitra craft tradition? Why or why not? Why do you think many young people prefer urban jobs over practicing traditional crafts?		
TRANSCRIPTS	CODE / SUB THEMES	FREQUENCIES (n = 20)
"Very few young people want to continue this work. They have seen how hard we work and how little we earn, so they prefer other careers."	Declining Youth Participation in Traditional Crafts	15
"Some children learn painting when they are young, but after completing their studies, most of them look for jobs in cities because they want a more secure future".	Occupational Shift from Traditional Crafts	16
"Our children respect the tradition, but they don't see it as a reliable livelihood. They want stable jobs with a regular monthly income".	Preference for Stable Employment	19
"If the craft provided a good income throughout the year, more young people would continue it."	Livelihood Security and Intergenerational Continuity	15

Analysis: The findings indicate that youth migration is driven primarily by economic insecurity rather than declining cultural identity. Although younger generations value Pattachitra, they perceive craft-based livelihoods as financially unstable, threatening intergenerational knowledge transfer. These findings align with earlier studies highlighting low incomes, limited market access, and urban migration as major challenges to traditional crafts (Dash, 2011; Kolay, 2016; Becker, 2020). Consumer survey results showed 93.7 % of respondents preferred authentic handmade products over machine-made alternatives. This creates a new avenue for younger generation of artisans to interact and make new crafts and hence there will be a stable employment.

Implications: AI-enabled digital platforms, direct marketing, product customization, and digital storytelling can improve livelihood security, reduce youth migration, and strengthen the long-term sustainability of Pattachitra heritage.

4.1.4 Quality compromise and Cultural authenticity

Quality compromise and cultural authenticity emerged as an important theme in understanding the sustainability of Pattachitra. Artisans reported increasing pressure to adopt synthetic colors, printed designs, and faster production methods to meet shifting consumer preferences and market competition. While these adaptations improve commercial viability, participants expressed concern that they may gradually erode Pattachitra's originality, cultural identity, and traditional craftsmanship.

Bharat Maharana, a male artist, said, *"Natural colors take time, but customers often choose cheaper products made with synthetic colors. Some artisans print Pattachitra designs through machines. It sells quickly, but it is not our tradition."*

Table 4: Quality compromise and Cultural authenticity

Do you feel pressure to use synthetic colors or modern production methods to remain competitive in the market? Do you feel pressure to use synthetic colors or modern production methods to remain competitive in the market?		
TRANSCRIPTS	CODE / SUB THEMES	FREQUENCIES (n = 20)
<i>"Some customers want brighter colors and cheaper paintings, so I use synthetic colors to finish the work faster. I still prefer natural colors because they are part of our tradition."</i>	Pressure to Use Synthetic Colors	16
<i>"Our identity lies in handmade work and natural colours. If we completely shift to modern methods, Pattachitra will lose its authenticity."</i>	Concern over Loss of Authenticity	18
<i>"Customers often compare our paintings with cheaper printed versions. To stay competitive, sometimes I use synthetic colors but that affects the originality of Pattachitra."</i>	Market Pressure to Compromise Authenticity	14
<i>"If customers appreciated authentic Pattachitra and paid fair prices, there would be no need to compromise by using synthetic colors or modern shortcuts."</i>	Fair Pricing for Authentic Craftsmanship	19

Analysis: The findings indicate a persistent tension between economic survival and cultural preservation. Although artisans recognize the need to respond to market demands, they remain concerned that using synthetic materials and modern production techniques that compromises the authenticity and heritage value of Pattachitra. The results suggest that fair pricing and greater consumer appreciation for handmade craftsmanship are essential to preserving traditional production practices. These findings are consistent with previous research highlighting that commercialization, globalization, and consumer demand for inexpensive products increasingly challenge the authenticity of traditional crafts (Dash, 2011; Hespanhol, 2023; He & Wen, 2024; Li et al., 2024). Earlier studies similarly emphasize that balancing market competitiveness with cultural preservation is critical for the long-term sustainability of heritage crafts. Consumer survey findings further revealed 95% preferred knowing the effort and craftsmanship involved that would make them pay a fair price. These findings indicate that informed consumers are more likely to value authenticity and support sustainable craft practices through direct engagement with artisans and pay fair price.

Implications: The findings underscore the need to balance market competitiveness with cultural authenticity. AI-enabled digital storytelling, authenticity certification, consumer education, and direct artisan–consumer interaction can increase appreciation for handmade Pattachitra, encourage fair pricing, and reduce the pressure to compromise traditional materials and production techniques, thereby supporting the long-term preservation of cultural heritage.

4.1.5 Piece-rate Earnings and Financial Constraints

Financial insecurity emerged as a major challenge for Pattachitra artisans' livelihoods. Participants reported unstable incomes, seasonal fluctuations in demand, and dependence on intermediaries who often set product prices. These factors limited earning potential and made it difficult for artisans to sustain their households, underscoring the need for improved market access and diversified income opportunities.

Abakash Nayak, a male artist, said, *"Sometimes we earn well during festivals, but for many months there is almost no income. Middlemen take most of the profit while artisans receive very little. If we refuse the price offered by middlemen, our paintings remain unsold. So, we accept whatever they pay. If customers could contact us directly, they would understand the effort that goes into each painting and be willing to pay a fair price"*.

Table 5: Piece-rate earnings and Financial constraints

Do you think the income you earn from Pattachitra is sufficient to support your household? How do intermediaries or middlemen influence the price you receive for your artwork? Do you think direct access to customers through digital platforms could improve your income?		
TRANSCRIPTS	CODE / SUB THEMES	FREQUENCIES (n = 20)

"No, the income is not enough to support my family throughout the year. We earn well only during festivals and tourist seasons, but the rest of the year it becomes difficult to manage household expenses."	Seasonal Income Instability	19
"Middlemen buy our paintings at a very low price and sell them for much more. We do all the work, but they earn the larger share of the profit."	Dependence on Intermediaries and Unfair Pricing and Profit Distribution	18
"We often have no choice but to sell through middlemen because they have better access to customers and markets."	Limited Market Access and Intermediary Dependence	17
"Digital platforms could help us reach customers from different cities and even other countries. That would increase our sales."	Digital Market Access and Direct Artisan-Consumer Engagement	19

Analysis: The findings indicate that financial insecurity arises from seasonal demand, unequal profit distribution, and limited direct access to consumers. Dependence on intermediaries reduces artisans' bargaining power and financial returns despite their craftsmanship. Participants perceived digital platforms as a means of connecting directly with customers, improving income stability, reducing reliance on intermediaries, and creating more sustainable livelihood opportunities. These findings support previous studies identifying low and irregular incomes, intermediary dependence, and limited market access as major barriers to artisan livelihoods (Dash, 2011; Kanungo et al., 2020; Mehra et al., 2019). Earlier research also suggests that digital technologies and direct-to-consumer marketing can strengthen financial resilience by expanding market reach and improving artisans' share of product value. Consumer surveys found that 91% of respondents were strongly willing to buy directly from artisans rather than through intermediaries. Consumers also expressed interest in product customization and interaction with artisans, highlighting the potential of digital platforms to improve market access and enhance artisans' incomes.

Implications: The findings highlight the importance of reducing dependence on intermediaries through AI-enabled digital marketplaces, direct artisan-consumer engagement, and digital storytelling. Expanding online market access, product customization, and transparent pricing mechanisms can improve income stability, strengthen financial resilience, and contribute to the long-term sustainability of Pattachitra artisan livelihoods.

4.1.6 Awareness of Market Trends

Awareness of market trends emerged as an important factor influencing the sustainability of Pattachitra livelihoods. While some artisans adapted their products to changing consumer preferences, many reported limited knowledge of market trends and inadequate digital skills. These challenges restricted their ability to promote products online, understand evolving customer demands, and respond effectively to changing market conditions.

Sipun Das : "We know customers like modern designs, but we don't know how to promote them online. Young artisans use social media, but many senior artisans don't know how."

Table 6: Awareness of Market trends

Do you think customer preferences for Pattachitra products have changed over the years? How do you learn about changing customer preferences and market trends? Have you modified your designs, products, or techniques to meet changing customer demands? What challenges do you face in understanding what customers want today?		
TRANSCRIPTS	CODE / SUB THEMES	FREQUENCIES (n = 20)
"Yes, customers today look for products that are useful in everyday life. Earlier, they mostly bought traditional paintings, but now they also ask for painted bottles, bookmarks, trays, and home décor items."	Changing Consumer Preferences	14
"Yes, we now paint on products like coconut shells, wooden boxes, bottles, and coasters because customers want something different from traditional scroll paintings.""	Adaptation to Changing Consumer Preferences	16
We don't have much information about market trends. We mostly rely on our experience and buyer feedback".	Lack of information on market trends	18
"Many of us don't know how to use social media or online marketplaces, so it is difficult to understand changing market trends."	Limited Digital Literacy and Market Awareness	19

Analysis: The findings indicate that although artisans recognize changing consumer preferences, limited digital literacy and access to market information constrain their ability to capitalize on emerging opportunities. Product diversification demonstrates artisans' willingness to innovate, but inadequate digital capabilities hinder effective online promotion and market engagement. Strengthening digital skills and market intelligence is therefore essential for improving competitiveness and sustaining traditional crafts. These findings are consistent with previous studies identifying limited digital literacy, inadequate market information, and restricted online

engagement as significant barriers to artisan sustainability (Kanungo et al., 2020; Mishra & Pattanaik, 2024; He & Wen, 2024). Earlier research similarly emphasizes that digital capacity building and market intelligence are essential for enhancing competitiveness, expanding market access, and supporting sustainable craft livelihoods. Consumer survey results showed that 88 % respondents would like to interact with artisans through live video sessions while they create Pattachitra artworks. These findings indicate that consumers value innovation alongside authenticity, highlighting opportunities for artisans to respond to changing market demands through digital platforms.

Implications: The findings highlight the need for digital literacy training, AI-enabled market intelligence, and interactive digital platforms to help artisans understand evolving consumer preferences and promote their products effectively. Strengthening these capabilities can support product innovation, expand market opportunities, improve artisan-consumer engagement, and enhance the long-term sustainability of Pattachitra.

According to our findings, the artisans understand the latest consumer trends but their general lack of digital literacy and market understanding also impede their accessibility to the modern marketplace. These six themes collectively demonstrate that Raghurajpur artisans face challenges that are inseparable. Public ignorance, geographic isolation, economic insecurity, lack of digital skills, youth migration, and doubts about cultural authenticity together constrain market entry and threaten the retention of traditional knowledge. Our results provide an empirical basis for the proposed Interactive Digital Framework (IDF) that the study aims to achieve: AI-enabled interactivity, digital storytelling, consumer co-creation, improved market access, and sustainable livelihood strategies, while promoting cultural heritage preservation and artisan resilience.

4.2 Consumer Survey Findings

The consumer survey was administered via Google Forms to 80 educated consumers with monthly incomes exceeding INR 20,000, representing financially stable individuals from urban and semi-urban areas. Respondents from Bhubaneswar were selected through simple random sampling because of the city's higher purchasing power and greater exposure to handicrafts, ensuring relevant consumer insights. Respondents showed a strong preference for handmade, culturally authentic, and interactive craft experiences.

Approximately 93.7% expressed a willingness to shift their purchasing preferences from machine-made to handmade products, reflecting growing consumer appreciation for artisanal craftsmanship and sustainable consumption. Furthermore, 82% wished to learn more about the artisans, their cultural heritage, and sustainable lifestyle practices, while only 10% considered such information to be of limited importance. The findings also indicated that 95% of respondents felt that greater awareness of the effort and craftsmanship behind Pattachitra would encourage them to pay a fair price for authentic handmade products. These findings suggest that consumers increasingly value transparency, authenticity, and the cultural narratives embedded within handcrafted products. 91% of respondents were strongly willing to buy directly from artisans rather than through intermediaries and to pay fair prices for authentic handmade products. A notable finding was the strong demand for participatory consumption experiences. Nearly 98.9% of respondents expressed interest in interacting directly with artisans to customize products, highlighting consumers' preference for personalized and collaborative design experiences that extend beyond conventional retail transactions. Another finding is 88 % respondents would like to interact with artisans through live video sessions while they create Pattachitra artworks. In addition, 83% indicated willingness to participate in awareness-building initiatives that promote traditional crafts and sustainable artisan practices. Collectively, these findings demonstrate substantial consumer support for digitally enabled platforms that facilitate direct artisan-consumer engagement, cultural storytelling, and heritage promotion.

These empirical findings, together with insights from the qualitative interviews, informed the development of the proposed Interactive Digital Framework (IDF). Rather than being purely conceptual, the framework was systematically derived from the convergence of the literature review and empirical evidence. Consumer demand for direct interaction and product customization informed the integration of conversational AI and AI-assisted customization, enabling real-time communication and collaborative product design while preserving artisans' creative autonomy. Similarly, consumers' interest in understanding the cultural significance of Pattachitra motivated the inclusion of AI-powered multilingual chatbots and AI-assisted storytelling to communicate the history, symbolism, production processes, and sustainable practices associated with the craft.

The qualitative findings further reinforced these design decisions by identifying limited public awareness, geographical isolation, financial insecurity, dependence on intermediaries, inadequate market intelligence, and concerns regarding cultural authenticity as major barriers to sustainable livelihoods. In response, the framework incorporates AI-powered recommendation systems to improve the visibility of authentic Pattachitra products, AI-driven analytics to provide artisans with insights into consumer behavior and emerging market trends, and computer vision-based image recognition to distinguish genuine handcrafted artworks from machine-produced imitations. Virtual exhibitions and digital heritage platforms further extend public engagement beyond the physical boundaries of Raghurajpur, creating opportunities for cultural dissemination and broader market access.

Grounded in Interactivity Theory, Co-creation Theory, and the Sustainable Livelihood Framework, the proposed Interactive Digital Framework is therefore an evidence-driven model in which each technological component directly addresses the socio-economic and marketing challenges identified through the empirical investigation. By integrating digital technologies with artisan-led knowledge and cultural heritage, the framework seeks to strengthen market access, foster meaningful interactions between artisans and consumers, preserve cultural authenticity, and support the long-term sustainability of Raghurajpur's craft ecosystem.

V. PROPOSED INTERACTIVE DIGITAL FRAMEWORK

5.1 Development of the Interactive Digital Framework (IDF)

The proposed Interactive Digital Framework (IDF) was developed through an iterative synthesis of the literature review and empirical findings from artisan interviews and consumer survey data. Rather than being conceived as a purely conceptual model,

each component of the framework emerged from the convergence of theoretical insights and the challenges identified in the empirical investigation. The literature established that interactivity, digital storytelling, AI-enabled personalization, and co-creation enhance consumer engagement, cultural appreciation, and market participation (Liu & Shrum, 2002; Prahalad & Ramaswamy, 2004; Throsby, 2021; Jia et al., 2023; Capece et al., 2024). Concurrently, interviews with Raghurajpur artisans revealed limited public awareness, geographical isolation, financial insecurity, inadequate digital capabilities, concerns about cultural authenticity, and declining participation among younger generations.

The consumer survey further demonstrated a strong preference for direct interaction with artisans, product customization, authentic cultural narratives, and greater awareness of traditional crafts. Accordingly, the IDF integrates AI-enabled interactivity, digital storytelling, co-creation, customization, market intelligence, and digital marketing, as these elements directly address the needs identified in the empirical findings while reflecting the theoretical principles established in the literature. The framework therefore represents an evidence-based synthesis linking technological capabilities to cultural preservation, consumer engagement, and sustainable livelihood outcomes.

The components of the IDF were not selected independently by the authors but were systematically derived from the convergence of theoretical evidence and empirical findings. The literature review identified the technological and theoretical mechanisms that support interactive heritage marketing, while the interviews and consumer survey identified the practical challenges and expectations within the Raghurajpur context. Consequently, every construct included in the framework directly addresses one or more empirically identified problems while remaining theoretically grounded in Interactivity Theory, Co-creation Theory, and the Sustainable Livelihood Framework.

5.2 Proposed Interactive Digital Framework (IDF)

The proposed Interactive Digital Framework (IDF) integrates AI-enabled interactivity, digital co-creation, and digital heritage technologies to strengthen artisan-consumer engagement while supporting the preservation and sustainable development of Raghurajpur's Pattachitra tradition. Developed from the synthesis of the literature review and empirical findings, the framework addresses the challenges of limited public awareness, geographical isolation, financial insecurity, inadequate market intelligence, and concerns regarding cultural authenticity by embedding practical AI applications within a human-centered, artisan-led ecosystem.

AI-enabled Interactivity - The first component of the IDF enhances meaningful communication between artisans and consumers through intelligent digital interfaces. AI-powered multilingual chatbots enable consumers from diverse linguistic backgrounds to learn about the history, symbolism, production techniques, and cultural significance of Pattachitra in their preferred language. Conversational AI further facilitates real-time interactions by allowing consumers to ask questions regarding artistic processes, customization options, pricing, and delivery while enabling artisans to communicate their craft knowledge more effectively. Complementing these tools, AI-assisted storytelling generates engaging narratives about individual artworks, artisans, and cultural traditions, thereby enriching consumers' understanding of the heritage value embedded within handcrafted products. Consistent with Interactivity Theory (Liu & Shrum, 2002), these technologies promote reciprocal communication, deepen consumer engagement, and strengthen emotional connections between artisans and buyers.

Digital Co-creation. Building on the principles of Co-Creation Theory (Prahalad & Ramaswamy, 2004), the second component transforms consumers from passive purchasers into active collaborators. AI-assisted customization enables consumers to visualize personalized motifs, colour palettes, or product formats before the final artwork is handcrafted by the artisan. Personalized recommendation systems analyse consumer preferences, previous browsing behaviour, and purchase history to suggest culturally relevant products while encouraging the discovery of lesser-known artworks. Throughout this process, consumers actively participate by sharing ideas, providing feedback, and collaborating with artisans during product development. Importantly, AI functions as a decision-support tool rather than a substitute for craftsmanship, ensuring that artistic creativity, cultural authenticity, and final design decisions remain under the control of the artisan.

Digital Heritage and Market Access. The third component employs AI and digital technologies to improve market accessibility while safeguarding cultural heritage. Interactive virtual exhibitions allow global audiences to experience Raghurajpur's artistic traditions remotely through immersive digital environments, reducing the constraints imposed by geographical isolation and declining tourist visits. AI-powered recommendation systems increase the visibility of authentic Pattachitra products by connecting them with consumers whose interests align with traditional art and cultural heritage. AI analytics provide artisans with insights into consumer preferences, seasonal demand patterns, and emerging market trends, thereby supporting informed production and marketing decisions. Additionally, computer vision and image recognition technologies can help verify the authenticity of handcrafted Pattachitra by distinguishing genuine handmade works from machine-printed or imitation products, thereby reinforcing consumer trust and protecting the cultural integrity of the craft.

Collectively, these components establish an integrated ecosystem in which AI supports rather than replaces traditional craftsmanship. By combining intelligent interaction, collaborative value creation, and digital heritage preservation, the Interactive Digital Framework (IDF) strengthens artisan-consumer relationships, expands market opportunities, enhances appreciation of cultural heritage, and contributes to the long-term sustainability of Raghurajpur artisans' livelihoods. The framework therefore operationalizes the principles of Interactivity Theory, Co-creation Theory, and the Sustainable Livelihood Framework into a practical model for heritage craft revitalization in the digital era.

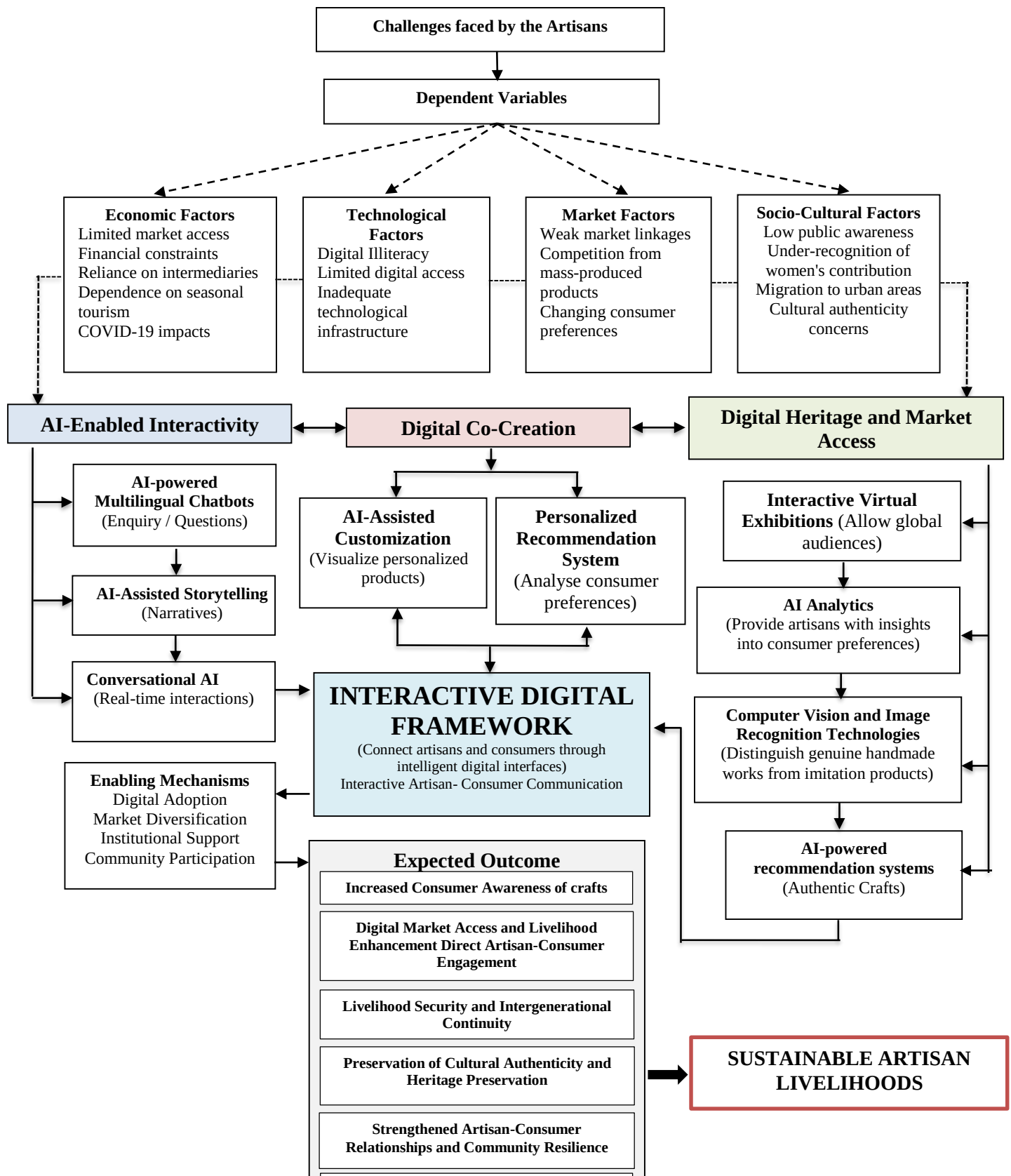


Fig 3. Proposed Interactive Digital Framework (IDF) for sustainable livelihood development and cultural preservation in Raghurajpur

5.3 implementation of the Interactive Digital Framework IDF)

The successful implementation of the Interactive Digital Framework (IDF) requires collaboration among artisans, government agencies, NGOs, and cultural institutions. While artisans produce authentic crafts, engage with consumers, participate in storytelling and co-creation to and engage consumers thus preserve cultural authenticity. Other stakeholders like Government support implementation through digital infrastructure, policy, funding, heritage documentation, capacity building, and digital literacy initiatives, ensuring sustainable craft development.

NGOs & Cultural Institutions can conduct training, community engagement, heritage documentation, awareness campaigns

Tourism bodies and technology partners can support the IDF through virtual exhibitions, heritage tourism, destination marketing and digital marketing, AI-powered chatbots, recommendation systems, virtual exhibitions, authenticity verification, and analytics. These assistive technologies enhance communication, personalization, and market access while preserving artisans' creative authority and cultural knowledge.

Consumers actively contribute to the IDF through product customization, digital co-creation, feedback, and awareness-building. Their participation strengthens artisan-consumer relationships, enhances market accessibility, promotes cultural authenticity, and supports a sustainable digital ecosystem for the long-term livelihoods of Raghurajpur artisans.

VI. LIMITATIONS AND FUTURE RESEARCH

The proposed Interactive Digital Framework (IDF) remains conceptual and has not yet been implemented or empirically tested in a real-world setting. Future research could validate the framework with larger, more diverse samples, examine its applicability across different craft clusters, and evaluate the effectiveness of specific digital interventions, such as AI-assisted consumer engagement, virtual heritage platforms, and digital storytelling tools. Strengthening digital skills and market intelligence is therefore essential for improving competitiveness and sustaining traditional crafts

VII. CONCLUSION

This study examined the socio-economic challenges affecting Raghurajpur's Pattachitra artisans and proposed an evidence-based Interactive Digital Framework (IDF) integrating AI-enabled interactivity, digital co-creation, and heritage preservation. Grounded in empirical findings, the framework addresses market constraints, cultural authenticity, and sustainable livelihoods while preserving traditional knowledge and artisan creativity.

Theoretically, this study advances digital heritage and craft sustainability by integrating Interactivity Theory, Co-creation Theory, and the Sustainable Livelihood Framework into the proposed Interactive Digital Framework (IDF). It demonstrates how AI-enabled interaction and collaborative value creation enhance consumer engagement, support heritage preservation, and promote sustainable artisan livelihoods.

Managerially, the proposed Interactive Digital Framework (IDF) provides practical guidance for artisans and stakeholders by integrating AI-powered storytelling, multilingual chatbots, virtual exhibitions, personalization, recommendation systems, and market analytics to enhance consumer engagement, expand market access, and support sustainable heritage marketing while preserving artisans' creative authority and cultural authenticity.

From a policy perspective, the study emphasizes collaboration among government, cultural institutions, tourism authorities, NGOs, and technology partners to strengthen digital heritage preservation. Investments in digital infrastructure, AI literacy, artisan training, heritage documentation, and financial support can enhance cultural resilience, sustainable livelihoods, and the preservation of intangible cultural heritage. Overall, the proposed Interactive Digital Framework offers a scalable, evidence-based model that integrates AI with traditional craftsmanship to strengthen heritage preservation, sustainable livelihoods, and artisan-consumer engagement in Raghurajpur and similar communities.

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