Heritage Meets Innovation: Elevating Traditional Crafts through Technological Advancements for Sustainability

Satabdi Roy, Gaurav Majumdar and Vikas Dargan

Abstract

India has had a history of culturally rich handloom and traditional craft. Despite the historical and economical vibrancy, the sector today faces multiple challenges. Issues like market fragmentation, policy gaps, and the rise of counterfeit products are rampant. The rise of mechanized, low-cost imitations in both domestic and international markets has weakened consumer trust. This misrepresentation, along with reduced artisan visibility and producers' limited ability to differentiate their work, has in its stead also forced economic marginalization of skilled craftspeople. In an ever-increasing competitive world, the wound cuts deep.

This study explores the role of technological innovation in addressing these long-standing issues through a focused case study of KOSHA, a social-tech enterprise developing authentication and traceability solutions for the craft economy. Adopting a qualitative case study methodology, the research draws upon field observations, structured and semi-structured interviews, and real-time documentation of technology deployment. Data was collected from artisan clusters using KOSHA systems, as well as from program implementers and support organizations. The study foregrounds artisan perspectives, with a particular emphasis on how technology influences their workflows, market access, pricing power, and recognition.

Findings indicate that KOSHA's systems have had a significant impact on both artisan livelihoods and consumer perception. The ability to verify handmade authenticity in real-time through IoT and blockchain-based systems has not only strengthened artisan credibility but also enabled higher price realization in premium markets. In parallel, the use of personalized, media-rich content linked to tamper-proof digital labels has created new pathways for brands and retailers to build trust and emotionally resonate with buyers. Artisans report increased income stability, greater market visibility, and an enhanced sense of dignity tied to the visibility of their names, stories, and creative labor.

This article contributes to existing literature by offering an artisan-centric perspective on digital transformation in the cultural economy, an area often overlooked in broader discussions of fashion tech and supply chain innovation. It argues that technology, when ethically and thoughtfully integrated, can reinforce rather than replace traditional systems of knowledge, production, and identity.

Keywords: Traditional craftsmanship, authentication, supply chain management, sustainable fashion, ethical consumerism, cultural preservation, fashion innovation

Introduction

India's handloom sector, often described as the soul of the country's textile heritage, represents one of the world's oldest and most enduring economic systems. With origins dating back to the Indus Valley Civilization, handloom weaving has long served not only as a mechanism for clothing production but also as a living archive of artistic expression, regional identity, and socio-economic resilience. The sector is especially vital to rural India, where weaving traditions have been passed down for centuries, embedding intricate technical knowledge within family and community lineages. According to the Fourth All India Handloom Census (2019–2020), 31.45 lakh households are engaged in handloom weaving, making it one of the largest unorganized industries in the country (Ministry of Textiles, 2020). The size of the sector highlights its cultural and economic value and shows how important it is for supporting rural communities.

Despite its historical prestige, the handloom sector faces serious structural and market challenges. Decentralization, which once allowed weaving to flourish across India, is now a concern because today's economy needs strong policy support, better access to funding, and infrastructure. Weak policies, limited financing, and poor market facilities have made it hard for the industry to compete with large-scale machine production (Lhoungu, 2021). Moreover, consumer awareness of authentic handmade goods remains quite low, with many unable to differentiate between the genuine craft and machine-made production (Kumudha and Rizwana, 2013; Prathap and Sreelaksmi, 2022; Paul and Goowalla, 2021). As a result, the sector struggles to balance preserving tradition with keeping up in a fast-changing market, and artisans often feel the most pressure from these changes.

The COVID-19 pandemic deepened the vulnerabilities within the handloom sector. Lockdowns, supply chain disruptions, and abrupt market closures interrupted the production cycles, resulting in prolonged income loss for the artisans. Handloom cooperatives and self-help groups, which already operated on narrow margins, faced

devastating challenges. Many artisans were forced to abandon weaving temporarily for lower-paying wage labor (International Labour Organization, 2021). For communities deeply tied to the craft, this disruption was more than simply economic. Its cultural and emotional effect disrupted the transmittance of practices across generations. The Covid-19 crisis pushed the already struggling handloom economy over the edge, raising critical questions regarding its long-term sustainability.

The unchecked spread of counterfeit and machine-made products masquerading as handmade has become a significant issue for the sector. Powerloom textiles are often falsely branded as authentic handlooms. Their lower cost and faster production cycles disrupt and erode both the market value and cultural credibility of genuine handloom goods. For instance, handcrafted Pashmina shawls, which can command prices upward of ₹50,000 due to the labor-intensive process and heritage significance, face direct competition from machine-made imitations sold online for as little as ₹2,400 (Vhavle and Krishnappa, 2020). Such disruptions cascade to market failures, leading to the devious circle of artisans' inability to compete fairly, which leads to losing consumer trust, which forces crafts to lose their symbolic value and thus their history. Scholars have emphasized how counterfeits destroy craft and force cycles of economic marginalization in perpetuity.

The answer, according to experts and practitioners alike, is to tap into the potential of digital technologies to improve transparency, traceability, and renewed consumer engagement. Innovations like the Internet of Things (IoT), blockchain, artificial intelligence (AI), and cloud computing have been proposed as solutions to improve the supply chain integrity and enable producers to verify authenticity (Khubchandani, 2023). Beyond functional benefits, such technologies also have the ability to transform the consumer-producer interactions by fostering ethical consumption and allowing tales/stories spun from the roots. Sadly, much of the current literature tends to focus on the brand or institutional interventions, with barely any consideration on how artisans themselves experience, accept, and adapt. The voice of the artist, which is vital to the continuity of such heritage crafts, is often absent from mainstream discussions about digital innovation in textiles.

Digital adoption on the grassroots level has pushed the Indian handloom sector's potential to transform on the global trends platform. IoT-enabled devices have already proved themselves in agriculture by improving the supply chain traceability, optimizing production efficiency, and enabling real-time monitoring for small farmers. Similarly, the implementation of blockchain has been successful in the fair trade of commodities such

as coffee and cocoa to establish origins, prevent counterfeiting, and transparent pricing processes. These examples demonstrate how digital infrastructures reinvent global value chains, especially by safeguarding producers while promoting their origins and identities. In this global trend, the Indian craft sector faces a critical decision: can we integrate these technologies without compromising the cultural integrity of traditional practices?

It is against this backdrop that KOSHA, a social-technology enterprise, has emerged with a targeted focus on the artisan economy. KOSHA AI is the entity behind the development of a comprehensive technology model that combines IoT, AI, blockchain, and cloud computing to address the authenticity and transparency challenges of the sector. The KOSHA suite includes innovations such as the HASTA IoT loom sensor, which authenticates weaving activity; wearable devices that record artisan-specific data for non-loom crafts such as embroidery and printing; and ScanLIVE, an augmented reality storytelling feature that connects consumers directly with artisan identities and production processes (Khubchandani, 2023). Unlike regular digital solutions, KOSHA's model is specifically made for traditional crafts, focusing on respecting artisans and ensuring fair economic practices while also being technically accurate.

Through the My E-Haat initiative, KOSHA's partnership with the HCL Foundation has facilitated the deployment of these tools in real-world artisan clusters. The technology's early adoption in Amravati and Barabanki, with expansion planned for Pochampally and other clusters, illustrates how it can be scaled within diverse craft traditions. Reports highlight that over 1,500 artisans are expected to benefit from the initiative, with outcomes including increased income stability, enhanced recognition, and improved bargaining power in markets. By embedding traceability into production cycles and linking products with tamper-proof digital identities, the system addresses counterfeit competition while creating new consumer experiences rooted in transparency and storytelling (HCL Foundation, 2022).

The integration of KOSHA's systems also reflects broader shifts in consumer preferences. Studies indicate that ethical and sustainable sourcing increasingly shape purchasing decisions in both domestic and global markets. By aligning authenticity verification with consumer demand for transparency, KOSHA's interventions position Indian handloom products within a premium segment that values provenance and craftsmanship. Importantly, this model demonstrates how heritage preservation and market competitiveness need not be mutually exclusive but can be strategically combined (India Retail, 2020).

Despite these promising developments, critical questions remain about how artisans themselves perceive and navigate these technological shifts. Existing scholarship often overlooks the lived realities of craftspeople who must integrate these tools into traditional workflows, negotiate new forms of visibility, and adapt to digital systems that may feel foreign to their cultural practices. When evaluating how emerging technologies shape communities, it's important to look beyond just financial metrics. One needs to consider what happens to people's sense of identity and personal worth and how knowledge passes between generations, especially in places where traditional craftsmanship remains central to life.

This study fills an important gap by examining real experiences of artisans working with KOSHA and the HCL Foundation. Rather than focusing on abstract concepts, the research draws directly from craftspeople's own stories about their work. It explores concrete questions: how do digital tools change the way their work is authenticated, who they can sell to, how they see themselves, and whether they can keep adapting to stay relevant? The methodology combines fieldwork observations, direct conversations with artisans, their personal accounts, and data from the organizations involved, creating a fuller picture of what digital tools actually mean for people doing craft work day to day.

This approach engages with three important debates in academic circles. On one level, it shifts the conversation about technology and creative industries away from what organizations are doing and toward what individual craftspeople themselves are choosing and learning. It also connects what's happening with Indian textiles to broader global patterns we're seeing in farming and ethical trade networks, helping us understand crafts within an international context rather than in isolation. Finally, it demonstrates that companies like KOSHA, when they work as part of larger development efforts, can show us a path forward, one where traditional practices and modern tools don't have to be at odds.

Perhaps most importantly, this work challenges how we think about traditional crafts. Instead of viewing them as endangered practices that need protecting, it presents evidence that they're actually dynamic and creative, perfectly capable of competing and succeeding online. By centering what artisans themselves have to say, the research suggests that when communities are genuinely involved in deciding how technology gets used, and when those choices are made thoughtfully, the result can be both stronger cultural traditions and better economic stability for people in one of humanity's oldest craft heritage sectors.

Methodology

This study adopts a qualitative case study design to examine the integration of digital technologies into India's traditional craft sector. Grounded in the lived experiences of artisans, it explores how authenticity, recognition, and sustainability are negotiated through digital adoption at the grassroots. KOSHA, a social-tech enterprise, has developed the technological tools, and the HCL Foundation, through its My E-Haat initiative, has facilitated their deployment across artisan clusters. At the time of research, more than 1,500 artisans across five clusters were engaged under two distinct models: the HASTA IoT device for handloom weaving and the HASTA wearable device for embroidery, hand printing, and other surface crafts (Kosha, 2023).

The case study approach was selected for its ability to provide in-depth, contextualized analysis of complex socio-technical dynamics in natural settings. India's handloom and craft sector represents such a context, where cultural traditions, market pressures, and digital innovation intersect. Informed by interpretivist traditions, the research design emphasizes artisan perspectives as central to understanding technological change.

The study draws on both secondary and primary data. The secondary data included organizational reports, program presentations, and implementation materials, providing contextual grounding and details of scale, models, and rollout. The primary data collection entailed on-site observations, semi-structured interviews with artisans, and testimonial documentation. On-site observations were conducted in HCL Foundation's intervention clusters engaged in *khadi*, cotton weaving, and linen crafts in Amravati and Barabanki. These field visits examined how technology was embedded into daily production environments. Particular attention was given to workspace arrangements, tool placement, and the rhythm of weaving or crafting alongside digital interfaces. Observational notes also documented group dynamics and instances of peer-to-peer learning, particularly where younger artisans assisted elders in adapting to wearable or digital systems. A total of 50 beneficiaries were interviewed across the clusters. Interviews followed an open-ended guide designed to elicit artisan perspectives on authenticity, pricing, market access, recognition, and ease of technological use. While artisans described practical changes, they also shared reflections on emotional and cultural dimensions, such as how visibility through digital storytelling altered their sense of dignity and professional identity. Artisans' experiential accounts were complemented by testimonial narratives collected during the implementation phase. Real-time documentation of authenticated product lifecycles, such as digital videos generated by wearable devices and tamper-proof labels, was analyzed to understand how authenticity was communicated to consumers.

The mixed-methods approach enabled the triangulation of data, enhancing both validity and depth by integrating experiential, observational, and documentary evidence. Ethical protocols were integral to the study's design. All participants were informed about the voluntary nature of their involvement, and informed consent was obtained prior to data collection. This framework was chosen to systematically interpret how technological adoption was experienced not only economically but also socially and culturally.

This methodological approach addresses a critical gap in existing knowledge. Much of the literature on digital innovation in textiles emphasizes technical efficacy or institutional adoption while neglecting the lived experiences of artisans who must adapt these systems to traditional workflows. By integrating field-level narratives with organizational documentation, this study captures the layered realities of technological adoption: the technical promise of IoT and blockchain, the institutional scaffolding provided by HCL Foundation, and the grassroots perspectives of artisans negotiating dignity, recognition, and sustainability.

Results and Discussion

This study explores digital integration in the craft sector from the perspectives of artisans, grounded in their lived experiences. The Indian craft economy, traditionally marginalized within global fashion narratives, is now experiencing what can be described as a technological renaissance. Through the integration of KOSHA's platforms, HASTA IoT devices for weaving, HASTA wearable systems for embroidery and surface embellishment, and ScanLIVE augmented storytelling, artisans are witnessing significant changes in how their work is validated, represented, and positioned in markets. These interventions do not simply digitize production processes; they redefine artisans' roles in supply chains, offering avenues for authenticity, recognition, and more stable economic participation.

Findings are presented across four thematic lenses: authenticity validation, market access and pricing power, artisan identity and recognition, and technological adaptability and ease of use, alongside attending to challenges such as digital literacy, cost, and generational divides. This discussion integrates practitioner insights, secondary documentation, and artisan testimonials to provide a holistic analysis of this transition.

Authenticity validation: securing cultural and market legitimacy

The handloom and craft sectors have long suffered from market distortions caused by mechanized and counterfeit products masquerading as handmade. Imitation

pashmina and other handcrafted products are often sold at a fraction of the cost of genuine handlooms, misleading consumers and eroding trust in handmade markets. In this context, KOSHA's authentication systems address a structural vulnerability by providing verifiable proof of handmade origin. The HASTA IoT loom sensor records the rhythm of manual weaving, distinguishing it from powerloom outputs. Similarly, the HASTA wearable device authenticates artisan labor in embroidery, hand printing, and other surface crafts. These systems link real-time data to blockchain infrastructure, producing tamper-proof records of authenticity accessible via digital labels.

Many artisans emphasized the significance of this shift. For many, authentication represented not just technical proof but moral validation of their work. One weaver from Amravati expressed, "What we make by hand is better than machine-made. Now, thanks to this device, people actually know who made their clothes and how they were made. Getting recognized like this helps us earn more and feel proud. It's not just about selling stuff. It's about being noticed."

The recognition really matters. In the past, most artisans simply didn't have a way to prove that their crafts were different from cheap knock-offs. With authentication, they can finally stand up for their work. Authentication operates as a counter-narrative to market invisibility. However, artisans expressed caution. Several noticed that, while authentication strengthened legitimacy in niche markets, it did not immediately eliminate widespread customer apathy toward handmade products. Some artisans pointed out that while these tools help in specialty markets, most regular shoppers still care way more about price than anything else. Unless a customer is looking for proof of authenticity, fakes and cheap goods will keep finding buyers. As one cooperative leader pointed out, provenance tools are only useful if clients consider authenticity a purchase aspect. Counterfeiters may continue to exert pressure in mainstream regions where price sensitivity reigns supreme. Another challenge lies in the financial sustainability of these systems. Although initial deployments were subsidized under HCL Foundation's partnership, artisans raised concerns about the long-term costs of devices, maintenance, and connectivity. For many working on thin margins, the risk of technology becoming another layer of dependency was noted with caution. Despite these challenges, authentication represents a fundamental breakthrough in aligning artisan credibility with verifiable evidence. It offers a way to stand out and build trust in a world full of look-alikes. As shared by Tarai and Shailaja (2020), this is a chance to finally get noticed for real skill and effort, not just fade into the background in a crowded retail landscape.

Market access and pricing power: from survival to premium positioning

The second thematic lens examines how authentication translates into market access and improved bargaining power. By embedding provenance data into tamper-proof labels and QR codes, KOSHA enables artisans to connect their products to narratives of origin, quality, and sustainability. This shift repositions artisans from undifferentiated producers to participants in premium and ethical markets. Program data show measurable impacts. In the Amravati cluster, authenticated production capacity expanded to 2,500–3,000 meters annually, creating a more reliable supply base for retailers. Artisans reported increased order volumes, particularly from ethical brands and social commerce platforms seeking verified products. This is consistent with studies indicating consumer trust in transparent and ethically sourced products can lead to premium pricing and recurring purchases (Bonderud, 2025).

For artisans, the impacts were immediate. One recorded statement reflects this transformation: “Previously, we had to accept whatever price was offered, because people queried whether our work was truly handmade.” Now that we have that evidence, we can negotiate more effectively. Customers are also more assured, and we no longer have to constantly compete with machine-made products.” Such outcomes imply a power shift in favor of producers, reducing reliance on middlemen, who frequently capture excessive value. By basing pricing on proven authenticity, craftspeople can claim margins that reflect both labor intensity and cultural worth. Yet challenges persist. Interviews revealed concerns about over-dependence on niche ethical markets, which, while lucrative, remain limited in scale compared to mass consumer demand. Additionally, some artisans questioned whether digital tools would guarantee consistent price premiums, especially in rural markets where consumers remain less attuned to concepts of traceability.

Generational divides also surfaced. Younger artisans expressed enthusiasm about linking their work to global buyers through digital labels, while older weavers feared being excluded from market opportunities if unable to adapt to QR-based systems. This suggests that while pricing power has improved, market inclusion is contingent upon addressing digital literacy gaps. Additionally, leveraging this authenticity, KOSHA has enabled artisans to access global markets, including collaborations with the Design Museum London and the World Economic Forum (HCL Foundation, 2022). Analysis suggests that authentication-driven transparent transactions yield economic and symbolic capital. It improves financial stability, connects artisans to ethical supply chains, and is consistent with global trends in sustainable consumption.

Artisan identity and recognition: from invisible labour to visible creators

Perhaps the most profound impact of KOSHA's systems lies in how they reshape artisans' social identity and recognition. Historically, artisans have been marginalized as invisible laborers within extended supply chains. Finished goods reached markets stripped of their makers' names, stories, or cultural context. The introduction of ScanLIVE augmented reality storytelling directly challenges this invisibility. By scanning tamper-proof tags, consumers access digital profiles, videos of production processes, and artisan narratives. This transforms consumption into a relational experience, reconnecting buyers with the humanity of producers.

The emotional resonance of this feature was repeatedly emphasized in artisan testimonials. A weaver from Barabanki expressed, "Earlier, our work was never recognized. Now, when people scan the tag, they see our faces, our names, and our process. Such recognition gives us dignity. Customers respect us more, and we feel proud that our identity is part of the product." The case of Sonali Prakash, a 24-year-old artisan from Amravati, illustrates the point vividly. By sharing her story through the Kosha app, Sonali connected directly with urban buyers, reigniting interest in her craft and repositioning herself not as an anonymous laborer but as a creative entrepreneur.

Recognition is not merely symbolic. Several artisans associated visibility with improved self-esteem, bargaining power, and intergenerational pride. For example, one artisan reflected that her children, once dismissive of weaving as an unviable livelihood, now viewed it as a respected profession after seeing her name attached to authenticated products. This aligns with Nussbaum's (2011) argument that true development requires expanding individuals' capabilities, including the ability to live with dignity and self-respect, rather than focusing solely on economic outcomes. Nonetheless, challenges persist. Some artisans expressed fear that their constant visibility could expose them to competition or exploitation, particularly if their profiles circulated without their consent. Others expressed concern about the sustainability of storytelling, whether consumer interest would wane over time, reducing identity recognition to a transient marketing tool. Despite these limitations, the introduction of artisan-centered narratives represents a paradigm shift. It reconfigures value chains to foreground the human element of craft, transforming invisible labor into visible creativity.

Technological adaptability and ease of use: negotiating change

The final thematic lens addresses how artisans adapted to new technologies and the challenges encountered. While the benefits of authentication and recognition were

widely acknowledged, adoption faced some hesitation. Initial apprehension was common, particularly among older weavers unaccustomed to digital devices. Some feared that technology might disrupt traditional rhythms or require skills beyond their capacity. An artisan shared that "The elders were skeptical at first. They thought the device would slow them down or replace their skills. But when they saw it work quietly in the background, they accepted it."

Training and support mechanisms facilitated by the HCL Foundation were critical in bridging these divides. Younger artisans often acted as intermediaries, helping elders navigate devices and interpret digital labels. Over time, the program fostered intergenerational collaboration rather than exclusion. Testimonials highlight this transition. One artisan from Amravati, Durga, recounted, "At first, I did not understand the device. But with training, I gained confidence. Now my earnings have improved, and I feel proud that my work is valued." Her income reportedly rose to INR 6,000 per month, underscoring the tangible impact of adaptation on livelihood security. Still, challenges remain. Some artisans raised concerns about the costs of devices, reliance on external maintenance, and uneven digital literacy. Connectivity gaps in rural areas also impeded smooth use of cloud-linked systems. Moreover, artisans expressed concerns about over-reliance on technology providers and the potential consequences of withdrawing external support.

These apprehensions reflect the "double-edged nature of technological change" in craft economies: while innovations enhance resilience, they also introduce new dependencies and vulnerabilities. Overall, artisans expressed cautious optimism. They valued tools that complemented rather than replaced traditional practices, favoring systems that amplified human creativity rather than automated it. This preference reflects a broader principle of coexistence: technology is accepted when it respects craft rhythms and cultural autonomy. This aligns with Luckman's (2015) observation that digital tools in craft sectors can both empower artisans and risk undermining the embodied, place-based knowledge that defines their creative identity.

Synthesis: beyond functional benefits

The findings suggest that digital technologies in craft economies cannot be reduced to functional benefits such as improved pricing or operational efficiency. For artisans, these systems are deeply tied to identity, dignity, and cultural continuity. Authentication validates the handmade nature of their work, market transparency enhances economic resilience, storytelling restores visibility, and adaptability demonstrates resilience amidst

change. Yet these benefits coexist with persistent challenges such as digital literacy gaps, generational divides, cost burdens, and risks of dependency. By centering artisan perspectives, this study underscores the dual nature of digital integration: it is both an enabler of empowerment and a site of negotiation. Artisans interpret technology not as a replacement but as an affirmation of their relevance in a rapidly digitizing economy. In doing so, the study advances understanding of how heritage and innovation can coexist. It illustrates that technology, when co-created and implemented with sensitivity, can reinforce cultural economies without eroding their human essence.

Conclusion

The integration of KOSHA's technological systems into India's traditional craft sector illustrates how digital innovation, when thoughtfully designed and collaboratively implemented, can address structural vulnerabilities while safeguarding cultural heritage. Rather than displacing artisanal knowledge, these tools enhance the credibility, visibility, and economic viability of handmade production, demonstrating that modernization need not equate to mechanization or cultural erosion.

By embedding end-to-end traceability through IoT devices, blockchain-led provenance systems, and augmented reality storytelling, KOSHA provides artisans with the means to validate authenticity, strengthen market positioning, and reclaim their identities as creators rather than anonymous laborers. The testimonies of artisans, who describe feeling "recognized for the first time" or newly able to "defend fair prices with confidence," underscore that the benefits of such innovations extend beyond technical validation. They are deeply tied to dignity, cultural continuity, and intergenerational pride. These findings resonate with global parallels in grassroots innovation. Just as IoT-enabled supply chains in agriculture have enhanced efficiency for smallholder farmers and blockchain systems have reinforced transparency in fair-trade commodities such as coffee and cocoa, KOSHA's interventions situate artisans within broader ethical consumption movements. Yet, what distinguishes this case is its artisan-first orientation, where technology is created to amplify craft traditions rather than override them.

The partnership with the HCL Foundation has been instrumental in scaling these innovations responsibly. By facilitating deployment across five clusters and supporting over 1,500 artisans, the Foundation ensures that technical tools are embedded within supportive ecosystems of training, market linkage, and fair pricing advocacy. This cross-sector collaboration illustrates how private innovation and social sector facilitation can converge to generate outcomes that are both economically sustainable and socially equitable. Artisans highlighted barriers related to digital literacy, affordability

of devices, and generational divides in adapting to new systems. Connectivity gaps and concerns about dependency on external providers also signal that technological adoption is neither seamless nor risk-free. However, the cautious optimism expressed by participants suggests that these challenges can be mitigated when innovation respects existing craft rhythms, builds local capacity, and preserves creative autonomy.

This study affirms that sustaining craft economies requires balancing global competitiveness with cultural authenticity. By safeguarding artisans from counterfeit-driven erosion and embedding them within ethical value chains, KOSHA demonstrates how heritage and technology can operate in synergy. As demand for authenticity and traceability rises, such initiatives signal a paradigm shift where innovation is inclusive, equitable, and creativity-driven, ensuring traditional legacies thrive as vital assets of a sustainable future.

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About the authors

Satabdi Roy is a dedicated development specialist with over seven years of experience in the development sector. Her career reflects a deep commitment to advancing social development through meaningful contributions to research institutes such as NIRD and PR, Hyderabad, and the Institute of Life Sciences, Bhubaneswar, as well as social purpose organizations like WASSAN and the VisionSpring Foundation. Currently, she is associated with the HCL Foundation, and her expertise lies in fostering sustainable partnerships and effective program management. She has been key in managing various national and state-level project reporting. She holds a professional certificate in Development Management from the Indian School of Development Management (ISDM), Noida, and a master's degree in Development Studies from NIT Rourkela.

satabdi.roy@hcltech.com

Gaurav Majumdar holds 12+ years of experience in the development sector with national and international development organizations in different verticals. He previously worked with the State Rural Livelihood Mission, Bihar, 'Jeevika,' and the Office of Refugee and Resettlement in Chicago. He serves as the technical lead for the skill development and livelihood thematic area, as well as the special initiative called My E-Haat, at HCL Foundation. Gaurav holds a master's in business administration (rural management) from KIIT University, Bhubaneswar, and a master's in public administration from Illinois Institute of Technology, Chicago, US. He has published three articles on the My E-Haat initiative, which were also presented at NIFT, Kangra, and IICD, Jaipur.

gaurav.majumdar@hcltech.com

Vikas Dargan has been working in the crafts and cultural sector for over seven years. His previous experience includes working with the Indian National Trust for Cultural Heritage (INTACH) and the Cultural Conservation Consultants Firm, where he gained extensive experience in projects related to craft revival, cultural management, architectural heritage restoration, and craft research. Currently, he is leading My E-Haat, a special initiative of the HCL Foundation. Vikas is a trained architect holding a postgraduate diploma in Built Environment from Anant National University, Ahmedabad; a postgraduate diploma in Cultural Management from IGNCA Delhi; and an executive master's in Business Analytics from IIM Indore.

vikas.dargan@hcltech.com