Issues of Rural Artisans: A Study and Implementation of E-Commerce Platform to Mitigate the Challenges

Thesis Submitted

by

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PROFORMA – 1

"Statement of Originality"

I, **Jayanta Basak**, registered on 14/03/2017, do hereby declare that this thesis entitled "**Issues of Rural Artisans: A Study and Implementation of E-Commerce Platform to Mitigate the Challenges**" contains a literature survey and original research work done by the undersigned candidate as part of Doctoral studies.

All information in this thesis has been obtained and presented in accordance with existing academic rules and ethical conduct. I declare that, as required by these rules and conduct, I have fully cited and referred all materials and results that are not original to this work.

I also declare that I have checked this thesis as per the "Policy on Anti Plagiarism, Jadavpur University, 2019", and the level of similarity as checked by iThenticate software is 6 %.

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CERTIFICATE FROM THE SUPERVISOR/S

This is to certify that the thesis entitled **"Issues of Rural Artisans: A Study and Implementation of E-Commerce Platform to Mitigate the Challenges"** submitted by Shri Jayanta Basak, who got his/her name registered on 14/03/2017 for the award of Ph. D. (Engg./Pharmacy) degree of Jadavpur University is absolutely based upon his/her own work under the supervision of Dr. Parama Bhaumik and that neither his/her thesis nor any part of the thesis has been submitted for any degree/diploma or any other academic award anywhere before.

Parama Bhaumik 14/03/2024

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JAYANTA BASAK

ABSTRACT

Understanding rural development involves improving life in rural areas across economic, social, cultural, and political aspects. Initially, rural development in developing countries like India focused on grassroots innovations by entities such as NGOs. These organisations adapted existing rural practices in areas like craft production and agriculture. This method succeeded but faced limitations, mainly because these changes were too localised and couldn't be expanded due to the need for extensive external resources. With the rise of digital technology, potential for more widespread solutions to rural development challenges. However, experts caution that merely adopting digital tools, like e-commerce platforms, without considering the unique local social contexts might lead to ineffective solutions. In response to these issues, this doctoral thesis focuses on a pivotal concern in rural development, especially in developing nations like India.

The essence of this doctoral thesis lies in an innovative approach to these longstanding challenges through the development and implementation of a community-driven e-commerce platform tailored for rural artisans, NCoRe. This platform emerges from comprehensive research that integrates local insights, ensuring the technology is not only efficient but also resonates with its users.

The foundation of this doctoral thesis is the belief that technology in rural development should be intrinsically linked to the community it serves. The research begins with an in-depth analysis of rural artisan communities, identifying key challenges they face, such as restricted market access, logistical issues, and socio-economic barriers. NCoRe is designed to focus on accessibility, functionality, and cultural relevance, aiming to address these challenges while being artisan-friendly.

Much of the thesis explores how feedback and opinions circulate on this community-centric e-commerce platform. It emphasises the importance of feedback loops, enabling artisans and consumers to continually provide input, facilitating the platform’s ongoing evolution to stay relevant and user-focused.

Furthermore, this research innovatively integrates blockchain technology into the platform. This strategic addition aims to digitise and secure artisans' assets, offering a robust, transparent, and reliable online transaction system. By adopting blockchain, the platform enhances security and efficiency and sets a new benchmark in rural development technology.

In conclusion, the thesis demonstrates how a collaboration of community-led design, technological advancement, and continuous user engagement can transform the economic landscape for rural artisans. It significantly broadens their market exposure, bolsters economic stability, and presents a sustainable model for rural advancement. The findings extend beyond the immediate context, providing valuable insights and a scalable method for integrating marginalised communities into the global digital economy. This research is particularly pertinent for future initiatives utilising technology in rural settings, highlighting the importance of cultural sensitivity, scalability, and adaptability in diverse rural environments.

CONTENTS

LIST OF FIGURES

LIST OF TABLES

LIST OF ABBREVIATIONS

Abbreviation/ Acronym	Description
NGO	Non-Governmental Organization
ICT	Information and Communication Technologies
GoI	Government of India
NPO	Non-Profit Organization
SHG	Self Help Group
ST	Social Technologies
IT	Information Technology
IS	Information Systems
ITU	International Telecommunication Union

Chapter 1

Introduction

1.1 Overview of the Rural Artisan Community

The Rural Artisan Community, which primarily resides quietly within the heart of our rural landscapes, represents a hardy and invaluable segment of our global society. The term "artisan" refers to a very traditional group, typically working alone or in small groups, who follow and pass down skills based on tradition handed down through generations. These artisans are the bearers of cultural diversity, carrying forward the spirit of local craftsmanship and facilitating the harmonious coexistence of tradition and modernity in rural settings. (Gupta et al., 2023; Jongeward, 2001)

Traditionally, from the rural heartlands worldwide, artisans serve as custodians of indigenous knowledge and traditional craftsmanship. Their creations are living monuments to the ingenuity and creativity of local communities, embodying cultural identity and heritage (Shah, 2016). In an era of mass production and homogenized consumer culture, these artisans stand as an oasis of authenticity, creating objects that deeply resonate with a sense of place and history (Duxbury, 2011).

Efforts to preserve and promote artisanal skills are evident through local and international initiatives, including artisan cooperatives, fair trade organizations, and cultural preservation programs (Crawshaw & Gkartzios, 2016b; Mahon et al., 2018). Adapting to changing times, many rural artisans are innovating within their crafts, integrating new designs or methods while preserving the essence of their traditions. Their work, characterized by using locally sourced materials and age-old techniques, is a testament to sustainability and regional uniqueness.

The rise of the Internet and global marketplaces has opened new avenues for these artisans, allowing them to reach a wider audience and sell their products globally. Rural artisan communities have also become vital cultural tourism attractions, offering tourists authentic experiences and handmade products. It provides a vital source of income and a platform for artisans to showcase the richness and diversity of their skills.

Rural artisan communities, which play an important role in preserving heritage and strengthening local economies, face numerous challenges when selling handcrafted goods in global markets. Geographically and economically isolated, these artisans face limited market

access, exacerbated by prohibitively high platform fees on traditional e-commerce sites, eroding their already slim margins. Branding and marketing, critical for competing in a global marketplace, pose another significant challenge due to lacking resources and expertise. Furthermore, international logistics and shipping of goods add complexity and cost, ranging from high shipping rates to navigating complex international regulations. These artisans must also deal with the pervasive presence of mass-produced goods, which frequently undercut their unique, handcrafted items in terms of price and availability. Language barriers complicate their expansion into global markets, affecting everything from customer service to understanding e-commerce platforms. A critical aspect of their business, the personal touch and stories behind each handcrafted item, is frequently lost in the digital marketplace, reducing their competitive advantage. Furthermore, protecting the intellectual property of their traditional crafts and designs remains difficult, with the risks of cultural appropriation and plagiarism looming. (Datta & Bhattacharyya, 2016b; Vadakepat, 2013; Parthiban et al., 2018)

In response to these issues, a ***community-driven e-commerce platform*** for rural handicraft artisans is a vital domain. It is a specialized online marketplace that focuses on connecting artisans from rural areas with a broader customer base in a global context. This platform is mainly designed to support and promote traditional crafts and handmade goods created by these artisans. The "community-driven" aspect indicates that the platform operates with significant input, involvement, and even governance from its community of users, which in this case includes the artisans themselves, as well as customers who are interested in handmade and traditional items (Gupta et al., 2023; Shah, 2016).

1.1.1 Cultural Significance and Diversity of Rural Artisan Practices

Rural artisan practices represent a rich tapestry of cultural heritage and diversity, reflecting communities' unique identities and histories across various geographical landscapes. These traditional crafts, encompassing a wide array of activities such as hand embroidery, weaving, pottery, woodwork, and metalwork, are not merely methods of producing utilitarian or decorative items but are pivotal in preserving and narrating rural communities' stories, traditions, and identities (Marques et al., 2018). Their significance extends beyond cultural preservation to socioeconomic impacts, providing vital income sources and sustaining local economies. Intrinsically linked to environmental sustainability, these practices often employ eco-friendly materials and methods, resonating with contemporary global priorities of

ecological consciousness. The transmission of these skills from generation to generation is an educational cornerstone within these communities, ensuring the longevity of these practices. Moreover, they foster tourism and cultural exchange, allowing for a broader appreciation and understanding of diverse cultural expressions (Dash, 2015). However, these artisan practices face challenges from globalization and modernization, making preservation efforts by various entities crucial to survival. Thus, rural artisan practices are a window into human societies' cultural diversity and heritage and are critical in understanding rural communities' socioeconomic and environmental interactions.

1.1.2 Economic contributions of rural artisans to local communities

Rural artisans significantly contribute to the economies of local communities, serving as pivotal agents of income generation and economic stimulation. Predominantly reliant on their crafts for livelihood, these artisans support their families and invigorate the local economy by circulating earnings within the community, including purchasing local materials and services. This cycle of economic activity extends to creating employment opportunities, both directly in their enterprises and indirectly through associated industries. Furthermore, the uniqueness of their products attracts tourism, a vital source of revenue, enhancing the economic vitality of these rural areas. The sustainability of these artisan practices also ensures the preservation and transmission of traditional skills, which hold long-term economic value, particularly in cultural tourism (Islam et al., 2020).

Moreover, rural artisans engage in market diversification, reaching national and international markets, thereby reducing economic vulnerability and fostering resilience. Their capacity for innovation and adaptation to contemporary market demands exemplifies their role as cultural custodians and dynamic contributors to rural economic development. This multifaceted economic contribution of rural artisans underscores their indispensable role in the socioeconomic fabric of local communities, a theme critical to understanding rural development dynamics globally (Steiner & Atterton, 2015).

1.2 Defining the Problems and Challenges Faced by Rural Artisan Community

One of the foremost challenges is the lack of access to markets. Many rural artisans are geographically isolated, making it challenging to reach broader markets where they can sell their products at fair prices (ITU, 2005; Khan & Amir, 2013). This isolation is physical and digital, as many artisans lack the technological know-how and resources to tap into online

marketplaces, a deficiency further exacerbated by inadequate internet connectivity in rural areas. Furthermore, the rural artisan community often grapples with the scarcity of raw materials. Environmental degradation, climate change, and unsustainable sourcing practices have led to the depletion of the natural resources many artisans rely on (Bandyopadhyay et al., 2015). This increases the cost of production and forces artisans to compromise on the quality of their products. Another significant issue is the diminishing transmission of traditional skills and knowledge. As younger generations migrate to urban areas for better employment opportunities, a growing disconnect exists between their cultural heritage and artisanal skills (Alstyne & Parker, 2017). This generational gap threatens the survival of traditional crafts, which are integral to cultural identity and heritage. Moreover, the exploitation by middlemen is a critical concern. Rural artisans, lacking direct access to markets, often rely on intermediaries to sell their products. These middlemen, capitalizing on the artisans' vulnerabilities, frequently offer unfair prices, leaving the artisans with meagre earnings and perpetuating cycles of poverty (Sundararajan, 2016).

1.2.1 Challenges and Views on India's Artisan Sector in India

Crafts are those products for which value added due to hand-driven processes (may or may not be functional) is substantially high (Khan & Amir, 2013; Reddy et al., 2016). The craft sector comprises essential livelihood opportunities for the marginalized sections of societies in many developing countries, specifically in rural areas in South Asia and Africa (Rogerson & Sithole, 2001). Moreover, the industry seeks to leave minimal environmental spoilage through production techniques with only a tiny carbon footprint and naturally occurring raw materials and indigenous methods. Despite its potential, the rural artisans in this industry face several obstacles that threaten its very existence. Rural artisans' fundamental problem is that most of their industries are informal and unorganized, with individual artisans working independently (Ghouse, 2012). This amounts to rural artisans not being able to exploit the same opportunities that the entities exploiting economies of scale enjoy, resulting in a set of problems, which include: (i) lack of/ limited access to quality raw materials and tools needed to compete in global markets (Scrase, 2003); (ii) their being out of touch with the needs of peoples beyond their local market (Shah et al., 2017); and (iii) limited ability to cater to global customers' needs (Rogerson & Sithole, 2001; Harrison & Zappen , 2005; Shah et al., 2017). These are the causes that make life difficult for them through such barriers and compel them to find other options for earning, thus jeopardizing current sources of livelihood and the future of indigenous talent and culture.

1.2.2 Limited market access for rural artisan products

Researchers have tried to explain the low participation in the marketplace by identifying four types of market separations between customers and producers: spatial, financial, temporal, and informational (Bartels, 1968; Singh et al., 2015; Tarafdar et al., 2012). *Spatial separations* are the geographical distances between producers and consumers. *Financial separation* arises from either a lack of purchasing power among consumers or limited access to capital for producers. *Temporal separation* occurs when there is a time lag between producing and consuming a product. *Informational separation* is due to an information imbalance between market producers and consumers. Additionally, religions, the caste system, and social customs significantly influence the development of Indian markets. This social discrimination (Singh et al., 2015) can manifest in dominant social norms and regressive socio-cultural practices that limit producers' capacity or market access.

Tarafdar et al. (2013) discuss how ICT-enabled product and process innovations can drive market growth at the grassroots level within the same industry. They explore the relationship between ICTs and the reduction of Bartels' four market separations (Tarafdar et al., 2012). Singh et al. (2015) studied Chanderi weavers in India. They found that the Digital Empowerment Foundation used ICTs through the Chanderi Weavers ICT Resource Centre (CWICTRC) to diminish the four market separations faced by weavers. Parthiban et al. (2018) introduced Capacity Separation and Capability Separation as additional market separations. *Capacity Separation* refers to the discrepancy between customer demand and the time-restricted capacity of producers to meet these demands. Business opportunities are sometimes lost when large retailers place bulk orders that rural producers cannot fulfil due to rural life's disaggregated and localized nature. Capability Separation is the gap caused by artisans' limited exposure to the latest design practices and trends. Artisans usually learn their craft within their families and pass it down through generations, often continuing to produce traditional products, even if they become obsolete, due to this lack of exposure, despite their solid core skills.

1.2.3 Technological Disparities Hindering Participation in the Digital Economy

Although policymakers have not focused much on modernizing the crafts industry, other stakeholders have tried to address its challenges. Each intervention, however, has faced specific limitations. For instance, entrepreneurial ventures like FabIndia (https://www.fabindia.com/), despite acting as bridge enterprises and significantly uplifting their target communities (Vong et al., 2017), are still limited in their inclusiveness within their operating regions and scalability across others. In contrast, digital technology-driven approaches have resulted in isolated

efforts, with ICT-based interventions targeting problems within specific sub-supply chain segments (Singh et al., 2015).

E-commerce platforms such as GeM, India Handmade Bazaar, Crafts Villa, etc., offer online storefronts for artisans, reducing middlemen layers and increasing product margins. However, these fragmented solutions, like passive e-commerce interfaces, have not addressed the artisans' complex challenges (Cui et al., 2017). Lastly, NPO interventions by organizations like Banglanatak (http://banglanatak.com/) and Digital Empowerment Foundation (http://defindia.org/) (with and without ICT) have attempted system-wide changes and made significant contributions to their communities. However, they too have been constrained by their reliance on donor-dependent models, limiting their scalability and sustainability (Singh et al., 2015).

Therefore, a more comprehensive approach is necessary to explore the relationships and interactions among these entities, fostering the formation of virtual communities that can bridge the knowledge and information gap and market segregation faced by rural artisans' communities.

1.3 Information System for Rural Artisans to Mitigate the Challenges

Information System for Rural Artisans designs and implements a technology-based solution to empower rural artisans. It addresses their critical barriers, such as limited market access, insufficient knowledge of market trends and pricing, and inadequate business acumen. The system's objectives include providing a platform for broader market exposure, disseminating crucial information on trends and prices, facilitating skill enhancement through online workshops, fostering a supportive artisan community, and offering financial guidance. Drawing upon existing literature, the study underscores the transformative role of technology in uplifting marginalized communities and emphasizes the need for a context-specific approach. The development methodology is participatory, involving artisans at each step, from needs assessment to system refinement based on pilot feedback. The implementation strategy considers the artisans' varying digital literacy levels and infrastructure challenges, proposing localized language options and user-friendly interfaces.

1.3.1 Definition of Information System for Rural Artisans

An information system for rural artisans is a technology-based framework designed to assist artisans in remote or rural areas in overcoming the unique challenges they face in their craft and business operations. This system typically comprises various digital tools and platforms

that enhance artisans' access to markets, information, and resources. Key components of such a system may include:

Online Marketplace: A digital platform where artisans can showcase and sell their products to a broader local and global audience.

Information Portal: A hub for real-time information on market trends, raw material prices, consumer preferences, and other relevant data that can help artisans make informed decisions about their products and pricing.

Training and Education Resources: Online resources, workshops, and training programs designed to help artisans develop new skills, understand modern techniques, and improve the quality of their craftsmanship.

Community Network: A virtual space for artisans to connect, collaborate, share experiences, and form support networks, facilitating knowledge exchange and peer learning.

Financial Services Access: Information and guidance on accessing financial services such as microfinancing, grants, and subsidies, which can be crucial for the growth and sustainability of their businesses.

The overarching goal of such an information system is a multifaceted digital solution to bridge the gap between rural artisans and the global market, empowering them through improved access to resources, knowledge, and opportunities. It addresses the unique challenges faced in rural settings, harnessing technology to preserve traditional crafts and cultural heritage while integrating artisans into the global marketplace.

1.3.2 Key components and functionalities

The information system for rural artisans is a dynamic, multifaceted platform designed to address specific challenges artisans face in rural and remote areas. This system comprises four key components: user profiles and community building, information sharing and dissemination, skill development and training resources, and market access with e-commerce integration. Each component plays a crucial role in empowering artisans, enabling them to harness the benefits of technology to enhance their livelihoods and sustain their cultural heritage.

- User Profiles and Community Building

At the system's core is creating individual user profiles for each artisan. These profiles serve not just as a digital identity but also as a comprehensive portfolio showcasing their skills, products, and unique stories. The community-building aspect of the system is facilitated through an online platform where artisans can connect, collaborate, and share experiences. This

feature aims to foster a sense of belonging and solidarity among artisans, allowing for the exchange of ideas, mentorship opportunities, and the formation of support networks. The community aspect is pivotal in breaking the isolation often experienced by rural artisans and building a collective identity that can advocate for their needs and rights.

- Information Sharing and Dissemination

Information sharing is another critical component. The system acts as a hub for disseminating relevant and timely information tailored to the needs of the artisan community. This includes market trends, materials sourcing, legal and regulatory updates, and opportunities such as fairs and exhibitions. By providing access to such information, the system ensures that artisans are well-informed and can make strategic decisions about their crafts and businesses. Regular updates, newsletters, and interactive forums further enhance the flow of information, keeping the community engaged and informed.

- Skill Development and Training Resources

Recognizing the importance of continuous learning and adaptation, the system includes an extensive section dedicated to skill development and training. This resource centre offers online workshops, training modules, video tutorials, and documentation on various topics ranging from traditional crafting techniques to modern business practices and digital literacy. The content is curated and designed to cater to different skill levels and interests, ensuring that all members of the artisan community can find valuable learning resources. The aim is to preserve traditional skills and equip artisans with the knowledge and tools necessary to innovate and compete in a changing market landscape.

- Market Access and E-Commerce Integration

The final and perhaps most impactful component is integrating market access and e-commerce capabilities. The system includes a digital marketplace where artisans can list and sell their products to a global audience. This e-commerce platform is designed to be user-friendly, accommodating varying levels of digital literacy among the artisans. It incorporates product catalogues, secure payment gateways, and logistics support. By providing artisans with direct access to broader markets, the system enables them to expand their customer base, increase their income, and gain greater control over their economic futures.

1.3.3 Extant ICT Initiatives in India's Crafts Sector

Despite the lack of focus from policymakers on modernizing the crafts industry, various stakeholders have attempted to tackle the sector's issues. Enterprises like FabIndia [https://www.fabindia.com/], though acting as intermediary businesses and significantly aiding

the development of their target communities (Tarafdar et al., 2012), have faced challenges in reaching inclusivity within their operational areas and expanding their impact into new regions. Additionally, digital technology-based efforts have often been fragmented, with ICT interventions targeting specific issues within parts of the supply chain (Leong et al., 2016). E-commerce platforms such as GeM, India Handmade Bazaar, and Crafts Villa, among others, provide online spaces for artisans to sell their products directly, circumventing the need for intermediaries and thereby increasing their earnings. However, these piecemeal solutions, like offering basic e-commerce capabilities to artisans, have not fully addressed the comprehensive issues they face (Cecchini & Scott, 2003). Non-profit organizations (NPOs), including Banglanatak [http://banglanatak.com/] and Digital Empowerment Foundation [http://defindia.org/] (with and without ICT), have strived for systemic changes and made significant strides in the communities they serve. Nevertheless, their reliance on donor funds has restricted their scalability and longevity (Singh et al., 2015). Thus, a more cohesive strategy is advocated to foster collaboration among various actors in this field, promoting the establishment of virtual communities to help overcome the knowledge, information gap, and market division that rural artisan communities encounter.

1.4 Objective of the Thesis

This dissertation seeks to leverage the potential of social technologies and socially enabled applications to address issues related to rural communities' marginalization and social exclusion. The conceptualization of a Community-Driven E-commerce Platform has led to developing a platform that empowers rural communities by establishing connections with non-local opportunity structures, including urban markets, government agents, trainers, and investors. The proposed platform aims to digitally bridge the rural-urban knowledge, information, and market divide by facilitating the online connection of rural community members with relevant agents and opportunities. Our study will explore the connections and collaborations among various entities with rural artisans in the craft supply chain that enable the formation of virtual communities, thereby bridging the knowledge, information, and market divide in rural communities. Forming these virtual communities positively impacts selling products in a global market context when they can increase network density and facilitate the spread of knowledge and information.

This dissertation aims to illustrate the effectiveness of the ***Community-Driven E-commerce Platform*** by showcasing how its collaborative foundation fosters various communities within rural and across rural-urban members. The proposed platform proves valuable in cultivating

two types of virtual communities: *communities of practice* and *communities of purpose*. Communities of practice involve a group of individuals sharing a specific practice. Collaborations among members or practitioners within a community of practice lead to collective learning, turning it into a collaborative space for learning. On the other hand, communities of purpose consist of people going through the same process or working toward a similar objective. In our research framework, we will endeavour to establish communities of purpose among rural-urban agencies to enhance the market prospects of rural producers. In rural settings, participants lack access to markets and face various ancillary factors contributing to their marginalization. Through community formation, meaningful dialogue, and collaboration, efforts can be made to empower the rural marginalised holistically.

Both communities of practice and purpose are pivotal forces in fortifying the knowledge capabilities of individual rural producers. They serve as dynamic drivers, rightly acknowledged as catalysts for fostering self-development along the intricate socioeconomic axis. These communities contribute to acquiring and exchanging valuable insights and play a vital role in empowering rural individuals to navigate and thrive within the complexities of their socioeconomic landscape.

Ultimately, both communities integrate with underlying blockchain technology to nurture trust, transparency, and collaboration among their members. Within communities of practice, where professionals collaborate and share knowledge, blockchain plays a pivotal role in enhancing the authenticity and security of information exchange. Its decentralized and tamper-resistant nature safeguards the integrity of shared data and the authenticity of handmade craft products, making it an optimal tool for validating credentials, certifications, and professional achievements. This functionality streamlines trust-building among community members and urban consumers and facilitates more accurate assessments of expertise, fostering a dynamic exchange of insights and best practices. Blockchain technology provides advantages regarding transparent and traceable transactions in communities of purpose characterized by a shared mission or goal. Leveraging smart contracts on a blockchain enables programmable agreements, automating the recording and execution of commitments and contributions based on predefined conditions. This not only bolsters accountability but also mitigates the risk of fraud, establishing a more efficient and reliable framework for collaborative initiatives within the community.

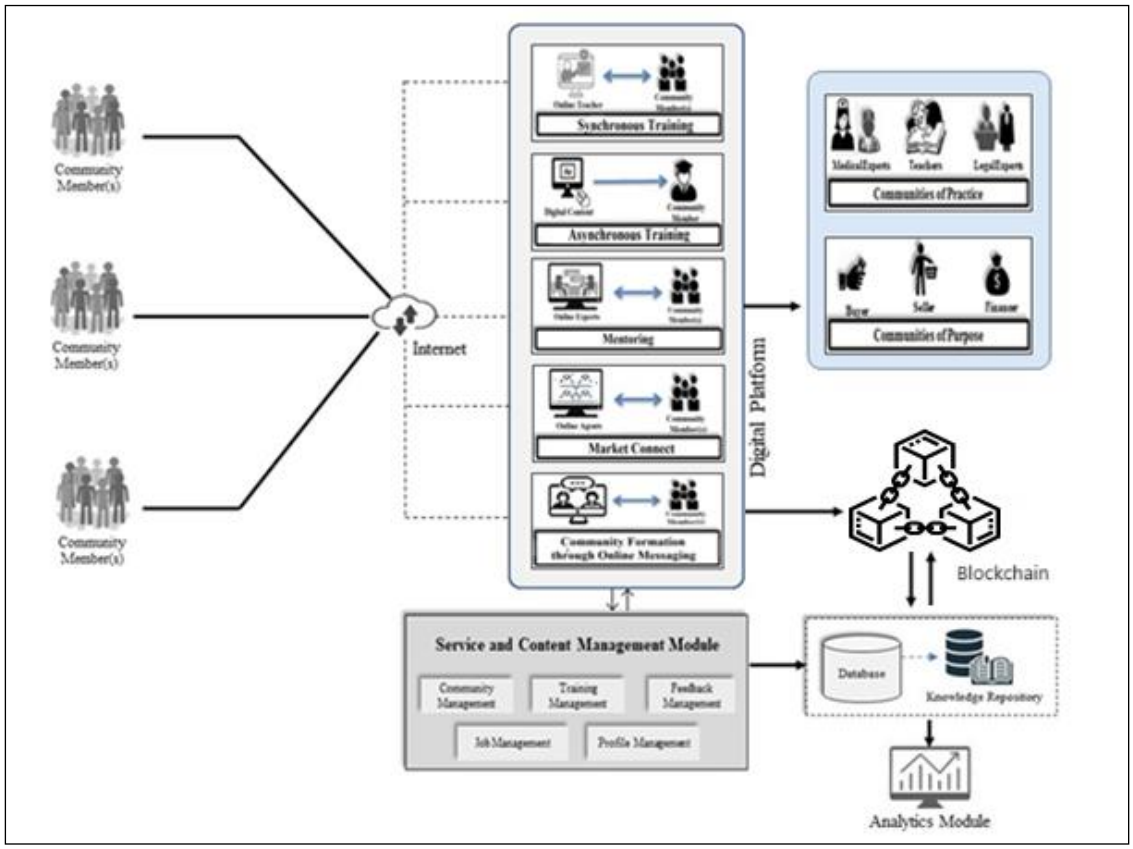


Figure 1.1 Functional Block Diagram of a Community-Driven E-commerce Platform

This dissertation will implement a Community-Driven E-commerce Platform to promote purposive urban-rural information and knowledge exchange through the Internet, thus bridging rural communities' rural-urban knowledge and information divide in the product selling context. This platform provides a decision support mechanism to rural life and livelihood management authorities through the active involvement of the rural community members who may share their problems and concerns through this platform. Web content is also significant in the Indian context. The dominance of the English language in internet content may inhibit the rural community of India from exploiting the benefit of readily available content from the Internet for their life and livelihood improvement.

Different virtual communities are expected to emerge from the resultant collaboration through this Community-Driven E-commerce Platform by facilitating rural-urban exchange. The platform traces the journey of the community members to highlight successful participation in the formed community of practice and communities of purpose.

In addition to this, the **Service and Content Management Module** oversees the shared knowledge resources within the platform. The **Service Management Module** is crucial in allocating services and resource capacities to individual users. This module allows the

formation of diverse user groups based on user preferences and manages all services related to real-time knowledge sharing and transactions among users. On the other hand, the **Content Management Module** serves as a logical block, facilitating the creation, storage, organization, access, and publication of content. The different segments of this module are Community Management, Training Management, Feedback Management, Job Management and Profile Management.

- The Profile Management Module automatically consolidates and optimizes user profiles, aiming to minimize management and storage demands. This module requires minimal administration, support, and facilities, while providing users with enhanced options.
- The Job Management module undertakes various tasks, including a) organizing and searching for open jobs, b) managing a list of available rural producers for job assignments, c) flagging unassigned work orders, and d) facilitating job management through a user-friendly job console.
- The Community Management module is designed to manage diverse activities within two distinct community types: Communities of Practice and Communities of Purpose.
- The Training Management module diligently monitors all training-related activities conducted through our platform.
- The Feedback Management module captures and processes feedback from various stakeholders, conducting analytical operations to derive meaningful insights.

Effective management during the Service and Content Module Phase facilitates the establishment of a Database and Knowledge Repository. Subsequently, the Analytics Module is applied to assess the effectiveness of collaboration within our platform. The Knowledge Repository module captures users' tacit knowledge, often found in chat logs from messaging apps, and oversees the management of an explicit knowledge pool. This pool can be accessed and expanded according to specific transactional requirements.

In the scope of this dissertation, our methodology unfolds in a two-fold process. Firstly, we have conceptualized and developed a robust, Community-Driven E-commerce Platform. This platform is intricately designed to holistically support the exchange of information and trustworthy knowledge within rural communities and between rural and urban counterparts. A distinctive feature of this platform involves the inclusion of domain experts. Rural participants

are given opportunities to interact, collaborate, and exchange knowledge with these experts in real-time, fostering a synchronous mode of communication.

Secondly, we have introduced an asynchronous messaging tool to complement these synchronous interactions. This tool serves as an additional layer, enabling community members to engage with each other or access various services personally at their convenience. This asynchronous component adds flexibility to the collaborative process, acknowledging the varied schedules and preferences of the individuals involved.

The ultimate goal of our approach is to bridge the existing knowledge and information gap between rural and urban communities. The proposed platform ushers in holistic rural empowerment by combining real-time interactions with asynchronous communication tools. This initiative seeks to empower individuals within rural settings with the resources and information needed to thrive in an increasingly interconnected world by facilitating seamless knowledge exchange.

1.5 Research Contribution of the Thesis

The research contribution of the thesis titled "Issues of Rural Artisans: A Study and Implementation of E-commerce Platform to Mitigate the Challenges" is multifaceted and significant, drawing on extensive analysis and innovative approaches to address the unique challenges faced by rural artisans. Key contributions of this research are:

- **Exploration of Information System Evolution for Rural Producers:** The thesis provides a comprehensive historical and technological review of information systems for rural producers. It traces the evolution from simple information dissemination systems to complex, interactive platforms, highlighting the shift towards collaborative, community-driven models. This contributes to a deeper understanding of how information systems can be tailored to serve rural communities better.
- **Development of a Community-Driven E-Commerce Platform (NCoRe):** A significant contribution is the design and implementation of NCoRe, a novel Community-Driven E-commerce Platform. This platform addresses the specific needs of rural artisans by incorporating their feedback and ensuring their active participation in the E-commerce ecosystem. The research details the architectural design, functionality, and validation of NCoRe, demonstrating its effectiveness in bridging the digital and market divide for rural communities.

- **Analysis of Opinion Dynamics in Rural E-Commerce:** The thesis delves into the role of opinion dynamics in rural E-commerce settings. It examines how opinions influence consumer behavior, decision-making, and trust-building in rural markets. The research underscores the importance of managing user-generated content, like reviews and artisan stories. It highlights the role of technology in amplifying these dynamics to enhance user experience and platform credibility.
- **Innovative Application of Blockchain Technology in Rural Artisan Supply Chains:** One of the most significant contributions in this thesis is the conceptualization and implementation of blockchain technology in the Community-Driven E-commerce Platform for rural artisans. The research outlines a blockchain-enabled framework that enhances transparency, traceability, and efficiency in product authentication, revolutionizing traditional practices. It includes a prototype for digital asset management and traceability, demonstrating how blockchain can create more equitable and transparent marketplaces for rural artisans.
- **Practical Field Studies and Prototype Implementations:** The thesis is enriched with practical field studies and the implementation of prototype systems, providing empirical evidence to support the theoretical frameworks and technological solutions proposed. These studies, particularly with Self-Help Groups (SHGs), rural youths and rural handicraft artisans in India, offer valuable insights into the real-world application and impact of the proposed solutions.
- **Interdisciplinary Approach and Future Research Directions:** The research integrates concepts from information systems, e-commerce, blockchain technology, and rural development, demonstrating a comprehensive interdisciplinary approach. It also suggests future research directions, including the further development of community-driven platforms, exploration of advanced technologies in rural settings, and expanded field studies in diverse rural contexts.

This thesis substantially contributes to rural development, e-commerce, and information systems by offering innovative solutions and comprehensive insights into rural handicraft artisans' challenges. It advances academic understanding and provides practical frameworks and tools to enhance rural artisan communities' livelihoods and market engagement.

1.6 Organization of the Thesis

The dissertation is structured as follows:

Chapter 2 of the thesis, titled "**Literature Survey: Information System for Rural Producers**", analyses the transformation of information systems intended for remote producers following its development from almost pointless customizations to modern integrations. The introduction to the chapter sets the stage for the deep analysis of the progressive generations of these systems. It starts with the first generation concentrating on Community Information Systems (CIS), primarily facilitating a one-way flow of information while earmarking the early effort in digital information sharing for rural communities. The narrative then transitions to the second generation, characterized by bidirectional information sharing. This evolution signifies a leap towards more interactive systems, enabling the dissemination of information to rural producers and allowing feedback and inputs to flow back to the source. The chapter also delves into the third generation, where a significant shift to multi-directional knowledge collaboration is observed. This generation is distinguished by its capacity to enable dynamic information exchanges, foster rich interactions among diverse stakeholders, including rural producers, experts, and consumers, and form an intricate knowledge network. Moving beyond the third generation, the chapter culminates with an insightful discussion on integrating blockchain technology with community information systems. This section underscores how blockchain can revolutionize these systems by enhancing transparency, security, and trust, crucial elements for rural artisans and producers. The conclusion of the chapter not only synthesizes these evolutionary stages but offers reflections on the impacts each generation has had on improving access to information and collaboration among rural communities. It closes with forward-looking insights into potential future directions and emerging research areas within this domain, underscoring information systems' continual evolution and significance in rural production.

Chapter 3 of the thesis, "**Building a Community-Driven Information System**", explores the development and impact of Community-Driven Information Systems in rural settings, focusing on both Communities of Practice and Communities of Purpose. The chapter begins with an introduction that sets the stage for understanding the significance of these Community-Based systems in empowering rural artisans. It delves into the *Community of Practice*, discussing the factors leading to its cultivation, its essential components and structure, and what determines its sustainability. Similarly, the *Community of Purpose* is explored, examining the same elements to highlight its role in rural development. The chapter then transitions to real-world

applications, showcasing field studies involving Self-Help Group (SHG) women and youth in rural India. It also captures different aspects of the rural handicraft artisan communities, detailing their experiences, challenges, and the outcomes of these community-driven approaches. Further, it examines the role of online Communities of Purpose in bridging market separations faced by rural producers, analyzing rural market dynamics, the challenges rural producers face, and how digital platforms can foster connections. This section also explores how technology and purposive collaboration via these communities can integrate rural markets. The chapter concludes by synthesizing the insights and implications of these community-driven systems, reflecting on their potential to enhance rural livelihoods and showing the directions for developing a community-driven e-commerce platform in the rural context. This comprehensive overview effectively highlights the transformative power of community-based approaches in leveraging information systems to benefit and empower rural communities.

Chapter 4 of the thesis, titled "**NCoRe: Architecting a Community-Driven E-Commerce Platform**", presents an in-depth exploration of the conceptualization, development, and validation of NCoRe, a novel Community-Driven E-commerce Platform designed to cater to the unique needs of rural communities. The chapter begins with an introduction to community-driven e-commerce platforms, defining the concept and examining the shift towards collaborative e-commerce models, emphasizing the growing emphasis on community involvement in the e-commerce sector. It contrasts this with traditional e-commerce platform architectures, providing an overview of their standard designs and identifying their limitations, particularly in serving rural communities. The chapter's core delves into the architectural design of NCoRe, detailing the technological frameworks that facilitate community integration, including the platform's motivation, conceptual framework, and functional description. It further examines the deployment of NCoRe, focusing on its design, salient features, and workflow and how it aims to mitigate the knowledge and market divide in rural areas. The chapter then moves to validate the effectiveness of NCoRe through field observations and simulation techniques, offering insights into its practical impact and areas for enhancement. Additionally, it discusses the potential integration of blockchain technology in NCoRe, highlighting how this could further enhance the security and authenticity of the platform. The chapter synthesises these aspects, underscoring the significance of NCoRe in community-driven e-commerce and its potential to revolutionize rural market engagement while also pointing towards future research and development directions. This comprehensive overview effectively demonstrates NCoRe's innovative approach to bridging the gap between traditional

e-commerce models and the specific needs of rural communities through community-driven strategies.

Chapter 5 of the thesis, "**Opinion Dynamics and its Significance in Community-Driven E-Commerce Platform**", thoroughly explores the role and impact of opinion dynamics in rural e-commerce. The chapter begins by introducing the concept of opinion dynamics, focusing on how they specifically manifest and influence consumer behaviour in rural e-commerce settings. It delves into the characteristics of these dynamics, examining the factors that influence opinion formation and change and their significant impact on rural consumers and producers. Special attention is given to the dynamics of user-generated content, such as the influence of reviews, ratings, artisan stories, and testimonials, and how these elements contribute to shaping opinions and building dynamics among users. The chapter then explores the crucial link between trust and user opinions, discussing strategies to enhance trust in rural e-commerce platforms through effective management of opinion dynamics. Furthermore, it examines the role of technology and e-commerce platforms in facilitating and amplifying these dynamics, emphasizing the importance of platform design and user experience. The conclusion of the chapter synthesizes these insights, highlighting the profound impact of opinion dynamics on consumer behaviour, trust-building, and decision-making in rural e-commerce. This comprehensive overview demonstrates the pivotal role of opinion dynamics in shaping the landscape of rural e-commerce, underlining their importance in community-driven platforms.

Chapter 6, "**Blockchain-Enabled Community-Driven Rural E-Commerce Platform: An Innovative Implementation Approach for Digitization of Assets**", provides an in-depth analysis of the implementation and impact of blockchain technology in creating the digital assets of handicraft products of rural artisans. The chapter begins with an introduction to blockchain, elucidating its fundamental concepts and potential applications in rural e-commerce settings. It then delves into rural artisans' current supply chain dynamics, identifying their challenges in traditional systems. The chapter outlines a conceptual framework for blockchain implementation and discusses the design of a blockchain-enabled supply chain and its impact on the digitization of assets. It is crucial for enhancing value realization and asset management for rural artisans. Focusing on digital asset management, it explores the process of defining and digitizing crafts as blockchain assets, emphasizing the technology's role in ensuring transparency, traceability, and provenance. The chapter details an innovative framework for implementing blockchain in the crafts sector in the rural context. It covers aspects such as creating digital identities for artisans and their products, artisan and product

registration, and establishing a traceable e-marketplace to connect sellers and buyers, ensuring product authenticity and transparent transactions. Implementing a prototype traceability framework is also discussed, showcasing practical applications. The chapter concludes by summarising the transformative potential of blockchain in the rural artisan sector, highlighting how it can revolutionize traditional supply chains by enhancing efficiency, transparency, and trust. This comprehensive overview showcases the pivotal role of blockchain technology in reshaping the rural crafts supply chain, marking a significant advancement in rural e-commerce ecosystems.

Chapter 7 winds up the dissertation with a conclusion and a discussion on possible works in the future direction.

Chapter 2

Literature Survey: Information System for Rural Producers

2.1 Introduction

Implementing information and communication technologies (ICTs) holds significant potential for impacting developing nations. These technologies can be instrumental in connecting rural areas with broader economic and social progress while also aiding in preserving and enhancing their cultural and intellectual heritage. Rebecca (2011) notes that ICTs can integrate rural communities into broader economic and societal growth. However, this perspective is grounded in an exogenous model of development, which forms the basis of many strategies aimed at using ICTs for poverty reduction. This model focuses on external development, overshadowing the endogenous approach, or internal development, which places greater emphasis on the individual human element, resources, and ambitions (ITU, 2011; Mansell,2010). Furthermore, it is essential to differentiate between "information systems" and "information technology," as the focus should not only be on the technology itself but also on the organisational processes it facilitates or transforms (Schlagwein, 2011). Thus, in studying the impact of social technology on societal good, the emphasis should be on the process rather than a purely technological viewpoint.

The Exogenous Model is predicated on the belief that the requisite technology—including hardware, software, and services—is universally accessible and that there is a broad base of experience in utilizing this technology. According to this framework, the development strategy promotes the procurement and implementation of technology, endorses training for its effective use, and calls for essential regulatory adjustments (ITU, 2011). This premise is deeply embedded in classic theories of modernization, which advocate for the transfer of technologies from more developed to less developed nations.

Mansell (2010) highlights that the exogenous model, along with certain variations of the endogenous model, often overlooks the motives of investors from the global North, who are chiefly interested in profiting from the sale of digital technologies and the content that is

accessed or distributed via these technologies. A prominent example of this trend is the Facebook Free Basics program, which provides users with free access to the internet but restricts this access to a predefined set of websites, Facebook included.

Undoubtedly, the adoption of this approach has led to numerous significant advancements. Through it, ICTs are acquired and utilized, telecommunication infrastructures are enhanced, the costs for these enhancements are lowered, and global connections are established. This progress is evident in various regions, including Africa, Sri Lanka, Thailand, Bangladesh, and India, as well as countries in South-East Asia and Eastern Europe. Notable improvements have been seen in four key areas: 1) agriculture and healthcare; 2) infrastructure development, communication, and community informatics or knowledge sharing; 3) fostering economic empowerment and small-scale entrepreneurship; and 4) the development of policies, strategies, and e-governance systems (Rebecca, 2011; ITU, 2005).

The impact of information and communications technology (ICT) on rural development goes beyond just enhancing ICT literacy and access for individuals. Bjorn-Soren Gigler's 2011 research highlights a gap between ICTs and socio-economic advancement. His findings suggest that ICTs, as tools for disseminating information, play a crucial role in the development process, not merely connecting individuals. If information is vital for development, then ICTs, as facilitators of information exchange, are integral to the development process. Furthermore, the capacity of ICTs to effectively amalgamate and stabilise disparate market elements into cohesive units can enhance market operations and foster a more enduring development model.

The potential of information and communications technologies (ICTs) for rural development is often discussed in the context of information and knowledge's power. However, sharing information and knowledge is complex, especially when engaging with individuals and groups who lack empowerment. This process cannot easily be turned into a commercial product or service. While certain types of information, such as agricultural prices or health-related details, can be disseminated through a rural kiosk model, most other forms of information and knowledge sharing necessitate a much greater degree of human interaction. These exchanges should be driven by a selfless, community-focused approach (IT for Change, 2009). For example, consider a poor and marginalized woman seeking help as a victim of domestic

violence. She may not have access to a digital platform that would enable her to seek and receive help and guidance from the wider world.

The Endogenous Model of development posits that the key influence of ICTs and their application is not rooted in the technology itself but rather in the novel patterns of information-related behavior they enable. Such emerging behaviours have the potential to forge new connections, paving the way for the generation of new values and transformative shifts not only in the economic realm but also in social, political, and cultural dimensions (Mansell, 2010).

The UNRISD (2005) workshop concluded that it is a significant error to view these developments as part of a uniform, global process with a singular outcome. Instead, it is essential to recognize them as diverse new processes, each interacting with and influenced by the specific society in which they occur. This perspective underscores that the primary goal of using information and communications technology (ICT) for economic development should be to address the unique informational challenges encountered during development. The fundamental developmental task is to ensure that these initiatives are driven by the community, fostering and aiding the evolution of community-based informational developments.

The exogenous model traces the roots of initial efforts in using ICT for creating First-Generation Community Information Systems back to their inception. These early endeavours employed information and communication technologies to distribute specialized information unidirectionally to specific social groups. In this approach, the nature and content of the disseminated information were determined not by the local needs but by external policymakers and development agents, including government bodies. Essentially, this method involved either distributing specialized information to or imposing it upon social groups from external sources.

During this period, the concept of interaction began to emerge, paving the way for the development of second-generation community information systems. This phase focused on facilitating dialogue among various stakeholders about the dissemination of information and knowledge. While interaction is a key component of this second generation, it is crucial to remember that, until this point, the initiatives only provided a platform for stakeholders to discuss the information shared. Consequently, stakeholders remained largely passive recipients of information, lacking the means to create new information or alter what was already available. Even though the interactive premise allowed the target audience to inquire about the information being disseminated, it did not foster community building or empower the target group to become

information "producers". The technology of the time, despite enabling the gathering of information from diverse sources and supporting a two-way exchange, lacked the necessary reach and capacity for facilitating collaboration and information exchange among multiple participants.

A Community-driven Information System transcends this two-way interaction model. It gives rise to a Third-Generation Community Information System, which promotes collaboration in information and knowledge among multiple agents. This is achieved by harnessing the connective essence of modern digital social technologies as a conduit for information dissemination.

As previously noted, social technology has unveiled new social and economic realms, largely dependent on effective resource sharing and coordination of efforts. At this stage, utilising a Community-driven Information System can optimally leverage crowd resources and enhance collaboration among crowd members, which are key in empowering social participants. These practices are recognised for fostering a network-centric ethos and enhancing multi-agent collaboration. This ethos empowers individual social actors and aims to cultivate an environment conducive to collaboration, supporting its formation and ongoing development. The initiatives of the third generation are adept at dynamically managing community information and knowledge. They promote social interaction within and among groups by harnessing the capabilities of social technologies.

2.2 The First Generation: Facilitating Information Dissemination through Community Information Systems (CIS)

The first generation of deploying digital services to manage social knowledge can be traced to the formulation of Community Information Systems. An information system designed to serve the community is rightly identified as Community Information Systems (CIS) (Venkatappaiah, 1999). The reason behind the emergence of CIS can be traced to the growing concern that disempowered groups majorly owe their marginalization to the lack of adequate information crucial to undertaking informed decisions. As a result, CIS emerged as a digital infrastructure, which attempted social development by feeding relevant information to socially marginalized people (Childers, 1975). The CIS attempted to provide information effective for mitigating problems and crises encountered by individuals in their everyday lives.

CIS attempted to serve different types of social groups. Starting from the geographic community (region, city) to communities of interest, CIS attempted to deliver contextual information for communitarian betterment. The CIS model mainly adopted a uni-directional information dissemination mode reliant on a combination of information resources. Uni-directional information flow is only successful in passively disseminating information to the target group, thereby treating them as inert consumers of information (Basak & Bhaumik, 2023).

Community Information Systems (CIS) were initially conceptualized by developmental agents and welfare pioneers, who identified two key types of information to be disseminated: survival information and citizen action information. Survival information encompasses essential health, housing, and income knowledge, enabling individuals to meet their basic needs and maintain a decent quality of life. Citizen action information, on the other hand, empowers individuals and groups to effectively participate in social, political, economic, and legal processes. These two categories of information were deemed crucial for empowering marginalized communities, and their dissemination became a central tenet of CIS initiatives.

Community Information Systems (CIS) sought to serve diverse social groups, ranging from geographic communities (regions, cities) to communities of interest, by providing contextually relevant information for community advancement. Like the maintenance of digital repositories in the early stages of organizational information management, CIS-inspired ICT for social causes focused on establishing and maintaining community information libraries. These libraries aimed to serve as information centres for community members. However, a one-directional flow of information only passively disseminates information to the target group, treating them as passive recipients rather than active participants in the information exchange.

During the 2003 World Summit on Information Society in Geneva, Arun Shourie, the former Union Minister of Information Technologies and Telecommunications of India, proposed four projects to commercialize CIS for developmental purposes (Ghosh, 2005)

- Utilizing ICT to eradicate illiteracy.
- Creating a universal networking language to enable individuals in India to input data on the internet in any recognized language, subsequently translated by machines into a universal networking language for widespread accessibility of information.

- Enhancing text-to-voice and voice-to-text software to perfection for the benefit of the print-disabled.

- Ensuring affordability and extended reach of ICT is crucial for supporting a comprehensive networking infrastructure.

The commitment made at the World Summit reflects global concerns about how ICTs can be effectively employed to address developmental issues. This concern has catalyzed numerous initiatives to use ICT to alleviate social challenges.

Joseph Kiplang's research in rural Kenya examined how ICT could improve access to, transfer of, and use of agricultural information among local communities (Kiplang, 1999). The results of the study emphasized that although ICT has the potential to be an effective channel for conveying vital information to rural areas, its beneficial effects are dependent on its integration with and relevance to the particular needs of the community it aims to support, rather than being an externally imposed solution (Kempson, 1986).

Moreover, expertise and information processing skills tend to be more constrained in rural communities than in urban ones. As a result, rural communities frequently face challenges in accessing CIS. The rural environment is marked by conditions such as poverty, geographical isolation, low literacy levels, inadequate education and healthcare services, and limited transportation and communication infrastructure (Kipling, 1999). The marginalisation of the rural sector constrains their material conditions and limits employment opportunities, reducing the quantity and quality of their information resources. In this demanding context, the CIS model holds limited promise for effectively disseminating information to marginalized groups on a broad scale.

Rural environments are often afflicted by poverty, geographical isolation, low literacy rates, inadequate education and healthcare, and deficient transportation and communication infrastructure (Kiplang, 1999). These factors contribute to the marginalization of rural communities, constraining their material conditions, employment opportunities, and access to information. In this context, the CIS model holds limited promise for effectively disseminating information to marginalized groups on a widespread scale.

In light of the worldwide context, a range of CIS (Community Information Systems) models have been advanced and launched by various developmental stakeholders, including governments and non-profit organizations, aiming to deploy computerized information systems to foster community development (DeSanctis and Poole, 1994). To bridge the gap between local experts and remote rural communities in Ghana, Literacy Bridge adopted the CIS framework and introduced the Talking Book, as documented by Schmidt et al. (2011). This portable, battery-powered device was crafted to provide crucial information accessible to Ghana's rural populace.

The Talking Book is designed to allow users to produce and playback audio recordings, in addition to enabling the transfer of these recordings between devices. Local specialists were engaged in inputting vital information on survival, including agricultural practices, health advice, and other essential knowledge, into the devices. These devices were subsequently disseminated among the community members. By enabling the exchange of information between development organizations and rural communities, the Talking Book has been instrumental in introducing innovative practices aimed at transforming local behaviours.

The Talking Books were allocated to the rural community of Ving Ving, located in the upper western region of Ghana, an area noted for its significant developmental challenges, including the absence of electricity and a 77% illiteracy rate among the local populace. In the assessment phase, an impressive 94% of the local users indicated that they had implemented new health or agricultural practices acquired through the Talking Book. Although the study confirms the beneficial impacts of the Talking Book, it also points out a crucial limitation: the device's unidirectional information dissemination method restricts the variety of information that can be shared, confining it to predetermined content.

Exchanging more intricate information and knowledge requires a framework that emphasizes human interaction, facilitating a space for dialogue. Additionally, the effectiveness of the device, as evidenced by user feedback, hinges on the selection of respondents by local leaders, which introduces a risk of bias and favouritism from the selectors. The validity of using a CIS-based development model based on a study of limited scope is questionable. The positive responses that ostensibly validate the CIS approach are largely based on the personal recollections of local users and lack a thorough critical examination.

Philip Parker's Toto Agriculture (ToToAgriculture, n.d.), developed in collaboration with the Bill and Melinda Gates Foundation, Grameen Foundation, Farmer Voice Radio, and Farm Radio International, serves as a prime example of the Community Information System (CIS) model in action. Toto Agriculture is an online database that offers a wealth of agricultural knowledge, including planting techniques, soil management, and weather predictions (Laureys, 2016). By aggregating information from over 750 sources, the platform provides tailored content in nearly 60 different formats. It organizes information by agricultural topics, presenting country-specific data on its dashboard, where, for example, Ugandan farmers can access content customized for their locale—features like a crop calendar guide farmers on timely discussions throughout the year. Additionally, Toto Agriculture is developing a GPS-enabled app to improve the accuracy of weather forecasts by locating the nearest weather stations. Despite its innovative approach to leveraging ICT to modernize agriculture, a critical analysis of Toto Agriculture reveals a significant limitation: the initiative mainly channels aggregated explicit knowledge to farmers, positioning them as passive recipients rather than active participants. This approach, while informative, does not facilitate the creation of a community or encourage interactive engagement. The program's top-down dissemination model suggests that it does not fully engage with the intricacies and specific requirements of the local contexts it aims to serve, making it an exogenous entity imposed on rural farmers without adequately addressing their unique needs and circumstances.

SAWBO, an acronym for Scientific Animations Without Borders, is an initiative from Michigan State University that transforms extension information on agriculture, health, and women's empowerment into animations in 2D, 2.5D, and 3D formats. These animations are narrated in numerous languages to cater to a global audience (Laureys, 2016). The program offers these educational animations for free, making them accessible for pedagogical use by anyone interested. These animations are available for download across various SAWBO platforms and can be viewed on a range of electronic devices, including PCs, tablets, smartphones, TVs, and projection systems. SAWBO's video library is rich with content that provides detailed agricultural knowledge, featuring videos on topics from soil testing for grain moisture content to biological control methods for legume pods, ensuring valuable information is readily available for global dissemination.

The e-Arik initiative, which was launched by the Indian government (e-Arik Center, n.d.), is a prime example of another major example of endeavour that fits within the purview of the CIS model. Through the use of computers, the internet, telephones, radios, and televisions, E-Arik is a single-window system that facilitates the delivery of advanced agricultural information and technology. It provides one-way dissemination of specialized information on agriculture production, protection, and marketing aspects through various forms of information and communication technology in the northeastern region of India (Saravanan, 2011).

Information needs assessment carried out in the rural areas of Arunachal Pradesh's East Siang District in the 2000s found that the vast majority of the state's tribal farmers lacked access to agricultural information that would have allowed them to address issues such as the control of pests and diseases. The goal of the e-Arik (e-agriculture) project, which was launched to achieve both climate-smart agricultural practices and food security, was to spread the word about the former (e-Arik Center). Agricultural practices that were considered to be climate-smart were those that were sustainable, required a low amount of input, and relied on organic technologies. The Department of Scientific and Industrial Research (DSIR), which is part of the Ministry of Science and Technology in India, was the organization that provided funding for the endeavour.

The e-Arik model's deployment for disseminating agricultural knowledge in North East India yielded positive outcomes, such as farmers adopting improved farming practices, including crop rotation and vermicompost (Saravanan, 2008). Despite these successes, the adoption of new agricultural techniques, like the system of rice intensification, saw minimal uptake, with only two farmers adopting it in 2010. This resistance can be attributed to the tribal farmers' reluctance to depart from traditional agricultural methods passed down through generations. Furthermore, the information dissemination was one-way, lacking any mechanism for feedback or dialogue, making the initiative feel imposed rather than integrative at the community level. The use of English and Hindi for communication also presented a barrier, as the tribal communities speak the Adi dialect, which lacks a written script, alienating a significant portion of the intended audience who are non-literate. Compounding these issues was the erratic electricity supply, disrupting online connectivity and further challenging the initiative's effectiveness. This combination of factors—resistance to new practices, unidirectional information flow, language

barriers, and infrastructure limitations—hindered the e-Arik model's potential impact on the tribal farmers.

The degradation of land resources, crucial for the livelihoods of rural communities and society at large, stems from poor land and water management practices, the lack of effective governance and regulatory frameworks to address the growing strain on finite resources, and the absence of measures to tackle the impacts of climate change. The World Overview of Conservation Approaches and Technologies (WOCAT, n.d.), founded in 1992, is a global network dedicated to collecting and sharing knowledge on sustainable land management (SLM) practices (Laureys, 2016). WOCAT distinguished itself early on by recognizing the paramount importance of SLM and the need for managing information for societal benefit, positioning itself well ahead of its peers in this regard. In early 2014, the United Nations Convention to Combat Desertification (UNCCD) officially recognized WOCAT as the primary recommended repository for global SLM best practices, a testament to WOCAT's consistent growth and continual enhancement over the years.

One more possible illustration of CIS is the telephonic advisory service that was provided to smallholder farmers in Africa. African smallholder farmers have the desire to turn their farms into businesses, but they do not know that it is necessary to do so. The majority of farmers are unable to alter their methods due, according to preliminary findings from research on user experience, to a lack of access to government extension officers. Because of the low literacy levels in the country, any changes that are made need to be supported by evidence. This is another obstacle in the way of information dissemination. Keeping this in mind, Human Network International (HNI, n.d.) developed the 3-2-1 Service, an innovative mobile phone information service, to empower individuals with limited resources to improve their health and well-being through the use of their initiative. Everyone, regardless of gender, race, sexual orientation, or age, can quickly retrieve information on a wide variety of subjects using even the most basic mobile phone. There is no need to use the internet. The toll-free number, 3-2-1, can be dialled by callers anytime, anywhere in the world. They are greeted with a message of welcome that is written in their native language. They are guided through the list of topics by a voice prompting them until they locate the reliable information that they require. Through content committees that are each convened by a 3-2-1 service partner in each country where the service is active, local,

regional, and international subject matter experts work together to develop the messages displayed on the 3-2-1 service. As a result, it is not only devoted to agriculture; rather, it varies from country to country and covers a wide range of topics, including gender, health, and others. Because it is not entirely clear whether the proposed content even remotely satisfies farmers' requirements, the effectiveness of such a unidirectional mode of information dissemination is still up for debate.

The examples given earlier demonstrate that initial efforts to achieve development through the implementation of the CIS model did not make any efforts to involve communitarian members in the development process, which resulted in the creation of very few opportunities for the marginalised to gain empowerment. This is true regardless of the context in which the initial attempts were made. Because of this, it is abundantly clear that the CIS model was never intended to foster communitarian growth. The main goal of the model was to deliver specific, detailed information to underserved communities to improve their socioeconomic status by bridging the informational divide between them and the broader society. Nevertheless, these efforts seldom led to tangible enhancements, largely because the nature and specifics of the shared information were not tailored to the actual needs of the community. The approach predominantly regarded community members as passive recipients or consumers of information, with the expectation that they would derive benefits from the information provided through Community Information Systems (CIS). This perspective overlooks the importance of empowering community members as active participants in the information exchange process. When initial efforts were made to implement CIS to achieve communal benefit, the active participation of the local community was never included in the scope of those efforts. The CIS was designed by the developmental agents on their own, without the participation of the local community in the agents' development process.

Numerous scholars and practitioners argue that a critical reason behind the shortcomings of Community Information Systems (CIS) initiatives is the insufficient engagement of local communities. Harrison and Zappen (2005) use the decline of 'Free Nets' as a poignant case study to underscore the sustainability challenges faced by CIS models. Introduced in the 1990s by the National Public Telecomputing Network (NPTN), Free Nets were inspired by the public broadcasting system, designed to provide communities with access to broad computer networks

and local information. Despite their initial promise, the affordability and availability of computing equipment and internet access led to the decline of many free internet services, including Free Nets. This situation was further complicated by the sustainability issues of other community networks funded by national governments, which struggled to maintain their operations post-initial funding due to the lack of active involvement from stakeholders (Rosenbaum, 1998). This evidence points to a fundamental challenge in CIS initiatives: the need for greater community engagement and stakeholder involvement to ensure long-term viability and impact.

The Need for a Second Generation: The global scenario became such that multiple models of CIS were furthered and initiated by diverse developmental agents, governments and non-profit bodies to implement computerized information systems for communitarian betterment (DeSanctis and Poole, 1994). To enable local experts to reach remote rural Ghanaian people, Literacy Bridge adhered to the CIS model to invent a device called Talking Book (Schmidt et al, 2011). The limitations of the unidirectional information dissemination mode of CIS paved the path for a new concern: to design and reform CIS by community functionalities and conceptual configuration, where users' goals, interests, ideologies of locals and others who use it in their developmental process, will shape the design and impact of technology (Lievrouw and Livingstone, 2002; Sproull and Kiesler, 1991). This new concern paved the path for incorporating users' goals, values and needs within the framework of CIS (Bjorn-Soren, 2011). This evolution signifies a move away from viewing communities as mere recipients of information towards recognizing them as active participants in the conceptualization and implementation of technology-driven solutions (Basak & Bhaumik, 2023).

The emerging concern outlined three crucial parameters to ensure the sustainability of CIS:

The success and sustainability of Community Information Systems (CIS) hinge on several key factors: Stakeholder Involvement: Schuler (1997) underlines the importance of encouraging cooperation between academic researchers and local communities during the design stages of community network projects. Such collaboration ensures that the technological solutions are not only technically viable but also culturally and socially relevant to the needs and aspirations of the community.

Commitment from Key Players: It is crucial for individuals connected with the CIS to actively engage and assume responsibility for the system's information dissemination. The case of Connected Kids, initiated in 1999 to utilize new technologies for serving the local community of Troy, exemplifies the necessity of securing commitments from both the local populace and governing bodies to ensure the project's success and longevity (Harrison & Zappen, 2005).

Critical Mass of Users: For a CIS to thrive, it must attract and retain a sufficient number of regular users who engage with the technology for its intended purposes. These users play a vital role in embodying and perpetuating the communal norms and values encoded within the technology through their ongoing interactions. This process naturally leads to the establishment of a dynamic ecosystem within the CIS, where information flow becomes multidirectional, fostering a community of both information producers and consumers who collectively contribute to the platform's evolution into a truly interactive space.

These factors collectively emphasize the necessity of designing CIS initiatives that are deeply integrated with the community's fabric, promoting a sense of ownership, relevance, and engagement among all stakeholders involved.

With this emerging concern, a second generation of practices has come forth aimed at managing information and knowledge for community development. In this phase, efforts go beyond simply disseminating specialized information; they also empower the target group to provide feedback on the information disseminated.

2.3 The Second Generation: Facilitating Bidirectional Information Sharing

The inaugural CIS (Community Information System) model was primarily focused on granting social actors access to Information and Communication Technologies (ICT), with the expectation that these actors would derive benefits from the information distributed through digital channels. During this phase, the emphasis was placed on constructing the technological infrastructure, with academicians and technical experts leading the efforts, and community participation was relegated to a secondary concern. These initiatives, which embraced an "ICT for development" philosophy, typically employed a top-down, exogenous approach aimed at aiding marginalized social communities. However, this strategy often fell short of generating tangible, grassroots-level impacts, primarily due to insufficient involvement from the local community. It was

commonly noted that the community members themselves were not adequately informed about the initiatives being implemented for their advantage, undermining the effectiveness and reach of these CIS models.

The latest approach in utilizing ICT for development marks a transition from an exclusive emphasis on technological access and infrastructure towards a more nuanced, human-centric perspective. Initially, the CIS model aimed to provide digital access to underserved communities, aiming to narrow the digital divide. However, current scholarship recognizes that the divide is not merely technological but also encompasses disparities in knowledge, education, and the capacity for mutual information exchange between socio-economically distinct groups (Eglash, 2002; Daniel & West, 2006). In response, both national and international organizations have launched initiatives aimed at bridging this wider gap.

The new wave attempted to employ ICT to mitigate the information asymmetry from which marginalized groups suffer. The approach assumes that apart from several crucial physical assets, disempowered people significantly lack informational assets, which in alliance contribute in sustaining their marginalization (Gurstein, 2003). In an attempt to disseminate information in productive ways, efforts in the second phase, instead of focusing on unidirectional information dissemination, attempted to encourage information exchange between policy-formulators and target groups in a bi-directional mode. This paved the path for externalization strategy, where explicit knowledge of experts got converted to tacit form in order to provide contextual solutions to stakeholders (Basu et al., 2017). Although this can be identified as an improvement from its preceding phase, where information dissemination was intrinsically unidirectional, how far the marginalized groups, at this stage, were capable of taking part in such informational exchange is an aspect, which needs to be critically investigated (Basak & Bhaumik, 2023).

The difference between information and knowledge becomes pertinent in this context. Marginalized communities are not just impoverished of information. Their social and material conditions shape their situations disadvantageously, where externally feeding them with information or throwing them open to an informational network is expected to yield dissatisfying outcome. Until the marginalized groups acquire skills and experience to process the information (ie, they become knowledgeable), it is difficult to expect betterment out of efforts driven to mitigate information asymmetry using digital medium (Basak & Bhaumik, 2023).

It is crucial to acknowledge that marginalized communities face challenges beyond mere information poverty. Their social and material conditions create disadvantageous situations where external information or exposure to an informational network alone may result in unsatisfactory outcomes. Expecting improvement from efforts to mitigate information asymmetry through digital means is difficult until marginalized groups acquire the skills and experience to process the information effectively. In the following, practical evidence adopted within the framework of the second generation will be presented to highlight its strengths, weaknesses, and the factors that led to the emergence of a third generation in deploying ICT for development.

The advent of the second generation of Community Information System (CIS) development saw a concerted effort by various information network groups to tackle the issue of information asymmetry within local communities through the use of digital platforms. Initiatives such as the Global Donor Platform for Rural Development, the Swiss Centre for Agricultural Extension and Rural Development, the African Forum on Rural Development, and the African Knowledge Network were established to utilize ICT to reduce information disparities among socially marginalized groups (Hess, 2006). These entities created digital platforms that allowed farmers, practitioners, researchers, and donor agencies to exchange experiences, information, and knowledge, representing a significant departure from the primarily one-way communication model of previous CIS initiatives. These new initiatives were designed to enable interactions not only among users of the platforms but also between these users and development professionals, thereby facilitating a more dynamic exchange of information. Despite these advancements, it is crucial to recognize that while there has been an improvement in bi-directional information flow, these efforts have not fully succeeded in fostering community formation. Community formation is critical for the development of social knowledge, which relies on multi-directional exchanges among all participants. Although the second generation has made strides in promoting interaction, its capacity to engender a sense of community and enable a truly inclusive, multi-directional flow of knowledge remains limited, thus maintaining an exogenous character in the interventions. This limitation underscores the need for further evolution in CIS models to fully realize the potential of ICT in fostering comprehensive, community-driven development.

Payakpate et al (2004) have formulated an information networking portal promoting Modern Rural Energy Services (MRES) among the ASEAN member, which accounts to be an appropriate measure undertaken in the second generation. The digital platform being proposed utilizes web service technologies to enhance, distribute, and facilitate the utilization of rural energy services within the local community. Agropaedia (Agropedia, 2004) happens to be another potential example of attempts undertaken with the motto to facilitate bi-directional information exchange in an attempt to empower the socially marginalized groups. Agropedia represents a visionary initiative aimed at addressing the gaps in knowledge and application within Indian agriculture. It specifically tackles challenges related to the lack of content, organized information, and extension services. To bridge these gaps, Agropedia has developed delivery mechanisms like vKVK-net (Voice Kisan Vigyan Kendra), which serve as a means to connect extension scientists and farmers through its web platform. This platform hosts a wealth of information on agriculture and rural livelihood (Gond et al, 2019; Basak & Bhaumik, 2023). Agropedia stands out in the agricultural domain due to its unique features, including semantic organization and the ability to assist users in finding precise information or services they seek.

Based on the findings of an impact study conducted in July 2016, fishing community members in the Indian states of Kerala, Andhra Pradesh, and Tamil Nadu have experienced positive outcomes from using the application. The app incorporates features facilitating users to share their experiences. Conversely, many fishermen have expressed challenges in using the app due to inadequate digital literacy, hindering them from fully benefiting from the information it contains. Furthermore, the application's compatibility only with high-end mobile devices poses an additional barrier for the economically disadvantaged fishing community. The initiative faced limitations due to a lack of community-wide knowledge about app usage and insufficient training facilities to educate users on its functionality.

Apart from India, various countries have also explored the use of technology to enhance the information access of community members on the fringes of society. For instance, countries like Vietnam have leveraged cutting-edge technology to boost agricultural productivity and bridge the information gap between the consumer and farmer communities. Vietnam's agricultural sector is recognized for its suboptimal productivity, with one of the lowest rates in Asia. The excessive use of pesticides and chemicals results in the loss of potential export revenue

exceeding 700 million dollars, along with a crop loss of over twenty to thirty per cent. Additionally, more than fifty per cent of irrigation water is wasted, and up to sixty per cent of applied fertilizer is not absorbed, leading to environmental pollution. Pests and diseases destroy twenty to thirty per cent of harvested crops, highlighting the significant issues arising from farmers' lack of awareness about their crops' requirements and conditions.

Tri Nguyen, an engineer with a deep interest in agriculture, is the man behind the conception of MimosaTEK. This company aims to improve farmers' ability to communicate with their crops. He utilized cutting-edge technology and set out on a mission to teach farmers about precision agriculture and convince them to adopt a precision management solution known as "MGreen" (MimosaTEK, n.d.). MGreen implements cutting-edge technology for precision agriculture to assist farmers in increasing their output while simultaneously reducing their costs and protecting themselves from potential hazards. The sensors embedded in the hardware devices continuously measure the environmental parameters, and algorithms are responsible for performing the computations necessary to recommend the best irrigation schedule to farmers. The digital infrastructure that was designed includes sections reserved for the farmers to enlist their experiences and feedback in applying the information that was acquired.

The evaluation of MimosaTEK's impact highlights that its clientele reported significant benefits, including up to a 50% reduction in water and electricity usage for farm irrigation and a 25% increase in crop yields. Despite these substantial advantages, the adoption and sustained interest in the technology faced challenges. A major hurdle was the literacy and technology familiarity levels of the farmers and other key stakeholders, who, being predominantly illiterate and unacquainted with advanced technological solutions, gradually disengaged from the initiative. The implementation of sophisticated technology in farming operations not only necessitates an increase in safety measures but also escalates the level of responsibility and accountability for the users. This heightened requirement can deter farmers, who are generally cautious about adopting new technologies, preferring to stick to traditional methods that, while potentially less efficient, are perceived as more reliable and trustworthy. This scenario underscores the importance of not just providing access to innovative solutions but also ensuring that these solutions are accessible and user-friendly for all stakeholders, regardless of their literacy or technological expertise. Although MimosaTEK attempted to provide useful information to

Vietnamese farmers in an interactive manner through the application of advanced technology, the specialized digital infrastructure devised by experts prevented the community, to a large extent, from feeling at home with it. This was even though MimosaTEK had attempted to do so. The new company made very few attempts to provide digital training to the local populace sustainably, which would have assisted them in becoming familiar with the technological infrastructure. This would have been helpful for them. In addition, because there was no provision to support peer-to-peer learning or discussion forums, the initiative appeared even more foreign to the group it intended for. Consequently, even though the company appears to be successful in providing information to the local community, there was little hope that it would "educate" the farmers about innovative business practices.

Disaster management involves intensive coordination among multiple agencies like police, fire departments, public health, non-govt. agencies, including local volunteers/field workers. Accurate situational information about damage, resource needs, available resources etc., in the affected areas helps the disaster management agencies in proper damage and need assessment and prepare suitable resource deployment plans. Crowdsourcing has become a popular approach for information collection where open crowds of people share multimodal situational information (text, images, audio, video etc.) about any event through social media posts. However, the authenticity and reliability of such posts are still debatable. Gathering situational data directly from the affected community (community-sourcing) can supplement social media posts to generate effective insights. In this paper, we attempt to design and develop a multiplatform disaster management information system where both social media-based crowdsourcing and community-sourcing techniques are used to accumulate location-specific situational information (Basak et al., 2020). The efficiency of a disaster management system requires the right mix of capabilities, scalability, and flexibility to meet the operational complexities of a disaster situation including the ability to provide on-demand services. As the different facets of a disaster situation are revealed and its consequences are identified, it becomes important to know what operational tools are there in place to help identify a condition, take action, and monitor the effectiveness of the action. Such a system should have functional capabilities that are integrated within a common platform and can provide an all-encompassing solution set to the stakeholders (Basak et al., 2020).

The Rural Universe Network Pilot Project (RUNPP) has led to the establishment of Rural Information Cafes in Jamaica, thanks to a collaborative effort involving several partners such as the Caribbean Agricultural Research and Development Institute, the German Centre for Documentation and Information in Agriculture, and the Rural Agricultural Development Authority. The primary aim of these cafes is to enhance the accessibility of local knowledge through the development of specific rural communication systems. These cafes serve as hubs where local communities can access, share, and discuss agricultural information, techniques, and innovations, thereby fostering a more informed and connected rural populace. This initiative represents a strategic effort to bridge the information gap in rural areas, enabling farmers and rural residents to make better-informed decisions and improve their livelihoods through the effective use of agricultural knowledge and resources. In addition, the Rural Agricultural Developmental Authority is responsible for developing these cafes (Laureys, 2016). The primary communication strategy that they have adopted is to make investments in online tools that will make it easier for farmers, researchers, and other stakeholders to share their knowledge. Each Information Café features a high-speed internet connection as well as a collection of CDs that cover a variety of pertinent topics. This information is gathered across various formats, such as print, video, or voice recordings, and various tools, such as printers, digital cameras, and scanners, are utilized. Because most of RUNetwork's efforts involve face-to-face communication between farmers and researchers, the organization allows community members to participate, at least to some extent.

Additionally, a Regional Information Broker, also known as an RIB, will be appointed to oversee the consolidation of knowledge bases and the exchange of information. Since it would be pointless to provide the rural population with a knowledge base without first ensuring that they are interested in participating, the RIB offers them training and information on other computer-based services. The entire program is predicated on imparting specialized information to members of the indigenous community in a unidirectional fashion. It does not make provision for opportunities for members of the community to educate one another. While the interaction with the RIB did require some communal participation on your part, a two-way information flow cannot engender substantial growth in a community's sense of cohesion and purpose.

IIT Kanpur's initiative, Agropedia, represents a significant step towards enabling a two-way exchange of information, aiming to empower socially marginalized groups within the agricultural sector. Launched in 2004 with the mission to facilitate this exchange, Agropedia addresses critical gaps in Indian agriculture by creating a comprehensive platform that tackles the issues of insufficient content, lack of organized information, and inadequate extension services. These challenges have historically impeded the flow of knowledge and hindered agricultural progress. To overcome these obstacles, Agropedia introduced innovative solutions like the vKVK-net (Voice Kisan Vigyan Kendra), a delivery mechanism designed to bridge the communication gap between extension scientists and farmers. This web-based platform serves as a repository of valuable information on agriculture and rural livelihoods, making it accessible to a wide audience. Through initiatives like Agropedia, efforts are being made to enhance the dissemination and accessibility of agricultural knowledge, thereby supporting farmers in improving their practices and livelihoods with scientifically backed information and resources. vKVK-net was developed by the organization (Huger et al., 2012). The web platform known as Agropedia is one of a kind in the field of agriculture because it is semantically organized and enabled to help users find the specific information or service they are looking for. In addition to the information contained in the library section that has been validated by the Indian Council for Agricultural Research (gyan dhara), it also provides a space for users to interact with subject matter experts to acquire contextual solutions to issues. However, for indigenous communities to successfully acquire and implement the information that has been disseminated, they need to have a certain level of literacy. This will allow them to practically grasp the explicit knowledge that experts have provided. These initiatives are unable to have a ground-level percolation because an excessive emphasis is placed on the formal dissemination of information without also creating scopes for peer-to-peer learning. As a result of these initiatives' inability to effectively stimulate communitarian development through collaborative learning, they are limited in their capacity to manage social knowledge appropriately. It is only through the facilitation of multi-directional knowledge exchange among social agents that optimal management of social knowledge can be achieved.

The Need for a Third Generation: An in-depth study of the example of projects undertaken during the first and second phases of deploying ICT to achieve communitarian betterment reveals that not only in the first phase but also in the second phase, the efforts practically

remained ineffective in mobilizing the local community. The second phase witnessed efforts, which theoretically aimed at disseminating specialized information to marginalized communities by adhering to an interactive mode, a lack of digital literacy of the locals, an absence of adequate training facilities to familiarize the locals with the digital infrastructure, and a lack of focus on communitarian development by facilitating peer-to-peer learning enormously contributed against its interactive theoretical premise. Dissemination of information, not coupled by imparting skills and experience on how to process the information, contributed in making the second-generation attempts exogenous, despite their theoretical inclination towards an interactive mode (Basak & Bhaumik, 2023).

The third generation attempted to use ICT as a medium to empower the social actors, prior to exposing them to information networks and expecting them to benefit from such informational exchange. Facilitating multi-directional knowledge collaboration among social actors, the third generation attempts to deploy ICT to facilitate socialization (conversion of tacit knowledge to tacit knowledge) among social agents (Nonaka, 1994; Nonaka and Takeuchi, 1995). Seeds of community development lie hidden in socialization resulting in multi-directional knowledge exchange among communitarian members. It is by making collaboration an effective premise, that third-generation attempts at deploying the digital infrastructure to manage social knowledge. It is only in this phase, with the help of social technology, an empowering ecosystem is created that has the potential to effectively tap and manage social knowledge by facilitating effective collaboration between and across communities (Basak & Bhaumik, 2023).

In the evolution of Information and Communication Technology (ICT) use for development, earlier phases primarily regarded ICT as a conduit for disseminating information. This approach often resulted in a one-way flow of information from external sources to individual members of marginalized groups without considering the broader social dynamics that influence the lives of these individuals. Recognizing that individuals are embedded within social contexts that significantly shape their abilities and actions, the third-generation initiatives seek to transcend the limitations of previous models. The third generation of ICT initiatives is characterized by its emphasis on multi-directional knowledge exchange rather than simply facilitating a two-way dialogue between information providers and recipients. This shift aims to enhance the social capital within marginalized communities by leveraging social technology to create spaces for

collaborative learning and peer-to-peer exchange. This approach acknowledges the critical role of social networks and relationships in enabling individuals to access, share, and co-create knowledge. By fostering environments where individuals can learn from one another, third-generation initiatives cultivate a sense of community and collective empowerment. This peer-to-peer exchange not only democratizes access to information but also recognizes and harnesses the value of local knowledge and expertise. Such initiatives embody a truly communitarian spirit, laying the foundation for social knowledge that is built, shared, and sustained by the community itself. This evolution marks a significant departure from viewing ICT solely as a tool for information dissemination to recognizing it as a catalyst for building social capital and facilitating communal growth and learning.

The transition into the third generation of Information and Communication Technology (ICT) utilization signifies a pivotal shift from viewing users solely as passive recipients of information to recognizing them as active participants in the creation and dissemination of knowledge. This evolution in digital infrastructure emphasizes collaboration, opening vast opportunities for individuals to engage directly in the knowledge-generation process. By considering every social actor as a potential contributor of knowledge, third-generation initiatives strive to dismantle the traditional barriers that have separated information producers from consumers. The objective of these initiatives is to establish a digital ecosystem that thrives on strong collaboration and networking among local community members and external contributors. Within this ecosystem, each participant plays a dual role: they are both a source of information and a seeker of knowledge. This reciprocal exchange ensures that information flow is not unidirectional but is instead a dynamic, interactive process that enriches the community's collective intelligence. The collaboration among a diverse array of social agents—ranging from local farmers and artisans to scientists and educators—lays the groundwork for what is known as social knowledge. This model not only democratizes information access but also fosters an environment where knowledge is continually co-created, shared, and evolved. Such an approach leverages the collective expertise and experiences of the community, empowering individuals to contribute to and benefit from the wealth of shared knowledge. The third generation of ICT initiatives, therefore, represents a significant advancement towards creating more inclusive, participatory, and sustainable knowledge ecosystems.

2.4 The Third Generation: Facilitating Multi-directional Knowledge Collaboration

Collaborative learning is deeply rooted in the strength of networking both within and across communities, as highlighted by Cummings and van Zee (2005). It emphasizes the integration of various actors into the learning ecosystem, facilitating the exchange of knowledge, goods, services, and experiences to achieve mutual learning objectives. Such an approach leverages relationships to create a vibrant community of practice where learning is not just a solitary activity but a shared journey towards a common goal (Plucknett et al., 1990).

Effective networking fosters an open environment that encourages the free flow of skills and expertise, thereby enriching the collective knowledge base. The role of networking in fostering development that is centred around knowledge is pivotal. Cummings and van Zee (2005) have insightfully pointed out that the true power of networking—especially in the context of knowledge exchange—comes to the fore when it transforms into a hub for innovation, experimentation, and continuous learning. This transformation underscores the network's capacity not just to facilitate the sharing of existing knowledge but also to spur the creation of new insights, practices, and solutions. Networking, in this sense, becomes a critical infrastructure for capacity building, institutional development, advocacy, and broader societal change. Without the collaborative learning spaces that these networks provide, engaging effectively with the complex challenges of development and driving meaningful change becomes significantly more difficult. Networking, therefore, is not merely a mechanism for information exchange but a foundational element for fostering an ecosystem where developmental actors can collaborate, innovate, and learn together.

The advent and widespread acceptance of social technology have been instrumental in materializing the concept of collaborative learning, particularly in the context of the third generation of ICT initiatives. Social technology, characterized by its inclusive approach, has significantly altered the landscape of socio-economic interactions in the modern era. It possesses the unique capability to bridge various sectors, thereby enhancing social cohesion and operational synergy through collaboration across these diverse areas. This digital infrastructure is pivotal in harnessing the power of the digital medium for the holistic betterment of communities. By integrating different sectors and fostering knowledge networks among them, social

technology creates a fertile ground for collaborative learning spaces. These spaces are underpinned by the principles of peer-to-peer learning and active community participation, enabling a rich, multi-directional exchange of knowledge. Participants in such a framework are not just passive recipients of information; they are active contributors and beneficiaries of a shared pool of knowledge. This dynamic fosters an environment where learning and innovation are not confined within silos but are spread across the network, enhancing the collective intelligence and problem-solving capabilities of the community. This ecosystem supports a variety of learning experiences and knowledge dissemination methods, from formal educational content to informal sharing of experiences and best practices. As a result, the application of social technology in fostering collaborative learning spaces represents a significant leap towards achieving comprehensive community development. It emphasizes the importance of connectivity, community, and collaboration in leveraging technology for social good, marking a departure from the earlier generations of ICT for development, which focused more narrowly on information dissemination and access.

Engel (1997) astutely points out that the unidirectional and bidirectional modes of social and institutional learning processes present a significant obstacle to the development of sustainable solutions. Previous endeavours relying on these limited modes failed to establish a sustainable learning system. It is through the utilisation of social technology and its ability to foster effective collaboration that efforts can be directed towards managing social knowledge by facilitating collaborative learning.

The efficacy of social technology in facilitating and concretely achieving effective collaboration is what truly upholds the essence of the third generation's objective to deploy digital services to empower communitarian members. In contrast to merely disseminating information between defined entities, initiatives of this nature strive to empower social actors by enabling multi-directional information exchange.

The effective management of community resources increasingly relies on collaboration, with social technologies serving as key enablers for this purpose. These technologies provide a platform for community members to transition from being mere recipients of information to active contributors and creators of knowledge. This shift towards a collaborative framework not only democratizes the flow of information but also diminishes the traditional barriers and

hierarchies between the creators and consumers of knowledge. Such an infrastructure is uniquely positioned to be self-sustaining and endogenous, leveraging the collective resources and intelligence of the community for social empowerment.

In this environment, collaboration among community members—often referred to as the "crowd"—plays a critical role in managing both internal and external community resources. This collaborative approach ensures that the dependency on external developmental agents is reduced over time, fostering a more autonomous and self-reliant community structure. Through effective use of social technologies, communities can orchestrate their development initiatives, sharing knowledge, resources, and expertise in a way that benefits all members. The third generation of Community Information System (CIS) development showcases several community-driven initiatives that exemplify this collaborative ethos. These initiatives are characterized by their emphasis on peer-to-peer learning, multi-directional knowledge exchange, and the active engagement of community members in the creation and dissemination of information. By harnessing the power of social technologies, these initiatives cultivate a sense of ownership and participation among community members, ensuring that the solutions and innovations developed are truly reflective of and responsive to the community's needs and aspirations. This model represents a significant evolution from earlier phases of ICT for development. It highlights the growing importance of collaboration, community engagement, and social technology in empowering communities to manage their resources and shape their futures.

WeFarm has built a platform for close to one billion small holding farmers to help them access basic information and solve problems through real-time multilingual knowledge sharing (WEFARM, n.d.). Headquartered in London, it aims to create an ecosystem for the global smallholder agriculture by fostering peer to peer learning and networking that addresses issues, such as the effects of climate change, sourcing best quality seeds, availability of loans among others. WeFarm collaborated with 280,000 smallholder tea, coffee, cocoa farmers on innovative, community-driven projects in Peru, Kenya, Tanzania (Laureys, 2016; Basak & Bhaumik, 2023). Recognized with the Google Impact Challenge Award, WeFarm has evolved into a for-profit entity, a strategic shift aimed at ensuring its financial sustainability. Looking ahead, WeFarm is keen on expanding its collaborations with both local and international partners, presenting a valuable case study for the potential of community-driven knowledge management models in

transforming farming systems in developing nations. This model exemplifies the third generation of CIS development, where collaborative learning and peer-to-peer exchanges are leveraged to empower communities and address their unique challenges.

Agri Pro (AgriProFocus, n.d.) focus as a beacon of community-driven development, uniting a diverse membership base in the fight against food insecurity. This coalition, encompassing farmers, agribusiness entities, civil society organizations, and governmental bodies, adopts a holistic approach to agricultural development centred on collaboration. The ethos of AgriProFocus is encapsulated in its three-pronged strategy: linking, learning, and leadership. This strategy aims to forge meaningful connections among farmers and key stakeholders in the agriculture and food sectors, facilitating a united front to tackle specific agricultural challenges. The platform provided by AgriProFocus serves as a dynamic space for peer-to-peer learning, where members are encouraged to exchange best practices, insights, and even lessons learned from failures. This environment promotes mutual learning and growth, leveraging the collective wisdom and experience of its community. Moreover, AgriProFocus is dedicated to nurturing agripreneurs—agricultural entrepreneurs equipped to make significant and sustainable impacts within the business landscape. Through targeted capacity-building initiatives, the organization transforms community members into innovative leaders ready to drive change and progress in the agricultural sector. By emphasizing the development of entrepreneurial skills alongside fostering a collaborative learning community, AgriProFocus embodies a community-centric model of development. This approach not only addresses immediate challenges related to food security but also builds a resilient and empowered network of individuals capable of sustaining long-term improvements in the agriculture sector.

Agri Pro Focus strategically organizes its wealth of knowledge into several critical themes relevant to contemporary agricultural challenges and opportunities: Climate Smart Agriculture, Circular Economy, Nutrition Sensitive Approaches, and Inclusive Agribusiness. This thematic approach allows for a focused and effective dissemination of knowledge and resources that cater to the varied needs of its community members, addressing key areas for sustainable agricultural development. To reinforce its community of practice, Agri Pro Focus extends a variety of e-learning opportunities that are designed to be inclusive and accessible. These educational resources include free online courses, training videos, and extensive agricultural libraries, all

available through its website. This provision of knowledge not only facilitates continuous learning and skill development but also ensures that members, regardless of their geographical location, have access to valuable information that can enhance their agricultural practices and business operations. The model's strength is further amplified by its integration of physical and local networks with its virtual platform, creating a hybrid structure that maximizes the benefits of both face-to-face and online interactions. This dual approach enables the organization to foster a rich tapestry of knowledge exchange and collaborative resource pooling, ensuring that the community remains vibrant, engaged, and continually evolving. Through this innovative model, Agri Pro Focus stands as a testament to the power of combining digital platforms with community engagement to drive sustainable development in the agricultural sector.

Savana Young Farmers' is a commendable initiative committed to effectively managing social knowledge. Operating under SavaNet-Ghana (SYFN, n.d.), they actively foster connections between research and practical farming, collaborating with other users to develop valuable products and services (Laureys, 2016). SYF provides vital support to Ghanaian farmers, empowering them to apply the latest knowledge and technology in innovative and efficient ways. The network encompasses diverse groups of farmers, including large-scale commercial farmers, small-scale farmers, semi-commercial farmers, non-poor complex diverse risk-prone farmers, and poor complex diverse risk-prone farmers. It is also made up of a wide range of agriculture value chain actors e.g. produce buying companies, mechanization service providers, aggregators, financial institutions, angel investors, agro-input companies, agro-processing companies, ware housing companies, etc. At the heart of this ecosystem is the iHub, SavaNet-Ghana's premier initiative focused on agribusiness innovation development. It positions itself as Ghana's hub for precision agriculture technology, aiming to revolutionize farming practices through the integration of advanced technologies (Basak & Bhaumik, 2023). The scope of SavaNet-Ghana's agricultural development initiatives is broad, covering areas such as the development of young farmers, agribusiness leadership, precision agriculture, natural resource conservation, environmental management, and the promotion of urban agriculture. This comprehensive approach ensures that various aspects of the agricultural sector and its associated challenges are addressed, fostering a more sustainable and productive agricultural landscape. SavaNet-Ghana's network is notably diverse, encompassing a wide range of farming groups from large-scale commercial and small-scale farmers to more specialized categories such as semi-commercial and

complex diverse risk-prone farmers. This inclusivity extends to the entire agricultural value chain, incorporating produce-buying companies, mechanization service providers, aggregators, financial institutions, angel investors, agro-input and agro-processing companies, warehousing entities, and others. Such a diverse network facilitates a holistic approach to addressing the needs and challenges of the agricultural sector. By creating an environment that encourages innovation, knowledge sharing, and collaboration among a wide array of stakeholders, SavaNet-Ghana is making a significant contribution toward securing the future of agriculture in Ghana and the broader African continent. Their efforts are geared towards enhancing food security, promoting sustainable agricultural practices, and driving economic growth within the agricultural sector.

ICT4dev.ci (ICT4DEV, n.d.) a startup founded in 2012, specializes in the development and integration of ICT solutions to the daily problems of African populations. One of its flagship project is: Lôr Bouôr (LôrBouôr, n.d.) ("excellent plantation"), a technology solution platform, targeted towards building a modern and efficient agricultural sector. Lôr Bouôr improves connections between different stakeholders in agro-sector: buyers and sellers, input suppliers and farmer cooperatives, and farmer-to-farmer themselves (ACP-EU (CTA), 2016). Lôr Bouôr is a comprehensive online platform designed to empower regional farmer cooperatives and their associated organizations by providing a suite of five critical services. This initiative represents a significant step forward in leveraging digital tools to enhance agricultural productivity and market access for farmers.

- Online Portal: The cornerstone of Lôr Bouôr's offerings is its dedicated website (www.lorbouor.org), which serves as a hub for information dissemination, educational resources, and promotional activities within the agricultural sector. This portal aims to keep farmers and cooperatives informed about the latest trends, techniques, and opportunities.

- GELICO - Cooperative Management Tool: A web-based application designed to streamline the management of cooperative activities. GELICO simplifies administrative tasks, financial management, and member coordination, thereby enhancing operational efficiency for cooperatives.

- Virtual Market Mobile and SMS Application: This application functions as a digital marketplace, bridging the gap between the supply of agricultural cooperatives and the

demand from customers. By facilitating direct connections between producers and buyers, the app aims to improve market access and income for farmers.

- SMS MIS (Market Information System): An application that provides timely market information to farmers via SMS, enabling them to make informed decisions about crop prices, market trends, and best times for selling their produce.

- Djassi - Voice Mailbox: Named "Djassi" (meaning news), this service allows for the direct transmission of agricultural information to producers in local languages through a voice mailbox system. This feature ensures that critical information reaches farmers who may have limited literacy or access to the Internet. By integrating these digital services, Lôr Bouôr not only enhances the operational efficiency of agricultural cooperatives but also fosters a vibrant community of practice. The platform enables members to centralize farm management data, access market and pricing information directly, and receive vital agricultural news in accessible formats. Through dynamic collaboration and knowledge exchange, Lôr Bouôr is actively contributing to community development in the agricultural sector. The sustainability of the project is ensured through ongoing training and guidance for users, coupled with the adoption of a Private-Public-Partnership (PPP) model for its implementation. This multifaceted approach positions Lôr Bouôr as a pivotal player in modernizing agriculture through digital solutions, promoting economic growth, and empowering farming communities.

All the previously cited examples, predominantly within the agricultural domain, can be regarded as tangible proof of effective social knowledge management. These practices, guided by a comprehensive vision, align with the collaborative ethos of the third generation. However, it is essential to note that while these initiatives incorporate provisions for facilitating peer-to-peer knowledge collaboration, they do so intermittently, lacking a connected and unified framework necessary to sustain such collaborations. An inter-connected, unified framework that supports rural producers in farm and non-farm activities can truly facilitate multi-directional knowledge exchange on an unimpeded scale driven by voluntary participation. Without such a connected and unified framework, achieving and sustaining communitarian development becomes a challenging endeavour.

2.5 Post-Third Generation: Integrating Blockchain Technology with Community Information System

Blockchain technology has gained significant attention due to its potential to revolutionise various information systems. Integrating blockchain technology with community information systems offers solutions to challenges related to trust, incentive mechanisms, information protection, and rights management (Lu, 2021b). In supply chain management, blockchain technology enhances transparency and traceability, contributing to social sustainability (Sharma et al., 2021). Furthermore, the technology is expected to impact auditing and accounting by creating a decentralised ecosystem for information sharing among stakeholders (Liu & Xu, 2019). The potential of blockchain technology in practical applications is highlighted, emphasizing its role in addressing varying network difficulties and enhancing the quality of information systems (Shbeil et al., 2024; Du et al., 2022).

Blockchain technology has the potential to revolutionize community information systems by providing secure, verifiable, and decentralized collaboration (Lange, 2020). It can also enhance the security and integrity of community interactions, as demonstrated by a proposed blockchain-based secure communication framework (Sharma, 2021). The tamper-resistant nature of blockchains ensures the immutability of recorded transactions, further enhancing the trust and transparency of community information systems (Yaga, 2018). However, the implementation of blockchain in community networks requires careful consideration, particularly in terms of incentivizing contributions and managing potential threats (Abbas, 2022).

Additionally, integrating blockchain technology in agricultural products' traceability systems and environmental accounting systems demonstrates its ability to address information asymmetry and improve transparency (Yan et al., 2021; Zhang & Zhu, 2022). The application of blockchain technology in supply chain finance and secure information sharing further underscores its potential to integrate information systems and enhance security and transparency (Wang, 2021; Liu et al., 2022). Moreover, the technology offers new possibilities for recording and securing sensitive accounting data, contributing to disintermediation (Alkan, 2021). Blockchain-enabled information sharing within supply chains has been recognised as a valuable tool for enhancing collaboration and information exchange in various sectors (Wang et al., 2019). Integrating blockchain technology in social media and financial information systems further demonstrates its

versatility and potential to revolutionise diverse information systems (Joia & Vieira, 2021; Guidi & Michienzi, 2022). Additionally, blockchain technology offers promising solutions for secure logistics information sharing and addresses challenges in distributed consensus, making it suitable for Internet of Things (IoT) applications (Abidi et al., 2021; Ali et al., 2021; Cao et al., 2019). The potential of blockchain technology to improve information systems is further supported by its role in cross-chain interoperability, dynamic KYC systems, and data integrity tools, emphasising its ability to enhance various aspects of information management (Tasca & Tessone, 2019; Pillai et al., 2020; Moyano et al., 2019). Furthermore, blockchain technology's cost-saving role as a data integrity tool and its potential to secure e-coupon services and monitoring systems further highlight its diverse applications in information systems (Choi et al., 2018). The technology's impact on secure communication schemes and public administration processes underscores its potential to enhance data security and public sector operations MAKAROVA et al., 2021). In conclusion, integrating blockchain technology with community information systems offers a wide range of benefits, including enhanced transparency, traceability, security, and collaboration. The diverse applications of blockchain technology across various information systems highlight its potential to revolutionize data management and information sharing.

Below Table 2.1 shows the comparison of research articles based on the generational evolution of Information Sharing in Community Systems

Generation	Author	Abstract Summary	Main Finding	Methodology	Technical Framework	Research Gaps
First Generation: Facilitating Information Dissemination through Community Information Systems (CIS)	Ghosh, 2005	The public information system in India is depressed.	The main finding of the paper is that it lists the challenges facing public libraries in India and sketches out a vision for their future based on the concept of "ICT for development".	Descriptive account based on official statistics and literature	ICT for development	No research gaps suggested
	Kiplang, 1999	The National and Regional Institutes for Information Democracy would explore empowerment issues.	There is a significant gap between the "information rich" and "information poor," but there is little up-to-date research on the magnitude, nature, and consequences of this gap. - The underlying issue is one of social empowerment. - Proposal to create National and Regional Institutes for Information Democracy to explore and mitigate equity problems.	The methodology used in the study involves proposing the creation of National and Regional Institutes for Information Democracy to explore and address the information gap and associated equity problems.	The theoretical framework is not explicitly stated, but the paper may be based on theories related to social inequality, empowerment, and information control.	No research gaps suggested
	Schmidt et al. (2011).	A low-cost audio computer significantly impacts learning, behavior change, and crop yields in a village with low literacy rates and no electricity.	- The low-cost audio computer ("Talking Book") significantly impacts learning in rural environments with low literacy rates and no electricity. - The device leads to behavior change among the users. - The Talking Book has a positive effect on crop yields in the studied village.	The methodology used in the study involves introducing a low-cost audio computer ("Talking Book") in rural areas with unique challenges and evaluating its impact on providing on-demand access to guidance created by local experts.	Not applicable (the paper does not mention a theoretical framework or foundational concepts)	No research gaps suggested

Generation	Author	Abstract Summary	Main Finding	Methodology	Technical Framework	Research Gaps
The Second Generation: Facilitating Bidirectional Information Sharing	Eglash, 2002	Electronic information is a part of the established order of things.	The main findings are related to the disruptive impact of electronic information on scholarly communication and the reactions and debates it has generated within the academic community.	Not applicable (the paper does not contain a specific methodology or description of methods used in a study)	Not applicable (the paper does not explicitly state a theoretical framework)	The paper does not explicitly identify any research gaps, but it acknowledges the limitations of the study and recommends future research to address macro and micro dimensions to understand the interaction between different levels.
	Daniel & West, 2006	The limited access that most of the world's population still has to information and communications technologies constitutes its challenge	Not applicable (the paper is not a research study and does not present specific findings or results)	Not applicable (the paper is theoretical and doesn't discuss a specific methodology or methods used in a study)	Not mentioned (the paper does not explicitly state a theoretical	No research gaps suggested
	Basu et al. (2017)	The knowledge production process of GCP-RRN is hybridized.	- The knowledge production process of GCP-RRN is a hybridized one with inclinations towards Commons-Based Peer Production (CBPP) within a larger context, and other attributes do not fall within CBPP theorization. - The implications of this hybridized model for agrarian knowledge production discourse and institutions are discussed.	The methodology used in the study is the application of the theory of Commons-Based Peer Production (CBPP) to analyze the knowledge production process of GCP, specifically focusing on the Indian context (GCP-RRN).	Commons-Based Peer Production (CBPP)	No research gaps suggested

Generation	Author	Abstract Summary	Main Finding	Methodology	Technical Framework	Research Gaps
The Third Generation: Facilitating Multi-directional Knowledge Collaboration	Sharma et al., 2021	The performance of the proposed framework is better than others.	- The paper recommends the design of a blockchain-based framework for community interaction. - The authors propose a blockchain-based secure communication framework for community interaction. - The provided security analysis demonstrated the security of the proposed framework against various types of possible attacks, and the performance of the proposed framework was found to be better than others.	The methodology used in the study includes proposing a blockchain-based secure communication framework, implementing an additional layer of security using the RAFT algorithm, conducting a security analysis, and comparing the performance of the proposed framework with other similar approaches.	Blockchain technology, key management systems, and the RAFT algorithm	No research gaps suggested
	Lu, 2021	The blockchain will be implemented and applied to daily activities among institutions, businesses, and personnel.	- Blockchain has the potential to form a secured system of value exchange. - Blockchain is foreseeable to be implemented and applied to daily activities among institutions, businesses, and personnel.	Not applicable (the paper does not provide a brief description of the methods used in the study)	Blockchain technology as a secured system of value exchange and its implementation in daily activities	No research gaps suggested
	Liu & Xu, 2019	A private and lightweight blockchain architecture is proposed to regulate access to valuable sensor and actuator data.	- The paper proposes a blockchain-based architecture for smart industrial environments, used to perform various industrial operations in a trustworthy manner. - The proposed framework is implemented in a fruit processing plant as an industrial experiment.	The methodology involves reviewing existing blockchain technologies for IIoT systems, designing a blockchain-based architecture suitable for smart industrial environments, and implementing the proposed architecture in a fruit processing plant.	Industrial Internet of Things (IIoT), Centralized architectures in IoT systems, Blockchain technology for security and privacy, Implementation of blockchain-based architecture for industrial operations	No research gaps suggested

Generation	Author	Abstract Summary	Main Finding	Methodology	Technical Framework	Research Gaps
Post-Third Generation: Integrating Blockchain Technology with Community Information System	Pillai et al., 2020	The inability of independent blockchains to communicate with one another is an inherent problem in decentralized systems.	The main finding of the paper is the proposal of a mechanism for cross-chain interoperability using transactions, aiming to address the lack of interoperability among different blockchain systems.	Not applicable (the paper does not provide a specific methodology or describe the methods used)	Not applicable (the paper is theoretical and doesn't discuss a specific theoretical framework)	Lack of interoperability among different blockchain systems, inability for independent blockchains to communicate with each other, strain on the mainstream adoption of blockchain due to lack of appropriate inter-blockchain communication
	Makarova et al., 2021	The introduction of blockchain into the field of public administration will help to increase trust in public authorities.	The main findings are the presentation of approaches to transform public governance using blockchain, identification of priority areas and risks of blockchain application in public administration, and the potential benefits of blockchain introduction in increasing trust, providing high-quality services, reducing corruption and bureaucracy, and protecting data.	The methodology used in the study involves determining the impact of blockchain on public administration processes using blockchain, and identifying the priority areas of blockchain application in public administration as well as the main risks of using blockchain systems by public authorities.	Not mentioned (no specific theoretical framework is mentioned in the paper)	No research gaps suggested
	Alkan, 2021	The potential advantages of a real-time blockchain accounting system were categorized according to four focus points.	Blockchain technology has the potential to create new bases for accounting information systems by producing verified, real-time data sets. The development of new blockchain-based accounting information systems integrated with ERP systems can enable businesses to instantly transfer information to information users.	Involves a descriptive approach to explore blockchain technology and its effects on accounting information systems, a comprehensive review of the present literature, and the examination of blockchain reports from major companies.	Distributed Ledger Technology (DLT)	Lack of accounting research in the field of blockchain technology, and a need for research on how to benefit from recent developments in the information technology environment.

2.6 Discussions

The deployment of digital technologies in the development of third-generation Community Information Systems (CIS) has been characterized by intermittent collaboration. Emphasizing community creation has taken centre stage in the third generation for managing social knowledge due to its demonstrated success within organizational settings, inspired by Nonaka's concept of ba (1995). Ba is understood as a collective space or context fostering the emergence of new knowledge, innovation, and learning opportunities (Suni & Hong, 2011). The importance of forming communities for the effective management of resources both within and across communities through CIS is acknowledged in the third generation, yet such formations often occur inconsistently. It is important to note that the mere formation of communities is insufficient for realizing tangible benefits unless the community is purposefully established. While groups may form and collaborate temporarily without a specific purpose, the absence of a well-defined aim and objectives prevents these communities from achieving long-term sustainability. This lack of a purposefully formed community is a significant challenge for most third-generation initiatives.

To evade the inherent shortcomings of existing efforts dedicated to managing inter- and intra-community resources using Community Information Systems (CIS), we will, in the next chapter, advocate for the credibility and necessity of *Building a Community-Driven Information System*. This advocacy is within the context of bridging the market separation of rural producers through the cultivation of an online *Community of Practice* and *Community of Purpose*. The formation of a purposive community using CIS binds the members with a common objective, which is key to sustainable community development using CIS.

Chapter 3

Building a Community-Driven Information System

3.1 Introduction to Community-Driven Information System

In today's interconnected world, Internet-based technologies and applications profoundly impact information and communication technologies, affecting individuals and organisations within and outside organisational boundaries (Fitzgerald, 2013). These technologies have ushered in a new economic paradigm with significant implications for existing business models: the Platform Economy (Alstyne & Parker, 2017). This framework describes a platform as a digital structure that serves as a marketplace to bring together producers and consumers. Companies like Uber, Airbnb, and Amazon are prominent examples of this. The most significant element of a platform is its community of producers and consumers. Recent research indicates the onset of crowd-based capitalism, potentially allowing smaller producers to merge into the mainstream economy via engagement on digital platforms, mainly through mobile applications and Web 2.0 (Sundararajan, 2016). Digital platforms enable billions of connected individuals to participate actively in innovation and wealth creation, contributing to significant developments. The spread of knowledge and information across a broad spectrum of digital platforms can revolutionise economies and reshape various aspects of society.

In this context, digital platforms have the potential to profoundly impact disadvantaged communities in developing nations. However, digital interventions for rural transformation extend beyond simply making individuals proficient in and accessible to digital technologies (ITU, 2005; Sundararajan, 2016). Our research aims to utilise digital platforms for disseminating information and connecting individuals, ultimately as a vital component in the development process. Digital platforms can bridge knowledge gaps and enhance market functionality by effectively integrating and uniting various cooperative agents, offering a sustainable development model (Basak et al., 2016).

Recent research suggests that Internet usage positively impacts rural communities by enabling voluntary participation and creating networks. Internet usage is linked to involvement in local organisations and networks and using Internet-enabled applications to learn about local events

(Barbara, 2015). Beyond online interactions, people utilise the Internet to seek information, exchange advice, and make crucial decisions. While only some people participate this way, the trend is clear, and studies show the significant enhancement the Internet brings regarding accessing resources from others and institutional web resources (Gur, 2015).

A wealth of research has demonstrated a positive correlation between the growth of community capital and various factors such as economic expansion, global commerce, macroeconomic equilibrium, active political and civic participation, crime reduction, health improvements, and overall well-being (Beugelsdijk & Schaik, 2005). There are numerous instances worldwide where the nurturing of community capital has been instrumental in rural advancement (Khan, 2013). Increasing evidence points to the significant role of community capital in driving sustainable development (Wilkinson & Quarter, 1995). Our goal is to leverage an internet-based information system to enhance and expand community capital in rural regions effectively and sustainably.

Keeping this in mind, this chapter proposes and implements an interactive, *Community-Driven Information System* for rural artisans to enhance their community engagement, ultimately improving their life and livelihood prospects.

Community-Driven Information Systems rely on cooperative technologies and the concept of open collaboration. Unlike traditional business information systems, these focus more on enabling online interactions and fostering open collaboration rather than supporting work-related tasks. A key characteristic of these systems is that they do not have a fixed number of contributors, allowing for a more dynamic and inclusive participation. Some characteristics of Community-Driven Information Systems (Daniel, 2006) include:

- **Interaction Focus:** At the core of these systems are community interactions. Governance structures often rely on community-based rather than legal mechanisms; governance follows a bottom-up and grassroots logic. Control is maintained through openness and feedback from the community.
- **Openness:** These systems typically do not have a predetermined participant limit.
- **Contributions:** Contributors to these systems are usually independent end-user communities.
- **Content:** The information in these systems is generated by users, making the material available to all participants.

- **Technology Utilized:** Collaborative technologies such as wikis, social networks, collaborative platforms, blogs, and related tools.
- **Location:** Operates online via the Internet, hosted on web servers, accessible through browsers or mobile applications.

"***Community-Driven Information System***" denotes a system created for a community or communities, offering extensive resources and support services. It aids in expanding networks, sharing knowledge, and encouraging collaboration locally. With a Community-Driven Information System, the community takes the lead in determining its own technological needs and applications and collaborates with others in the community to find solutions (Sudan et al., 2010).

To bridge the knowledge, information, and market divide in rural artisans' communities, our study proposes to examine the connections and collaborations between various entities that enable the formation of virtual communities. These online communities have the most significant impact when they enhance network density and enable the spreading of knowledge and information. Our Community-Driven Information System is designed to usher in holistic rural empowerment by enhancing community engagement and bridging the information, knowledge, and market gaps rural artisans face. Through this platform, improved access to knowledge and informational resources in local languages will facilitate access to other resources. This platform enables people to engage and work together, create community standards and values, exchange resources, and forge reliable relationships (Putnam, 2000).

In the subsequent sections, we conceptualise a Community-Driven Information System that synergises the Community of Practice with the Community of Purpose, effectively leveraging these elements to bridge the market divide for rural producers. Our proposal outlines and validates a comprehensive model for a Community Information System meticulously designed to support and enhance interactions and activities among various actors within this ecosystem.

We have extrapolated fundamental mechanisms for crafting practical Community-Driven Information Systems tailored to rural settings based on a thorough literature review in the previous chapter on information system design practices and platform architectures. These mechanisms are shaped by understanding these environments' unique challenges and opportunities, ensuring the system is technologically sound, contextually relevant, and user-friendly.

To empirically validate our proposed design, we conducted a comprehensive field study, engaging with over 300 rural artisans across various districts in West Bengal, India. This hands-on research approach gave us invaluable insights into the practicalities and impact of implementing our Community-Driven Information System in a real-world rural context. The study's findings offer a robust foundation for understanding how such a system can be optimally designed and deployed to meet the specific needs of rural artisans, ultimately contributing to bridging their market gap and enhancing their overall economic and community engagement.

3.2 Conceptualizing Community of Practice and Community of Purpose

3.2.1 Understanding Community of Practice

Social actors are constantly engaged, organically or in a structured manner, in forming relationships to create opportunities for collaborative learning. Such learning is a critical factor in enhancing the awareness and practices of these actors. The collective knowledge gained through this process becomes a community asset, developed over time through the continuous commitment to a common goal. Wenger (1997) described this as a 'community of practice'. He defined these communities as individuals united by a shared interest or enthusiasm in a particular area who regularly interact to improve their skills and knowledge (Wenger, 1997). These communities may develop spontaneously due to a common interest, or they can be intentionally formed and nurtured to expand expertise in a specific area (Wenger et al., 2002). Wenger and colleagues likened communities of practice to "gardens" that thrive with careful tending. Organisations increasingly recognise the value of nurturing such communities to leverage collective knowledge for enhanced productivity (Wenger et al., 2002; Wenger et al., 2000). Many now see communities of practice as vital for capturing the implicit knowledge that is often challenging to articulate. By exchanging insights, members contribute to the group's knowledge, experience, and personal and professional growth (Lave & Wenger, 1991).

The concept of 'community of practice' primarily emerged in the field of learning theory, originating with Jean Lave and Etienne Wenger. They introduced this term while exploring apprenticeship as a model for learning. Their focus was on the intricate dynamics between students and their mentors, revealing that learning within this context is not merely a straightforward interaction but a complex web of social relationships (Lave & Wenger, 1991).

Their investigation shed light on the effectiveness of apprenticeships in facilitating learning. In the context of an organization, newcomers initially observe and learn from more experienced members, gradually acclimating to the organization's operational nuances. This process of social integration transforms learning into an active, participatory experience, a concept Lave and Wenger termed 'situated learning' (Lave & Wenger, 1991). Over time, the idea of a community of practice has become synonymous with collaborative or networked learning, underscoring its significance in collective educational contexts (Cummings & van Zee, 2005).

Virtual Communities of Practices (VCoPs) have emerged to address the challenges of geographically scattered work practices, enabling online member interactions through internet-based social technologies (Dubé et al., 2005). Additionally, the widespread adoption of mobile technologies has given rise to the concept of "Mobile Communities of Practice" (MCoP) (Kietzmann et al., 2013), in which participants use smartphones for communication and engage in remote community activities. These virtual communities significantly contribute to the innovative and productive development of their members and the community as a whole, surpassing the capabilities of traditional formal organizational structures (Wartburg et al., 2006).

The concept of Community of Practice, as outlined by Hoadley (2012), is characterized by two distinct perspectives: **feature-based** and **process-based**.

In the **feature-based perspective**, the focus is on the principle of sharing within a community. This viewpoint posits that learning is not merely an individual cognitive process but is relational, occurring through interaction and context within the community (Hoadley, 2012). This perspective challenges the traditional cognitive view of learning as an internal process, proposing a situated view where learning is embedded in social interactions and shared practices.

On the other hand, the **process-based perspective** highlights the dynamics of knowledge creation, application, and dissemination within the community. This view sees participation as the key to entering and assimilating into a community, whereby learners adopt and adapt its practices over time. Wenger's later work, particularly, emphasises learning as a form of social participation, where individuals construct their identities through active engagement in these communities (Wenger et al., 2002).

- Elements Contributing to the Development of Community of Practice

Following his collaborative work with Lave, Wenger further developed the concept of the community of practice, grounding it in both theory and practice. In his 1997 work, Wenger identified seven crucial factors that contribute to the successful cultivation of a community of practice:

- Natural Evolution: The community should be structured to evolve organically, with a flexible design that adapts to shifts in focus and changes in the external environment.
- Open Dialogue: It is essential for the community to foster open communication, both internally among members and externally with different viewpoints.
- Varied Participation Levels: The community should be inclusive, allowing for different degrees of involvement from its members.
- Private and Public Spaces: To facilitate a comprehensive shared context, the community should offer spaces for both private and group interactions within the practice.
- Emphasis on Community Value: Special attention should be given to highlighting and enhancing the value derived from the community.
- Member-Driven Learning: Opportunities should be provided for members to actively shape their learning experiences, such as through collective brainstorming sessions.
- Active Cycle of Activities: The community should engage in a continuous cycle of events and activities that encourage regular meetings, reflection, and progressive development among its members.

Wenger's insights provide a framework for nurturing and sustaining effective communities of practice.

- Components of Community of Practice

Following his outline of the prerequisites for developing a community of practice, Wenger identified three fundamental components integral to such communities (Wenger, 1997):

- Domain: The identity of a community of practice is defined by a shared domain of interest. This domain forms the common ground and unites the members, giving them a sense of collective identity and purpose.
- Community: Within this shared domain, members engage in joint activities, discussions, mutual support, and exchanging information and knowledge. Such interactions foster a

collaborative learning environment, which is central to the formation and sustenance of the community.

- Practice: Distinguishing it from a mere community of interest, a community of practice comprises practitioners. These members actively participate and contribute to the community, bringing it to life through their engagement. The practice involves developing a shared collection of resources – experiences, stories, tools, etc. – that members create and utilise over time.

Wenger's framework underscores that a community of practice is not just about shared interests but also about shared practice –where the members connect over common interests and engage in collective learning and doing.

- Structure of Community of Practice

In his formalization of the community of practice concept, Wenger outlined a structured approach based on its essential components. He proposed that the architecture of a community of practice is founded on three interrelated elements (Wenger, 1997, pp. 72-73):

- Mutual Engagement: This element refers to the way members of the community engage with each other through participation. Such engagement establishes norms and develops collaborative relationships, crucial in binding the members together as a social unit. This mutual engagement is instrumental in enhancing both bridging and bonding social capital within the community.
- Joint Enterprise: This aspect arises from the interactions among members, leading to a collective understanding of what unites them. Known as the joint enterprise, it essentially forms the 'domain' of the community. It represents the shared goals and values that members collectively acknowledge and work towards.
- Shared Repertoire: Community members create a collective pool of resources, known as the shared repertoire, through their everyday practice. These resources, stemming from the community's standard practices and experiences, help to further unite and strengthen the community.

Wenger's structure emphasizes the dynamic interplay between mutual engagement, joint enterprise, and shared repertoire, which forms the backbone of a community of practice.

- Elements Influencing the Sustainability of Community of Practice

Forming and maintaining a community of practice hinges on continuously nurturing certain key aspects. According to CoP (2017), the sustenance of such a community depends on three primary factors:

- Social Presence: Engaging in a community of practice entails fostering a sense of social presence. Tu (2002) describes social presence as how much another individual is perceived as 'real' during communication and the subsequent importance of the interpersonal connection. The level of social presence directly impacts an individual's likelihood of participating actively in the community of practice.
- Motivation: The willingness of members to share knowledge plays a vital role in sustaining a community of practice. Ardichvilli et al. (2003) highlighted the importance of member motivation as a critical factor in the continuity and effectiveness of these communities.
- Collaboration: The ability to network effectively among members is essential for the success of a community of practice. Effective collaboration is both a necessary and sufficient condition for ensuring the vitality and growth of such communities.

These three factors – social presence, motivation, and collaboration – collectively contribute to the robustness and endurance of a community of practice.

The detailed descriptions underscore the capacity of a community of practice (CoP) to foster democratic knowledge exchange, recognizing every participant's ability to contribute to the collective knowledge base. CoPs connect individuals with other relevant social actors, creating a dynamic knowledge repository and facilitating discourse through connections with experts, all fueled by voluntary collaboration among community members. While CoPs can exist in physical spaces, contemporary social technology offers promising avenues for developing such communities in virtual environments. Effectively nurturing an online practice community involves synchronous (real-time interactions like video conferencing) and asynchronous (time-shifted interactions such as instant messaging and discussion forums) communication methods. This approach does more than grant community members access to knowledge resources; it actively fosters their knowledge operating capacities or capabilities, enabling them to exchange and cultivate knowledge within the community effectively.

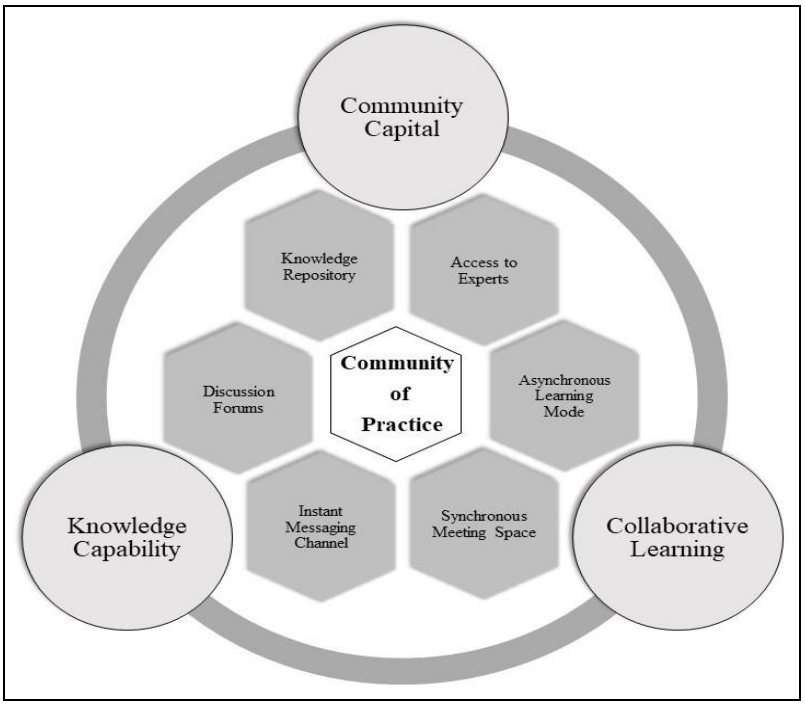


Figure 3.1 Community of Practice: A Conceptual Framework

Groups of people who all engage in the same activity are said to form "communities of practice" (Wenger 2004). A community of practice is a place where practitioners can work together to advance their knowledge and skills through shared experience. Figure 3.1 demonstrates the potential of an online community of practice (Dubé et al. 2005; Kietzmann et al. 2013) to catalyse the development of a shared body of knowledge, the launch of related discussion forums, the facilitation of contact with subject matter experts, and the promotion of appropriate exchange in both real-time and asynchronous settings. Only through such optimum facilitation, in the form of the creation of a practice-oriented community, is there a chance that communitarian members' social capital and knowledge capability can be cultivated in tandem through the development of collaborative learning spaces. The academic, development and business communities recognise the growing significance of the community of practice due to its multiple credentials in facilitating democratic knowledge exchange (Basak & Bhaumik, 2023)..

Ba conceptually refers to a community of practice, a shared space or context, which leads to the creation of new knowledge, innovations and learning opportunities (Suni and Hong, 2011). Ba was initially used by Japanese researchers as a knowledge management strategy to boost the performances of Japanese firms. This shared space, enlivened through collaborations, serves as a

foundation for knowledge creation and exchange (Von Krogh et al, 2012). Digital technologies have shown their immense potential in fostering and nurturing communities of practices where groups of strangers communicate and mutually engage with each other to reach a common goal. As a result of these virtual spaces, the spatial (physical space) and temporal (time) barriers have effectively diminished, allowing individuals to participate in the community and engage in their practice from any location and at any time (Ardichvilli, 2008). Community of practice, in our context, helps the rural producers in nurturing and exchanging specific practice-related knowledge among communitarian members (Basak & Bhaumik, 2023)..

3.2.2 Understanding Community of Purpose

According to Stokes (2016), a "community of purpose" refers to a group of people who share a common experience or goal. In our research framework, we will attempt to build a community of purpose among rural-urban agencies to boost the market prospects of rural producers. In the rural context, participants not just lack market access but also suffer from other ancillary factors, which in amalgamation contribute to sustaining their marginalization. Since they account to be disempowered groups, economic initiatives, with a solely economic focus, account to be insufficient in generating desired outcomes. It is through community formation, through relevant dialogue and collaboration, attempts can be undertaken to empower the rural marginalized on a holistic scale. Communities of purpose, in our context, refer to the formation of purposive communities, where the purpose is to bridge the market separation experienced by rural producers (Singh et al, 2015). Cultivating a community of purpose through social knowledge management offers hope in this prospect, because, apart from providing relevant market-related connections, it also attempts in developing the knowledge capability of rural members through purposive collaborations (Basak & Bhaumik, 2023).

In this thesis, we have explored the development of a community of purpose among rural-urban communities as a potential solution to the economic challenges rural producers face. The community of purpose emerges as a promising approach in our research because it emphasises purposeful collaboration and networking. Stukes (2016) provides an insightful analysis of the factors that contribute to the success of networks supported by a community of purpose:

- Bridging Structural Holes: Structural holes refer to the gaps in social networks that prevent connections within the network. These can be effectively bridged through deliberate collaboration within a community of purpose.
- Mobilizing Social Capital: A community of purpose can initiate purpose-driven networking, thereby harnessing the social capital of its participants.
- Mediating Societal Barriers: Open, purpose-driven interactions within the community help members overcome societal stereotypes and biases. The focus on a shared purpose, rather than ascriptive traits or geographic location, allows the community of purpose to challenge conventional societal norms that typically influence community formation.
- Awareness of the Isolated: By fostering purposive collaborations, a community of purpose can improve the knowledge and awareness of its members, thereby enhancing their operational capacities.
- Decentralized Leadership: In a community of purpose, interactions and transactions are driven by collaborative efforts among members rather than being directed by a centralized authority.
- Capturing Dynamic Processes: The community of purpose is inherently adaptable, capable of innovation and expansion beyond its local context. Its flexible nature allows it to adjust to changes in alignment with alterations in its surrounding environment.

The outlined factors demonstrate a community of purpose's significant role in creating effective networks that address economic and social challenges in rural-urban areas.

To further validate the impact of developing a community of purpose on the socio-economic conditions of rural producers, section 3.4 of this thesis will examine its role in bridging the market gap experienced by these producers. This analysis will underscore how a community of purpose can significantly improve the economic situation of rural producers, making it a fitting approach in rural settings where individuals are already endeavouring to overcome marginalization and economic challenges.

- Elements Contributing to the Development of a Community of Purpose

Several key factors influence the cultivation of a Community of Purpose. Firstly, shared goals and objectives are crucial; members unify around a common purpose, aligning their aspirations with the collective aim. Effective communication plays a vital role, as clear and transparent

communication channels are essential for facilitating interaction and understanding within the community. Leadership and governance are also pivotal, with effective leadership guiding the community and governance structures that align with and support its purpose (Malin et al., 2015).

Technological infrastructure is increasingly essential in today's digital world, providing the tools and platforms necessary for members to connect and collaborate effectively. Trust and mutual respect form the bedrock of any community of purpose, as building trust among members and fostering an environment where mutual respect is paramount are essential for the health and productivity of the community (Shiferaw et al., 2009).

Resource sharing and collaboration are key factors; pooling resources and working on collaborative projects and initiatives can significantly amplify the community's impact. Finally, a culture of continuous Learning and adaptation is vital. Encouraging members to learn and adapt to changing environments and needs ensures that the community remains dynamic, relevant, and able to pursue its shared purpose effectively.

- Components of Community of Purpose

A Community of Purpose comprises several vital components that create a dynamic and influential group. Central to this concept is a unified vision and set of goals, which provide clear direction and unite members in their efforts. Membership engagement is crucial; members must be actively involved and committed to the community's objectives (Shiferaw et al., 2009). Effective leadership and a well-organized structure are essential for guiding the community and supporting its activities. The environment within the community is collaborative, fostering cooperation and collective action towards common goals. Efficient communication channels are vital for facilitating information exchange and collaboration among members. The allocation of resources, including time, knowledge, and financial assets, is managed efficiently to support the community's activities (J. Bhattacharyya, 2004). Feedback and evaluation mechanisms are in place to assess progress and gather member input, ensuring the community remains aligned with its objectives. Adaptability and flexibility are also crucial, allowing the community to respond to changing circumstances and evolve as necessary. At its foundation, the community is built on trust and mutual respect, ensuring a respectful environment for diverse perspectives and contributions. Lastly, shared learning and development opportunities are offered, enhancing the

skills and knowledge of community members and thus contributing to the overall growth and effectiveness of the group.

- Structure of Community of Purpose

The structure of a Community of Purpose is multifaceted and designed to support its functionality and effectiveness. It begins with a leadership structure, typically comprising a leadership team or steering committee responsible for coordination, decision-making, and providing guidance. The membership composition is diverse, consisting of individuals united by shared interests or goals, with clear criteria established for membership to ensure focus and alignment with the community's objectives (Shiferaw et al., 2009). Resource management is another critical component involving mechanisms for the efficient allocation and management of resources and includes financial management systems if necessary. Feedback and evaluation processes are integrated to regularly assess the community's progress and effectiveness and incorporate member feedback. Activity and project management structures are established for planning and executing community projects, complete with tools for tracking progress. Learning and development opportunities are offered to enhance member skills and encourage knowledge sharing, often through workshops or collaborative activities (“Communities of Practice,” 2003b). Adaptation mechanisms ensure the community can respond to goals, environment, or membership changes, maintaining flexibility to incorporate new ideas and approaches. Finally, networking and external relations are fostered to engage with external stakeholders and partners, expanding the community's reach and impact. This comprehensive structure is pivotal in ensuring the community operates efficiently, remains goal-aligned, and nurtures a collaborative and supportive environment.

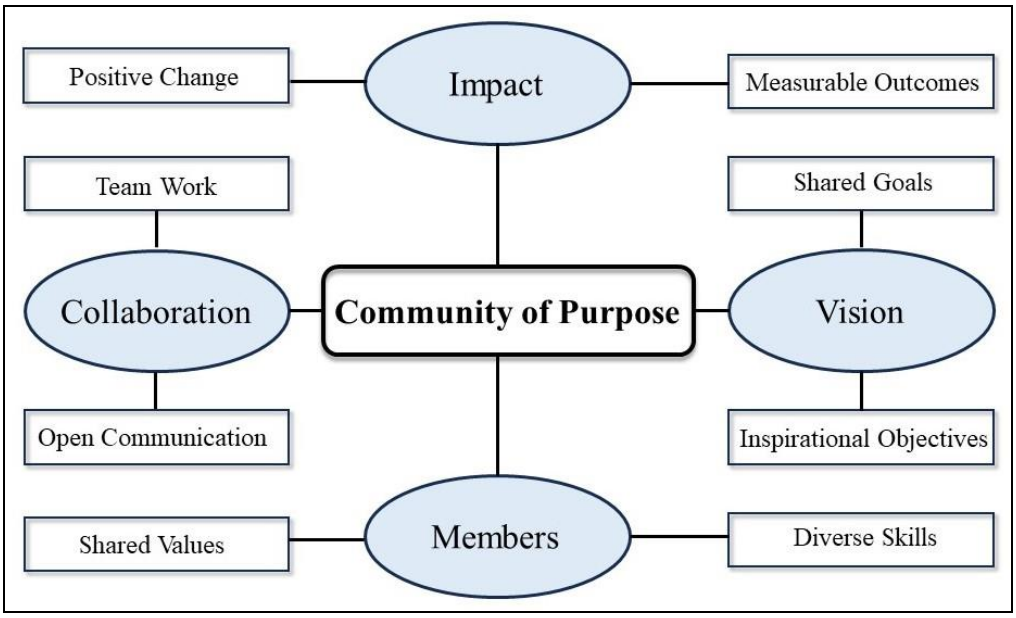


Figure 3.2 Framework of Community of Purpose

- Components for Sustaining a Community of Purpose

The sustainability of a Community of Purpose hinges on several interconnected factors. Foremost is aligning vision and goals, where the community's longevity is anchored in the congruence between individual and collective objectives. Effective leadership and governance are pivotal, providing transparent and accountable direction essential for maintaining the community's focus and integrity (Maida & Beck, 2016). Equally crucial is robust membership engagement, as active participation and commitment from members are fundamental to sustaining the community's activities. Financial viability ensures that the community has sustainable economic models or funding sources for its operations. The community's adaptability to change is vital in maintaining relevance and effectiveness in a dynamic environment. Strong communication networks are necessary for precise and consistent information flow among members, fostering a sense of unity and understanding. Efficient resource management, focusing on the judicious use of resources, underpins the community's operational efficiency. A continuous learning and innovation culture is encouraged to keep the community evolving and relevant. Cultivating a positive community culture and cohesion is essential for member satisfaction and retention. External partnerships and collaborations expand the community's reach and resource pool, providing additional support and opportunities. Lastly, regular feedback and evaluation mechanisms are indispensable for assessing the community's impact and guiding

its continuous improvement. These factors are critical in ensuring a Community of Purpose's long-term viability and success (“Sustainable Community,” 2019).

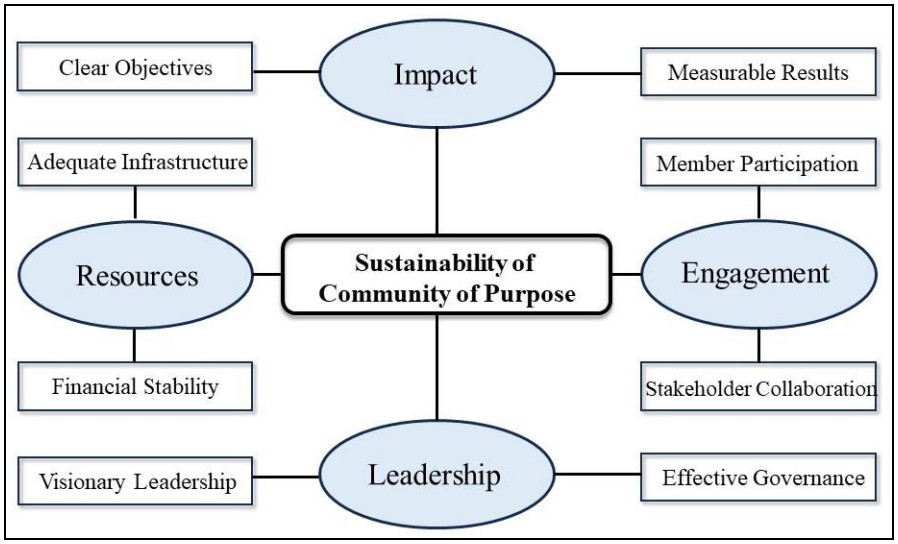


Figure 3.3 Factors Determining the Sustainability of the Community of Purpose

3.3 Developing Virtual Communities of Practice within Rural Environments

Wenger et al. (2002) compare Communities of Practice (CoPs) to gardens, emphasizing that while they develop naturally and voluntarily, strategic intervention and nurturing can significantly improve their productivity and success.

This section will explore how cultivating CoPs among rural producers can develop and reinforce the knowledge network within marginalized rural sectors. By fostering these communities, we aim to create an environment where rural producers can share experiences, learn from one another, and collectively advance their knowledge and practices. This cultivation plays a crucial role in empowering these producers, allowing them to overcome isolation, access broader networks of knowledge and resources, and effectively respond to challenges and opportunities.

In the subsequent section, we will outline how our proposed framework can facilitate the development of these communities of practice. This framework provides the necessary tools, resources, and support systems to enable rural producers to participate in and benefit from these communities actively. By integrating principles of social knowledge management, we aim to enhance the effectiveness of CoPs in improving the socio-economic conditions of rural producers, thereby contributing to the overall resilience and sustainability of the rural sector.

The unobstructed exchange of knowledge within a community of practice, leading to a collaborative learning environment, holds significant promise for enhancing the livelihoods of rural participants. By actively sharing knowledge within their communities and with external groups, including urban counterparts, rural populations can harness and apply new insights for personal and communal advancement. As discussed in the previous section of this thesis, despite concerted efforts from various sectors to improve rural livelihoods, the results still need to meet expectations fully. Two primary obstacles can be identified: (i) the limited exchange of information and knowledge within rural communities and (ii) the gap in information and knowledge sharing between rural and urban regions. Our research suggests that the marginalization of rural sectors is mainly attributable to this asymmetry in knowledge. Therefore, establishing and nurturing communities of practice and facilitating free-flowing knowledge exchange presents a potent strategy in our approach to rural empowerment. This model emphasizes the importance of reducing knowledge gaps and fostering an environment where rural communities are recipients, active contributors, and beneficiaries of shared knowledge. The goal is to create a more equitable information landscape where rural populations can leverage knowledge exchange for sustainable socio-economic development.

Wenger describes Communities of Practice (CoPs) as collectives of people united by a shared interest or enthusiasm who frequently collaborate to enhance their knowledge and skills in that domain (Wenger, 1997). Everyday activities define these groups, the co-development of a mutual identity, recognition of each member's expertise and contributions, and the swift spread of information and innovations (Roberts, 2006, p. 625). At the heart of this idea is learning as a social endeavor, with members actively participating in community practices and forming their identities within these groups (Wenger et al., 2002). Thus, a CoP is an assembly where individuals exchange knowledge and cultivate a shared identity through practice-driven collaborations.

Alexandra Talpau notes the significant impact of internet-enabled social media platforms in revolutionizing communication (Talpau, 2014). Similarly, digital technologies have demonstrated immense potential in facilitating and nurturing CoPs. These technologies enable groups of individuals, often strangers, to communicate and engage with each other towards a shared objective, regardless of physical or temporal constraints. This reduction of spatial and

temporal barriers allows for more involvement in CoPs, making it possible for people from diverse locations and time zones to contribute and engage in these communities. In such virtual environments, the essential elements of a CoP, namely knowledge creation and sharing, can be effectively cultivated (Ardichvilli, 2008). The digital era, thus, opens up expansive opportunities for CoPs, allowing them to flourish beyond traditional physical and temporal limits.

In the research initiative outlined below, we have leveraged social technologies to successfully develop a virtual community of practice (VCoP) encompassing rural and rural-urban communities. This approach aims to address and reduce the existing knowledge asymmetry among rural participants.

In the following sections, we will present specific examples of our research activities conducted with selected segments of the rural population in West Bengal, India. These examples will demonstrate the effectiveness of our proposed implementation framework practically. Through these case studies, we will illustrate how the application of social technologies in these communities has facilitated knowledge sharing and collaboration, mitigating knowledge gaps and fostering a more equitable information environment.

Key areas of focus in these examples will include how the VCoP has:

- Enhanced access to information and resources for rural participants.
- Facilitated the exchange of best practices and innovative solutions among community members.
- Enabled rural and rural-urban participants to connect and collaborate effectively, overcoming geographical and social barriers.
- Contributed to the overall empowerment of these communities through improved knowledge and skill development.

These real-world instances from West Bengal will provide concrete evidence of the impact and utility of virtual communities of practice in rural settings, particularly in bridging knowledge asymmetries and promoting socio-economic development.

3.3.1 Examples from Field Research Involving Self-Help Group (SHG) Women in Rural India

- The Universe of the Study

This study focuses on Women's Self-Help Groups (WSHGs) in West Bengal's rural areas, which are notably equipped with adequate electricity and internet facilities. A significant segment of India's rural populace comprises small-scale farmers, landless workers, minor merchants, and traditional artisans, including tribal groups, who face social and economic disadvantages. These communities often struggle with poverty, illiteracy, limited knowledge and skills, and inadequate healthcare. Conventional institutional measures, which impose development programs externally on rural populations, largely fail to improve the economic opportunities and living conditions of India's native communities. Furthermore, these challenges are of a nature that cannot be resolved by isolated, individual efforts but require collaborative group actions. Small collectives are established within villages to tackle shared issues to achieve this goal. These collectives, widely recognized as Self-Help Groups (SHGs), are small communities within the larger village community, typically consisting of 10 to 15 members. These established micro-communities are acknowledged by both the public and developmental organizations as potential agents of transformation for the impoverished and marginalized sectors (VOICE, 2008; Sreedhar, 2012).

The Self-Help Group (SHG) movement in India is characterized by the voluntary gathering of individuals, predominantly women, in small groups to improve their living conditions and economic stability. While savings and credit activities often serve as the core unifying element, SHGs transcend mere microfinance functions. They are increasingly recognized as dynamic institutions capable of driving change and fostering human development, particularly in empowering local members. SHGs play a crucial role in addressing social issues and combating gender inequality, positioning themselves as key catalysts for women's empowerment. This comprehensive approach significantly bolsters local governance by encouraging community involvement. Through three primary pathways, Self-Help Groups (SHGs) have become significant in India. The first pathway is the SHG Bank Linkage Program (BLP) by NABARD, which links SHGs with banks for financial transactions. The second is the government-led Swarnajayanti Gram Swarojgar Yojana (SGSY), which is aimed at encouraging micro-entrepreneurship and providing sustainable livelihoods for people experiencing poverty. The third path involves the efforts of non-governmental organizations (NGOs) to aid underserved

communities. Specifically, under the BLP, about 94 million rural people in nearly 7.5 million SHGs have collectively saved approximately Rs. 33,000 crores (around US$5.5 billion) and received loans of Rs 66,000 crores (US$11 billion) (Narender, 2015; NABARD, 2014).

- Difficulties Faced by Self-Help Groups (SHGs)

Although various sectors are interested in enhancing living standards and economic opportunities in rural areas, there remains room for improvement in achieving these goals (Savitha, 2014). The persistent marginalization of rural communities can be partly attributed to a need for more effective communication and collaboration within groups, between groups and agencies (such as NGOs, Banks, or Government), and with the external world. A secondary research study (Thileepan & Soundararajan, 2013; Basak & Bhaumik, 2023) has identified an array of challenges faced by Self-Help Groups (SHGs) in India, which are detailed in Table 3.1:

Themes	**Analysis of Gaps in SHG Developments from an Information-Sharing Perspective**
Networking and External Links	There is limited interaction between different Self-Help Groups (SHGs), and they lack knowledge about SHGs beyond their locality. The growth of SHGs primarily relies on word-of-mouth references, and new members are only enrolled through member recommendations.
Market Awareness	The group relies on personal selling to promote their products, and they have limited knowledge about markets beyond their local area.
Supporting Agencies	There is a lack of significant interactions with NGOs, and the group has limited awareness of other supportive agencies. Additionally, they often encounter difficulties and harassment from the banking system.
Government Schemes	There is a limited understanding among the group about the advantages and benefits offered by government schemes.
Health	There is a lack of knowledge regarding the procurement of health insurance, and the group has limited awareness about seasonal epidemic diseases.
Miscellaneous findings	There is a lack of task interdependence within the group, and they rely on regular manual maintenance of multiple record books, which is a cumbersome process.

Table 3.1: Analysis of Shortcomings in Information Exchange

To summarize, a substantial gap exists in the flow of information and knowledge within SHG communities and between these groups and external bodies (Basak et al., 2016; Basak et al., 2017). This lack of connectedness among individuals with shared interests leads to frail relationships and tenuous network ties, resulting in low internal community bonding and weak external bridges. Additionally, there is an insufficient exchange of knowledge, limiting access to new ideas and reducing awareness of developments that could facilitate informed decision-making.

A key issue contributing to this situation is the digital exclusion of SHG members (Basak et al., 2016). However, the solution extends beyond simply providing access to digital technologies. As Muir (2004) pointed out, forming community connections, alongside access to and basic training in internet technologies, is crucial for true digital inclusion. This understanding has driven our efforts to develop online communities of practice among SHG members.

- The Study Design

In conclusion, our research encompassed a sample of 48 women from Self-Help Groups (SHGs) affiliated with the Kandi Block Mahila Cooperative Credit Society Limited, also referred to as the Kandi Federation, located in Kandi town, Murshidabad district, West Bengal, India. This federation, a Civil Society Organization (CSO), is dedicated to empowering local women and oversees 307 SHGs. The women involved have been trained in various skills, including tailoring, handicrafts, kitchen gardening, and pickle making.

Our study focused on creating an online community of practice that brought together rural participants and urban professionals, aiming to foster the sharing of expert knowledge (Basak et al., 2017). The goal of this endeavour was not only to broaden the skills of rural SHG women but also to boost their market opportunities by offering vital market insights. We randomly selected 48 SHG women from the Kandi Federation with basic tailoring, stitching, and painting skills for our study. These women, primarily engaged in household activities and limited SHG meetings, also pursued local market activities due to financial constraints, selling handmade products like fabric-painted blouse pieces and garments.

In collaboration with Panasonic India and Airtel, we provided these 48 women in the SHG Federation with smartphones equipped with internet access. Following the distribution of these devices, our field workers trained the selected groups in their native language, Bengali, using

smartphones and key social media platforms like WhatsApp (Figure 3.4). This intervention aimed to connect them with broader markets and knowledge, overcoming their limited exposure to urban market trends and the global marketplace.

Figure 3.4. Training SHG Women on using Smartphones

A WhatsApp group facilitated regular communication between the SHG women and urban-based specialists. Through this platform, the women asynchronously shared ideas and sought advice from experienced trainers on creating various handmade items, including soft toys, clothing, paper flowers, and paintings. This interaction displayed an evident enthusiasm among the women to expand their prospects for financial independence. The two-way communication on WhatsApp, characterized by the exchange of product images between the SHG women and the trainers, is depicted in Figure 3.5.

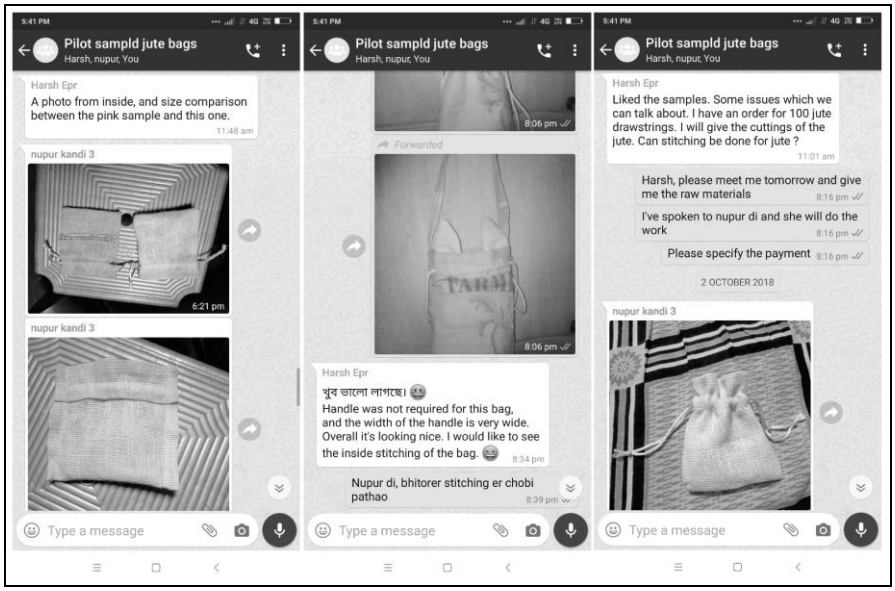


Figure 3.5. Sample WhatsApp Communications: Sharing Information

In addition to utilizing WhatsApp for connectivity, our field workers, integral members of the newly formed community, received online training. The training featured demonstrations on stitching methods, different textiles, and fabric painting, delivered through pre-recorded videos by experienced instructors. This blend of practical exercises and digital education significantly improved the skills of the SHG women, adding substantial market value to their craft. These practice-focused exchanges showed a notable ability to promote learning from one another among the women, as depicted in Figure 3.6. Live Skype sessions with distant educators further supported this approach.

Figure 3.6. Asynchronous Video Training Coupled with Online Discussions

Figure 3.7 showcases the online training sessions held synchronously for the women of Kandi, focusing on fabric painting, led by an urban-based artist. These sessions and live interactions with urban professionals fostered a collaborative learning environment. In this space, the members had the opportunity to acquire specialized knowledge and benefit from peer learning. Live interactions with experts were crucial for immediately resolving doubts and questions, providing the SHG women with contextual solutions to their challenges. The feedback from these experts played a pivotal role in shaping a skill set for the rural producers, better aligned with enhancing their socio-economic status.

Figure 3.7. Virtual Feedback Meetings Conducted by Urban Professionals for Kandi's Women

- Results and Discussion

After six months of regular WhatsApp group activity among the community members and the trainers, it was observed that there were many women in the SHG community who were previously not closely associated with each other (as they rarely met each other), but now are communicating quite frequently through WhatsApp. Thus using WhatsApp, these women can easily share their needs and their created products, which was not possible earlier. Most of the women were previously unaware of what the other SHG group members produced and sold. This intervention created willingness among SHGs to learn and replicate others' products. They have also started sharing their product images and thoughts, which indicates the strengthening of "***bonding social capital***".

Regular interactions with senior trainers and facilitators from the city of Kolkata enable them to acquire information about the products that are in demand in the market and about the latest techniques for creating products that can be marketable. This indicates increasing "bridging social capital" that connects rural women of Kandi with facilitators outside the region. Here, social capital grows by gaining access to global knowledge and resources such as information regarding the availability of raw materials, markets, design ideas, etc.

Date-wise recorded usage of WhatsApp is shown in Figure 3.8. The nature of the graph shows that, at the beginning WhatsApp usage among SHG women was high as they were enthusiastic about using this new form of communication. Gradually the usage dropped to a great extent due to a lesser exchange of concrete information. Later on, after the inclusion of some trainers from the city, a three-day video-based (asynchronous) training workshop and live interaction

(synchronous) with Kolkata-based trainers and facilitators, WhatsApp usage increased to a peak level. This indicates that a proper form of reciprocation, inclusion of a mediating agency and sharing of relevant resources can make an enormous impact on the usage characteristics. All spikes indicate contributions from external trainers/facilitators with newer inputs/ suggestions/feedback which boosted WhatsApp interaction periodically. So, it can be concluded that to make this CoP active, the involvement of external agents within the CoP is necessary (Basak et al., 2017).

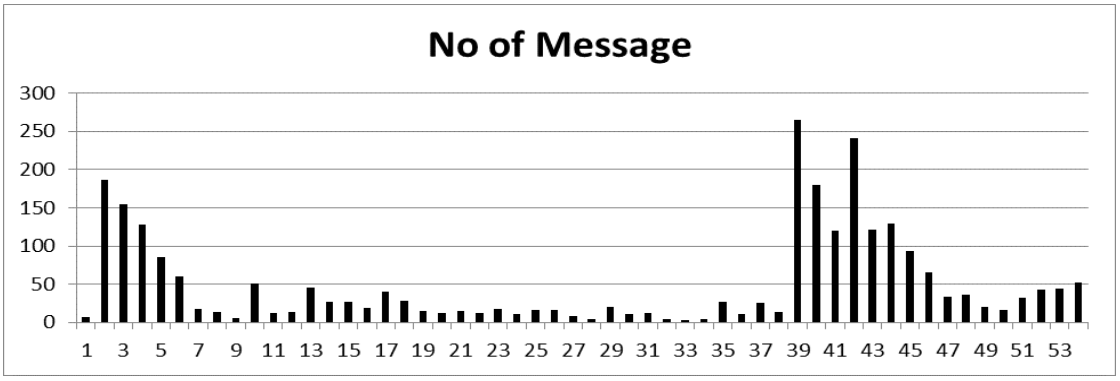


Figure 3.8. Day-wise usage of WhatsApp by SHG Members

It is evident from Figure 3.9, that the contribution of individual members in terms of the total number of messages during these 6 months varied widely. Out of fifty members, seven members are aggressive participants (with a total number of messages > 100) and they made the CoP alive. In this regard, it is also to be noted that the aggregated number of messages contributed by external facilitators is quite high, indicating that the involvement of external agents is a significant factor in sustaining community engagement (Basak et al., 2017).

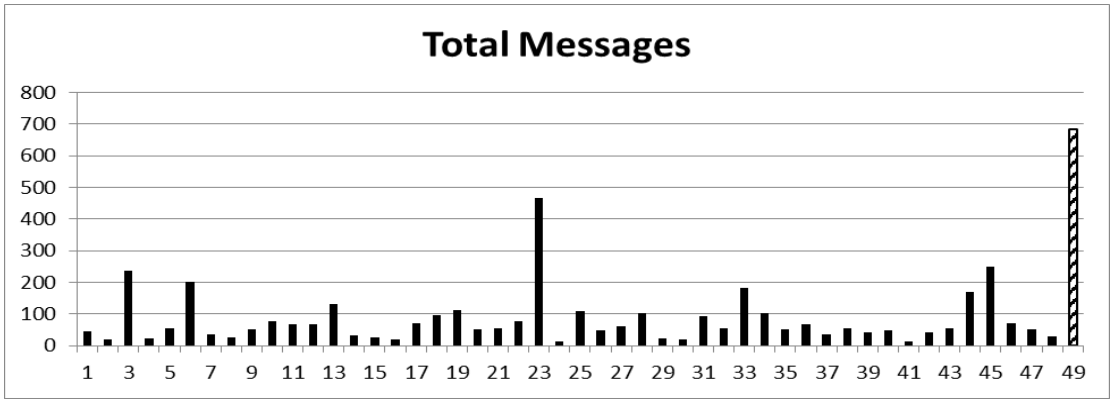


Figure 3.9. Participation of Individual Members Measured by Total Message Count

In this context, it must be reiterated that although 48 accounts are the number of women we intervened with, only 11 can be identified as active participants. Although the training given to all was similar, Figure 3.9 indicates non-uniform usage of social media platforms by the intervened women. This observation underscores the fact that despite efforts to empower marginalized communities, local constraints and challenges frequently impede the realization of comprehensive benefits for all involved. Educating rural populations in digital literacy and equipping them to engage in meaningful collaborations is gradual and requires time to materialize fully. Particularly in developing countries, this endeavor faces numerous social obstacles that can hinder its successful implementation. The insights gathered from our fieldwork can effectively highlight and address these prevailing issues.

The interactions with SHG women revealed that many have limited literacy, significantly challenging their ability to use smartphones and other digital devices freely. Therefore, providing contextual digital literacy training is essential. This training should introduce the rural population to digital technology in a way that is both accessible and engaging, thereby maintaining their interest in these new tools. Additionally, the prevalent gender bias in rural India often restricts women's participation in public forums. Despite digital platforms offering marginalized women a space for free expression, introducing digital technology to local women requires substantial awareness-raising at the community level. It is crucial to create a socially supportive environment in the immediate surroundings. Only with such backing can we anticipate the rural marginalized population to engage in digital usage without hindrance.

When implementing digital solutions to enhance virtual collaborations and reduce knowledge disparities in rural communities, it is essential to recognize that this promising approach is relatively novel in the existing rural context. During our initiative to introduce virtual collaboration to the women of Kandi, we encountered several obstacles, particularly from local authorities. These challenges included restrictions on the participation of local women in our research activities. Over time, we persuaded the authorities, who eventually allowed us to proceed with our research, but only with women they deemed suitable for our target group.

This experience illustrates that an all-encompassing empowerment strategy for marginalized communities may yield short-term desired outcomes. It is crucial to allocate time for the rural population to become acquainted with digital tools and platforms. Equally important is the need

to engage and negotiate with the local socio-cultural milieu. Only after these steps can we realistically expect the rural community to leverage digital means for their betterment effectively.

Following the intervention, a post-study was conducted after five months to assess the impact of the established Community of Practice (CoP) on the community members. The evaluation involved a questionnaire comprising 46 questions, categorized into 10 different sections. The response options for these questions ranged across a five-point scale: Strongly Agree, Agree, Neutral, Disagree, and Strongly Disagree. A representative selection of these questions can be found in Table 3.2.

Q. No.	Question	Category
1	I have used ideas from other community members and trainers to expand my business	**Livelihood enhancement**
2	I have earned money using ideas or knowledge acquired from community members	
3	We can discuss our health-related problems and seek help from our mentors	**Health-Related Issues**
4	We can learn more about health-related risks and how to mitigate them	
5	I have become more professional in my work attitude	**Productive Activity**
6	I have become more productive and enthusiastic about my work these days	
7	I am learning new things I did not know before	**Education**
8	I am now more eager to learn new things related to SHG	
9	I am more aware of avenues through which I can help my children to study	**Family**
10	I am feeling more confident as I can now provide a significant contribution to my family	
11	I am now more equipped to combat sudden disaster	**Security**
12	I can find solutions to mitigate disaster through this participatory community	
13	I feel positive about myself these days	**Subjective Wellbeing**
14	I am more confident in my approach nowadays	

Table 3.2 Sample Questions Translated into the Local Language for Evaluating the Effect of CoP on Individual Members

To calculate the aggregated response of community members for these queries, we combine the total number of responses, as shown in Figure 3.10. From the graph, it can be concluded that the benefits of this Community of Practice (CoP), as perceived by its members are significantly high and it has created a positive impact on their life and livelihood. Our interviews with SHG members reveal that all of them are quite enthusiastic, even though some of them were passive listeners (Basak et al., 2017).

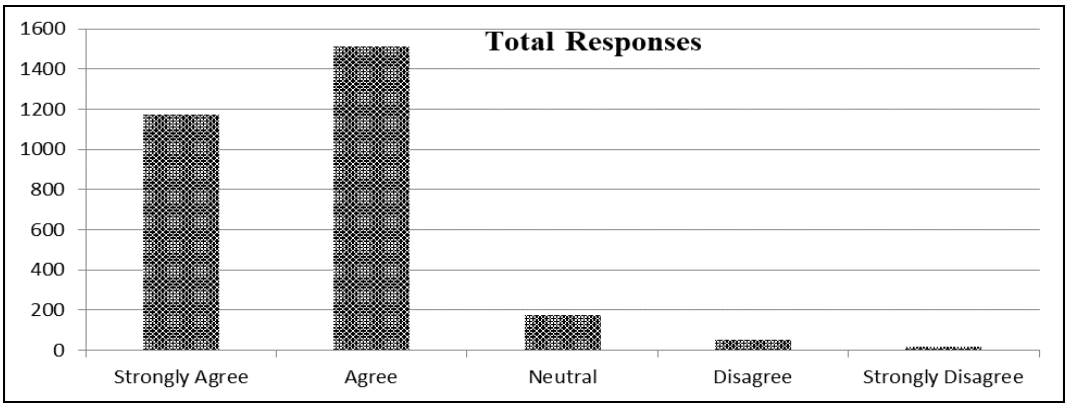


Figure 3.10. Aggregate Responses to all queries from Community Members

The conclusion from the research indicates that rural producers gained from both live training sessions and the asynchronous sharing of images and videos. They leveraged these materials to craft comparable products, thus improving their abilities and market prospects. Forming this community and developing effective interpersonal relationships among its members significantly boosted their motivation. This increase in motivation can be attributed to having access to professional advisory services. The experiential feedback from rural participants, with some sample testimonials presented in Table 3.3, indicates the effectiveness of cultivating communities of practice through social technology-supported blended learning environments. Such environments are promising in facilitating social knowledge exchange on a democratic level.

Supporting Testimonials (first-order concepts)	Second Order Theorizations
"I have never used digital medium before to cater to orders. Now after using it, I have realized its worth. I could produce from home and get deserving wages, more than the wage I can get by selling locally"	Enabling socio-economic development
"I used to finish work and post the photos in our online group. My buyer immediately corrected them. This helped me in learning faster."	Promoting socio-economic development by inducing self-learning.
"Online communication and exchange of photos always kept me in the loop of what my rural producer is producing".	• Promoting production by specificities of demand • Easy and smooth communication makes the production process a dialogic one, thereby reflecting the spirit of collaborative production.

Table 3.3. Impact of Community of Practice on Rural SHG Women (Translated from Bengali)

The conceptual derivations or second-order themes from the study are summarised as follows:

- Self-motivated learning through Intentional Rural-Urban Interaction: Creating a community of practice that connects rural and urban areas, supported by social technology and mixed learning approaches, enables rural participants to partake in proactive and participatory learning. This self-motivated learning process results from active participation, transforming learning into a self-driven endeavour.
- Fostering Peer-to-Peer Learning: Learning within this blended environment guarantees the dissemination of specialized and contextual knowledge from experts and fosters a collaborative learning space. This enables effective knowledge exchange among community members, paving the way for peer-to-peer learning where members benefit from each other's experiences and insights.
- Potential of Contextual Professional Guidance and Advisory Services: The availability of context-specific professional advice and services, facilitated through regular interactions with urban experts in a blended learning setting, provides a sustainable way to enhance rural skill sets. It also increases awareness about current market trends, operations, and demands.

- Promoting a Conducive and Collaborative Learning Environment: The combination of peer-to-peer learning, easy access to expert guidance, and prompt resolution of queries through virtual interactions with experts cultivate a learning environment conducive to social knowledge collaboration. Such an environment is vital to developing a thriving community of practice between rural and urban communities. This achievement is rooted in a social knowledge management framework based on blended learning (Basak & Bhaumik, 2023).

3.3.2 A Field Study with Rural Youth in India

Diamond Harbour, located in the South 24 Parganas of West Bengal, is characterized as a semi-urban area. Unlike in Kandi, where the focus of cultivating Communities of Practice (CoP) was vocational, in Diamond Harbour, the approach was oriented towards academic development. Specifically, a group of rural youth, predominantly female, was chosen to receive online spoken English training. This training was conducted synchronously to enhance their personal and professional prospects. To complement the synchronous training sessions, a WhatsApp group was created. This group included the English teacher, rural youth group members, and research unit members. The purpose of this WhatsApp group was to provide additional support and reinforce the lessons taught during the live classes.

- Universe of Study:

The rural youth population forms a substantial part of the rural demographic, many of whom have some education level but experience physical and knowledge-based barriers to accessing urban job markets. This contributes significantly to the issue of educated unemployment in these areas. A key challenge for them is the need for more proficiency in English, a language widely regarded as essential for entering the professional job market, especially considering their primary education is often conducted in local languages. In addressing this challenge, it is crucial to recognize that passive English teaching methods are unlikely to effectively motivate and engage the rural youth in becoming proficient in the language. To maximize impact, spoken English training should be delivered interactively. This approach involves active dialogue between students and teachers, focusing on understanding and practising the intricacies of English. Such an interactive method fosters a more engaging and effective learning environment, encouraging the learners to use and become comfortable with the language actively.

- Characteristics of Rural Youth Chosen for Our Research Study:

We chose five young rural individuals in Diamond Harbour, West Bengal, India, primarily women, for our research. This decision was reached in partnership with the BRWAS group, a local NGO committed to improving the community's quality of life and economic opportunities through educational initiatives. The support from the NGO played a crucial role in pinpointing the group we aimed to study. These individuals, despite being educated, found themselves in poverty due to the lack of suitable employment opportunities. They received their education in Bengali, the local language. However, a preliminary study by our research team revealed that their limited English proficiency was a significant barrier to improving their job prospects. To address this issue, our research group initiated synchronous online English language sessions conducted by urban English teachers. This was complemented by an asynchronous messaging tool, creating a collaborative learning environment. The aim was to enhance the English language skills of the target group, thereby improving their socio-economic prospects. This approach focused on language proficiency and fostered a supportive knowledge exchange and community learning space.

- Blended Learning Environment:

To improve the English skills of the targeted group in Diamond Harbour, we set up real-time online lessons led by English teachers from urban areas via video conferencing. The course content was extensive, addressing reading, writing, and especially speaking abilities in English, emphasising enhancing the group's spoken English fluency. This concentration on verbal communication skills made the sessions very participative, prompting the rural students to actively participate in discussions among themselves and the instructor, thereby creating a more vibrant educational setting.

In addition to these live classes, we employed an asynchronous messaging tool to supplement learning and create a collaborative space in line with the concept of a community of practice. This tool allowed for sharing reading materials relevant to the topics covered in the online classes and related images, videos, and texts. This variety of learning materials and the flexibility of asynchronous communication enhanced the learners' ability to grasp concepts more quickly. The blended learning approach, combining synchronous and asynchronous methods, facilitated the immediate resolution of doubts and queries by professional experts and classmates, leading to

more effective and rapid learning. Figure 3.11 contains screenshots illustrating the communication pattern between rural learners and urban-based academic professionals, showcasing how this facilitated and eased the learning process.

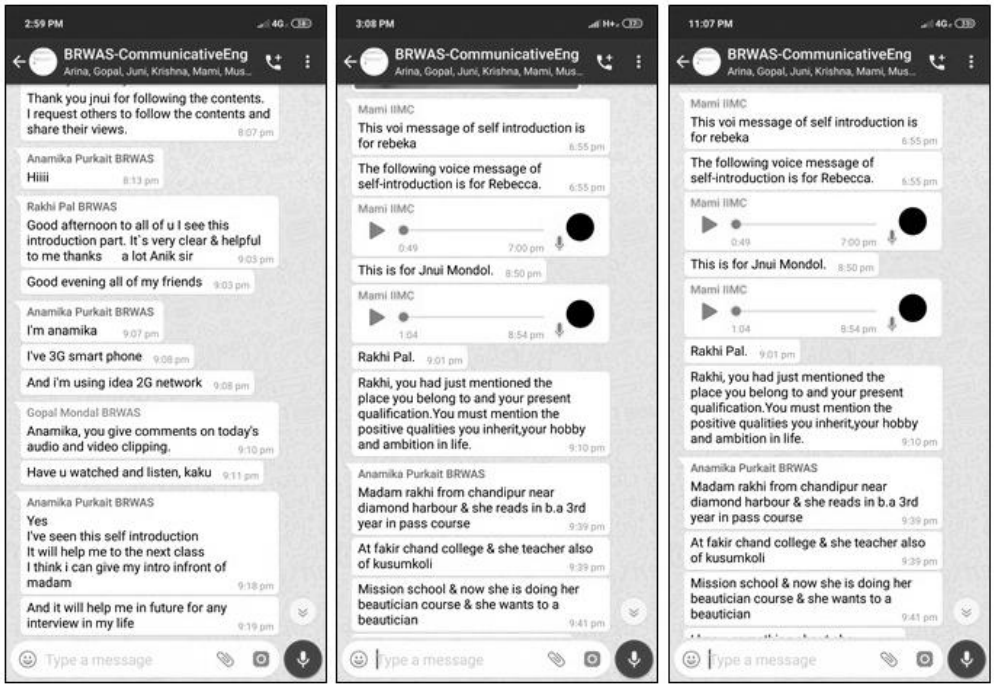


Figure. 3.11 Screenshots of Communications taking place over Messaging Tools

- Findings:

Jenson (2003) highlighted the significance of creating a learning community to improve learning English as a second language. This method is further validated by several studies that underscore the effectiveness of WhatsApp as an educational tool to enhance learning experiences (Jafari & Chalak, 2016; Bouhnik & Deshen, 2014; Gon & Rawekar, 2017; Cetinkaya, 2017). Our research involved a post-study examination to assess the benefits of integrating synchronous and asynchronous learning modes to promote cooperative learning. The feedback from rural learners, as shown in Table 3.3, vividly showed the positive impact of this approach in the virtual community we established. Participants reported that although they were sometimes reluctant to pose questions in a complete classroom setting, seeking clarifications through direct messaging made the education process more accessible. Forming a practice community centred on English-speaking lessons facilitated a learning environment where students could benefit from each other's questions and errors. Additionally, the instructor observed that the learning dynamics improved significantly with the introduction of blended learning and the formation of a virtual

learning community. This strategy made the learning atmosphere more engaging and offered a more tailored and immediate educational experience.

Supporting Testimonials (First order Concepts)	Second order Themes
"I have learned new English words through the online classes. The flexibility of communicating with the teacher through messaging, other than the fixed time in class, has helped me learn".	Promoting a flexible and conducive learning environment
• "In class, as well as in the messaging group, we, the students, also discuss our doubts and queries, which eases the process of learning" • "Videos sent through the messaging tool on relevant topics have helped me revise the lessons taught in class."	Fostering Peer-to-Peer Learning

Table 3.4. Effect of Community of Practice on Rural Youth (Translated from Bengali)

The second-order themes identified in Table 3.4 can be summarized as follows:

- *Promoting a Flexible and Conducive Learning Environment:* Establishing a community of practice, bridging urban teachers and rural youths, created a learning space distinct from traditional classroom settings. This approach enabled flexible learning hours, uncomplicated interactions with teachers at any time and from any location, and the immediate resolution of doubts through a virtual asynchronous messaging application (WhatsApp). Such a setup fostered an adaptable and supportive learning environment, effectively disseminating specialized knowledge tailored to the local context, pace, and needs.
- *Fostering Peer-to-Peer Learning:* The collaborative learning environment established by the community of practice fostered peer-based learning. In this environment, rural learners could voluntarily consult with and learn from their peers as part of the learning process. This approach facilitated efficient and faster learning, ensuring a higher internalisation rate and comprehension of the newly acquired knowledge.

3.4 Cultivating Online Communities of Purpose in Bridging Market Separation of Rural Producers

3.4.1 Understanding Market Separation in Rural Contexts

- Analysing Rural Market Dynamics

Analyzing rural market dynamics in the context of bridging market separation for rural producers through e-commerce involves a multifaceted examination of unique market challenges and opportunities. It encompasses evaluating limited market access and inefficient distribution channels that hinder rural artisans from reaching broader markets, necessitating understanding local and global demand for their products. This analysis delves into competitive pricing and the perceived value of rural goods, highlighting the need for strategies that ensure fair compensation while catering to consumer preferences. Moreover, it considers the barriers to technological adoption and digital literacy among rural communities alongside infrastructural constraints that limit e-commerce participation (Chandrasekhar, 2012). Furthermore, the analysis recognizes the importance of social networks, community trust, and cultural considerations, suggesting that leveraging these social dynamics can foster collective engagement in e-commerce platforms. This comprehensive understanding of rural market dynamics is critical for designing e-commerce solutions that are sensitive to the challenges faced by rural producers, offering them sustainable avenues to expand their market reach and improve their livelihoods (Sharma, 2013).

- Identifying Challenges Faced by Rural Producers

The challenges faced by rural producers extend beyond merely accessing marketplaces. They also need a deep understanding of market dynamics, operations, trends, and characteristics. This highlights that simply providing additional market connections is not sufficient. While establishing new channels for market access is essential for rural producers, it is equally crucial to enhance their overall market-related knowledge and capabilities. This underscores the value of creating a community of purpose, which, through fostering targeted collaborations, can significantly boost the performance of the rural economy (Kakati & Ahmed, 2014).

The rural economy is a critical livelihood source globally, with its importance being even more pronounced in developing countries (Singh et al., 2015). Although it supports a large portion of the population, the rural economy is predominantly informal and disenfranchised. Sales are often confined to fluctuating and unpredictable local markets, leading to rural producers being caught

in a cycle of low investment capacity, reduced productivity, weak market linkages, and inconsistent income.

Rural economies are characterized by production processes with a low carbon footprint, utilizing locally available raw materials and traditional methods. This indigenous nature of rural production minimizes environmental impact and positions it as a sustainable industry. However, rural producers need help in sustaining their industry despite its potential. A core issue is the largely informal and unorganized nature of rural production, with many producers operating independently on a freelance basis (Ghouse, 2012).

The consequences of the informal and unorganized nature of rural production are significant, as it hinders rural producers from harnessing the advantages that organized entities typically enjoy. This results in multiple challenges:

- Limited Access to Quality Raw Materials: Rural producers often struggle to procure high-quality materials for producing goods that meet global market standards (Aref & Aref, 2011).
- Limited Awareness of Non-local Market Demands: There is often a gap in understanding consumer demands in markets beyond their local area (Olayiwola & Adeleye, 2005).
- Inability to Produce High-Quality Products for Global Markets: Due to constraints in skills, technology, and resources, rural producers find it challenging to create products that satisfy global market requirements (Rogerson & Sithole, 2001).
- Restricted Access to Non-local Markets: The reach of rural producers is typically confined to local markets, limiting their exposure and access to broader market opportunities (Shah et al., 2017).

These barriers hinder the sustainable practice of their trade and force many rural producers to seek alternative livelihoods, endangering the preservation of indigenous talent and culture.

- Using digital platforms to connect Rural Producers

The concept of cultivating a community of purpose holds great promise in enhancing the performance of the rural economy. This approach aims to shift to a more decentralized production model fueled by collaborations among community members. Effective partnerships between rural and urban entities within a community of purpose can significantly improve

mutual understanding of market dynamics and help mitigate the market separations faced by rural producers. Communities of purpose, comprising relevant rural-urban entities (as illustrated in Figure 3.12), not only facilitate economic gains for rural producers but also enhance their overall experience by enabling knowledge exchanges across various dimensions:

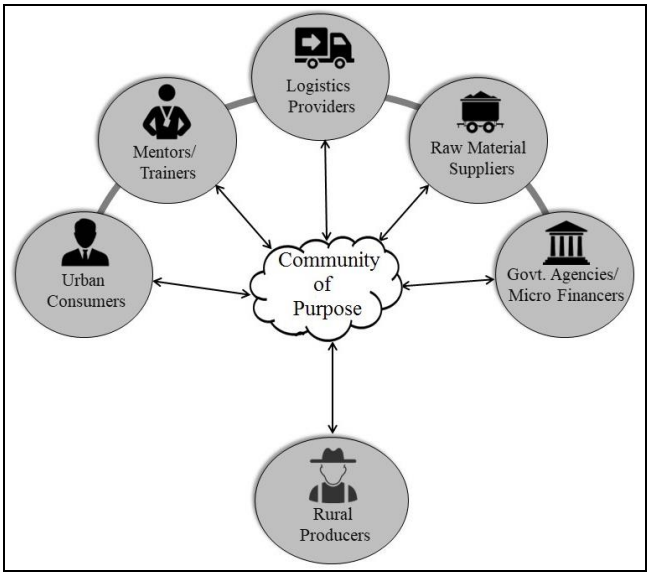


Figure 3.12 Community of Purpose

- Developing communities of purpose for rural producers involves establishing strategic connections across various sectors to address the identified market separations. These connections include:
- Connecting with Urban Designers/Experts: By establishing a link with urban designers and market experts, rural producers can gain insights into current market trends. This knowledge will enable them to tailor their business ventures to meet market demands more effectively.
- Linking with Government Professionals: Facilitating interactions with government officials allows rural producers to learn about public policies supporting rural production. This can help them navigate and leverage available government resources and programs.
- Engaging with Trainers for Blended Learning: Connecting rural producers with trainers for blended learning sessions (both synchronous and asynchronous) will help upgrade their skills. This approach introduces innovative production techniques and practices to the rural community.

- Access to Micro-financers: Connecting with micro-financers ensures that rural producers receive necessary financial support and advice. This can assist them in developing cost-effective and profitable business strategies.
- Sourcing from Various Raw Material Providers: By linking rural producers with a diverse range of raw material suppliers, they can access a more comprehensive selection of resources, allowing them to choose the most cost-effective procurement options.
- Collaborating with Logistics Suppliers: Partnering with logistics providers can help reduce the time, effort, and expense of delivering finished products and sourcing raw materials from non-local markets.

These connections are essential for empowering rural producers, enhancing market access and production capabilities, and ensuring a more sustainable and profitable operation.

Forming interpersonal and communitarian bonds through a community of purpose offers substantial economic benefits for rural participants. This community facilitates peer-to-peer learning, enabling members to learn from each other's successes and mistakes (Jones et al., 2009). Given rural producers' physical and virtual isolation from market dynamics and poor economic performance, developing purposeful communities becomes a critical step in empowering them.

In a rural context, cultivating a community of purpose and the multi-agent knowledge exchange it fosters empowers rural producers to engage actively in collaborative decision-making. This active participation involves them in the problem-resolution process, leading to collective agreement and action (Braesemann et al., 2020). The voluntary nature of participation within communities of purpose makes it an especially suitable strategy for addressing the unique challenges faced by rural production and its practitioners. In contrast to their urban counterparts, rural producers' isolation has often relegated them to passive labourers, exploited by urban markets without adequate recognition or fair compensation.

While the necessity of cultivating communities of purpose is apparent, the challenge lies in how to effectively create them, particularly in the context of disenfranchised rural communities. Communities of purpose do not spontaneously arise; they require a structured framework to facilitate their formation. The subsequent section of the study proposes a digital framework for

establishing and operationalizing communities of purpose in rural settings. This proposed framework highlights how the unifying power of contemporary Information and Communication Technologies (ICT) can be harnessed to foster a potent community of purpose that bridges rural and urban divides.

3.4.2 The Role of Communities of Purpose in Bridging Market Separation of Rural Producers

- Exploring the Role of Technology in Bridging Gaps

Technology is transforming rural handicraft makers' operations as a key instrument in closing gaps and creating new possibilities. Through digital platforms and online commerce, these artisans gain access to international markets, allowing them to circumvent conventional intermediaries and connect directly with customers globally, which boosts their earnings and visibility (Vaswani et al., 2005). Adopting digital payment methods and financial technology solutions promotes broader financial inclusion, offering secure and quick transactions and simplifying access to financial services such as loans and insurance. Moreover, online educational resources and training programs are becoming essential for skill enhancement, enabling artisans to improve their craftsmanship and keep up with international market trends and business techniques. Technological advancements in supply chain management contribute to improved inventory oversight and demand forecasting, making production more efficient. Online communities enhance networking and collaboration, where artisans can exchange ideas, work together, and form groups for increased economic power (Shiferaw et al., 2009). Digital marketing tools provide effective promotion and branding avenues, helping these creators establish a unique brand presence and reach a wider audience. Technology also advocates for sustainable methods and traceability in material sourcing, aligning with consumers' increasing focus on sustainability (Vaswani et al., 2005). Additionally, it is vital to preserve culture, as rural artisans employ digital mediums to document, share, and maintain their traditional arts, ensuring their cultural legacy prospers in the digital age.

- Mobilizing Rural-Urban Communities Towards Purposive Collaboration

Mobilizing rural-urban communities towards purposive collaboration involves a multifaceted approach that recognizes their interdependence and focuses on shared goals for mutual benefit. Central to this is the understanding that rural areas often provide essential resources and

products, while urban areas offer technological, economic, and educational advancements. Effective collaboration starts with identifying common objectives, such as economic development, sustainability, or healthcare improvement. Key to this process is fostering open communication and ensuring community engagement in decision-making, which can be facilitated through regular meetings and digital platforms. Technology plays a crucial role in bridging gaps, with applications ranging from telemedicine and online education to digital marketplaces for agricultural goods. Supporting policies and advocacy are also vital, as are encouraging governmental incentives for cross-regional operations and sustainable practices (Shiferaw et al., 2009). Initiatives should be environmentally conscious, promoting green technology and sustainable farming. Enhancing connectivity through infrastructure development, like improved transportation and communication networks, is equally important. Economic ties can be strengthened by rural products for urban markets (Shiferaw et al., 2009). Furthermore, educational and cultural exchanges enhance mutual understanding, while collaborative research addresses specific challenges, leading to innovative solutions. Regular monitoring and evaluation ensure that these collaborative efforts are practical and goals are met, ultimately leading to a more cohesive and mutually beneficial relationship between rural and urban communities.

- The Potential of Online Platforms in Rural Market Integration

The potential of online platforms in integrating rural markets into larger economic ecosystems is profound, offering transformative opportunities for growth and empowerment. These platforms provide rural producers with unprecedented access to national and global markets, significantly expanding their customer base and breaking the limitations of local sales. This expansion is further enhanced by the transparency in pricing, which helps mitigate exploitation by intermediaries and ensures fairer pricing structures (J. Bhattacharyya, 2004b). Online marketplaces also notably reduce transaction costs by minimizing the need for physical marketplaces, making products more affordable and transactions more efficient. A critical advantage is the facilitation of information exchange, giving rural sellers insights into consumer trends, quality standards, and product demands, which are crucial for improving product quality and diversifying offerings (Fitzgerald, 2013). Integration with digital payment systems streamlines transactions and promotes financial inclusion, enabling rural sellers to access modern banking services and credit facilities. These platforms streamline supply chains, connecting rural producers directly with a broader array of consumers, retailers, and wholesalers, thus enhancing

overall supply chain efficiency. Additionally, they serve as resources for capacity building and skill development, providing training in marketing and logistics, essential for effective competition in broader markets. Beyond economic benefits, these platforms empower rural communities by enabling informed decision-making and improving livelihoods. Furthermore, online platforms encourage networking and forming partnerships with diverse stakeholders, including NGOs, government bodies, and international entities, thus ensuring more comprehensive market integration for rural communities. Online platforms are not just tools for economic integration but catalysts for social and cultural empowerment, weaving rural producers into the larger fabric of the global economy.

3.5 Conclusion:

This chapter demonstrates the significant role of Communities of Practice and Purpose in enhancing the socio-economic status of rural producers. Rural producers access specialized knowledge and improve market performance by fostering collaborative environments and purpose-driven collectives. The key to success lies in the strategic cultivation of these communities, characterized by shared visions, robust leadership, and the integration of technological tools for improved connectivity and collaboration. Moreover, external partnerships amplify the community's impact, providing additional resources and opportunities. Collectively, these communities facilitate knowledge sharing and socio-economic development and empower rural producers to navigate market challenges more effectively. The findings underscore the importance of community-driven approaches in achieving sustainable development and empowerment for rural sectors, offering a blueprint for leveraging collective efforts towards enhanced socio-economic resilience.

Chapter 4

NCoRe: Architecting a Community-Driven E-Commerce Platform

4.1 Introduction to Community-Driven E-Commerce Platform

A community-driven e-commerce platform represents a novel approach to online commerce, focusing on the collective involvement of a community in shaping the marketplace. This model emphasizes the active participation of users, including buyers, sellers, and other stakeholders, in creating a vibrant, interactive, and responsive online shopping environment. Unlike traditional e-commerce platforms that operate top-down, community-driven platforms leverage the power of the community to drive decisions, curate products, and set standards that reflect its members' collective values and preferences.

The core philosophy behind a community-driven e-commerce platform is to foster a sense of ownership and belonging among its users. This approach encourages transparency, democratic decision-making, and direct feedback mechanisms, allowing the community to influence the platform's development, product offerings, and policies. It operates on the principle that a collectively managed platform can better cater to its user base's unique needs and interests, leading to a more tailored and satisfying shopping experience.

One of the key features of community-driven e-commerce platforms is their emphasis on social interaction and collaboration. These platforms often integrate social media-like features that allow users to communicate, share opinions, and offer recommendations. By doing so, they facilitate transactions and build a sense of community among users, fostering trust and loyalty.

Moreover, community-driven platforms typically support local businesses, artisans, and producers by providing a marketplace to showcase and sell their products. This helps promote local economies and offers unique, high-quality products that reflect the community's culture and values. Sustainability and ethical practices are often highlighted, aligning the platform with the values of environmentally conscious consumers and producers.

Technologically, these platforms leverage the latest web and mobile technologies to offer a seamless and intuitive user experience while employing robust data analytics to understand user behaviour and preferences. This data-driven approach enables continuous improvement of the platform, ensuring that it evolves in line with community expectations. Community-driven e-commerce platform is a collaborative, democratic, and socially connected online marketplace that prioritizes the needs and values of its community. It represents a shift towards more personalized, responsible, and community-focused online commerce. It offers a sustainable model that benefits local economies, supports ethical practices, and fosters a strong sense of community among users.

4.1.1 Defining the Concept of Community-Driven Platforms

As Sherry (2017) discussed, community-driven platforms are essential for public health interventions, serving to develop and maintain community-centred solutions. These platforms, which NGOs can only establish with effective government presence, are crucial for convening communities and marshalling resources. Schmid (2000) further emphasizes the role of community-supporting platforms in fostering online communities, highlighting the need for digital mediums that meet community-specific requirements. This is particularly relevant in mobile communities, as explored by Fremuth et al. (2005), who discuss innovative value-added service concepts for mobile coordination support. Stanoevska-Slabeva (2000) provides a generic architecture for community-supporting platforms based on the concept of media, which can be applied to various application areas.

The concept of community-driven platforms refers to digital or online spaces where the governance, development, and operational decisions are significantly influenced or directly made by the platform's community of users, including both producers and consumers. Unlike traditional centralized platforms, where decision-making is typically reserved for the platform's owners or a small group of administrators, community-driven platforms engage a broader base of stakeholders in these processes. This approach democratizes the platform's evolution, ensuring that it aligns more closely with its user base's needs, preferences, and values.

Key Characteristics of Community-Driven Platforms

- **Participatory Governance:** Community-driven platforms operate on principles of participatory governance, where users have a say in significant decisions through mechanisms like voting, feedback, and direct dialogue (Spagnoletti et al., 2015). This can cover aspects ranging from new feature development to community standards and policy changes.
- **Transparency and Openness**: These platforms prioritize transparency in operations and decision-making processes, fostering a culture of trust and inclusivity (Ostrom, 1990). Openness in making decisions and addressing problems helps build a loyal and engaged community.
- **Decentralized Decision-Making:** Decentralization is a hallmark of community-driven platforms, distributing power among many stakeholders rather than centralizing it (Benkler, 2006). This approach can lead to more innovative and diverse outcomes by harnessing the community's collective intelligence.
- **Community Engagement and Collaboration:** High levels of engagement and collaboration among community members are encouraged and facilitated, with tools and spaces provided for interaction, collaboration, and mutual support (Lessig, 2004).
- **Social Connectivity:** Beyond mere transactions or content sharing, these platforms often emphasize building social connections and fostering a sense of belonging among users (Putnam, 2000).

4.1.2 Examining the Shift Towards Collaborative E-Commerce

The shift towards collaborative e-commerce is a complex process that involves various factors. Chen (2010) emphasizes the importance of awareness in this environment, while Cameron (2012) highlights the need for a theoretical framework, particularly in projects involving small and medium-sized enterprises. McIvor (2002) discusses the role of electronic commerce in supporting collaborative buyer-supplier relations, noting the need for a culture change and the challenge of system incompatibility. Rahayuab (2020) focuses on knowledge sharing in collaborative e-commerce, particularly the role of trade secrets in building trust partnerships.

These studies collectively underscore the multifaceted nature of the shift towards the digital marketplace, moving away from traditional, centralized models to embrace community-driven, decentralized platforms. Collaborative e-commerce platforms, exemplified by entities like Etsy and Kickstarter, leverage the collective power of their communities to create, fund, and distribute products, fostering a model that prioritizes shared value creation and long-term sustainability over short-term profits. Despite facing technical, trust, security, and regulatory challenges, these platforms offer a glimpse into the future of commerce, where innovation, community engagement, and shared economic power redefine the consumer landscape. The continued growth of collaborative e-commerce, fueled by advancements in blockchain, AI, and decentralized finance, suggests a blurring of lines between traditional and collaborative models, urging businesses and consumers to adapt to a more interconnected, community-oriented marketplace. This evolution not only enhances consumer choice and market accessibility but also promises a more sustainable, transparent, and equitable economic framework for the digital age.

4.2 Traditional E-Commerce Platform Architecture

4.2.1 Overview of Traditional E-Commerce Architectures

Traditional e-commerce architectures have evolved significantly since the inception of online shopping. Yet, they share common foundational elements that facilitate the buying and selling goods and services over the Internet. The following are the primary building blocks of Traditional E-Commerce platforms.

1. Front-End Layer (User Interface):

- Purpose: The front-end layer is the user interface of an e-commerce platform designed for customer interaction. It includes the website or app layout, product catalogues, search and filter functions, and checkout.
- Characteristics: This layer emphasizes usability, responsiveness, and aesthetics to enhance the user experience. It’s developed using web technologies like HTML, CSS, JavaScript, and frameworks such as React or Angular.

2. Back-End Layer (Server-Side):

- Purpose: The back-end layer handles business logic, database management, authentication, and server interactions. It processes user requests, manages data, and executes core functionalities like payment processing and inventory management.
- Characteristics: It's built using server-side programming languages (e.g., PHP, Java, Ruby on Rails) and database systems (e.g., MySQL, MongoDB). This layer ensures data integrity, security, and performance.

3. Database Management:

- Purpose: Databases store and manage all data related to products, customers, orders, and transactions. They are crucial for inventory management, user authentication, and personalisation.
- Characteristics: Traditional architectures often use relational database management systems (RDBMS) for structured data storage and retrieval. These systems support ACID (Atomicity, Consistency, Isolation, Durability) properties, ensuring reliable transaction processing.

4. Payment Gateways and Processing:

- Purpose: Payment gateways integrate with e-commerce platforms to facilitate secure payment transactions. They encrypt and transmit payment information to payment processors and banks.
- Characteristics: They must comply with security standards (e.g., PCI DSS) to protect sensitive data. Integration with multiple payment methods (credit cards, PayPal, digital wallets) is common to accommodate diverse user preferences.

5. Content Management System (CMS):

- Purpose: A CMS allows non-technical users to create, manage, and publish content without coding. It's essential for updating product listings, blog posts, and marketing materials.
- Characteristics: E-commerce platforms often use a CMS for its flexibility and ease of use, with options like WordPress, Magento, and Shopify being popular choices.

6. Security Measures:

- Purpose: Security is paramount in e-commerce to protect against data breaches, fraud, and cyber-attacks. Measures include SSL certificates, data encryption, secure authentication, and regular security audits.
- Characteristics: Implementing robust security protocols is crucial to maintaining customer trust and complying with legal and regulatory requirements.

7. Scalability and Performance Optimization:

- Purpose: E-commerce platforms must be scalable to handle varying loads, particularly during peak traffic. Performance optimisation ensures fast loading times and a smooth user experience.
- Characteristics: Techniques include content delivery networks (CDN), caching strategies, and load balancing. Scalability can be achieved through cloud computing services, allowing for dynamic resource allocation.

4.2.2 Identifying Challenges and Limitations

The challenges and limitations of traditional e-commerce architectures, particularly in addressing the needs of rural producers, have been extensively studied. Longdon & Shaw (2000) identified the critical need for systems that reliably locate buyers and sellers in electronic marketplaces, including rural producers, and facilitate automated transactions that cater to their unique requirements. D. Gupta (2020) highlighted the architectural challenges in integrating e-commerce and ERP systems, proposing an approach for ERP-dependent organizations, focusing on including rural producers, to start selling online. This integration is vital for rural producers who often face difficulties accessing broader markets. Longdon & Shaw (2000) proposed the concept of electronic commerce management systems (ECMS) to address the uneven quality, low productivity, and low reusability of in-house programmed e-commerce systems, issues that disproportionately affect rural producers. Birkhofer (2000) introduced a new distributed e-commerce system architecture aimed at improving reliability, scalability, stability, and maintenance, crucial factors for enhancing the online presence of rural producers. Collectively, these studies underscore the need for more efficient and integrated e-commerce architectures that consider and actively incorporate the perspectives and needs of rural producers. The following are the significant challenges and limitations of Traditional E-Commerce platforms.

- **Scalability, Flexibility, and Producer Inclusion:** Traditional e-commerce architectures often struggle with scalability and flexibility, and this limitation extends to including rural producers' opinions on crucial aspects like pricing and order acceptance. As businesses grow, the rigid structure of these systems makes it difficult to efficiently scale up or incorporate feedback from rural producers, whose insights could enhance product offerings and market responsiveness.
- **Integration Challenges and Rural Producer Engagement:** The complexity of integrating new technologies or third-party services is compounded when considering the inclusion of rural producers in the e-commerce ecosystem. Traditional architectures offer limited support for dynamically incorporating producers' preferences and feedback, making it challenging to reflect the actual value and cost of rural-produced goods accurately.
- **Performance Bottlenecks and Producer Connectivity:** Increased user traffic can lead to performance bottlenecks, impacting not only customer experience but also the ability of rural producers to manage orders effectively. The lack of real-time connectivity and interaction with these producers exacerbates inventory management issues, potentially leading to order fulfillment delays and dissatisfaction.
- **Security Risks and Data Privacy for Producers:** The centralized nature of traditional e-commerce systems not only presents security risks but also raises concerns about the privacy and protection of rural producers' data. Ensuring the confidentiality of their information and safeguarding against breaches is crucial yet often overlooked in centralized architectures.
- **Data Management, Analysis Limitations, and Producer Insights:** Traditional architectures' limitations in handling and analyzing data restrict the ability to leverage rural producers' insights for better decision-making. These systems often fail to capture rural producers' nuanced preferences and constraints, missing out on opportunities to optimize pricing, product selection, and supply chain logistics.
- **Cost, Resource Intensity, and Access for Rural Producers:** The resource-intensive nature of maintaining and scaling traditional platforms can be particularly prohibitive for rural producers. High costs and complex infrastructure requirements limit these producers' ability to participate fully in the e-commerce marketplace, reinforcing existing market access barriers.

- **Overlooking Rural Producers in Consumer Expectations:** Traditional e-commerce architectures may struggle to adapt to modern consumer expectations for transparency, sustainability, and ethical sourcing, partly because they often fail to incorporate rural producers' perspectives. This oversight can lead to a disconnect between consumer values and product sourcing and pricing realities, undermining efforts to offer a truly inclusive and equitable shopping experience.

Adding challenges to excluding rural producers' opinions in traditional e-commerce architectures underscores the need for more inclusive, flexible, and responsive systems. Emerging architectures, like microservices, promise greater adaptability, but a conscious effort to integrate rural producers' insights and preferences into these systems is essential. Addressing these limitations is a technical challenge and a fundamental shift towards more equitable and sustainable e-commerce practices, ensuring that all voices, especially those of rural producers, are heard and valued in the digital marketplace.

4.3 Architecting a Community-Driven E-Commerce Platform: NCoRe

4.3.1 Technological Frameworks for Community Integration

- Motivation

In the evolving e-commerce landscape, the need for inclusive, sustainable, and adaptable platforms has never been more critical. Traditional e-commerce architectures, while foundational to the digital marketplace, have shown significant limitations, particularly in scalability, flexibility, integration, and the inclusion of diverse stakeholder voices. Among these overlooked voices are those of rural producers, whose invaluable insights into product pricing, order acceptance, and supply chain dynamics often go unheard. This gap not only impacts the producers but also affects the market's ability to offer authentic, value-driven products to consumers. Recognising these challenges, we are motivated to develop NCoRe, a community-driven e-commerce platform designed to bridge the gap between rural producers and the global market, fostering a more inclusive, equitable, and sustainable digital economy.

In the context of rural artisans, there are other difficulties with existing e-commerce platforms:

- **Inventory Management:** Due to the handmade nature of the products, every product is unique in design, style and shape. It is tough to maintain the same standard for every handmade item. It is challenging for rural artisans to upload their products on the e-

commerce platform while maintaining standardization. Selling items through platforms like Amazon requires a minimum inventory to deliver items within the delivery deadline specified by Amazon (usually 7-10 days from the date of order placement). Most rural artisans work on a daily wage basis and do not have any stock of physical products due to their financial constraints. It is difficult for them to maintain a minimum inventory of their items regularly.

- **Product Visibility:** Listing products on platforms like Amazon requires selecting a brand name. Artisans do not have their brand; in that case, they can list their products under a Generic brand. Here, the chances of visibility of products to the customers on the Amazon platform are meagre and getting organic orders is negligible. Also, acquiring good trust scores and customer feedback is a big challenge for the newly registered artisans under the Generic brand category.

Our field research underscores the necessity for a community-focused e-commerce platform that enhances interactions, collaborations, and commerce among rural artisans, non-local consumers, entrepreneurs, and other key stakeholders (such as financiers, raw material suppliers, and logistics providers). This platform is distinguished by its standardized, adaptable, and transparent infrastructure, which not only boosts productivity but also guarantees equity and economic gains for all participants. On this platform, each rural artisan has their digital storefront showcasing their profile and product images. Furthermore, a mobile application available in the local language simplifies the process for artisans to share their personal and professional information. Consequently, this platform offers rural artisans a direct and engaging way to integrate into the digital marketplace, fostering a more personalized and effective e-commerce experience.

Considering all the above observations regarding the promotion and selling of rural handicraft artisans' products in the urban marketplace, we have developed NCoRe: A Community-driven e-commerce Platform, which not only promotes rural artisans and their traditional and indigenous art forms in the global marketplace but also ensures fair and equitable participation in the marketplace. We have designed and implemented this platform and conducted a pilot study with the rural artisans of Birbhum, West Bengal, India, to validate the platform.

- The Conceptual Framework

The envisioned NCoRe framework is designed as an interconnected digital environment that facilitates interaction and collaboration among its users. It aims to foster the establishment of community norms and values, enable the sharing of resources, and promote the development of trustworthy relationships.

The foundational goal of the NCoRe framework is to develop and strengthen social capital both within rural areas and between rural and urban regions, thereby enhancing cooperation across these communities. Essential to enhancing the market connections of rural areas is the provision of high-quality educational support, training, and advisory services, insights into local opportunities, and the availability of a platform for discussing local governance issues. By promoting the effective exchange of information and knowledge between urban consumers and rural communities, the NCoRe framework aims to improve the market access of rural areas to urban markets.

To realize the objectives outlined for the NCoRe framework, the implementation strategy focuses on three critical tasks:

- Develop and Implement a Digital Platform: Create an internet-enabled digital platform that incorporates social technologies and offers local language support. This platform is aimed at practically applying the NCoRe framework's proposed functionalities, facilitating seamless interaction and collaboration among users.
- Equip Rural Communities with Smartphones: Provide selected rural communities with smartphones to access the digital platform, thereby fostering integration between rural and urban communities. This step is crucial for connecting rural populations with broader markets and knowledge resources. The impact of this connectivity on social capital and community wellbeing will be a key focus of our research, examining how the NCoRe Platform's engagement opportunities contribute to these areas.
- Integrate E-Learning Platforms with NCoRe: Enhance the NCoRe framework with synchronous and asynchronous online e-learning platforms. These platforms will offer vocational training and advisory services to rural community members, aiming to improve their skills and knowledge base. This integration is essential for providing comprehensive support and resources to rural users, enabling them to benefit fully from the digital and economic opportunities presented by the NCoRe framework.

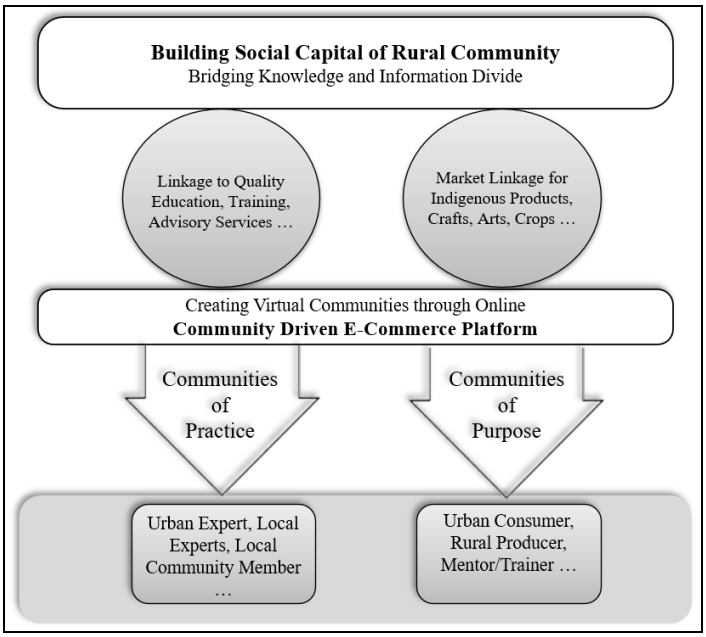


Figure 4.1. NCoRe Framework Facilitating Virtual Community Formation

Virtual communities based on rural-urban knowledge exchange are crucial for holistic rural empowerment. Unhindered knowledge exchange facilitates two types of virtual communities: *communities of practice* and *communities of purpose*. Communities of practice enhance individual capability, while communities of purpose solve market linkage and livelihood-related problems and promote local community assets. Collective participatory credentials are necessary for rural communities to mobilize local resources crucial to achieving resilience.

The platform's services are structured into three primary sections:

It firstly presents an opportunity for urban customers to participate in the design and creation of crafts and textiles by partnering with rural artisans. As its second function, it operates as a conventional exhibition space, showcasing an assortment of artisan-made products such as apparel, bags, jewelry, and home decor. Each product is featured along with the story of its maker, providing a digital storefront for numerous artisans to share their journey, including videos and photographs of their work. Lastly, the platform facilitates skill enhancement opportunities for individuals from both rural and urban backgrounds, allowing them to access and benefit from educational resources without barriers.

A virtual community allows multiple actors to exchange information through a temporary association of autonomous entities. It shares skills, resources, information, risks, costs, and benefits for business opportunities.

4.3.2 Deployment of NCoRe to Mitigate Knowledge and Market Divide of Rural Community

- System Design

The NCoRe platform enables interactions, partnerships, and commerce among rural manufacturers, urban buyers, and other participants within the ecosystem. It specifically facilitates dealings among rural manufacturers, urban buyers, and additional parties (like suppliers of raw materials and logistics services) by offering an adaptable, standardized, and open platform that enhances efficiency and guarantees equitable and financial advantages for everyone involved. The cooperation supported by this platform promotes openness and aids in improving the situation for all business stakeholders. It offers a digital forum where various entities within this network can share and acquire knowledge. This digital environment is referred to as a 'community.' Hence, this platform (referenced as Figure 4.2) is characterized as a temporary collaborative space for independent gig workers who form dynamic one-on-one connections to engage in shared activities, including the exchange of expertise, resources, information, risks, costs, and rewards, to fulfill a specific business need.

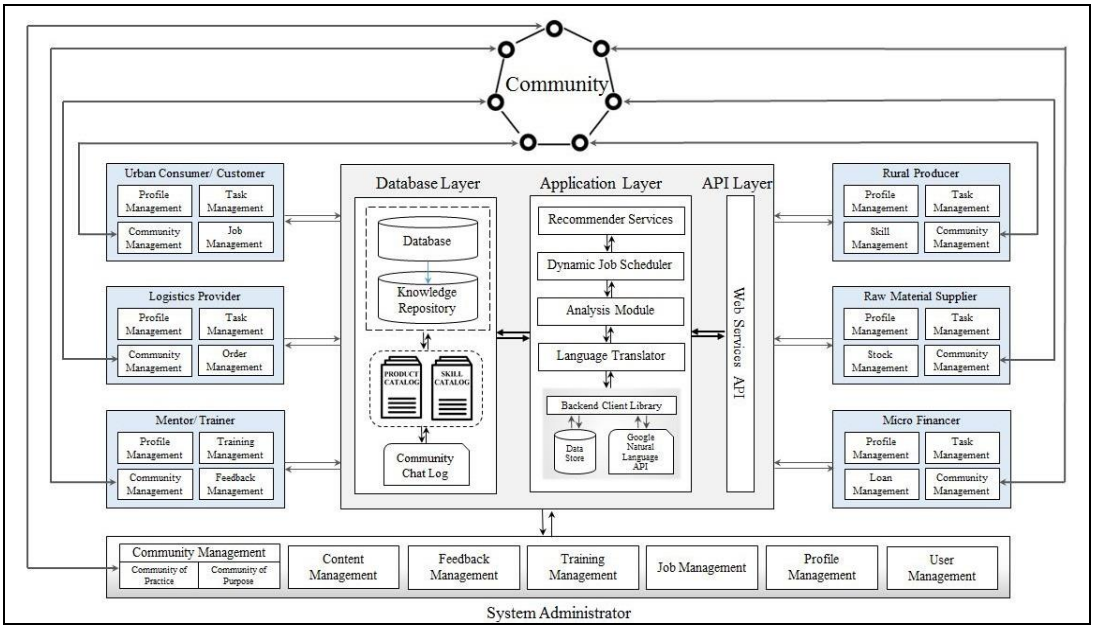


Figure 4.2. System Architecture

The function of our platform (Figure 4.2) is based on peer-to-peer micro-manufacturing that employs many independent rural producers, urban consumers, and other related entities such as

raw material suppliers, logistics providers, trainers, micro-financiers, etc. This platform facilitates their decentralised coordination. The following is a functional description of each entity:

Mainly four different modules are present in the system-level architecture,

- Module-1: Users
- Module-2: Core Information System
- Module-3: User Community Management
- Module-4: System Administrator

The various components of the NCoRe platform, illustrated in Figure 4.2, are outlined as follows:

Users

The system incorporates six distinct user categories:

- ✓ **Urban Customers:** Individuals residing in urban areas seeking unique products or services.
- ✓ **Rural Producer:** Artisans and producers from rural regions offering traditional or handmade items.
- ✓ **Logistics Provider:** Companies or individuals providing transportation and delivery services.
- ✓ **Advisors/Educators:** Professionals offering guidance, training, or expertise.
- ✓ **Raw Material Supplier:** Suppliers distribute the necessary raw materials for product creation.
- ✓ **Micro Financer:** Government entities or microfinance institutions involved in regulation, support, or funding.

These participants are interconnected through a digital platform accessible via mobile applications, ensuring continuous and convenient interaction among all parties involved.

Rural Producers: Rural producers can showcase their products, contact information, skills, production abilities, and customer feedback in an online catalogue. They're encouraged to explore the offerings of their counterparts to enhance their perspectives and knowledge, aiding in making well-informed decisions regarding skill development and pricing strategies. Participating in bidding processes enables them to set competitive prices and negotiate for optimal profit and

competition. Rural producers are also active members of the "user community," which fosters communal interaction and learning.

Urban Consumers: Urban consumers, who may be micro-entrepreneurs or individual shoppers, have the opportunity to peruse rural producers' profiles in digital catalogs and post job opportunities with specific requirements, budgets, and timelines. They can initiate customizations on products to meet market demands, necessitating training for rural producers on these customizations before placing orders. Urban consumers are responsible for selecting, training, and monitoring the progress of rural producers for their projects through the platform's tools.

Raw Material Suppliers: Suppliers of raw materials can register to offer their goods, displaying their inventory, pricing, delivery schedules, and more in a digital catalog accessible on the platform. When orders are placed, the platform notifies relevant suppliers, allowing them to respond to the needs of rural producers efficiently.

Logistics Providers: These providers manage the logistics of transporting goods from producers to consumers or between other stakeholders, enrolling based on location to meet the specific logistical needs of the platform's users.

Mentors / Trainers: Mentors and trainers provide essential skills training and expert advice to rural producers, conducting remote training sessions on various topics through the platform. They can also share asynchronous video tutorials to extend their educational reach to users on specific subjects.

Government Agencies / Micro Financers: These entities offer financial support, advisory services, and information on government programs and subsidies to rural producers and other relevant parties, ensuring access to necessary resources and assistance when required.

Core Information System

Analysis Module: The Analysis Module integrates data such as order distribution, product demand, customer feedback, and ratings specific to each rural producer. By examining these data points, the module identifies areas where rural producers can enhance their business operations and strategies for future growth. It acts as a crucial tool for continuous improvement by providing actionable insights based on comprehensive data analysis.

Dynamic Job Scheduler (DJS) Module: The DJS Module plays a pivotal role in orchestrating the workflow between urban consumers and rural producers. It assesses resource availability and

efficiently aligns various stakeholders—rural producers, material suppliers, logistics services, trainers, and financiers—to form an effective supply chain for specific tasks. Objectives of the DJS Module include:

- Efficient Load Balancing: Distributes tasks evenly across resources to ensure optimal utilization.
- Quality of Service Assurance: Selects resources to maintain high-quality standards in service delivery.
- Minimized Response Time: Aims to reduce the duration from task initiation to completion.
- Maximized Fairness: Ensures equitable access to opportunities for all users, factoring in their priorities and current workloads.

Language Translator Module: This module, leveraging a backend client library and Google's API, facilitates the translation of the platform's content into various languages. Given the platform's focus on rural contexts, it offers features that allow rural users to navigate and interact with the platform in their native languages, enhancing accessibility and user experience. This inclusion ensures that language barriers do not impede the participation of rural producers and other stakeholders in the platform's ecosystem.

User Community Management

The User Community Management segment is vital for fostering communication and collaboration within the NCoRe ecosystem. It revolves around essential messages and discussion themes, which serve as the backbone for community interaction. Messages are conveyed from individuals or groups with the goal of eliciting a response. At the same time, discussion themes are designed to concentrate group focus on specific issues, sparking dialogue and potential action plans. Participants can join the user community module upon approval from the system administrator, allowing them to share messages, images, and short videos on relevant topics. Responses can be made through text or image attachments. The system meticulously analyzes all interactions, maintaining a chat log in the database for future reference.

This community module is especially crucial for connecting talented rural producers who often face geographical and communication barriers. It creates a virtual space for knowledge exchange, enhancing problem-solving capabilities and enabling business opportunities through

digital networking. Additionally, it fosters skill development across the rural-urban production landscape.

System Administrator

The system administrator plays a crucial role in ensuring the smooth operation and maintenance of the platform. Responsibilities include:

- User Management: This involves overseeing user access to the platform's features, including authentication, authorization, and auditing of user activities.
- Profile Management: Automates the consolidation and optimization of user profiles to reduce management and storage requirements with minimal administrative overhead.
- Job Management: Facilitates organization and tracking of open jobs, management of available rural producers for tasks, flagging of unassigned work orders, and streamlining job processes through an intuitive interface.
- Community Management: Critical for nurturing two types of virtual communities: the Community of Practice, where actors share and improve upon their common interests, and the Community of Purpose, comprising actors engaged in similar job execution processes.
- Order Management: Oversees the processing and monitoring of orders within the NCoRe platform to ensure efficient execution and tracking.
- Training Management: Maintains records of all training activities facilitated through the platform, supporting continuous learning and skill development.
- Feedback Management: Gathers and analyzes feedback from various actors, utilizing this data to derive actionable insights and improve platform functionality.
- Content Management: Manages the collection, organization, and publication of digital content, allowing for the easy update and addition of new materials to the platform.

These functions are essential for the platform's operational integrity, user satisfaction, and the overall success of the NCoRe ecosystem.

- Implementation of NCoRe Web Portal

The NCoRe platform's architectural framework is designed as an integrated and decentralized e-commerce solution, fostering community-driven engagement. It uniquely supports the establishment and growth of both communities of practice and communities of purpose,

engaging a broad spectrum of stakeholders from both rural and urban settings. This innovative structure enables seamless interaction, collaboration, and commerce among diverse groups, including producers, consumers, suppliers, and facilitators. The proposed NCoRe framework is implemented in Hibernate (a Java web framework) with a backend system in MySQL database and hosted in a cloud-based web server.

NCoRe is a creative digital platform connecting rural artisans to a global network of urban buyers and designers to collaborate and co-create handcrafted products. NCoRe promotes rural artisans and their traditional and indigenous art forms in the global marketplace by providing an organic connection between rural artisans and urban consumers. This platform also provides a social B2C or C2C e-commerce marketplace to urban consumers for unique, fashionable handmade goods by trusted rural artisans. In this context, NCoRe will directly link these urban consumers with thousands of rural artisans. These artisans have the skill and traditional abilities to redefine fashion in accordance with traditional culture and heritage.

User view of the NCoRe platform

The NCoRe platform works based on three things to connect rural artisans directly to the urban market, namely "Buy Product", "Create Product", and "Education & Training" (Figure 4.3).

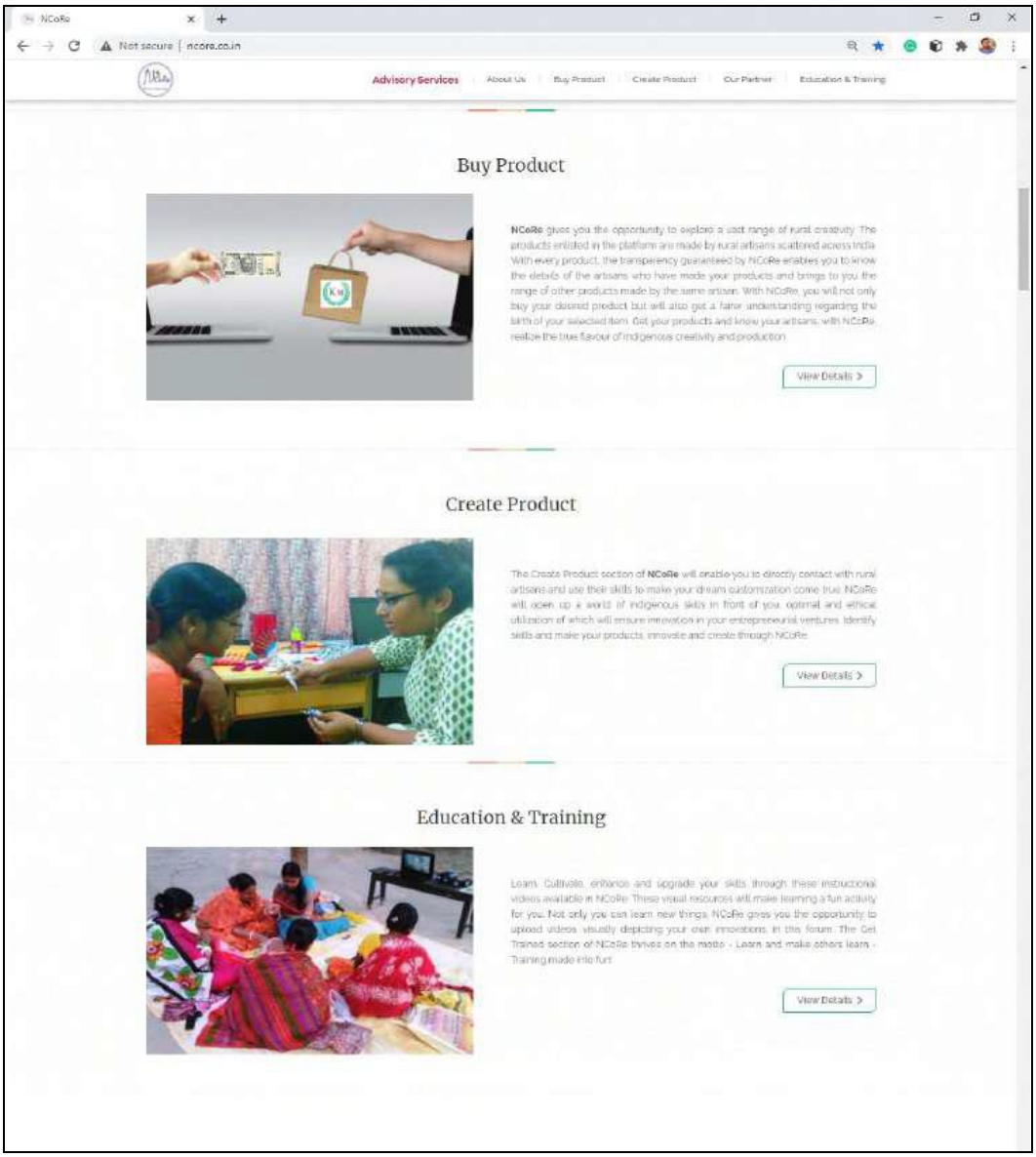
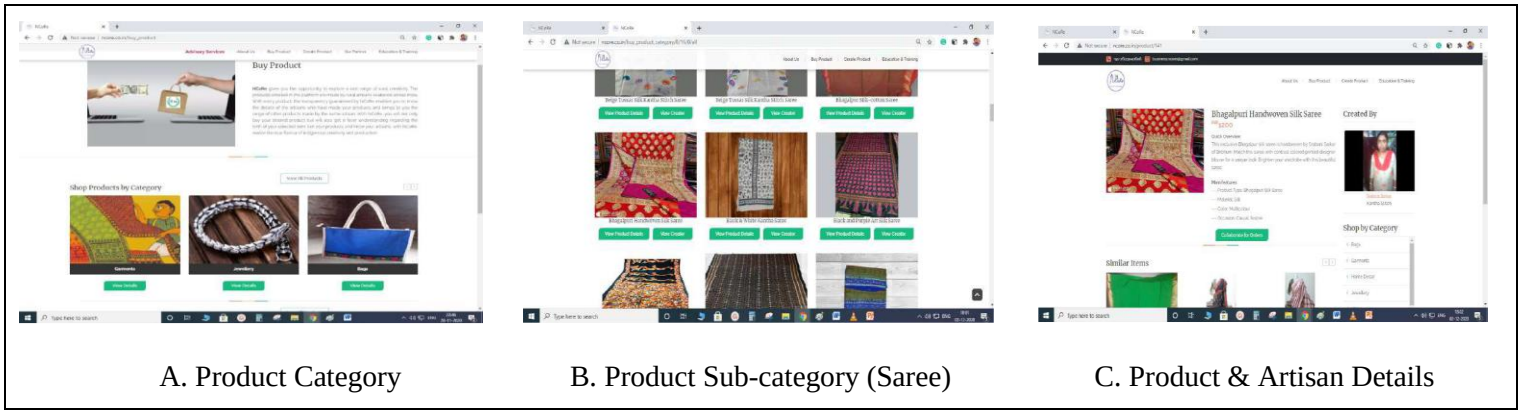


Figure 4.3. A glimpse of the NCoRe platform

The buy Product section in the platform (Figure 4.4) is a business model which allows promoting rural artisans with their products along with price and other features directly to the customers. Through this section, a customer can place an order for particular products, which directly notifies the artisans with a track record in the platform.

Any user can search for an item in the platform by applying **three different filters (Product Category (Figure 4.4 (A)), Sub-category (Figure 4.4 (B)) and Art-form) present at** the top of the website. Based on the search string, the platform will display some relevant items from the database. Every "product detail" page displays the artisan, the producer of the product ((**Figure**

4.4 (C)). On clicking the artisan name, the entire artisan profile with their digital shop is displayed.



A. Product Category B. Product Sub-category (Saree) C. Product & Artisan Details

Figure 4.4. The "Buy Product" section in the NCoRe platform

Create Product section in the NCoRe platform (Figure 4) will allow customers to co-create any product as per their own needs with the help of rural artisans. This section provides a collaborative environment that allows customers to know about any handicraft art form and the associated artisans. Co-creation in the NCoRe platform will be done in the following four steps:

1. Users can search for some artisan by their 'Art & Craft' or 'Skill'.
2. Based on the 'Art & Craft' and 'Skill', a user can select one or more than one artisan.
3. The user needs to negotiate with the artisan regarding the price, timeline, etc. and finalize it.
4. Place the order, and the item is delivered.

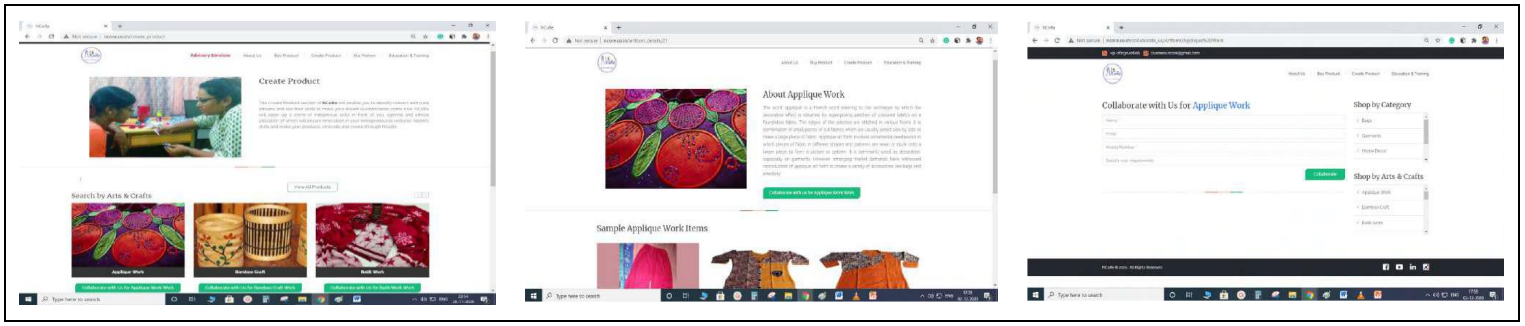


Figure 4.5. Create a Product section in the NCoRe platform

Through the "Education & Training" section in the NCoRe platform (Figure 4.6), an artisan can get trained by urban designers/trainers, or an urban consumer can learn about traditional rural art forms from rural artisans. Anyone can request a trainer for live synchronous training using a video conferencing platform, e.g. Zoom. Also, a user can search/view the short video tutorials

(asynchronous training materials) on different topics collected or created in the platform as per requirements.

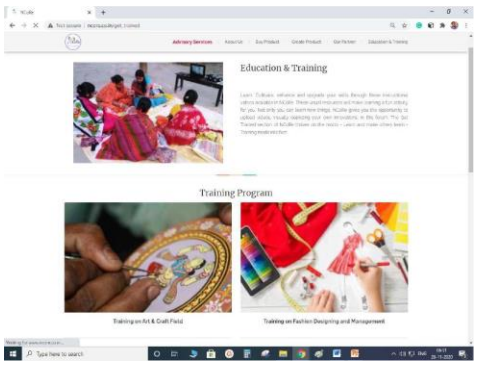
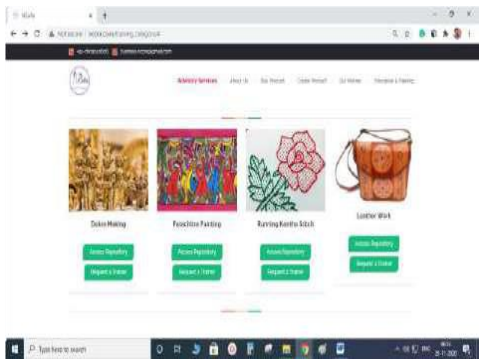


Figure 4.6 (a). Education & Training section in the NCoRe platform



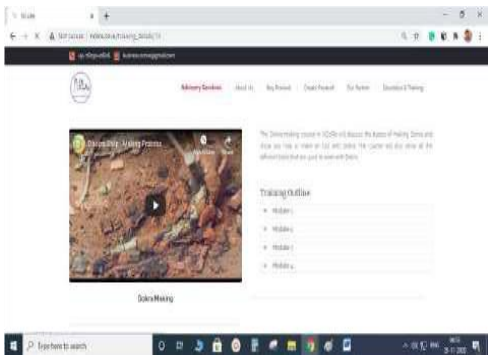


Figure 4.6 (b). Asynchronous Training Modules in the NCoRe Platform

Apart from the above three functionalities in the NCoRe platform, a user can additionally find the following details in the NCoRe home page (Figure 4.7):

i. **Details of all on-boarded artisans** with their digital shop in the NCoRe platform, which includes their promotional video and their handcrafted products with detailed descriptions and prices

ii. **Detailed product catalogue** of various handicraft items of Birbhum district

iii. **Details of different traditional and indigenous arts and crafts** of Birbhum.

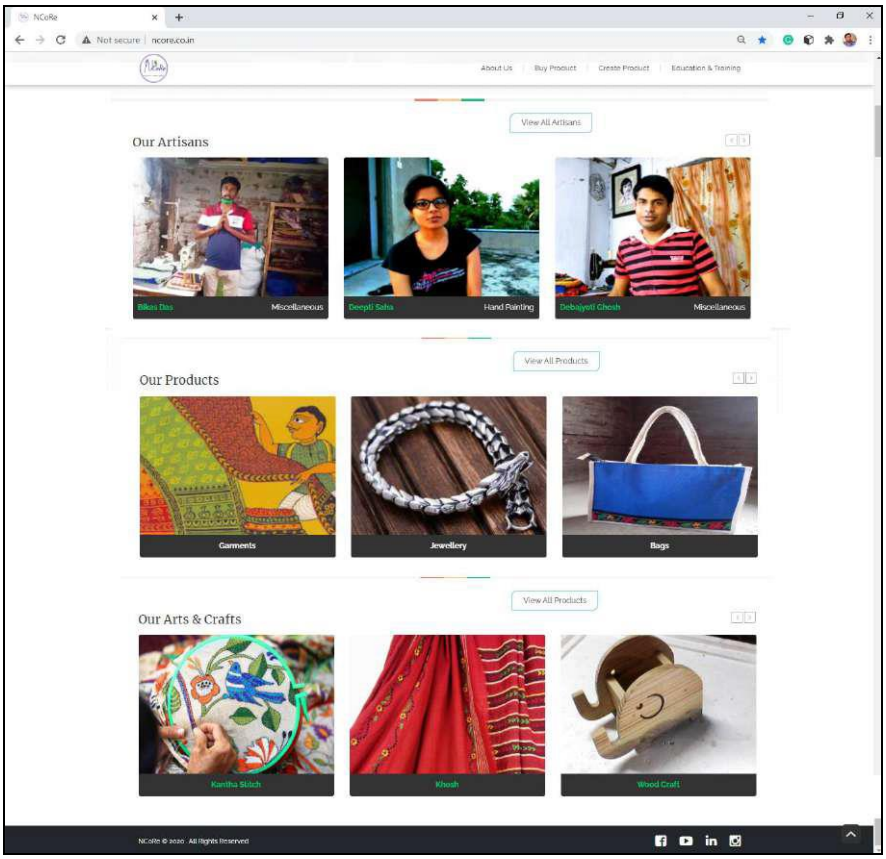


Figure 4.7. Details of on-boarded artisans, product catalogue and Art & Craft details of Birbhum

(i) Details of all on-boarded artisans:

All the artisans who are currently on the NCoRe platform are from the Birbhum district of West Bengal and are primarily involved in making handicrafts and handloom items (Figure 4.8). This section allows the creation of a digital shop for every artisan to showcase their skills and products. Every digital shop has two different sections: (i) the profile details section of artisans (Figure 4.9) and (ii) the product details section of artisans (Figure 4.10). In the profile details section, an artisan can promote their skill by making a short video with a general introductory section, which primarily includes a short bio of the artisan, practising art form, year of experience, address, etc. In the product details section, an artisan can showcase their products with detailed descriptions. This entire profile is projected to the end-users of the platform in order to make a direct connection between them (end-users and artisans) and also to promote them in the global marketplace.

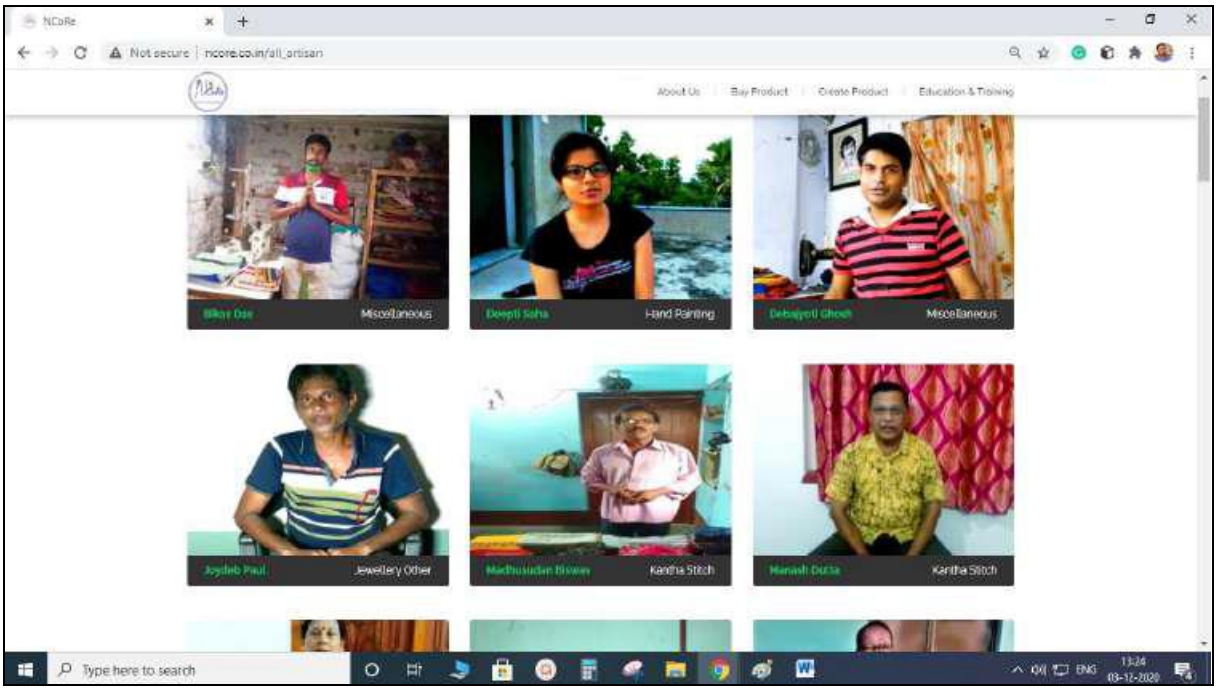


Figure 4.8. All artisans onboarded in the NCoRe platform

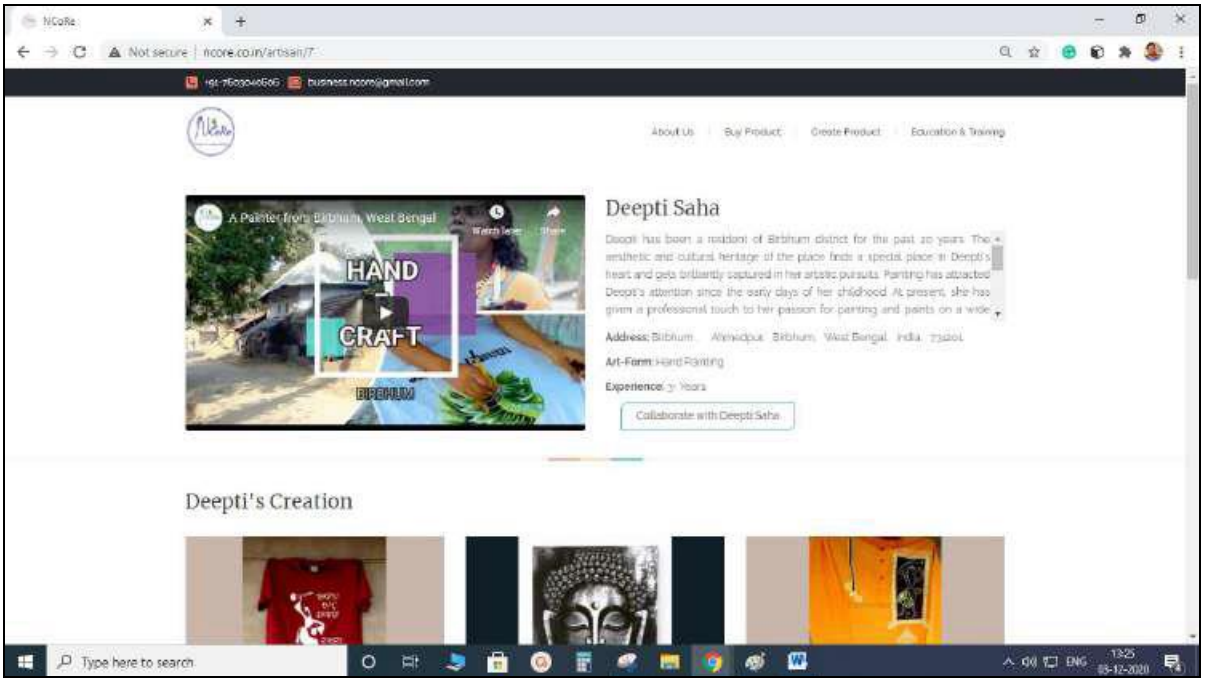


Figure 4.9. Digital shop of an artisan in the NCoRe platform

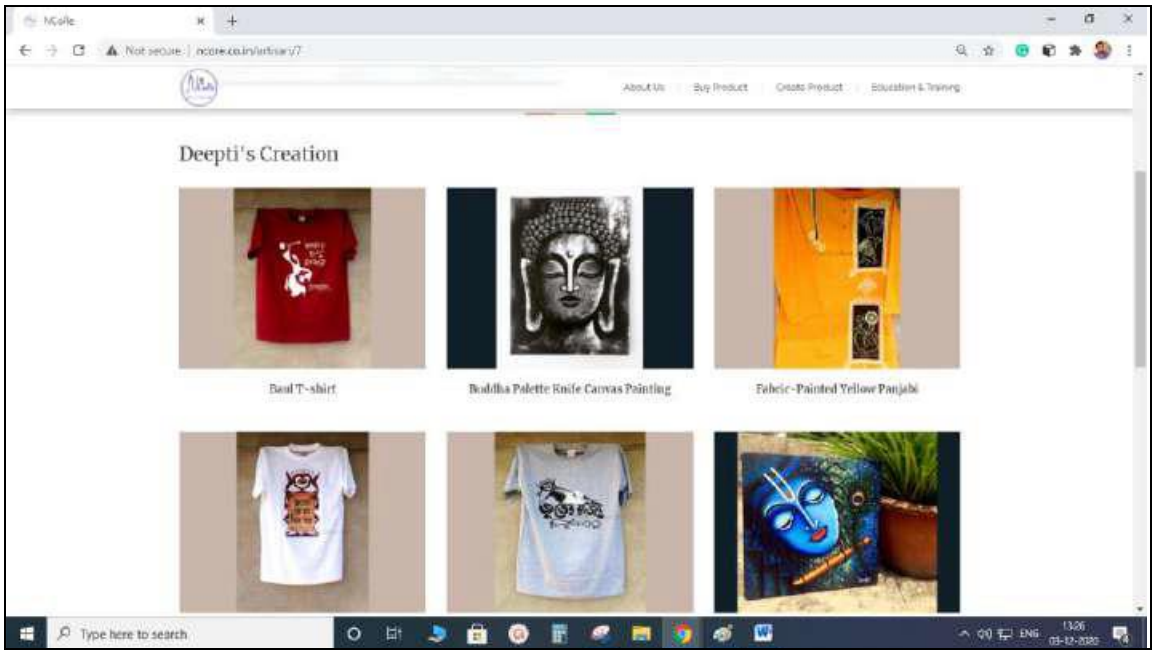


Figure 4.10. product gallery of an artisan

(ii) Detailed Product Catalogue:

The NCoRe platform primarily promotes the handicraft items of the Birbhum district. Handicraft artisans manufacture all products on the platform and have been categorized into different sections like garments, jewellery, bags, home decor, and utilities. All items in every category are further subdivided into subcategories for better representation and visualisation in the platform. Category and subcategory of products are further used as a search string to find the required items easily from the database (Figure 4.11).

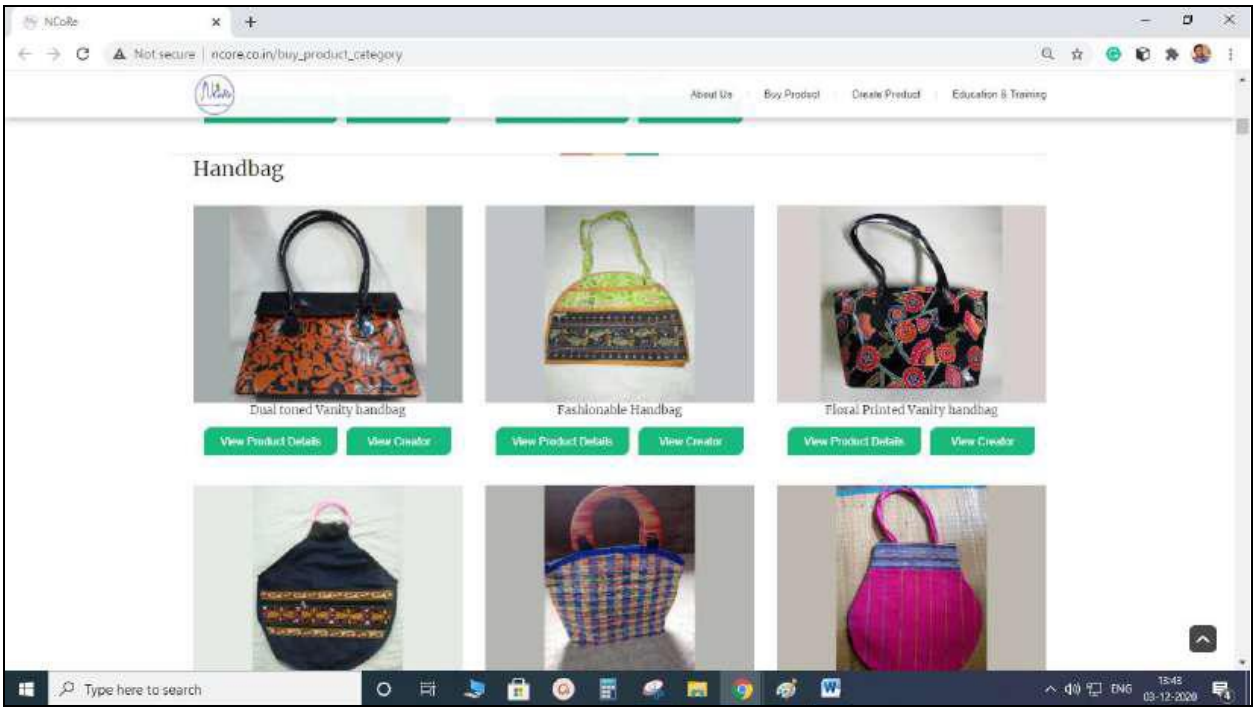


Figure 4.11 Product sub-category "Handbag" made by rural artisans of Birbhum

(iii) Details of different traditional and indigenous arts and crafts

Birbhum is rich in culture and heritage. It is essential to categorize all handicraft items made by rural artisans as per the art and craft. In this context, the NCoRe platform categorizes all items as per the art form associated with a product, which shows a clear message and better understanding of the products to the viewers of the platform. Presently NCoRe platform caters for the following art forms of the Birbhum district, like Katha Stitch, Khesh, Woodcraft, Hand painting, Leathercraft, Dokra art, Batik painting, Applique, Terracotta, Bamboo work, Jute work, Oxidized metal and different jewellery. A sample art form is shown in Figure 4.12.

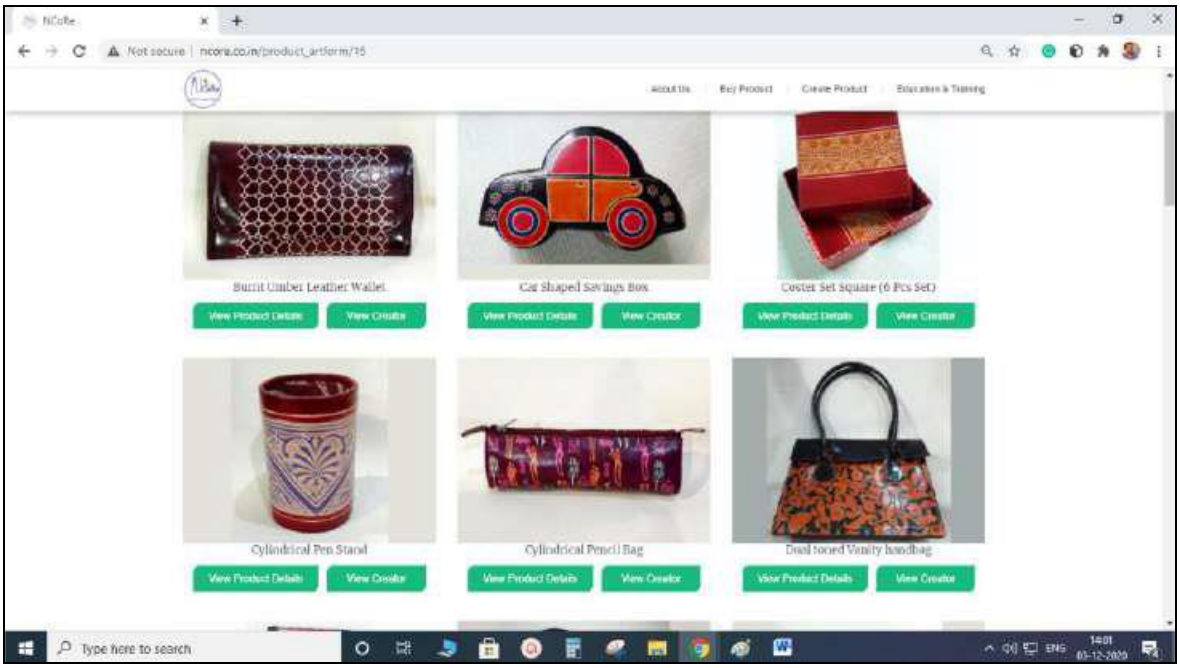


Figure 4.12 A sample of leather craft is shown in the above picture

Administrative modules in the NCoRe platform

User Management Module:

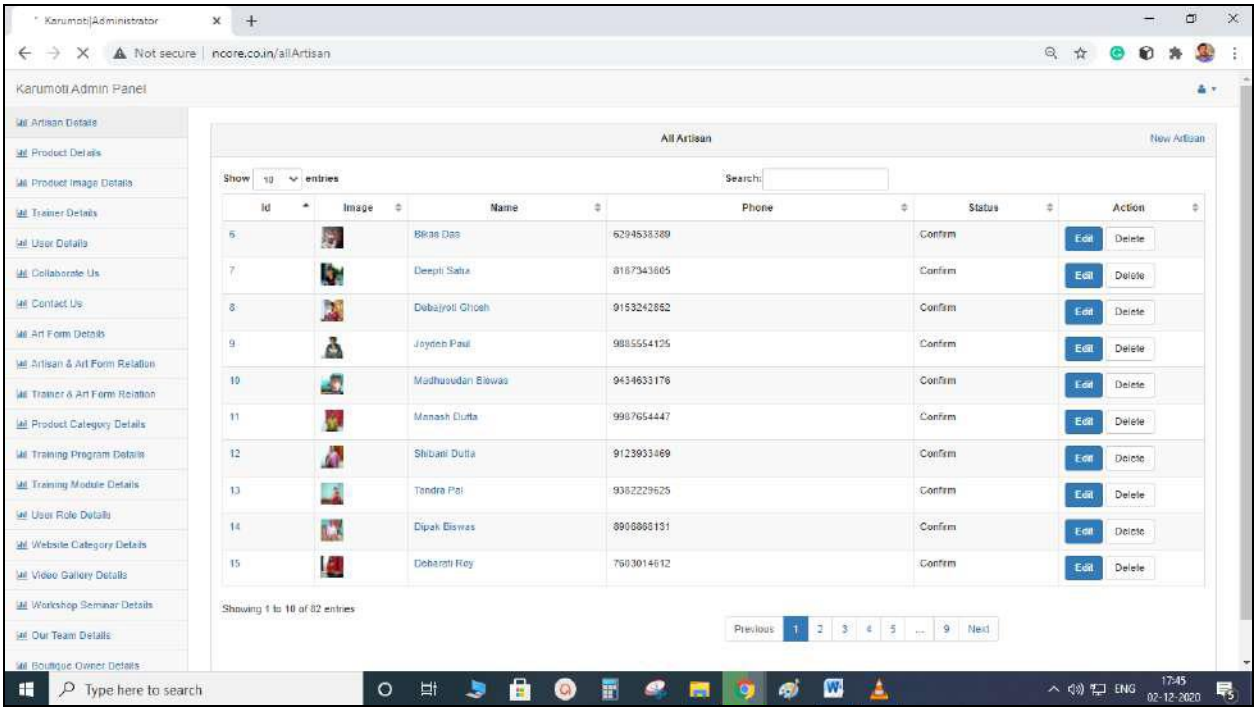


Figure 4.13 User Management Module in NCoRe Platform

Product (content) Management Module:

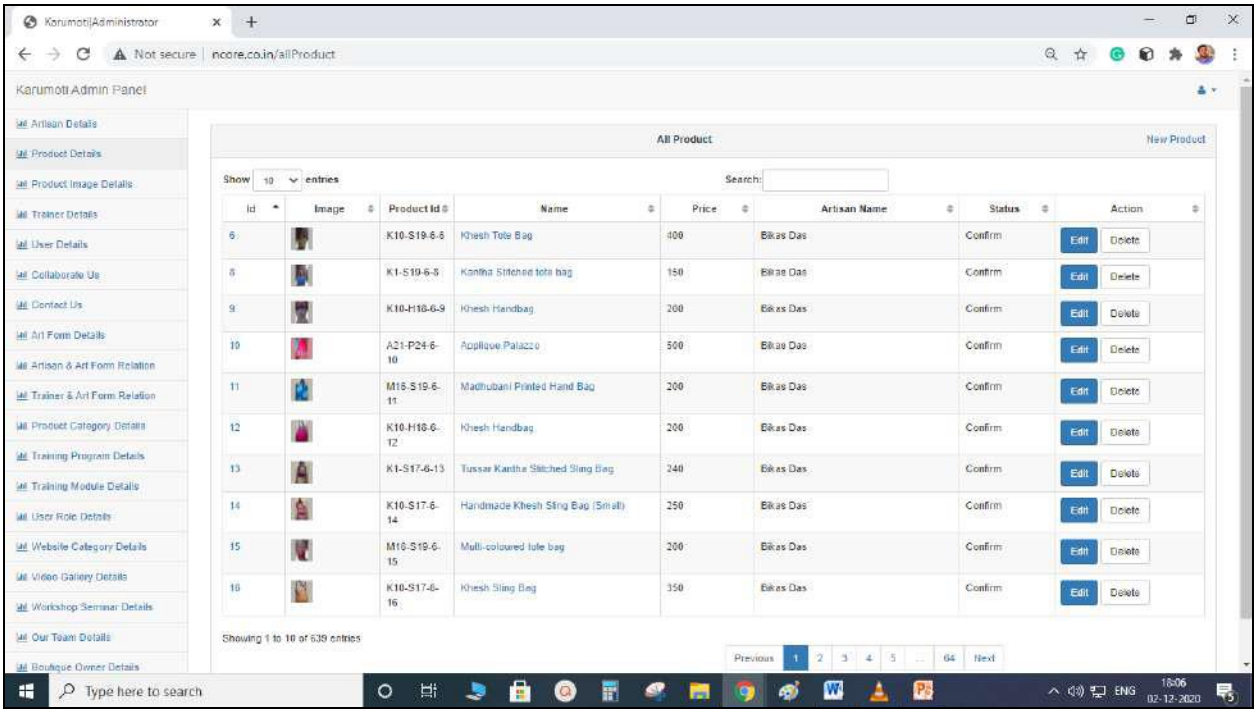


Figure 4.14 Product (content) Management Module in NCoRe Platform

Training Management Module:

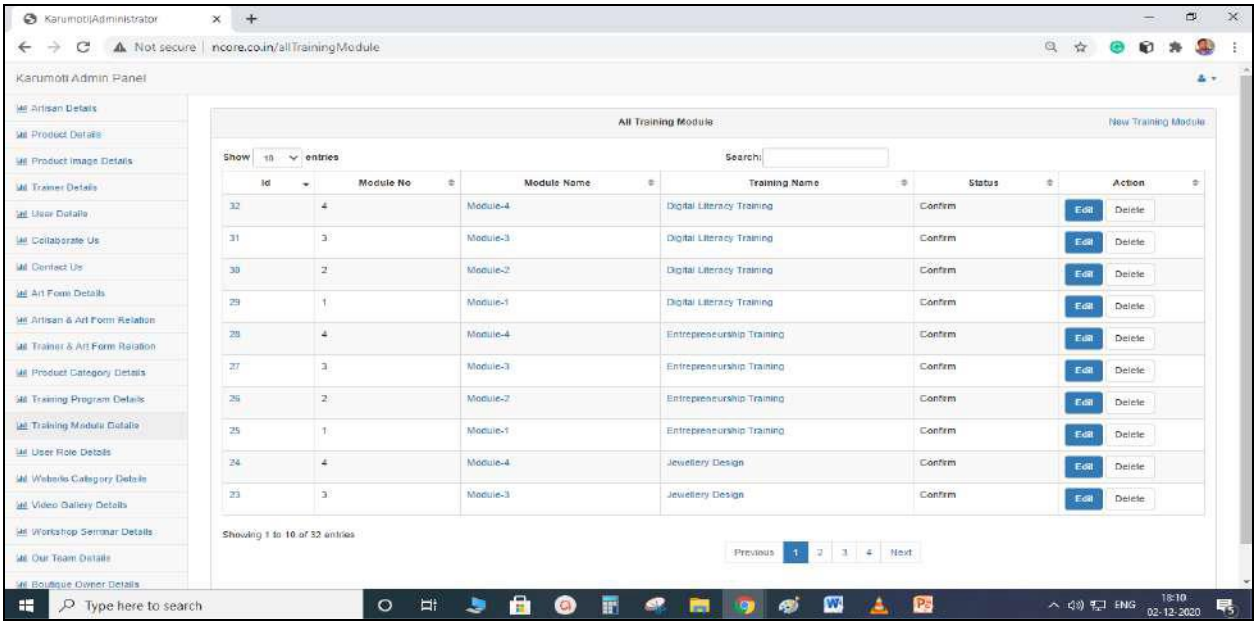


Figure 4.15 Training Management Module in NCoRe Platform

Profile Management Module:

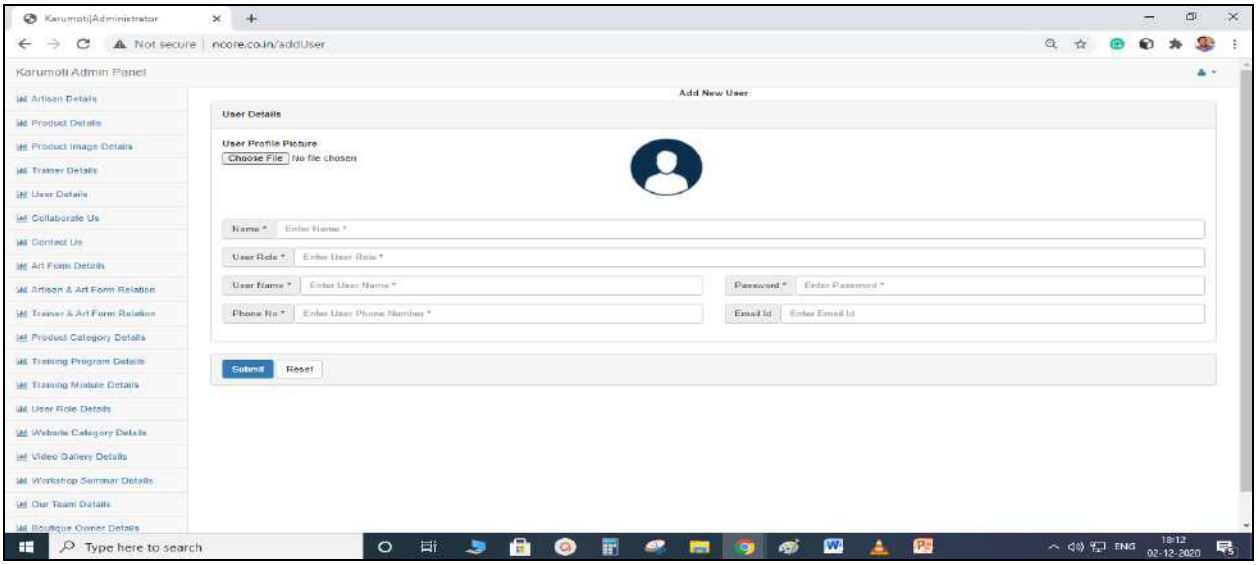


Figure 4.16 Profile Management Module in NCoRe Platform

Feedback Management Module:

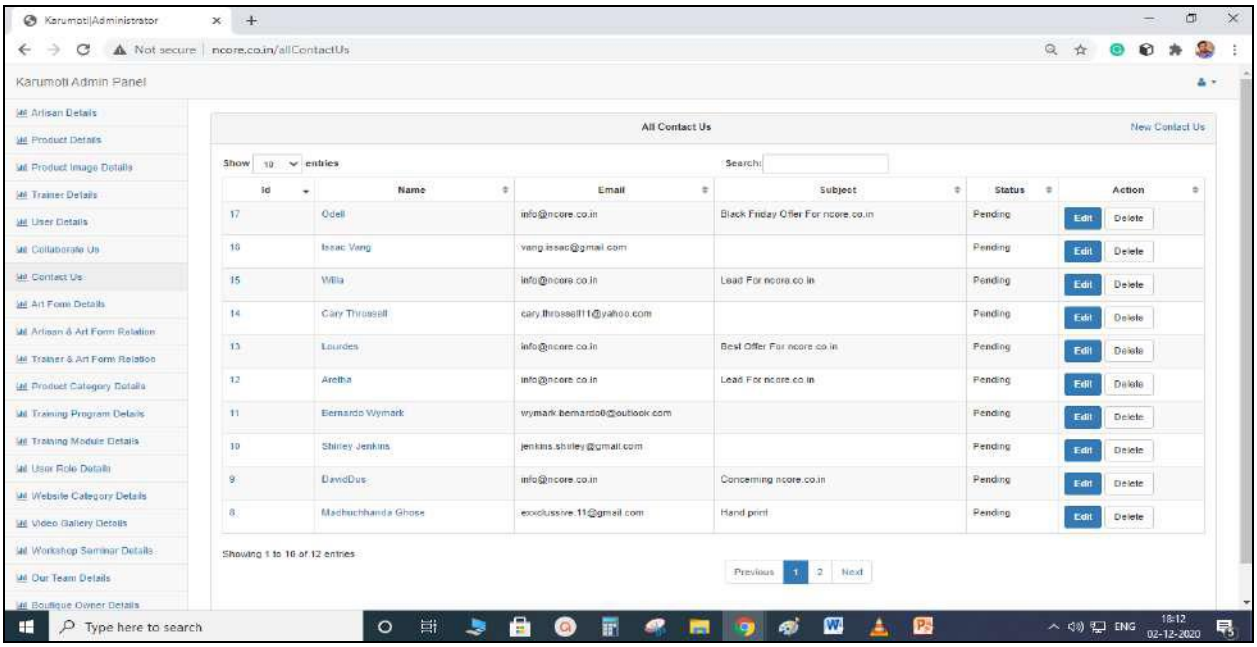


Figure 4.17 Feedback Management Module in NCoRe Platform

- Development of the NCoRe Mobile App

About the App

The Artisan-Profiling-App serves as a sophisticated mobile data collection tool and web dashboard designed to enhance the NCoRe administrators' ability to gather comprehensive data from rural artisans. This app supports a wide array of data types, from basic text and numbers to more complex audio and video inputs. Its mobile interface empowers artisans to document their product details in their native languages, complete with images, facilitating the generation of a digital product catalog directly on the NCoRe platform.

Embedded with various modules in its backend, the app ensures real-time data validation, which significantly improves the quality of data collection and subsequent analysis. An innovative feature of automatic product categorization allows for the seamless organization of items within the NCoRe platform, streamlining the browsing and search experience for users.

Artisans benefit from the ability to compile a comprehensive digital catalog showcasing their craftsmanship, including specifics about their art form, years of experience, product features, pricing, and visual representations through multiple images. With the simplicity of a single button, artisans can instantly publish their profiles and product details to the NCoRe platform, making their offerings accessible to a broader audience. This app not only simplifies the process of digital catalog creation but also plays a crucial role in bridging the gap between rural artisans and potential markets.

Features of the NCoRe Mobile App

- Automated data collection — in Bengali languages
- Translation — It converts artisan responses from Bengali to English and stores it in a database
- Built-in monitoring — Monitor entities longitudinally without redundant input of foundational data.
- Tailored checks to guarantee information accuracy.
- Import surveys from Excel for rapid questionnaire creation.
- Supports different data formats like text, numbers, images and videos.
- It supports image and video compression algorithms, which ensures data collection in low-bandwidth
- Collect multiple artisan data at the same time
- Download data in real-time

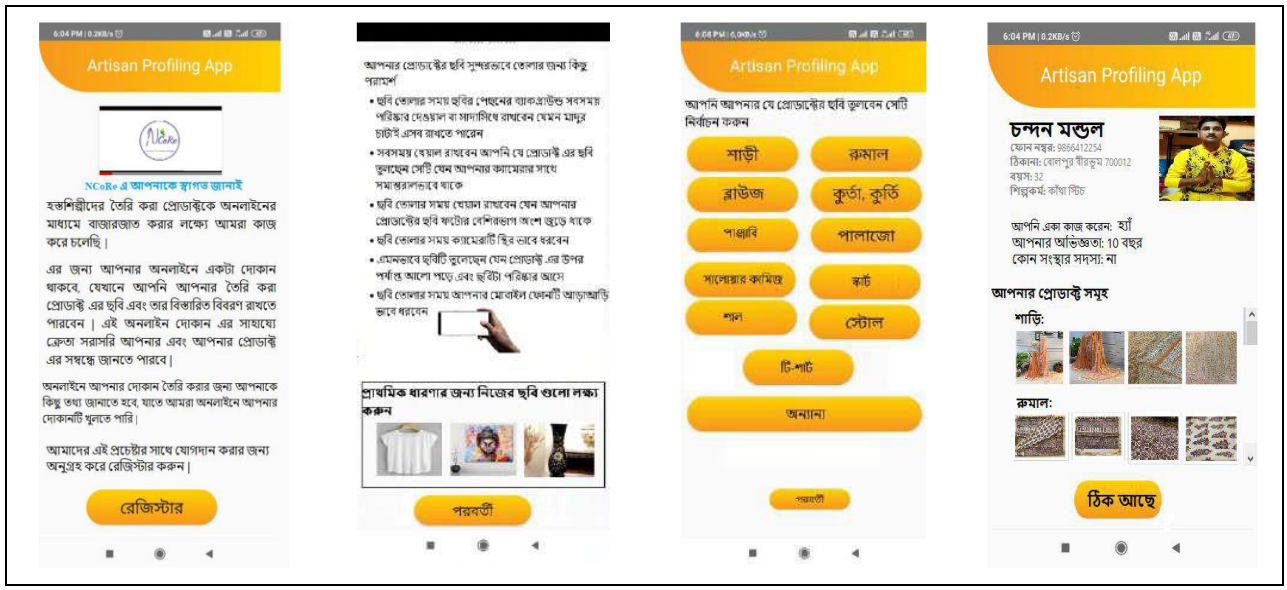


Figure 4.18 Some sample Snapshot of the NCoRe App (in Bengali)

- Onboarding Artisans in the NCoRe Platform

  Process of Pilot Intervention

  On-boarding is the process of helping new artisans to understand and experience how the NCoRe platform is going to help them achieve their goals. The intervention towards onboarding artisans into the NCoRe platform has been done in the following ways.

  1. Design detailed questionnaires for artisans
  2. Digitize artisans' answers for record-keeping
  3. Evaluate the gathered responses from artisans
  4. Integrate artisan data into the NCoRe system

  Design detailed questionnaires for artisans: Preparing structured questionnaires for the artisans is the primary measuring instrument in our survey research. The use of a structured questionnaire has a close relationship with quantitative analysis. In this section, we will highlight only the questions on artisan details and their product details. Based on the questionnaires, we interviewed approximately 100 artisans from the Birbhum district of West Bengal to collect their details and product-related information. All information has been used to create a digital catalogue, which will eventually be used to promote them in the global marketplace and establish market connections with urban agents. For the convenience of explanation, we have shown below a sample example of information obtained from an artisan.

Artisan Details

1. **Name:** Bikash Das
2. **Age:** 35 Yrs
3. **Gender:** Male
4. **Where do you stay?** Pashoa, Bolpur, Dist. Birbhum
5. **How long have you been residing in this place?** Since birth (35 Yrs.)
6. **Are you part of any organization or group? (For eg. - *Kopai Charulata Welfare Society, Amar Kutir)*** DIC, NAC & Amar Kuthir
7. **Which art form do you practice? (*for e.g., Kanthastitch, Patachitra, Leather Craft*)** Kantha Stitch
8. **For how long have you been practicing this art form?** Since 9 Yrs.
9. **How have you learnt this art form? (For eg. - From family members or after acquiring professional training from an organization):** Trained from a bag maker residing at Bolpur.
10. **Do you work alone or you have people employed under you? If yes, how many?** Yes. 4 people working under him.
11. **What are the different categories of product you make? (for eg. – garments, utilities, kitchen appliances, accessories, etc.)** Accessories & Garments
12. **What are the different product subcategories made by you? (for eg. - *(for e.g., Saree, Kurta, Kurti, blouse piece in garments; Mugs in kitchen appliances, bags in accessories; Penstand, Coaster in Utilities:*** Sling bags, Laptop bags, Hand bags, Shoulder bags, Money purse (male & female), Shopping bags in accessories.
Kurta & Kurti, Panjabi, Tops, Palazzo, Wrapper in garments

Artisan Name	Art form	Conversation	Progress
Bikash Das	Kantha stitch	Collected all details and instructed for the picture and video	He told that he will send it by tomorrow

Figure 4.19 Sample Artisan Survey Form

Digitize artisans' answers for record-keeping: All responses collected from every artisan are stored in a digital space to maintain the overall consistency and accuracy of the data. These records are used to analyze this in order to extract meaningful information from it. Apart from the above information, we have collected their profile video and pictures of their products with prices and other associated features. Below is one sample glimpse of collected responses (stored in Google Drive).

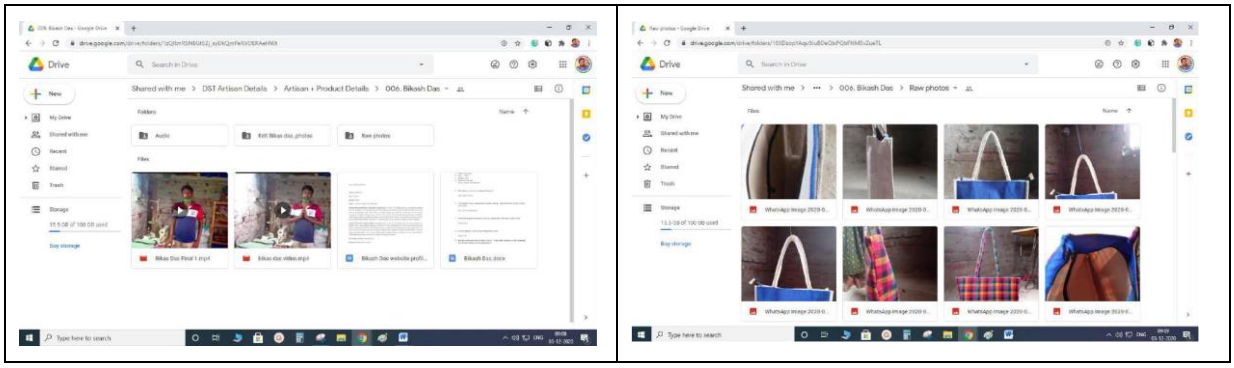


Figure 4.20 Sample glimpse of collected handicraft artisan's responses

Evaluate the gathered responses from artisans: All responses are collected from the artisans and are stored in a spreadsheet for analysis. Analysis has been done manually to understand the pattern of collected data and keep a track record of all data in a single place.

Integrate artisan data into the NCoRe system: The last step of artisan on-boarding in our intervention is to create a digital shop of every artisan in our NCoRe platform. For this purpose, we have done post-processing on the collected information from the artisan in order to maintain the consistency of the data throughout the website. For the convenience of understanding, below are some screenshots of an artisan's digital shop/catalogue with their detailed product description in the NCoRe platform.

- Workflow of the System

Figure 4.21 represents the workflow visualization of our platform, which is self-explanatory. Through our information system, we seek to aggregate the talented but fragmented labour force in rural India and build a distributed production system that would meaningfully engage their human capital and provide sustainable income to them. We propose to achieve this through a layered digitization approach that would exploit the talent within the community and build on the same.

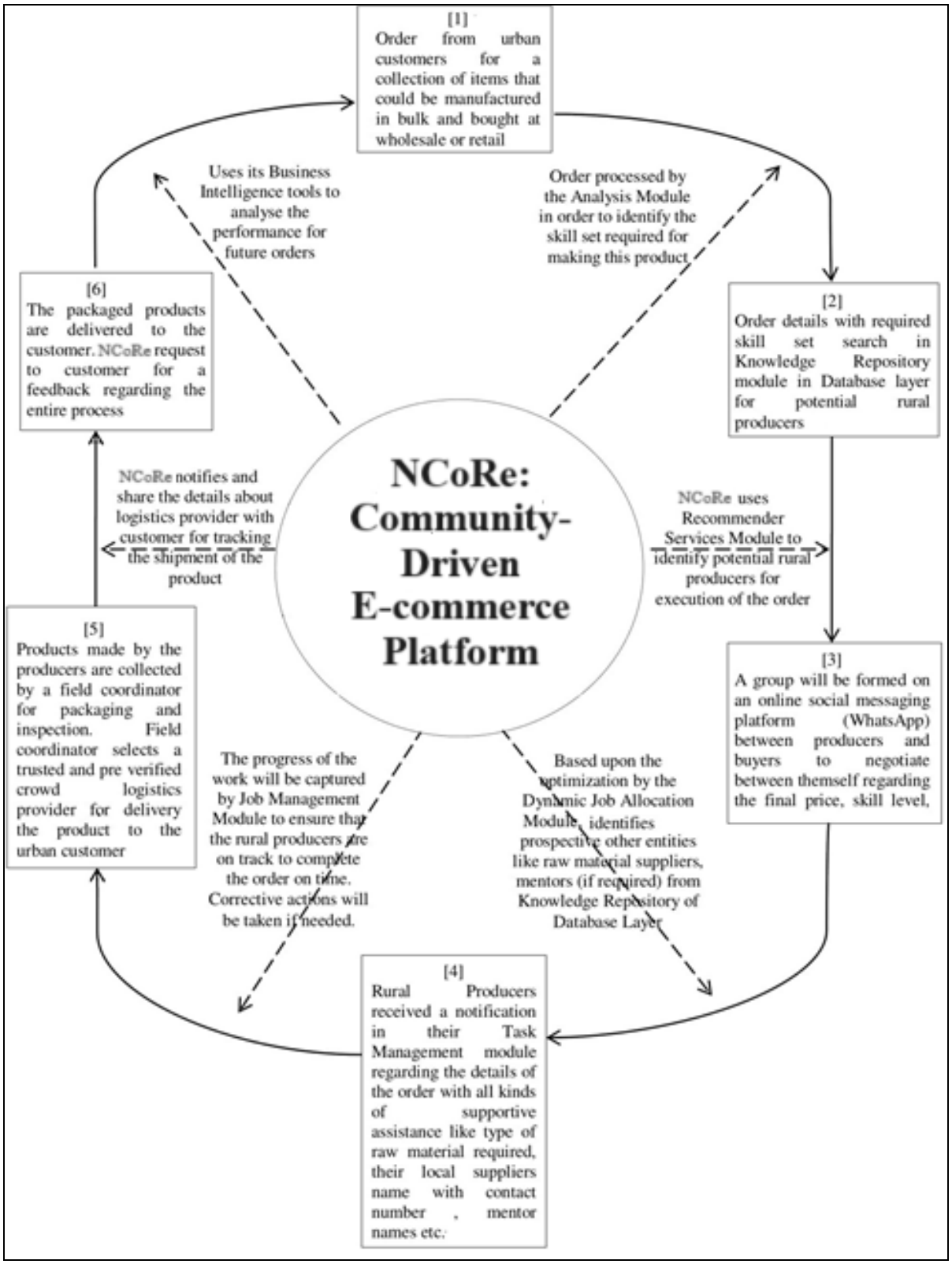


Figure 4.21. Workflow Visualization of the NCoRe Platform

The above system should be able to

- offer role-based authorized access to the registered users through mobile app and web portal
- provide a user-friendly interface so that the users with minimum level computer literacy can operate the system
- capture structured, semi-structured and unstructured data from heterogeneous sources viz. Twitter, Facebook, WhatsApp, SMS, news feeds, mobile app and web portal
- analyze the reliability of the source of captured data which may help in identifying 'reliable crowd' who can be treated as a reliable source of information in future
- assist disaster management authorities in damage and need assessment as well as in gap analysis through summarization of crowdsourced information and through simulation during initial stages of disaster situation
- improve the efficiency of disaster management practices and aid social continuity management through engagement and interaction with the targeted community throughout the year
- generate agency-specific reports in various formats and granularity
- notify the local community about any forthcoming emergency through early warning message in regional language
- issue de-warning messages confirming that emergency is over
- form a disaster-resilient community by helping in disaster preparedness, such as sharing local emergency contacts, local resource inventory and available skill sets in the local community

Users of the System

The system is designed keeping in mind the different kinds of users who would be using it according to their role in the disaster management process, such as:

- *Admin* – the administrator, who has complete access to all the features of the portal.
- *Organization* –disaster relief and rescue management organizations will be one of the users. Some senior members of such organizations will be given access to the system where a subset of the admin feature set can be accessible.
- *Volunteer* – the people who are affiliated to a particular organization (Govt. or non-govt.) and take part in relief and rescue operations. They can access a subset of the organization feature set.

- *Information requester/ information provider* – refers to the common people who may want to access the system to request for some assistance or to provide some resources/ information.

A user may access the system in various roles; they sometimes maybe a resource requester and/ or resource provider and/ or may even be an emergency volunteer. Based on the requirements, the system can interact with the users of specific roles to gather/ provide necessary information (Basak et al., 2020).

4.4 Validation of NCoRe

To assess the efficacy of the NCoRe platform, extensive groundwork was conducted across seven districts in West Bengal, India. This effort resulted in a comprehensive database of over 100 rural artisans on the NCoRe platform. The platform's analytics module leverages this rich dataset to evaluate artisans' skill levels and identify challenges related to market access and resources. Beyond profiling artisans, the platform also focuses on other crucial participants in the craft ecosystem, including urban entrepreneurs, suppliers of raw materials, logistics providers, trainers, and micro-financers.

An NCoRe mobile app was developed to facilitate interaction within the platform, enhancing connectivity between rural artisans and urban markets. Through a series of experiments, the ecosystem of artisans and entrepreneurs was explored to find effective strategies for bridging existing gaps. Researchers played a key role as facilitators, directly linking rural artisans with urban boutique entrepreneurs and retailers. This direct linkage, enabled by the NCoRe platform and app, allowed for the validation of the platform's effectiveness in connecting rural artisans with urban buyers. Urban entrepreneurs gained the ability to place orders with rural artisans and monitor order statuses directly, streamlining the procurement process. A significant feature of the platform is the integration of the Google Language Translator API, which translates the NCoRe platform's content between English and Bengali. This translation capability is pivotal in breaking down language barriers, allowing rural artisans to communicate effortlessly with urban entrepreneurs in their native language.

The forthcoming section 4.4.1 will detail observations from a pre-pilot study conducted in Kandi, a secluded village in West Bengal, India. This study aimed to foster a "community of purpose" through social technology, bridging the rural-urban divide. A qualitative analysis, both before and after the study, was undertaken to measure the initiative's impact.

4.4.1 Validation through Field Observations

To examine the development and nurturing of communities of purpose aimed at improving market access for rural producers, a preliminary study was conducted with the artisans of Kandi, a secluded village in India. This initial investigation employed social technology platforms to foster intentional collaborations among Kandi's rural producers, urban consumers, and other key players in the supply chain. This initiative represents an extension of our previous research efforts in Kandi, which focused on establishing a community of practice connecting rural and urban participants. Moving beyond mere practice-based interactions, our goal was to cultivate a community of purpose among these rural artisans. This aimed at engaging them in cooperative creative processes and enhancing their market opportunities, with the eventual goal of integrating them into the NCoRe platform.

Background of the Study

Despite possessing basic productive skills, women in Kandi need more market opportunities to sell their produce. Lack of knowledge about contemporary market trends and direct access to urban market sites heavily hinder their market prospects. To cultivate a community of practice, 50 women underwent skill-upgradation training in blended mode from urban-based experts. Twelve women were selected through purposive sampling based on motivation level, prior skill upgradation training, and familiarity with digital devices. A qualitative pre-study was conducted among these women to capture the market hindrances faced by them.

Insights from Field Work

A virtual community of purpose was established, connecting rural producers in Kandi with urban consumers and essential stakeholders within the supply chain. Through the use of platforms enabled by social technology, this initiative facilitated collaborative creation in a blended mode among participants. Rural producers were able to receive orders from urban consumers digitally, with communication supported by both synchronous and asynchronous methods. The primary objective was to empower each participant to execute their specific tasks effectively, aligning with the requirements of other members of the community to ensure the seamless completion of customized orders through collective effort. This collaborative approach resulted in the successful fulfillment of two actual market orders. The article further explores these two specific orders and delineates the advantages realized by this community-driven model.

Puja (name changed) was tasked with creating earrings for a wedding gift, following detailed design specifications from an urban customer through online video conferencing. The communication between Puja and the customer also involved asynchronous messaging, primarily using WhatsApp, where a group including Puja, the research team, and local community members from Kandi was formed. This setup facilitated efficient communication throughout the production process, with the local members possibly serving as logistics providers, ensuring seamless coordination and updates between the buyer and the producer. During the production process, any uncertainties were addressed using a blended approach. The majority of inquiries were resolved through asynchronous discussions, allowing for flexibility in communication. For more intricate issues, we convened synchronous online sessions to provide real-time assistance. Additionally, the customer asked Puja to create videos detailing her challenges and share them via WhatsApp. The customer also illustrated the design details and sent these visuals through WhatsApp, enabling Puja to consult them at her leisure. Examples of these asynchronous exchanges are illustrated in Figure 4.22.

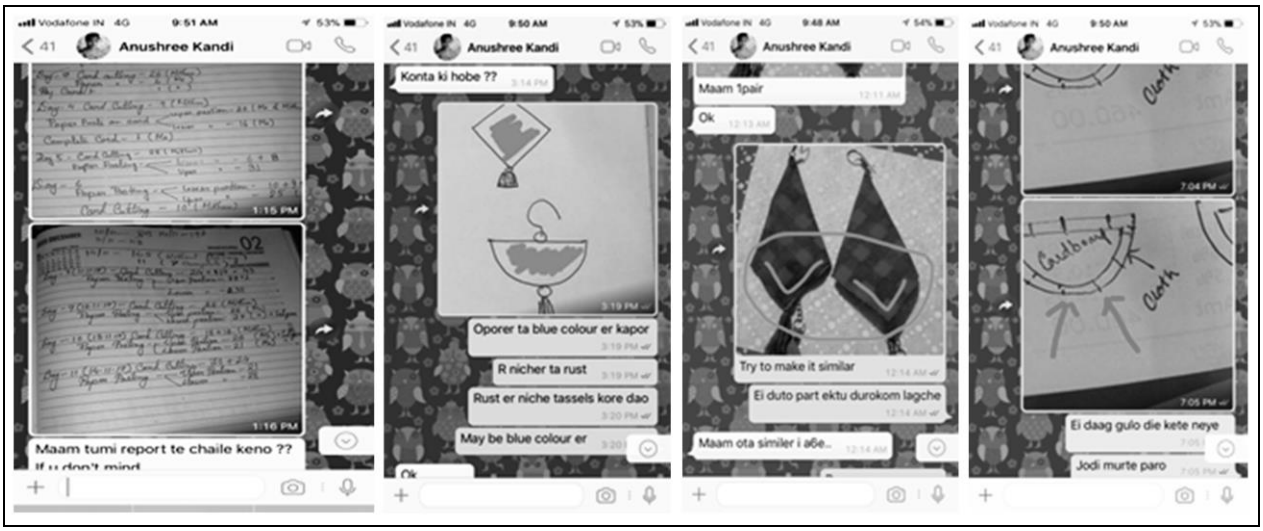


Figure 4.22 Asynchronous Discussions over WhatsApp During Production Process

Puja actively engaged in customizing a product by sending daily updates to her customers via WhatsApp, ensuring a collaborative production process. When faced with a tight deadline, she enlisted the help of a local artisan, who was also part of their messaging group, to meet the order's requirements on time. The collaboration was facilitated by the group's discussions, with the artisan being compensated by Puja. Additionally, Puja's brother, a group member, handled the logistics, delivering the finished products to the city. The customer's positive feedback and

the subsequent payment highlighted the project's success and profitability. Following this and similar orders, an online Instagram shop was established for Puja, showcasing her products and new designs inspired by urban trends, with ongoing support in design and training provided by the research team. This initiative not only broadened Puja's exposure but also her creativity in product design, aligning her creations with urban consumer preferences.

Findings from Field Work

Puja's experiences and feedback from other orders in Kandi highlight the positive impact of our community of purpose on market outcomes and satisfaction for both urban consumers and rural producers. In Table 4.1, a comparative analysis of the feedback from rural producers gathered before and after the implementation of the community of purpose will be detailed. This comparison aims to shed light on the significant shifts in experiences and perspectives among rural producers, underscoring the transformative effects of purpose-driven collaborations on their livelihoods and market engagement.

Functional Area	Broad Functional Area	Findings of pre-study	Findings of post-study
Market Sphere	Knowledge Asymmetry between Rural Producers and Urban Marketplace	Over 80% of the interviewed women in Kandi recorded extreme dependency on the local market in the context of both procuring raw materials and selling finished products. However, lack of information pertaining to the appropriate selling price of their products compels the majority of them to sell their goods at undeserving rates.	All the respondents recorded an enhanced awareness regarding the dynamics of the market because of increased communitarian communication occurring through the created community of purpose. Over 95% of them expressed how they have utilised the fruits of collaboration derivative through purposive exchange for practical benefits. They now have better knowledge pertaining to selling channels, contemporary market demands and innovative designs, which enhanced the rural producers' capacity to produce in accordance with market demands.
Civic Sphere	External Assistance for sustaining business ventures	Over 90% of the women interviewed recorded not receiving any governmental assistance to flourish their entrepreneurial ventures. At the same time, the same majority expressed willingness to receive external assistance to transform their business initiatives into profitable ventures.	Barring 3 out of the total number of women interviewed, every one of them expressed strong agreement in favour of receiving innovative business and investment-related ideas from a cultivated community of purpose. A strong majority of them also recorded practically utilising those ideas for profitable outcomes. The ability to implement the knowledge acquired for practical benefits paves the path for an elevated confidence level among rural producers.
Social Sphere	Inter-communitarian solidarity	The majority of the women rural producers interviewed recorded no prior adherence to digital networks to communicate with members of their community. Inter-communitarian communication was mostly performed by virtue of physical and telephonic connection. As a result, they needed to be made aware of what others in their community are producing.	Findings of post-study recorded widespread usage of social technology platforms among intervened women of Kandi to communicate with members of their community, outside their community, in order to establish purposive collaborations. Easy and smooth communication fostered through the cultivation of a community of purpose enabled the women to have better knowledge regarding what others in their community are producing and gave them the opportunity to frame their business strategy by learning from other's success stories and failures.

Table 4.1 Comparative Analysis of the Pre and Post-Study Conducted with Rural Producers in Kandi

The comparison of pre-and post-study responses from rural producers in Kandi underscores the beneficial impact of the community of purpose on their business opportunities. As detailed in Table 4.1, the establishment of purpose-driven collaborations significantly improved the market prospects for these artisans. Moreover, the effective networking facilitated by this community positively influenced not only the economic but also the civic and social dimensions for the participating rural producers, leading to a comprehensive empowerment effect. The encouraging outcomes from this initial observation have motivated the expansion of the community of

purpose model for rural producers on a broader scale. Although the study focused on a relatively small cohort of 12 women artisans, the challenges they encountered are broadly representative of those faced by many rural producers, whether in agriculture or artisanal crafts. Therefore, the experiences documented by the non-farm rural producers of Kandi provide a solid foundation for leveraging an integrated and scalable digital platform to foster a community of purpose across a wider spectrum of rural production activities.

Discussions

To broaden the impact of community formation between rural and urban areas, the NCoRe platform was developed as a social knowledge management tool. This platform aims to foster a community of purpose among rural producers by offering opportunities for both synchronous and asynchronous collaborations across rural-urban divides. However, the effectiveness of NCoRe hinges on rural participants' digital literacy—specifically, their ability to utilize digital technologies confidently. While there is some familiarity with smartphones among rural users, achieving proficiency for independent engagement in a community of purpose through NCoRe necessitates additional education and support.

- NCoRe's approach to empowering rural producers is grounded in the concept of purposive collaborations, advocating for their active and voluntary engagement in the production process. This approach aligns with an endogenous model of development, which emphasizes community self-empowerment and the gradual shift of control from external development bodies to the community members themselves. Nevertheless, the transition to community empowerment and the decentralization of transactional processes demand significant time, financial investment, and skill development. Steiner and Farmer (2017) suggest that while endogenous empowerment is the ultimate goal, exogenous empowerment practices can serve as valuable and practical means to facilitate capacity building in communities where it might not spontaneously emerge. Therefore, the successful deployment and operation of a digital platform like NCoRe in rural settings are contingent upon establishing supportive frameworks that encourage the decentralization and active participation of rural producers in the digital ecosystem.
- Even though purposive collaboration accounts be the premise of NCoRe, it will majorly fail in doing justice to its goal if the surrounding environment is not conducive to facilitating such purposive collaboration between rural-urban agents. This highlights that apart from

endorsing endogenous developmental initiatives, we are also in dire need of supportive external agencies interested in sustaining ventures undertaken to empower rural communities from within. NCoRe can only be successful in effectively mobilising a community of purpose for rural producers in the presence of an inter-connected developmental ecosystem comprising symbiotic exogenous and endogenous developmental efforts. This has been discussed in section 4.2, where we have explained six enablers that are needed for the successful operationalisation of online communities of purpose.

4.4.2 Validation through Simulation

- ***Description and Hypothesis***

Typically, e-commerce systems prioritize artisans' skills when allocating orders. However, our approach also incorporates the Order Category, Cost Estimate, and Artisan Review Score into the selection process. The overarching 'artisan selection' model, depicted in Figure 4.23, integrates three primary components: the Urban Entrepreneur, the Platform, and the Rural Artisan. The process begins with urban entrepreneurs submitting their requests to the platform, which then seeks suitable artisans for order fulfillment. The platform curates a list of potential artisans by evaluating various criteria linked to their profiles, as elaborated in Section 4.3. For each specific order, the platform sifts through its extensive database of artisan records to identify candidates capable of meeting the order's requirements within the stipulated timeframe. The outcome—a curated list of eligible artisans—is then relayed back to the urban entrepreneurs, enabling them to make informed decisions on artisan selection based on a broader set of considerations beyond mere skillset.

Usually, any e-commerce system only considers the skill set of an artisan to distribute an order. Apart from the skill set, we have tried to consider *Category of Order*, *Cost Quote* and *Artisan Review Score* for artisan selection. The top-layer model of ‘artisan selection’ is shown in Figure 4.23. In the model, there are three modules: Urban Entrepreneur, the Platform itself and Rural Artisan. The platform accepts requests from urban entrepreneurs and searches for a list of prospective artisans for the execution of the order. The list of potential artisans is prepared by the platform based on several specifications associated with the artisans as mentioned in the next section (Section 4.3). Based on the parameters for a particular order, the platform searches in the large pool of artisan records and prepares a list of potential artisans to execute that order within

the deadline and the information returns to the urban entrepreneurs (Basak, Bhaumik, et al., 2020).

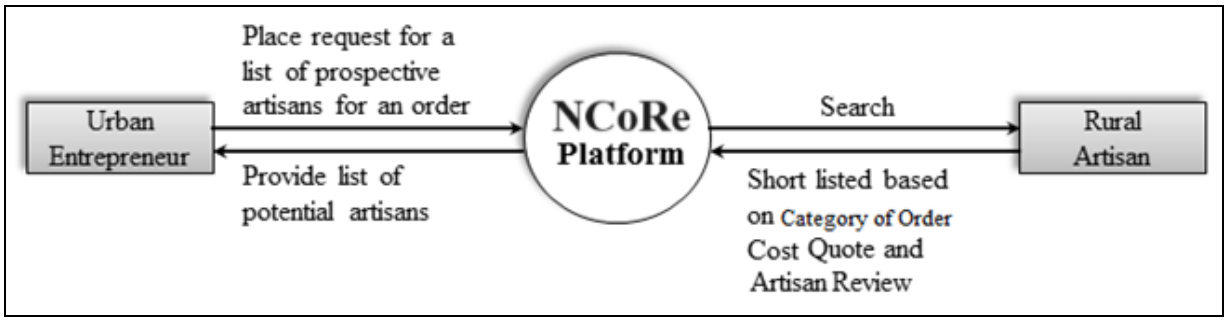


Figure 4.23. Top layer of artisan selection model

In this analysis, the Euler method and the Runge–Kutta fourth-order method (RK4) are employed to refine the process of identifying a suitable list of artisans, taking into account three key factors: Order Category, Cost Quote, and Artisan Review Score. The model addresses the challenge of processing customer orders that are both random in nature and time-sensitive. This approach leverages the variability in artisans' skill levels, which are assumed to range from 1 to 4, against the backdrop of a maximum artisan population of 50,000. This figure aligns with the limit for agent numbers in AnyLogic Personal Learning Edition 8.2.4. The simulation model is designed to gather and incorporate feedback from both artisans and entrepreneurs regarding various aspects of the artisan selection process.

- ***Simulation Model Setup:***

The setup for our simulation model involves collecting insights from artisans and entrepreneurs on several dimensions related to job execution and artisan selection. This gathered data feeds into two distinct differential equations, utilizing the Euler method and the RK4 method, to evaluate the effectiveness of the proposed 'artisan selection' framework for specific jobs. The performance comparison between these two methodologies offers insights into the operational efficiency and accuracy of the selection mechanism under different conditions. Figure 4.24 illustrates the 'artisan_selection' mechanism as implemented in AnyLogic, showcasing how these mathematical models are applied to simulate and optimize the process of matching artisans with job orders. The integration of these advanced numerical methods into the simulation allows for a detailed analysis of how different variables influence the selection process, thereby enabling a more dynamic and responsive approach to aligning artisan skills and capacities with the specific needs of urban entrepreneurs. This analytical framework not only enhances the precision of the

artisan selection process but also contributes to the overall efficiency and effectiveness of the e-commerce platform in facilitating productive collaborations between rural artisans and urban markets.

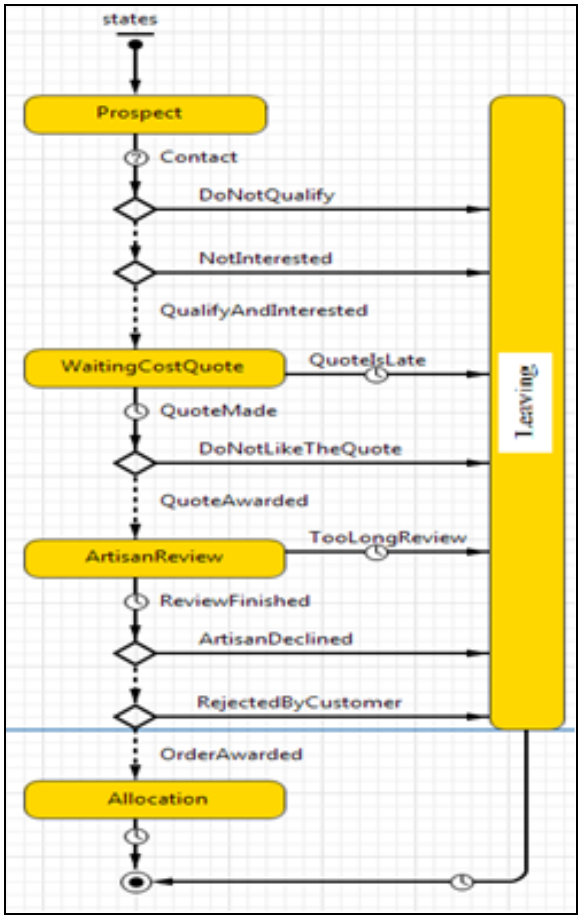


Figure 4.24. artisan_selection mechanism in AnyLogic.

- ***Simulation result and analysis***

A comparison is made between two separate differential equations (RK4 and Euler method) in job allocation strategies among a large number of artisans with different skill levels. Simulation experiment verifies the exactness of this model and concludes that Euler method is better than RK4 method of order 4 with respect to artisan selection as more number of artisans can get a job. The primary aim was to assess the accuracy and efficiency of these mathematical models in optimizing artisan selection within an e-commerce framework. The experiment concluded that the Euler method outperforms the RK4 method for artisan selection, particularly because it facilitates the employment of a larger number of artisans. This outcome is crucial for the e-

commerce platform aiming to maximize employment opportunities for artisans by efficiently matching them with job orders based on their skills and other relevant criteria.

The simulation's goal was to identify the optimal set of conditions that yield the best possible solution for matching artisans with jobs. To achieve this, the simulation leveraged the OptQuest Optimization Engine within AnyLogic, capable of determining the model's best parameters under specified constraints. Both the Euler method and the RK4 method were applied to generate a list of potential artisans, aiming to maximize the total number of artisans selected for jobs.

The findings, as documented in Table 4.2, reveal the outcomes of various artisan selection strategies, considering different skill levels and additional factors previously outlined. The optimization results, presented in Figure 4.25, demonstrate that the maximum proportion of selected artisans from the total available pool is approximately 15%, accounting for the variability in individual skill levels ranging from 1 to 4. This optimization insight is invaluable for refining the artisan selection process, ensuring a more effective and equitable distribution of job opportunities among artisans within the platform.

	Euler Method				**RK4 Method of order 4**			
	Skill=1	Skill=2	Skill=3	Skill=4	Skill=1	Skill=2	Skill=3	Skill=4
Do Not Qualify	9900	10100	10100	10100	9987	10000	9900	10000
Not Interested	12050	11950	11950	12000	12150	12050	12050	11900
Quote Too Late	22050	4150	24	280	21970	11850	25	18
Do Not Like Quote	1750	7100	8350	8300	1680	4800	8500	8400
Too Long Review	1800	7150	8350	8400	1874	4650	8400	8500
Order Declined	650	2800	3350	3350	587	1950	3350	3300
Customer Rejects	200	700	750	800	182	450	800	800
Selected	**1600**	**6050**	**7126**	**6770**	**1570**	**4250**	**6975**	**7082**

Table 4.2 demonstrates that using the Euler method for artisans with the lowest skill levels slightly surpasses the RK4 method in terms of outcomes

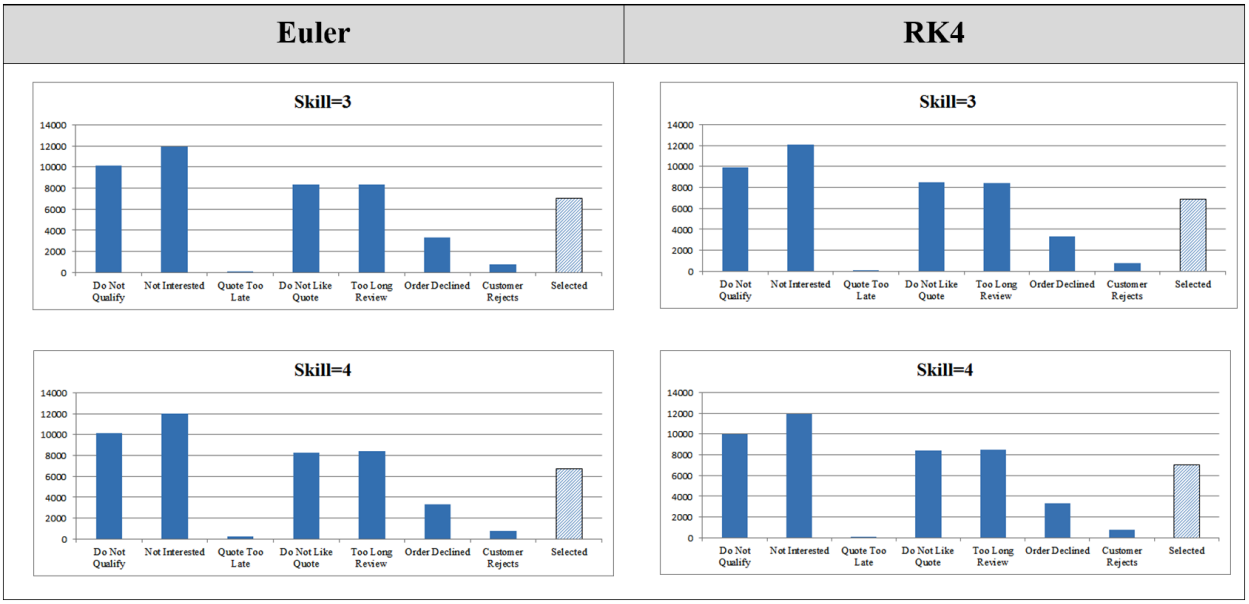


Figure 4.25. Results showing the number of artisans selected with varying skill sets of every artisan

Most e-commerce platforms, designed primarily as sales and marketing channels, provide artisans of all skill levels with equal opportunities for growth and global exposure at minimal cost. However, these platforms typically utilize a "push" model that limits interactions to the listing and selling of catalogued items without accommodating buyer-seller negotiations on product customization or pricing. A significant drawback of this model is its failure to allow artisans to communicate their availability or constraints regarding order acceptance, wage expectations, delivery timelines, etc.

Innovatively, our NCoRe platform introduces a feature enabling artisans to express their willingness to accept orders, considering factors like wages and deadlines. This capability is integrated through opinion dynamics, allowing artisans to bid for jobs in their native language, directly posted by urban entrepreneurs. The job allocation then depends on the artisans' bids, capacity, and delivery promises, aiming to ensure product quality and punctuality. This approach emphasizes fairness in job distribution.

To evaluate the fairness and efficiency of our job allocation model, we employed the AnyLogic simulator, which adjusts artisan allocation strategies based on their opinion scores. Our findings indicate an optimized selection of artisans within set parameters, showing that the Euler method

results in fewer artisan rejections compared to the RK4 method, making it a more equitable approach.

4.4.3 The Need for Blockchain Technology in the NCoRe Platform

The integration of blockchain technology within the NCoRe platform is not merely a technological upgrade but a strategic necessity to address critical issues of trust, security, and transparency, which are paramount in a community-driven e-commerce model (Nakamoto, 2008). Blockchain technology, characterized by its decentralized nature, immutable records, and consensus-driven operations, offers a robust solution to these challenges (Tapscott & Tapscott, 2016). This section outlines the rationale for embedding blockchain technology into NCoRe, focusing on enhancing the platform's reliability and fairness for rural artisans.

- Decentralization to Empower Participants: Blockchain's foundational principle of decentralization ensures that control and data are not centralized within a single entity, which is crucial for empowering rural artisans (Buterin, 2014). This approach democratizes access to the digital marketplace, thereby leveling the playing field for all users and fostering a more inclusive e-commerce environment.
- Immutability for Enhanced Trust and Transparency: The immutable nature of blockchain, where once data is recorded it cannot be altered, establishes a transparent and trustable system (Swan, 2015). For NCoRe, this means ensuring the integrity of transaction records and product authenticity, which are essential for building confidence among platform users and facilitating a transparent marketplace.
- Consensus Mechanisms for Security: Blockchain employs various consensus mechanisms to validate transactions, which significantly bolsters the security of the platform against fraudulent activities and cyber threats (Zheng et al., 2017). By incorporating these mechanisms, NCoRe can safeguard artisan and consumer interests, creating a secure online environment conducive to e-commerce activities.
- Smart Contracts for Efficient Transactions: The utilization of smart contracts, which automatically execute transactions upon the fulfillment of predefined criteria, offers a streamlined and efficient transaction process (Szabo, 1997). This automation minimizes the need for intermediaries, thereby reducing transaction costs and enhancing the operational efficiency of NCoRe for rural artisans.

- Traceability for Authenticity Verification: Blockchain technology facilitates the traceability of products, enabling consumers to verify the provenance and authenticity of artisan goods (Tian, 2016). This capability is crucial for maintaining the cultural integrity of rural crafts and ensuring that artisans receive fair compensation for their work, thus promoting a sustainable and ethical marketplace.

4.5 Conclusion

This chapter's exploration into the creation and deployment of NCoRe, a pioneering community-driven e-commerce solution tailored for rural artisans, underscores a significant advancement towards overcoming the challenges these communities face in accessing digital markets. By detailing the design and technological backbone of NCoRe, this discussion highlights how innovative applications of technology can play a crucial role in empowering underrepresented groups. Integrating blockchain technology into NCoRe emerges as a key strategy in establishing a platform that is not only secure and transparent but also equitable for all users. The shift towards a decentralized information and management system ensures that artisans retain control over their content and transactions, leveling the playing field in the digital domain. Blockchain's inherent immutability further strengthens trust between artisans and their clientele, ensuring the authenticity of transactions and product origins. The adoption of consensus protocols and smart contracts within NCoRe enhances its security posture and streamlines operations, making the digital marketplace more accessible to rural artisans. These technological interventions facilitate a reduction in transaction complexities and costs, removing significant barriers to entry for these communities. Moreover, the capacity for product traceability within the blockchain framework safeguards the cultural significance and authenticity of artisan products, fostering a marketplace grounded in sustainability and ethical practices. Reflecting on Chapter 4's insights into NCoRe's architecture and the strategic use of blockchain, it's evident that this endeavor is not just about bridging the digital divide but also about setting a precedent for how community-centric platforms can reshape the global marketplace. NCoRe's narrative is a powerful illustration of the potential for technology to catalyze social and economic inclusion. Looking ahead, the framework and achievements of NCoRe offer invaluable lessons for developing inclusive, effective, and equitable digital platforms. The initiative not only confronts the current barriers faced by rural artisans but also paves the way for future innovations in leveraging technology for broader societal benefits.

Chapter 5

Opinion Dynamics and its Significance in Community-Driven E-Commerce Platform

5.1 Introduction to Opinion Dynamics

Exploring opinion dynamics among rural handicraft producers engaged with Community-Driven E-Commerce Platforms in rural areas is a complex and nuanced process.

Opinion Dynamics provides a modeling tool for managing opinions. The existing studies primarily focused on agent-based group opinion management, which was the key issue in the field of opinion dynamics. The primary domain of this study is to determine the reliability of a statement with the help of aggregated group opinion values of the associated local agents. In this chapter, we propose a new mathematical model of Opinion dynamics which is a slight modification of the Bounded confidence model to find the Reliability Percentage of a statement. Bounded confidence model in opinion dynamics is a stochastic model within a finite group of agents for the evolution of continuous-valued opinions. On the basis of the opinion values given by the local agents regarding any situation, our mathematical model computes aggregated group opinion which is used to find the Reliability Percentage of a statement that is associated with the same situation (Basak, Nath, & Bhaumik, 2020).

To effectively model the opinion dynamics among rural handicraft producers using Community-Driven E-Commerce Platforms, we've developed a computational framework based on a probabilistic model called Bounded Confidence. This cutting-edge model is a digital representation of a craftsman's knowledge base, enabling a detailed examination of how opinions are formed by merging various knowledge elements. This process includes evaluating the impact metric to assess the reliability of different pieces of knowledge and identifying influential sources, which are often hidden, that influence the broader opinion landscape. The outcomes of this chapter are multifaceted, offering

1) a domain-independent computational strategy that underlines the interconnected nature of knowledge pieces,

2) the capacity to explore the multiple dimensions of opinion dynamics comprehensively,
3) an intuitive depiction of opinions that reveals the reasons behind changes in viewpoint,
4) the ability to outline the influence patterns within social communities by applying them based on communication.

This thorough method of examining opinion dynamics among rural handicraft producers engaged with Community-Driven E-Commerce Platforms highlights the intricate relationship between traditional practices and digital advancements, significantly shaping how these key community members perceive and make decisions.

5.1.1 Opinion Dynamics in the Rural E-Commerce

Opinion dynamics within rural e-commerce intertwine the essence of traditional social structures with the burgeoning realm of digital marketplaces, creating a pivotal area of study that underscores the transformation of rural economic landscapes. These dynamics are instrumental in shaping consumer trust, product reputation, and the technological embrace in rural settings, where digital platforms augment traditional word-of-mouth within rural communities (Lalitha, 2022). These platforms extend the reach of individual opinions and introduce a new dimension of urban customer feedback through reviews and ratings. Influential figures and community leaders within these rural areas play a significant role, as their endorsements or critiques can dramatically influence collective behaviours towards products and digital adoption. The evolution of opinion dynamics in rural e-commerce faces challenges like digital literacy and access. Yet, it presents opportunities for bridging the gap between tradition and modernity, facilitating sustainable economic growth. By enhancing an understanding of how opinions are formed and disseminated in rural contexts, stakeholders can craft strategies that promote the inclusion of rural communities into the digital economy and ensure that the transition respects and incorporates these communities' unique cultural and social fabrics (Kshetri, 2018). This comprehensive approach to studying opinion dynamics offers a lens through which the impact of e-commerce on rural development can be viewed, highlighting pathways to empower rural areas through informed decision-making and tailored technological interventions.

This chapter delves into the intricate opinion dynamics among rural handicraft producers engaged with Community-Driven E-Commerce Platforms, highlighting a nuanced interplay between traditional craftsmanship and digital innovation within rural e-commerce contexts. By

adopting a computational approach grounded in Bounded Confidence of Opinion Dynamics, the study explores how these producers assimilate, evaluate, and integrate external influences and knowledge fragments into their decision-making processes, marking a significant cognitive and social shift towards digital marketplaces. Historical perspectives on opinion formation, traditionally focused on consensus-building, are reexamined through the lens of the digital age, which demands an understanding of opinion dynamics. The findings illuminate the complexity of transitioning from traditional to digital platforms, revealing that social interactions, the reliability of information sources, and integrating new knowledge into existing systems deeply influence this shift. Through this investigation, the chapter contributes a novel domain-independent opinion-driven computational strategy that underscores the interconnected nature of knowledge and opinions, offering insights into the adaptive strategies employed by rural communities at the intersection of traditional craftsmanship and digital commerce. This comprehensive analysis enriches the theoretical framework of opinion dynamics. It provides practical implications for enhancing digital inclusion among rural handicraft producers, thereby underscoring the critical role of Community-Driven E-Commerce Platforms in shaping the future of rural e-commerce.

5.1.2 Understanding the Role of Opinions in Consumer Behavior

Understanding the role of opinions in consumer behavior offers valuable insights into how individuals make purchasing decisions and how collective opinions shape market dynamics. By recognizing the complex interplay between social influence, cognitive and emotional factors, and the resulting behavioral and economic outcomes, businesses and marketers can develop more effective strategies to engage with their audience, build trust, and foster positive brand relationships. This understanding not only aids in navigating the current market landscape but also in anticipating future trends and consumer responses (Lennon et al., 2007; Liu et al., 2021).

Understanding the role of opinions in shaping consumer behavior is pivotal in the context of today's diverse and digital-driven marketplaces. Opinions, influenced by an array of factors including social influences, marketing communications, cultural norms, personal experiences, and cognitive biases, serve as a critical determinant in guiding consumer decisions and preferences (Kokkoris & Kühnen, 2014). Social influence, mainly through word-of-mouth and online reviews, wields significant power over purchasing decisions, allowing consumers to

navigate the vast product landscapes based on the shared experiences of others. Marketing strategies, leveraging advertising and content, play a key role in crafting brand narratives that resonate with consumers' values, aiming to shape positive opinions and foster brand loyalty. Cultural and societal norms further dictate product desirability and acceptance, underscoring the importance of cultural sensitivity in global market strategies. Personal experiences with products or brands directly impact consumer opinions, where positive interactions can lead to repeat purchases, and negative ones can deter future engagement. Cognitive biases, such as confirmation bias and the bandwagon effect, influence how consumers process information and make purchasing decisions (Punj, 2011; Meng & Wei, 2016; Foxall, 2005). In e-commerce, the influence of opinions is magnified, with online reviews and ratings serving as a cornerstone for consumer trust and decision-making. For marketers and businesses, a deep understanding of these opinion dynamics is essential for designing effective marketing strategies, developing products that meet genuine consumer needs, and ultimately driving consumer behaviour in favourable directions. This comprehensive grasp of opinion influence not only aids in navigating competitive markets but also in enhancing consumer satisfaction and loyalty, establishing a positive feedback loop that benefits both consumers and businesses alike.

5.2 Opinion Dynamics in Rural E-Commerce

5.2.1 Characteristics of Opinion Dynamics

Opinion dynamics is a fascinating field that examines how individual opinions, beliefs, and attitudes change over time under various factors such as interpersonal communication, social media, and personal experiences. Here are some key characteristics of opinion dynamics:

- **Social Influence:** One of the fundamental aspects of opinion dynamics is the role of social influence, where the opinions of individuals are affected by the views and attitudes of others within their social network. This can lead to phenomena such as consensus, where opinions converge, or polarization, where opinions diverge into distinct groups (Gezha & Kozitsin, 2023).

- **Information Processing:** Individuals process new information differently based on their pre-existing beliefs, biases, and the source's credibility. This selective exposure and confirmation bias are crucial in how opinions evolve (Meng & Wei, 2016).

- **Complex Systems Behavior:** Opinion dynamics is inherently a complex systems behavior, characterized by non-linearity and emergent properties. Small changes in individual opinions can lead to significant shifts in the overall opinion landscape of a community (Punj, 2011; Meng & Wei, 2016).

- **Adaptive and Evolutionary:** Opinions are not static; they adapt and evolve as individuals interact with their environment, receive new information, and reassess their positions in light of social feedback and personal reflection (Meng & Wei, 2016; Foxall, 2005).

- **Heterogeneity of Agents:** Different individuals (or agents) may have varying levels of influence, susceptibility to change, and interest in specific topics, leading to a diverse range of dynamics in opinion formation and evolution (Xia et al., 2013).

- **Modeling and Simulation:** Various models, such as the bounded confidence model, Sznajd model, and Deffuant model, simulate opinion dynamics, providing insights into potential outcomes of social interactions and the impact of communication technologies Foxall, G. R. (2005).

- **Impact of Media and Technology:** The advent of the internet and social media has significantly altered the landscape of opinion dynamics, amplifying the speed and reach of information dissemination and creating new avenues for influence and manipulation (Kokkoris & Kühnen, 2014).

- **Cultural and Contextual Factors:** Cultural norms and societal context greatly influence opinion dynamics, shaping the foundational beliefs and values that guide individual and collective decision-making processes (Xia et al., 2013).

5.2.2 Factors Influencing Opinion Dynamics

Opinion dynamics, the study of how individual and collective opinions change over time, is influenced by various factors. These factors can be broadly categorized into interpersonal, media-related, psychological, and environmental influences. Understanding these factors is essential for analyzing how opinions form, evolve, and impact social phenomena such as political elections, consumer behavior, and public health campaigns. Here are some key factors influencing opinion dynamics:

- **Interpersonal Influence:** The dynamics of opinion formation and change are deeply intertwined with the structural and characteristic nuances of an individual's social network, encompassing connections to friends, family, and colleagues. Such networks play a pivotal role in shaping opinions, as individuals are inherently more susceptible to the influence of those within their immediate social circle. This susceptibility is further compounded by social influence and conformity, where individuals adjust their viewpoints to align with their social group's perceived norms and values Foxall, G. R. (2005). This inclination towards conformity is a testament to the decisive role of social cohesion and the desire for acceptance within a group. Moreover, the opinion-formation process is significantly influenced by interpersonal communication, through which direct conversations and interactions facilitate the exchange of ideas and perspectives. These interactions serve as conduits for disseminating information and viewpoints, thereby acting as a critical mechanism for the evolution of opinions. Through this intricate interplay of social networks, the desire for conformity, and interpersonal communication, opinions are formed, moulded, and often transformed, highlighting the complex nature of social influence and the human propensity towards communal validation and belonging.

- **Media-Related Influence:** The shaping of public opinion in contemporary society is significantly influenced by the multifaceted realm of media exposure, encompassing both traditional outlets, such as newspapers and television, and the vast expanse of digital media platforms. The content and volume of media that individuals are exposed to play a crucial role in moulding their viewpoints, acting as both a mirror and a moulder of societal norms and values. This process is further nuanced by selective exposure, wherein individuals gravitate towards media content that resonates with their pre-existing beliefs, thereby

entering a feedback loop that reinforces their current perspectives. This selective engagement with media content is a testament to the inherent bias towards cognitive unity and the avoidance of dissonance. Furthermore, the impact of media on public opinion is intricately linked to the strategies of media framing and persuasion techniques. How stories are framed, the selection of what is highlighted or omitted, and the strategic use of persuasive language are all potent tools in the arsenal of media influence, capable of subtly shifting the public discourse and moulding opinion. Through these mechanisms, the media wields a profound influence on the formation and evolution of public opinion, highlighting the complex interplay between media consumption habits and the psychological predispositions of individuals (Lalitha, 2022).

- **Environmental and Contextual Factors:** The landscape of opinion formation is deeply rooted in the cultural and economic contexts in which individuals exist, illustrating the profound impact of societal norms and economic conditions on personal beliefs and openness to change. Cultural norms, imbued with a society's traditions, values, and practices, provide a framework for forming and expressing opinions. These norms dictate the boundaries of acceptable thought and behavior, influencing individuals' willingness to entertain and adopt new ideas. This cultural backdrop shapes the content of opinions and the processes by which opinions are changed, highlighting the intricate relationship between cultural identity and cognitive flexibility (Meng & Wei, 2016). On the economic front, personal financial situations and the broader economic milieu play a crucial role in shaping opinions on a myriad of issues, ranging from political ideologies to consumer preferences. Economic conditions act as a lens through which individuals view the world, influencing their priorities, concerns, and expectations. The interplay between economic stability and uncertainty can significantly sway public opinion, reflecting the sensitivity of beliefs to material circumstances. Together, cultural norms and economic conditions weave a complex tapestry of influences that mold individual opinions, underlining the multifaceted nature of opinion dynamics about societal structures and personal experiences (Punj, 2011; Meng & Wei, 2016).

- **Technological Advances:** Social media and online platforms have revolutionized the landscape of opinion formation, introducing novel dynamics that facilitate the rapid spread of

information and the emergence of echo chambers. These digital arenas have democratized content creation and distribution, enabling individuals and groups to share their views with a global audience at an unprecedented scale and speed (Meng & Wei, 2016). However, this ease of access to many perspectives fosters environments where like-minded individuals cluster, often amplifying their pre-existing beliefs and shielding themselves from divergent viewpoints. This phenomenon of echo chambers exacerbates polarization and complicates the process of reaching a consensus on various matters. Concurrently, the digital age has ushered in an era of information overload, where the sheer volume of available data can overwhelm individuals, impairing their ability to sift through content critically and form well-informed opinions. This deluge of information, ranging from factual to misleading, demands significant cognitive effort to navigate, posing challenges to discernible sources and synthesising nuanced understandings. Together, the dynamics introduced by social media and the issue of information overload highlight the complexity of contemporary opinion formation, marked by both the empowering potential of widespread information access and the daunting challenges of ensuring the quality and integrity of public discourse (Meng & Wei, 2016).

5.2.3 Impact of Opinions in Rural Settings

Opinions among rural handicraft producers in rural contexts play a vital role in shaping these communities' socio-economic and technological frameworks. The perspectives and attitudes of these artisans, key stakeholders in the rural economy, significantly influence a broad spectrum of outcomes—from adopting innovative techniques and economic resilience to social cohesion and political engagement. Given the unique challenges and opportunities inherent in rural settings—marked by lower population density, limited access to cutting-edge technology, and distinct socio-economic dynamics—the formation and evolution of opinions among rural handicraft producers in these areas have profound and far-reaching effects.

- **Social Impact:** Rural handicraft producers' opinions are vital for fostering social cohesion within rural communities and play a significant role in connecting these communities with urban markets. The collective emphasis on community values and collaborative practices among artisans often acts as a catalyst for strengthening the social fabric of rural areas, enabling them to withstand both external and internal challenges. This shared commitment to

communal principles enhances social cohesion and positions rural handicraft communities as attractive partners for urban markets looking for unique, authentic products. However, divergent views among artisans can create social divisions, potentially hindering the community's ability to present a unified front to urban consumers and markets (Lalitha, 2022). On the other hand, the engagement of rural handicraft producers with urban markets extends beyond mere economic transactions; it involves the strategic positioning of their products in a way that appeals to urban consumers' preferences for authenticity and craftsmanship. This interaction opens up new economic opportunities for rural communities and introduces urban markets to the rich diversity of rural handicrafts. The relationship between rural handicraft producers and urban markets is thus multifaceted, encompassing the potential for economic growth, strengthening community ties, and creating bridges between rural and urban spheres. Through these dynamics, rural handicraft communities can leverage their unique strengths to gain access to broader markets, ensuring their sustainability and growth in an increasingly interconnected world (Punj, 2011; Meng & Wei, 2016).

- **Economic Development:** The perspectives of rural handicraft producers towards technology adoption and entrepreneurial activities are critical determinants of their ability to innovate, enhance productivity, and access urban markets. A positive outlook on adopting new tools and techniques can significantly expedite technology integration within these rural sectors, leading to increased productivity and new avenues for market expansion. This embracement of innovation allows rural handicraft communities to meet the demands of urban consumers better, thereby widening their market reach and improving economic prospects. Conversely, skepticism or resistance towards technological advancements can hinder technological integration, limiting growth opportunities and reducing rural handicrafts' competitiveness in broader markets (Meng & Wei, 2016). Furthermore, the success of entrepreneurial endeavors in these communities is deeply influenced by collective attitudes towards innovation and risk-taking. Supportive community opinions foster an environment where entrepreneurial activities can thrive, encouraging exploring new ideas, diversifying products, and pursuing novel business models. This entrepreneurial spirit is essential for stimulating local economic development and ensuring the sustainability of rural handicraft producers in the face of evolving market demands and the increasing globalization of trade. The combination of technology adoption and entrepreneurial vigor positions rural handicraft communities to

capitalize on opportunities presented by urban markets, not just by expanding their economic footprint but also by reinforcing their social cohesion and ensuring their long-term viability (Punj, 2011).

- **Technological Access and Digital Inclusion:** The stance of rural handicraft producers towards internet and mobile technology is a pivotal factor in achieving digital inclusion and leveraging online platforms for economic gain. A positive perception of these technologies can significantly ease the path to accessing digital marketplaces, enabling artisans to market and sell their products to a much wider audience than traditional methods allow (Zha et al., 2020). This digital engagement broadens the scope of their potential customer base and introduces rural handicrafts to national and international markets, thereby enhancing their economic prospects and visibility. Conversely, negative attitudes towards digital tools and platforms can serve as a substantial barrier to digital participation, effectively sidelining these producers from the burgeoning digital economy and limiting their access to the vast opportunities it presents. Furthermore, the attitudes of rural handicraft producers towards e-commerce play a critical role in determining their level of participation in online marketplaces. Trust in online transactions and openness to engaging with e-commerce platforms are essential for these producers to venture beyond local markets and tap into global consumer bases. Positive attitudes towards e-commerce encourage rural artisans to adopt online selling platforms, facilitating the expansion of their businesses and allowing them to compete more effectively in the global market. This transition to online sales channels can significantly impact the economic viability of rural handicrafts, providing a sustainable avenue for growth and development. By embracing internet and mobile technologies and participating in e-commerce, rural handicraft producers can overcome geographical limitations and socioeconomic barriers, positioning themselves as active players in the global marketplace (Zha et al., 2020).

Understanding the dynamics and impact of opinions among rural handicraft producers in rural contexts is crucial for policymakers, businesses, and community leaders aiming to address the unique challenges and leverage the opportunities in these sectors. Effective communication, community engagement, and inclusive decision-making processes can help align artisanal opinions with broader development goals, ensuring sustainable progress and enhanced livelihoods for rural handicraft producers.

5.2.4 Impact on User Decision-Making

The impact of opinions on user decision-making, particularly in the context of rural handicraft producers, plays a significant role in shaping consumer behaviors, market trends, and the overall dynamics of the rural economy. Understanding how opinions influence decision-making can help stakeholders effectively address producers' and consumers' needs and preferences, fostering a more sustainable and inclusive rural economy. Here are some key ways in which opinions impact user decision-making:

- **Consumer Trust and Brand Loyalty:** Consumer perceptions of the quality and authenticity of rural handicrafts are crucial in building consumer trust and fostering brand loyalty. Positive views on these attributes enhance the desirability of handicrafts, setting them apart in a market dominated by mass-produced items. Authentic, high-quality handicrafts resonate with consumers who value craftsmanship and cultural heritage, leading to repeat purchases and recommendations. This advocacy is compelling in today's digital landscape, where social media and consumer reviews significantly influence buying decisions. Maintaining high standards of craftsmanship and authenticity thus not only boosts consumer trust but also acts as a lever for increased market reach and brand loyalty (Wang et al., 2018).

- **Adoption of Technologies and Platforms:** The willingness of both producers and consumers to engage with digital marketplaces for handicrafts is heavily influenced by their perceptions of these platforms' reliability and user-friendliness. Positive views toward online marketplaces can significantly encourage the adoption of e-commerce, facilitating a broader access to markets for rural producers. This increased digital engagement enables producers to reach a wider audience, while consumers benefit from the convenience and variety offered by online shopping. The result is a mutually beneficial scenario that enhances rural handicraft producers' market access and economic opportunities (Kshetri, 2018).

- **Innovation and Product Development:** Consumer demand for innovation and customization in rural handicrafts plays a pivotal role in shaping the offerings of rural producers. Opinions favoring innovative design and functionality can steer artisans towards creating products that align with contemporary market needs, potentially influencing consumer choices and setting new trends. Similarly, the growing preference for customized

and personalized handicrafts underscores the importance of producers adapting to offer bespoke options. This adaptability meets individual consumer preferences and adds unique value to handicrafts, enhancing their appeal in a competitive market. Embracing innovation and customization, therefore, can be a strategic move for rural handicraft producers, enabling them to connect more deeply with consumers and expand their market presence (Wang et al., 2018).

- **Policy and Community Support:** The perception of community-based marketing strategies significantly influences the promotion and sale of rural handicrafts. Positive attitudes towards these strategies can lead to a greater emphasis on community-endorsed products, affecting both producer and consumer decisions. By leveraging social networks and trust in community relationships, rural handicraft producers can effectively market their products, enhancing their appeal through the authenticity and story behind each piece. This approach supports rural communities' economic development and aligns with consumer preferences for products with a meaningful backstory and community impact. Adopting community-based marketing can thus be a powerful tool for rural handicraft producers, potentially increasing market access and consumer loyalty (Kshetri, 2018).

The impact of opinions on user decision-making in rural handicraft production is multifaceted, affecting everything from consumer trust and technology adoption to sustainable consumption and innovation. By understanding and leveraging these opinion dynamics, stakeholders can devise strategies that enhance the appeal and marketability of rural handicrafts, supporting the livelihoods of rural producers while meeting consumers' evolving preferences.

5.3 Dynamics of User-generated Content

5.3.1 Social Influence of Reviews and Ratings

The formation of opinions within individuals is significantly influenced by social factors, a subject that has been extensively studied from various angles. A significant portion of this research focuses on analyzing social networks, viewing social influence as a key driver in the spread of ideas. This area includes investigations into how ideas spread (Rodriguez et al., 2010; Adar & Adamic, 2005), identifying key influencers (Kimura et al., 2009), and tracking the flow of information (Leskovec, 2008; Nowell & Kleinberg, 2008). Simulations of how people influence

each other have also been used to examine what triggers widespread sharing of information. Insights from Watts and Dodds (Watts & Dodds, 2007) indicate that major information spreads are often initiated by a handful of easily influenced individuals, rather than by traditionally influential people.

Yet, the similarity between these models and the complexity of real-world influence is not perfect. The dynamics of influence are more intricate in reality, as the patterns identified in one situation may not hold in another due to strategic social behaviors and the inherent autonomy individuals have in selecting their social interactions.

From a different perspective, research on social influence also delves into the underlying reasons for its impact. For example, Granovetter (1983) explored threshold models of collective action to explain why group behaviors sometimes diverge sharply from individual preferences, shedding light on seemingly paradoxical behaviors like riots and the spread of new ideas. The concept of trust within social networks, determining with whom we share and accept information, has also been a focal point. Models quantifying trust levels have been developed to facilitate recommendations within social networks (Quercia, 2007; Kuter & Golbeck, 2007; Golbeck & Hendler, 2006).

Trust measurement in these models is often simplified to a single value (Quercia, 2007, Katz & Golbeck, 2006). However, the reality of social trust is influenced by various factors that are challenging to capture through computational models (Golbeck, 2009) fully. This is partly because trust varies with the context of each interaction and despite believing someone, individuals may not always be persuaded to change their opinions. In this thesis, we propose a novel approach to understanding and modeling social trust, focusing on how individuals perceive and adopt the views of their acquaintances. We introduce a concept of reliability, which reflects a person's openness to new ideas, measured through specific assessment methods. Recognizing that the influence of others' opinions can vary across different contexts, we propose modeling reliability based on several universal social factors: the nature of the relationship, frequency of contact, and similarity of opinions. Communication and social theory scholars have identified these factors as crucial to forming opinions through social interaction.

Relationship: The degree of closeness between individuals significantly influences their likelihood of accepting each other's viewpoints. This closeness, which constitutes the social

context such as family or friends, encourages individuals to align their perspectives with those of their group (Neumann, 1993). For example, advice from a close friend is often given more weight than that from a stranger. Rotter's research (Rotter, 1967), which involved a sociometric analysis, found a direct correlation between the level of trust and the strength of friendships.

Contact Frequency: In our examination of social influence mechanisms detailed in Chapter 4, we delve into the significance of recent contact frequency between individuals. The premise is that without regular interaction, even individuals with strong bonds, such as close friends, may develop divergent knowledge bases to the extent that persuasion becomes challenging. Chong and Druckman (Chong & Druckman, 2007) introduced a framing theory to pinpoint crucial factors influencing the formation of public opinion. Among their insights is the observation that consistent communication enhances the credibility of one's opinions when presented to others.

Opinion Similarity: In the realm of social network analysis, similarity is often utilized as a key metric to assess the connections between individuals (Singla & Richardson, 2008). Rather than focusing on the similarity of personal attributes such as age or location, our analysis prioritizes opinion-based similarity, given that personal characteristics can frequently mirror the nature of the relationship itself. Research by Sniderman and Theriault (Sniderman & Theriault, 2004) indicates that people are predisposed to embrace ideas that align with their pre-existing values. Furthermore, Crandall et al. (2008) pioneered methods to examine the interplay between social influence and selection through online interactions, employing an empirical study of Wikipedia as their dataset. Their findings underscore that similarity in perspectives not only fosters future interactions but also that such interactions can, in turn, heighten the degree of similarity between the parties involved.

5.3.2 Bounded Confidence Model of Opinion Dynamics

In studying opinion dynamics within community-driven e-commerce platforms, bounded confidence is pivotal in understanding how consumer opinions converge or diverge over time. Bounded Confidence Models describe situations where individuals adjust their opinions only if the difference between their opinions and those of others falls within a certain tolerance level or confidence bound. This concept is particularly relevant in online communities where users frequently exchange opinions, reviews, and feedback on products or services.

Mathematical Framework of Bounded Confidence Models

The bounded confidence model can be mathematically represented in various forms, with the Deffuant-Weisbuch model and the Hegselmann-Krause (HK) model being among the most prominent. These models illustrate how individuals with different initial opinions can influence each other, reach a consensus, remain divided, or form clusters of shared opinions based on their confidence levels.

Deffuant-Weisbuch Model: The Deffuant-Weisbuch model is defined by a simple rule. Consider a population of N agents, each with an initial opinion $x_i(0)$ where i=1,2,..., N, and opinions are represented on a continuous spectrum from 0 to 1. At each time step, a pair of agents i and j is randomly selected, and they adjust their opinions if and only if the difference between their opinions is less than a predefined threshold ϵ, which represents the confidence bound. The opinion update rule is given by:

The Deffuant-Weisbuch model is characterized by a straightforward principle. Envision a group of N individuals, each possessing an initial viewpoint xi(0) where i=1,2,..., N, with these viewpoints distributed along a continuous range from 0 to 1. During each interval, a random pair of individuals i and j are chosen, and they modify their viewpoints only if the variance in their opinions is smaller than a pre-established limit ϵ, symbolizing the boundary of confidence. The formula for updating opinions is as follows:

$$x_i(t+1)=x_i(t)+\mu(x_j(t)-x_i(t))$$

$$x_j(t+1)=x_j(t)+\mu(x_i(t)-x_j(t))$$

where $0<\mu\leq 0.5$ is the convergence parameter, indicating how much agents adjust their opinions after each interaction.

Hegselmann-Krause (HK) Model: The Hegselmann-Krause (HK) model broadens the idea by taking into account the impact of all neighbors within the confidence limit at every time step. For any given agent i, the revised opinion $x_i(t+1)$ is computed as the mean of the opinions of all agents j whose views lie within the confidence range $[x_i(t)-\epsilon, x_i(t)+\epsilon]$, including their own:

$$x_i(t+1) = \frac{1}{|N_i(t)|} \sum_{j \in N_i(t)} x_j(t)$$

where $N_i(t)$ is the set of agents j such that $|x_i(t)-x_j(t)|\leq\epsilon$, representing those within the confidence bound of agent i at time t.

Framework of Bounded Confidence Model in Opinion Dynamics

Incorporating the Bounded Confidence Model into the dynamics of community-driven e-commerce platforms, focusing on rural producers, offers a nuanced understanding of how shared opinions and values within an online community influence purchasing decisions and producer strategies. The proposed model in this section suggests that opinions on product quality, sustainability, and ethical standards—shared through reviews, ratings, and forums—are more likely to influence interactions and purchasing behaviors when they fall within a specific range of acceptance, or "bounded confidence threshold," among consumers and producers. For rural producers, engaging with and leveraging these community platforms requires aligning their products with the community's values and expectations and active participation in the community through responsive communication and adaptation to feedback. Such engagement can lead to a convergence of opinions towards a consensus on the value and quality of goods, potentially expanding the producer's customer base within the platform.

The below diagram provides a simplified view of complex interactions, emphasizing the interconnectedness of rural producers and community-driven e-commerce platforms within the ever-changing landscape of consumer demand and market trends. It suggests a mutual dependency where both entities must be flexible and responsive to thrive.

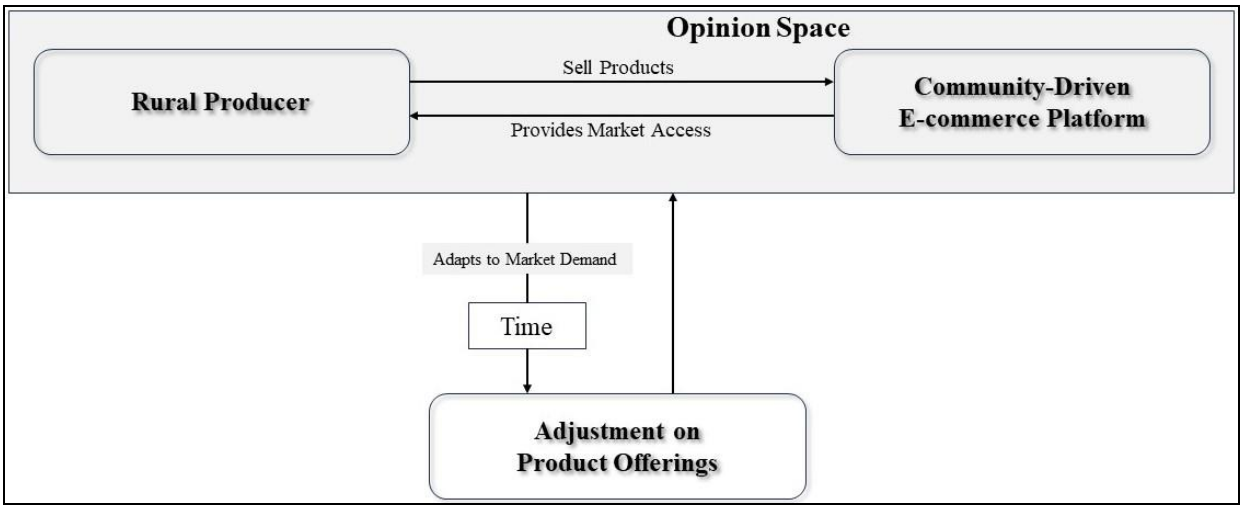


Figure 5.1 Interaction between Rural Producer and Community-Driven E-Commerce Platform

The above diagram illustrates the dynamic relationship between a rural producer and a community-driven e-commerce platform within the broader context of market demand and product offerings regarding Opinion Dynamics. Here's an explanation of its components:

- **Rural Producer:** This entity represents rural handicraft producers operating in rural areas. The critical actions highlighted in the diagram include:

  Sells products to the platform: Indicates the primary interaction where rural producers offer their goods, such as crops, dairy, or handcrafted items, to be sold on the e-commerce platform.

  Adjusts product offerings based on demand: Reflects the adaptive nature of rural producers to market needs. By receiving feedback or analyzing sales data from the platform, rural producers can modify their products to match consumer demand better.

- **Community-Driven E-Commerce Platform:** This represents online marketplaces that focus on providing access to goods from rural producers to a broader audience, typically emphasizing sustainability, local produce, or artisanal products. Its functions include:

  Provides market access to rural producers: The platform bridges rural producers and potential customers, enabling producers who might otherwise have limited market exposure to reach a broader customer base.

  Adapts to market trends and demands: Just as rural producers adjust their offerings, the platform must respond to changes in consumer preferences, seasonal trends, and other market dynamics to support its users effectively.

- **Opinion Space:** Conceptually, this represents the dynamic market environment within which rural producers and the e-commerce platform operate. It encompasses consumer preferences, market trends, and the economic ecosystem influencing product demand and supply. The diagram suggests that the opinion space is subject to change and evolves with time and interactions, symbolising the need for both producers and the platform to be adaptable and responsive.

- **Time:** This element underscores the temporal aspect of market dynamics and the continuous nature of adjustments in product offerings and platform features. It highlights that the

relationship between rural producers and the e-commerce platform is not static but evolves as both respond to ongoing changes in market demand.

5.4 Opinion Dynamics in Community-Driven E-Commerce Platform

That social influences alter an individual's opinions is a truism to which anyone can readily consent. However, people do not shape opinions on an issue for no reason. To understand opinion dynamics in a rural community, it is crucial to study how opinions are formed and how to quantify and represent opinions.

5.4.1 Opinion as a Reasoning Product

According to Damer (2012), opinions supported by arguments should be viewed as the conclusion resulting from specific processes of rational reflection on evidence. Moreover, studies on cognitive processes have shown that arguments are inferred from one's knowledge bases. Thus, in this chapter, we assume that all opinions are accompanied by the reasons that support them. Though everyone is entitled to have their opinions, supported opinions are considered more valuable when evaluating a bunch of given opinions (Damer, 2012). Traditional models mainly focus on the opinion formation process, where opinions are treated as independent values. Multiple opinions are integrated into one based on some weighting strategies (DeGroot, 1974; Friedkin & Johnsen, 1999; Hegselmann & Krause, 2002). Then, the question becomes how to assign weights to each received opinion. Different weighting functions lead to different results, e.g. consensus or polarization (Hegselmann & Krause, 2002). In recent years, more and more works have started evaluating the trust between people in social networks based on homophily effects such as the similarity in demographic features, e.g. age, gender, etc. (Golbeck, 2009; Golbeck & Hendler, 2006). The intuition is that individuals in homophilic relationships share common characteristics that make communication easier.

To evaluate whether an opinion deserves acceptance, homophily only is insufficient. However, what if an individual is temporarily isolated from others? Can she change her opinions due to self-learning, e.g., by observing her own experience? The answer is yes. The study by Gureckis and Douglas (2012) posits that self-directed learning plays a crucial role in enhancing the educational experience by enabling individuals to concentrate on beneficial information. Essentially, this research views opinions dynamics as outcomes of logical deductions drawn from

an individual's existing knowledge base, with new pieces of knowledge being gained via diverse learning experiences (Acemoglu & Ozdaglar, 2011).

5.4.2 Model of Opinion Formation

Opinion Dynamics can be characterized as a dynamic and iterative system. In opinion dynamics, a group of agents express their initial views on the same issue. Their views are continually updated based on the contact system as time goes by. At the final stage, a consensus (or fragmentation) is established between the agents (Basak, Nath, & Bhaumik, 2020).

Bounded Confidence is one of the important models in opinion dynamics. This model assumes that only the peers whose views are similar to theirs interact with each person. The earliest bounded confidence models are presented independently by Hegselmann and Krause (2002). In the HK model, agents change their opinions synchronously by combining all views in their confidence sets. This method is mainly used to build the evolution model of opinions.

The objective of this chapter is to suggest a modification to the normal Bounded Confidence Model of Opinion Dynamics so that in the same time frame the collective opinion and weight of comparable individuals will be regarded as significant parameters within the same domain. Based on the Classical Model and Bounded Confidence HK model of Opinion Dynamics, we suggest our model with slight changes that will calculate the Reliability Percentage of a statement based on some aggregated opinions. Furthermore, a numerical example is given to illustrate the feasibility of the proposed opinion dynamics model. To test our model, we have collected the opinions from the Artisan, Urban Customer and NCoRe administrator for their opinions on different aspects, artisan is interested in executing the order or not? Price quoted by a rural artisan for an order is aligned with the market rate or not? The previous customer reviews about the artisans for the execution of an order (Basak, Nath, & Bhaumik, 2020).

- Mathematical Formulation

This section briefly introduces the basic knowledge regarding the Classical Model and Bounded Confidence HK model, and then we propose our mathematical model with slight modifications to determine the justifiability of a statement, which will deliver a basis for this study.

✓ **Classical Model:**

Consider a consistent opinion dynamics problem; let us consider a group of n entities P= {P_1, P_2, P_3, … P_n}

To model the procedure of recursive opinion formation, we consider t=0, 1, 2,… to be discrete points of time. We assume the opinion of the entity P_i be x_i (t) at the time point t for i=1,2,…n, such that $x_i(t) \in | R$.

Let, $x(t)=(x_1(t),x_2(t),\ldots x_n(t))^T$ be the vector of opinions of entities (P_1, P_2, P_3, … P_n) at time t, known as the Opinion Profile and $A=\{a_1,a_2,\ldots a_n\}$ be the respective weights such that $a_i>0$ for i=1,2,…n. Having these notations, the opinion formation of the group can be described as taking weighted arithmetic mean in the following way; $X(t+1) = a_1x_1(t)+a_2x_2(t)+\ldots+a_nx_n(t)$ for t=0,1,2,…

By gathering the weights in a matrix X(t+1) = AX(t); where A is a fixed stochastic matrix and X(t) be the column vectors of opinions at time t. This model was developed and used to test the pooling of opinions through expert dialog (Basak, Nath, & Bhaumik, 2020; Groot, 1974)

This mathematical framework facilitates analysing how opinions evolve within a group, considering the influence of each entity's opinion weighted by a set factor. It serves as a foundational model for investigating the pooling of opinions and the impact of dialogue among experts on consensus-building processes.

✓ **Bounded Confidence Model:**

With reference to the notations used in the section Classical Model, we define the Bounded confidence: Hegselmann-Krause model (Basak, Nath, & Bhaumik, 2020).

Let ε>0 be the bounded confidence. The opinion-forming process in the HK model involves three steps:

Confidence Set Definition: In opinion dynamics problems, entity P_i only trusts the opinions which differ not more than ε from its opinion.

Let, $I(P_i,x(t))$ be the confidence set, such that, $I(P_i,x(t)) = \{ 1\leq j\leq n \ni |x_i(t)-x_j(t)| < \varepsilon \}$, where P_i is a fixed entity and $x(t)=(x_1(t),x_2(t),\ldots x_n(t))^T$ be an opinion profile, | . | denotes the absolute value of a real number.

Calculation of Weights: Here entity P_i assigns equal weight to the entities within its confidence set $I(P_i,x(t))$.

Let, $w_{ij}(t)$ be the weight that entity P_i assigns to the entity P_j at time t,

$$w_{ij}(t)=\begin{cases} |I(P_i,x_i(t))|^{-1} & \text{if } P_j \in I(P_i,x_i(t)) \\ 0 & \text{if } P_j \notin I(P_i,x_i(t)) \end{cases}$$

where i=1,2…n and t=0,1,2…Clearly, $w_{ij}(t) \geq 0$ and $\sum w_{ij}(t) = 1$

Evaluation of the Opinions: The formation of the opinions in the Hegselmann-Krause [9] model is demonstrated as the weighted arithmetic mean of opinions in the confidence sets i.e.

$X_i(t+1)= w_{i1}x_1(t)+w_{i2}x_2(t)+\ldots+w_{in}x_n(t)$ where t=0,1,2,…

✓ **Proposed Mathematical Model:**

With reference to the classical model in Opinion Dynamics, as described in section 5.4.2, we define the group opinion X(t) for the set of entities (P_1, P_2, P_3, … P_n) as,

$$\mathbf{X(t+1)=a_1x_1(t)+a_2x_2(t)+\ldots+a_nx_n(t), \text{ where } t=0,1,2..} \quad \mathbf{(5.1)}$$

where, a_i represents the weights of the corresponding entities (P_1, P_2, P_3, … P_n) in a particular context, in which the opinion is being taken.

$x_i(t)$ represents the individual opinion values of the members of any group for i=1,2,…n at a time point t. As $t\rightarrow\infty$, we can replace (t+1) by t in equation 5.1

$$\mathbf{X(t)=a_1x_1(t)+a_2x_2(t)+\ldots+a_nx_n(t), \text{ where } t=0,1,2..} \quad \mathbf{(5.2)}$$

For a large population, considering individual weights would be tiresome, so we introduce k representative weightage values $a_1', a_2', \ldots a_k'$

The earlier weightage scale $A= \{a_1,a_2,\ldots a_n\}$ has to be divided into k finite intervals, where $a_j'>0$ is the central mass value of the j-th interval for j=1,2,…k such that, for any pre-assigned positive quantity δ, however small it may be, $| a_i - aj' | < \delta$ for i=1,2,…n; j=1,2,…k

Then, the value of a_i is replaced in (5.2) by the central values in its δ-neighbourhood.

$$\mathbf{X'(t)=a_1'\sum x_{i1}(t)+a_2'\sum x_{i2}(t)+\ldots+a_k'\sum x_{ik}(t)} \quad \mathbf{(5.3)}$$

Where $x_{ij}(t)$ is the Opinion profile belonging to a_j' at a particular time point t where i=1,2,…n and j=1,2,…k.

Now let us assume that there exists m distinct groups $Y=\{Y_1,Y_2\ldots Y_m\}$, such that each and every group provides independent opinions at a particular time point t on a specific context.

$O_Y(t)= (OY_1(t),OY_2(t)\ldots OY_m(t))^T$ where $O_Y(t)$ is the opinion profile of m groups.

The model we are going to discuss portrays Bounded Confidence among the groups in the following manner.

The group Y_i with maximum weightage in that specific context is fixed and a set of those groups is formed whose opinions differ from the opinion of Y_i not more than a certain confidence level ε_0, where ε_0 is a very small pre-assigned positive quantity.

The set of groups is defined as,

$I(Y_i,O_{Yi}(t)) = \{1 \leq j \leq m, Y_j \ni |O_{Yi}(t) - O_{Yj}(t)| < \varepsilon_0 \}$ where, i,j=1,2,…m ; t=0,1,2….

We define the cardinality of the set as, $n[I(Y_i,O_Y(t))]=g$ (say) where $0 < g \leq m$

Now the percentage of the justifiability of the topic under consideration is defined as,

$P=(g/m)*100$ where $n[I(Y_i,O_Y(t))]=g$ and $n[O_Y(t)]=m$

5.4.3 Validation and Evaluation of Proposed Opinion Dynamics Mathematical Model

NCoRe represents a meticulously crafted initiative designed to bridge the gap between rural artisans and the broader market, specifically targeting the direct engagement with urban consumers over the execution of orders. This innovative approach is operationalized through the creation of a dedicated WhatsApp group. This digital forum integrates rural artisans, urban consumers, and a designated NCoRe administrator into a single communicative platform. The primary function of this group is to oversee the progression of orders, providing a real-time solution to any emerging issues or disputes, thereby ensuring smooth transactional flows.

Within this platform, artisans can express their readiness to fulfill an order, submit bids, or offer perspectives on product pricing, manufacturing costs, and estimated timelines for completion.

A diagram (Figure 5.2), intended to be showcased below, visually maps out the intricate workflow of order execution, encapsulating the essence of the Community-driven Driven E-commerce platform facilitated by NCoRe.

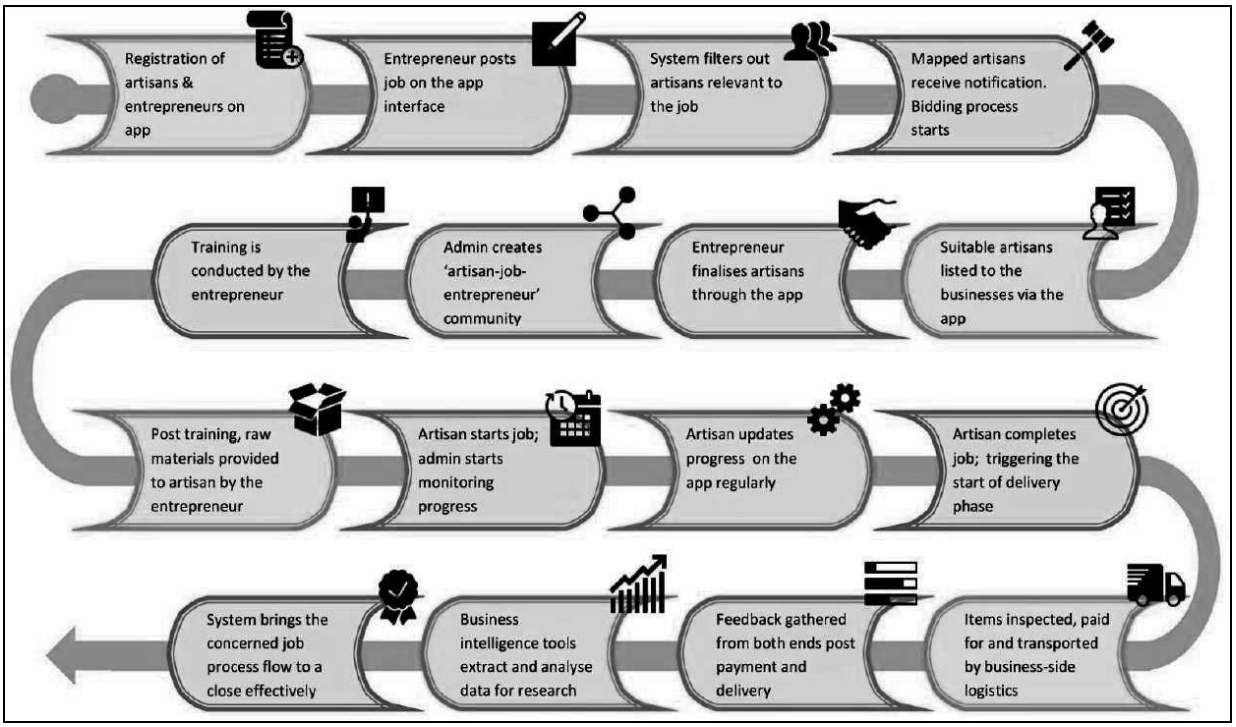


Figure 5.2. Depicts the streamlined order execution workflow

The strategic utilization of the WhatsApp group empowers artisans, allowing them to interact with potential customers directly. This interaction is not limited to transactional exchanges; it extends to sharing valuable insights regarding the nuances of order execution, thereby enriching the buyer's understanding and appreciation of the craftsmanship involved. NCoRe plays a pivotal role in this ecosystem, offering unwavering support to artisans from the moment they initiate contact with buyers until the finalization of transactions on this online platform. This model is not just a conduit for commerce; it is a platform that champions fair trade, ensuring artisans are adequately compensated for their labour and creativity, while simultaneously allowing buyers to purchase authentic products at fair prices.

Moreover, an empirical approach was adopted to substantiate the theoretical foundations of this model, particularly the mathematical model of opinion dynamics that underpins it. By extracting and analyzing data related to order specifics directly from the WhatsApp group conversations, insights were gained into the artisans' readiness to accept orders, the economics of their wages, and the pricing strategies employed by urban buyers for the final products. This data collection effort is pivotal, as it not only validates the theoretical model but also provides actionable insights that can be leveraged to enhance the efficiency and effectiveness of the NCoRe platform. Through this systematic approach, NCoRe not only fosters a direct and transparent

digital marketplace but also contributes to the broader understanding of how digital platforms can be leveraged to empower rural artisans, thereby making a significant impact on their economic well-being.

For the simulation described earlier, we gathered opinions from artisans across various WhatsApp groups concerning order execution as requested by urban customers. Table 5.1 will showcase the aggregated feedback from artisans, urban buyers, and NCoRe administrators collected throughout the order execution cycle.

A. Calculation of Reliability Percentage

In this section, we will determine the Reliability Percentage for each Order Execution utilizing our specialized mathematical model. Our approach involves compiling and analyzing responses from artisans and urban customers, as reflected in Table 5.1. This table provides a comprehensive summary of artisans' feedback on a variety of aspects related to garment products, analyzed through our mathematical model. The objective of employing this model is to calculate the Reliability Percentage, a metric designed to assess the truthfulness of statements. This percentage will gauge the accuracy of information based on the collective opinions of artisans. In essence, the Reliability Percentage will act as an indicator of the credibility of the data, offering a quantitative method to evaluate the trustworthiness of opinions from artisans regarding order execution.

#	Opinion Score Marked by Artisan (out of 10 scale)	Opinion Score Marked by Urban Customer (out of 10 scale)	Opinion Score Marked by NCoRe Administrator (out of 10 scale)
Do Not Qualify	7	3	7
Not Interested	7	1	7
Quote Too Late	7	5	7
Do Not Like Quote	7	1	7
Too Long Review	8	1	8
Order Declined	8	1	8
Customer Rejects	6	5	6

Table 5.1: Collective Opinions of Artisans, Urban Buyers and NCoRe administrators regarding the execution of an order for handicraft items in different contexts as discussed in Chapter 4 Section 4.4.2

Three key groups participated in the order execution cycle via a WhatsApp group: Artisans, Customers, and Administrators. Opinions were solicited from these groups, focusing on the importance of executing orders on time and employing a fair pricing strategy.

We denote $x_{artisan}(t)$, $x_{customer}(t)$, and $x_{administrator}(t)$ as the opinion profiles for the groups Artisan, Customer, and Administrator, respectively. In calculating the group opinion score, we utilize the formula outlined in (5.1), which involves taking the opinion values of each individual within the group, multiplying them by their respective weights, and then summing these products. Following this, the arithmetic mean of these weighted sums is computed to obtain the group's overall opinion score. To enhance accuracy, we assume the total number of individuals in each group is equal.

Let us assume that Artisan, Customer and Administrator are assigned weightages 3, 2 and 1 respectively.

Calculation of Group Opinion score based upon Table 5.1 data

$x_{artisan}(t) = 1/3 * (0.3*7 + 0.3*7+0.3*7) = 2.1$

$x_{customer}(t) = 1/3 * (0.2*7 + 0.2*8+0.2*8) = 1.53$

$x_{administrator}(t) = 1/3 * (0.1*6 + 0.1*7+0.1*9) = 0.73$

Assume that $\varepsilon=0.6$, where ε is the bounded confidence.

Now if we apply our proposed model with bounded confidence, we get

$I(artisan, x_{artisan}(t)) = \{artisan,customer\}$

We obtain the confidence set according to our Mathematical model by obtaining whether the absolute difference of the variables under consideration lies within bounded confidence or not.

Since, $|x_{artisan}(t) - x_{artisan}(t)|<0.6$ & $|x_{artisan}(t) - x_{customer}(t)|<0.6$

Now cardinality of $I(artisan,x_{artisan}(t)) = n[I(artisan, x_{artisan}(t)]=2$

Therefore the Reliability Percentage of the opinions as calculated is,

$P = (2/3*100)\ \% = 66.6\%$

For the sake of proper weightage assignment let us assume that, our entity groups Artisan, Customer and Administrator are to be assigned weightages {1,2,3}. To clarify the reason behind the perfect weightage assignment towards the groups, we consider all possible combinations of {1,2,3} and also calculate the group opinion value as well as the Reliability Percentage for each possible combination.

Weightage assigned to Artisan	Weightage assigned to Customer	Weightage assigned to the Administrator	$X_{artisan}(t)$ (out of 3)	$X_{customer}(t)$ (out of 3)	$X_{administrator}(t)$ (out of 3)	Reliability Percentage (ε=0.6)
3	2	1	2.1	1.53	0.73	66.67
3	1	2	2.1	0.76	1.47	33.33
2	3	1	1.4	2.3	0.73	33.33
2	1	3	1.4	0.76	2.2	33.33
1	2	3	0.7	1.53	2.2	33.33
1	3	2	0.7	2.3	1.47	33.33

Table 5.2. Calculation of Reliability Percentage for each possible combination of weightages of the participating entities

To find the weightage value of every entity in this section, we have taken the individual opinion score from Table 5.1 to calculate the group opinion scores. The group opinion scores will be calculated using the formula (5.1).

From our analysis (as shown in Table 5.2), it is observed that the Reliability Percentage will be maximized for the combination of weightage values of 3,2,1 for the entity set Artisan, Customer, and Administrator respectively.

B. **Analysis of results**

Calculation of Group Opinion score based upon Table 5.1 data

$x_{artisan}(t) = 1/3 * (0.3*7 + 0.3*7+0.3*7) = 2.1$

$x_{customer}(t) = 1/3 * (0.2*7 + 0.2*8+0.2*8) = 1.53$

$x_{administrator}(t) = 1/3 * (0.1*6 + 0.1*7+0.1*9) = 0.73$

Assume that ε=0.6, where ε is the bounded confidence.

Now if we apply our proposed model with bounded confidence, we get

$I(artisan, x_{artisan}(t)) = \{artisan,customer\}$

We obtain the confidence set according to our mathematical model by obtaining whether the absolute difference of the variables under consideration lies within bounded confidence or not.

Since, $|x_{artisan}(t) - x_{artisan}(t)|<0.6$ & $|x_{artisan}(t) - x_{customer}(t)|<0.6$

Now cardinality of $I(artisan,x_{artisan}(t)) = n[I(artisan, x_{artisan}(t)]=2$

Therefore, the Reliability Percentage of content posted by recognized rural artisans, when compared to anonymous sources is,

P = (2/3*100) % = 66.6%

Calculation of Group Opinion score based upon Table 5.2 data

$x_{artisan}(t) = 1/3 * (0.3*3 + 0.3*1+0.3*5) = 0.9$

$x_{customer}(t) = 1/3 * (0.2*1 + 0.2*1+0.2*1) = 0.2$

$x_{customer}(t) = 1/3 * (0.1*6 + 0.1*1+0.1*3) = 0.33$

Assume $\varepsilon=0.5$, where ε is the bounded confidence.

Now applying our proposed model with bounded confidence we get,

$I(artisan, x_{artisan}(t)) = \{artisan\}$

We obtain the confidence set according to our mathematical model by obtaining whether the absolute difference of the variables under consideration lies within bounded confidence or not.

Since $|x_{artisan}(t) - x_{artisan}(t)| < 0.5$

Now cardinality of $I[artisan, x_{artisan}(t)] = n[I(artisan, x_{artisan}(t)]=1$

The key findings of our mathematical model are as follows:

Reliability Percentage of our model showed a clear contrast in trust levels for statements based on where they came from. Specifically, content from acknowledged rural artisans scored a Reliability Percentage of 66.66%. Conversely, posts from unidentified sources received a lower reliability rate of 33.33%, according to feedback from urban customers during order processing. This difference highlights how perceived credibility greatly influences consumer trust and participation in online markets.

5.5 Conclusion

This chapter has meticulously explored the intricate role of opinion dynamics within the land of a community-driven e-commerce platform, specifically focusing on its impact on rural artisans and their marketplace. Through a detailed analysis of the characteristics, influencing factors, and overall impact of opinion dynamics on rural e-commerce settings, this research has found the thoughtful effect that opinions and user-generated content have on consumer behavior and decision-making processes. The study on opinion dynamics in rural settings revealed how rural e-commerce platforms could control the power of user opinions to cultivate trust, credibility, and

community engagement. By implementing a model of opinion formation and representation, the NCoRe platform demonstrates a significant move towards understanding and manipulating the variation of urban consumer behavior.

Furthermore, the validation and evaluation of the proposed mathematical model for opinion dynamics have underscored the utility of such frameworks in predicting and enhancing user interaction within e-commerce platforms. The ability to calculate reliability percentages and analyze results provides a valuable tool for platform administrators to customize their strategies for order execution.

Chapter 6

Blockchain-Enabled Community-Driven Rural E-Commerce Platform: An Innovative Implementation Approach for Digitization of Assets

6.1 Introduction to Blockchain Technology

6.1.1 Blockchain and its Fundamental Concepts

Blockchain technology represents a distributed and decentralized ledger system that documents the origins of digital assets. This framework allows for a secure and transparent method of handling data across a network of computers, facilitating the alteration or tampering of historical data only through consensus within the network (Gaurav, 2020). It ensures security, privacy, and trust, and its layers play a significant role in its architecture (Gupta, 2020). The technology has evolved from Bitcoin to Ethereum and smart contracts and is now addressing challenges in scalability, interoperability, sustainability, and governance (Padmavathi, 2021). Its fundamental concepts, including data transparency, integrity, and decentralization, have made it a powerful tool for instilling computational trust in society (Gupta, 2021).

Here are the fundamental concepts that underlie blockchain technology:

- Blockchain Architecture

Originally known for powering cryptocurrencies like Bitcoin, blockchain technology has now become a versatile and transformative tool, extending its applications well beyond the confines of digital currencies. Central to its operation, blockchain serves as a decentralized, unchangeable, and transparent digital record, guaranteeing that transactions or data are documented securely and resistant to tampering.

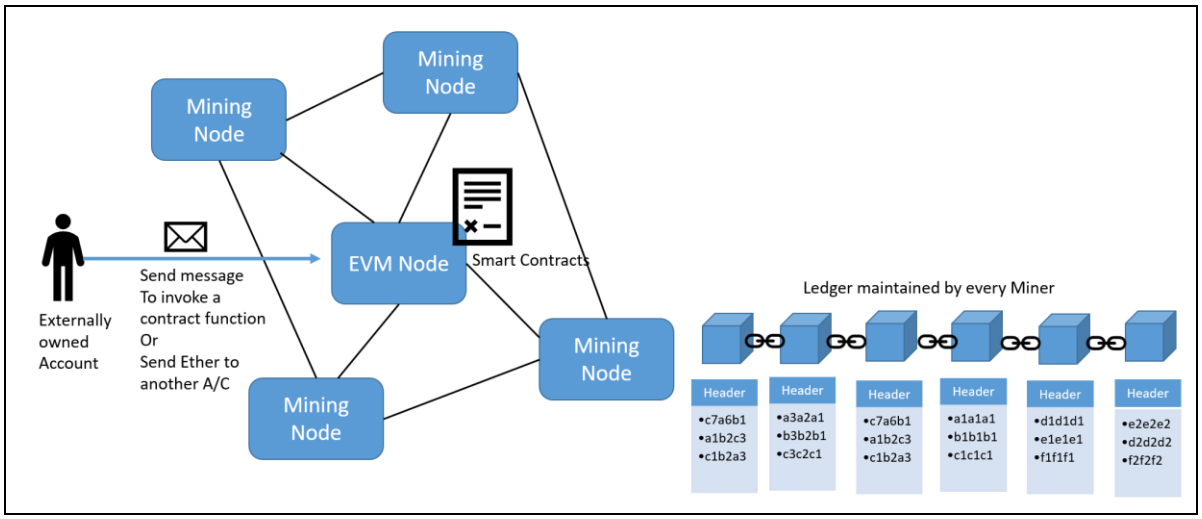


Figure 6.1. Blockchain Architecture

Blockchain technology is built on a series of interconnected blocks, with each block housing a compilation of transactions or data entries. These blocks are interconnected through cryptographic hashes, establishing a time-sequenced and immutable sequence of information. A central attribute of blockchain is its distributed structure, wherein a network of participants, referred to as nodes, are responsible for upholding and verifying the network's authenticity.

Blockchain technology is classified into two primary categories: private, also known as permissioned blockchains, and public, known as permissionless blockchains.

- *Private Blockchain:* Private blockchains operate within closed networks, where a central authority or a collective of verified organizations govern access and participation. These blockchains are distinguished by their known participant identities, with designated permissions for engaging with the network. They are particularly favoured in corporate contexts, emphasizing data confidentiality, system scalability, and adherence to legal standards. The governance of private blockchains often employs consensus protocols such as Proof of Authority (PoA) and Practical Byzantine Fault Tolerance (PBFT), which restrict block validation and addition to approved members, enhancing trust and security within the network.
- *Public Blockchain:* Public blockchains are open, decentralized platforms that allow unrestricted access without the need for permissions or centralized governance. Networks like Ethereum and Bitcoin exemplify this model, leveraging a vast array of global nodes to safeguard network integrity. They utilize consensus algorithms such as Proof of Work (PoW) and Proof of Stake (PoS) to ensure network security and transaction validity. PoW involves

network participants, or miners, solving intricate computational puzzles to add new blocks, whereas PoS enables block validation by users based on their token holdings or stakes. Both public and private blockchains present distinct benefits tailored to various applications. Private blockchains are typically chosen for environments requiring secure, trusted participant interactions, while public blockchains are ideal for scenarios demanding transparent access, decentralized control, and collective governance. In the context of improving the supply chain for rural Kantha artisans through blockchain, choosing between private and public blockchains depends on the particular requirements for privacy, scalability, and the level of decentralization desired in the supply chain structure.

- Smart-Contracts

Smart contracts are automated agreements encoded directly into software designed to autonomously execute agreed-upon actions when certain conditions are met, thus bypassing the need for intermediaries. This innovation fosters increased trustworthiness and transparency across a multitude of uses. Solidity, the preferred programming language for crafting the logic and functionality of smart contracts, plays a pivotal role within the Ethereum blockchain network.

This language is equipped with capabilities for managing data structures, controlling execution flow, and supporting inheritance, enabling the development of intricate and decentralized platforms. Solidity's comprehensive security architecture empowers developers to construct stable and secure smart contracts. Thanks to its broad acceptance and rich ecosystem of development tools, Solidity has emerged as a foundational element in the decentralized applications (dApps) landscape, facilitating the creation of decentralized finance (DeFi) solutions, standards for non-fungible tokens (NFTs), and a variety of other blockchain-driven innovations.

- InterPlanetary File System (IPFS)

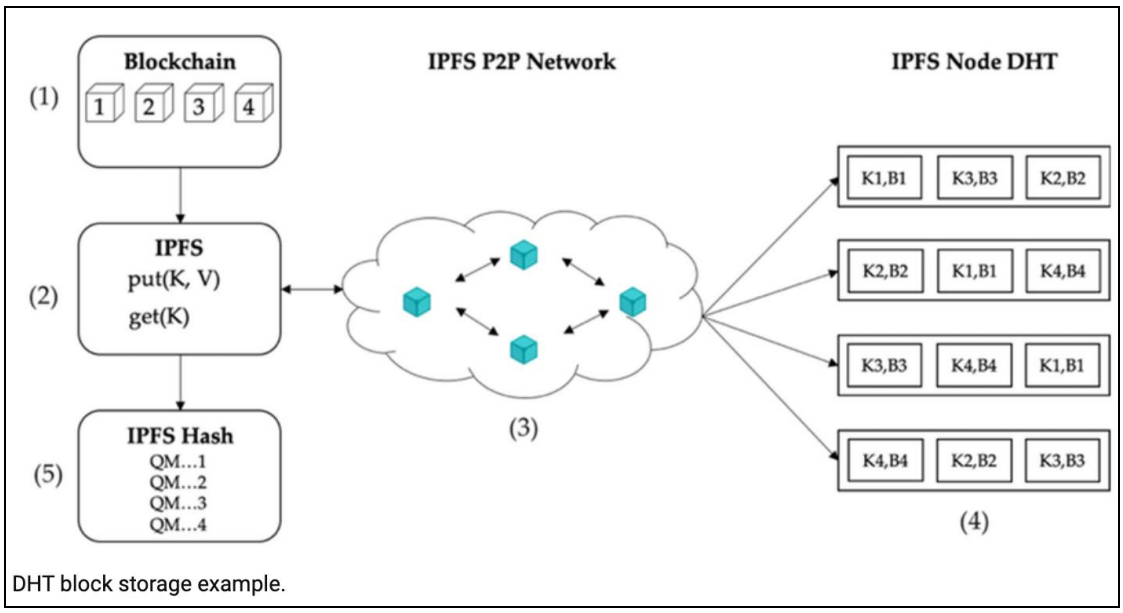


Figure 6.2. IPFS Architecture

The InterPlanetary File System (IPFS) revolutionizes data storage and access on the internet through a decentralized and distributed approach. Moving away from the centralized server-based model of traditional file systems, IPFS adopts a peer-to-peer network structure. This design allows for data to be stored and accessed from numerous points within the network, enhancing redundancy and resilience. IPFS's foundation is content-addressable storage, which assigns a unique hash to data based on its content, serving as a direct address for data retrieval. This method not only facilitates efficient data access but also guarantees the integrity of the data. Since any alteration in the content generates a new hash, the originality and immutability of the data are preserved, ensuring that the content remains unchanged over time.

IPFS leverages a Distributed Hash Table (DHT) to establish a comprehensive index of content addresses across its network, facilitating content discovery without the dependency on a centralized server. When a file is requested, the IPFS client employs the DHT to identify and locate the nodes that house the desired content. Given the decentralized nature of IPFS, these nodes can be distributed across various geographical locations, ensuring that the file is accessible from multiple points within the network. This system enhances the efficiency and reliability of file retrieval, embodying the decentralized ethos of IPFS by empowering nodes to share and access data directly.

IPFS employs a distributed hash table (DHT) to index content addresses across the network, enabling nodes to locate files without central oversight. When a user requests a file, the IPFS client leverages the DHT to identify nodes that hold the requested content, which may be distributed across diverse locations, ensuring the file's availability.

In Figure 6.2, the demonstration of key-value pairs (k,v) outlines how data is cataloged within the IPFS network. Through the "put(k,v)" function, input data is subjected to a content-addressing procedure, culminating in the creation of a distinctive IPFS hash (for instance, "QM...1"), which becomes the data's unique identifier. Here, 'k' signifies the hash derived from the input data, while 'v' represents the data itself. They are executing the "put(k, v)" operation that stores 'v' within the IPFS network, allowing for its retrieval by using the hash 'k'. This method ensures that data is stored efficiently and can be accessed securely and reliably on the IPFS network.

In the system's operations:

- **put(k,v):** This function adds data to the IPFS network by generating a unique IPFS hash from the data's content, acting as the identifier for future retrievals. Here, 'k' represents the data's hash, and 'v' is the data itself, enabling storage and subsequent access through the hash 'k'.
- **get(k):** A function enabling the retrieval of data from the IPFS network using the hash 'k', ensuring users can access the data associated with that hash.
- **IPFS node DHT storage (e.g., (K1, B1), (K2, B2)...):** Each node in the IPFS network maintains a segment of the Distributed Hash Table (DHT), a decentralized database spread across the network's nodes. The DHT stores pairs of hashes and data blocks (e.g., 'K1' with 'B1', 'K2' with 'B2'), facilitating efficient data lookup and retrieval.
- **IPFS hash (e.g., QM...1):** Represents a specific hash in IPFS, utilizing content-addressing to enable file retrieval based on content rather than location, with each hash uniquely identifying the content of a file stored within the network.

6.1.2 Applying Blockchain to Rural E-Commerce Platforms

The application of blockchain in rural e-commerce platforms has the potential to address various challenges, including fraud, lack of transparency, and data security (Jiang, 2021; Taherdoost, 2023; S., 2022). By providing a secure and transparent platform, blockchain can enhance trust and efficiency in transactions, particularly in the agro sector (Murugesan, 2021). The use of

blockchain can also enable the development of an autonomous transaction model, further enhancing the security and privacy of user data (S., 2022). These findings suggest that the integration of blockchain in rural e-commerce platforms can significantly improve their functionality and reliability.

Apart from that, blockchain technology in rural e-commerce platforms offers a transformative approach to overcoming various challenges faced by rural artisans in less developed areas, such as limited market access, difficulty in proving product authenticity, and inefficient payment systems. By leveraging blockchain's unique capabilities, these platforms can enhance transparency, trust, efficiency, and security in transactions, significantly transforming the trade of goods and services. This technology not only facilitates a transparent, secure, and efficient marketplace but also addresses critical issues such as supply chain transparency, payment security, product authenticity, and financial inclusion. The detailed exploration of blockchain's benefits for rural e-commerce platforms, grounded in foundational works and research, underscores its potential to revolutionize how goods and services are traded in these regions, creating a more accessible and reliable marketplace for artisans.

Here's a detailed exploration of how blockchain can benefit rural e-commerce platforms, supported by references to foundational works and research in the field:

- **Enhances Product Traceability**: Blockchain can provide a transparent supply chain, allowing consumers to trace the origin and authenticity of artisan products, thus adding value to the craftsmanship (Jiang, 2021; Taherdoost, 2023; S., 2022).
- **Facilitates Payments**: Through cryptocurrencies or tokenized assets, blockchain enables faster, cheaper, and more secure transactions, removing barriers associated with traditional banking systems (Murugesan, 2021).
- **Ensures Fair Trade**: By providing a transparent record of transactions, blockchain can help ensure that artisans receive fair compensation for their work, fostering sustainable business practices (Jiang, 2021).

Blockchain technology holds the potential to transform the rural e-commerce landscape by addressing fundamental challenges and enabling artisans to connect directly with consumers and markets, thereby unlocking new opportunities for growth and development.

6.2 Blockchain Paradigm in Crafts Supply Chain for Rural Artisans

6.2.1 Challenges, Obstacles, and Potential Uses of Blockchain Technology

Blockchain is defined as an electronic, decentralized, and distributed ledger technology that ensures transactions are recorded in detail and added in sequence, creating permanent and tamper-proof records (Treiblmaier, 2018). Decentralization means that there's no single authority overseeing the processing of transactions, and a distributed ledger is a database managed by multiple parties without a central control point (Hyperledger, 2018). In the blockchain system, data related to transactions is gathered into blocks and arranged in time order to form a continuous link (Menon & Jain, 2021), which is then shared among all participants. Through the use of a clear consensus method, blockchain verifies and executes only legitimate transactions (Bocek & Stiller, 2017). Additionally, blockchain technology allows for the automation of the management of exchanges between organizations (Petersen, 2022). The adoption of blockchain technology offers significant advantages for enterprises, such as the capability for instant, live processing and validation of transactions via a decentralized ledger, thereby obviating the necessity for a centralized supervisory entity (Glaser, 2017). Notably, the transaction information of one party is accessible to all, acting as a deterrent to fraud (Naef et al., 2022; Tapscott & Tapscott, 2017). By diminishing the need for intermediaries and transitioning physical processes to digital formats, blockchain technology boosts the efficiency of assorted operations and proves to be cost-effective (Cole et al., 2019; Nandi et al., 2020).

In the realm of supply chains, the need for trust between suppliers and buyers, stemming from differing goals and objectives, is a significant issue (Nyaga et al., 2010). By incorporating blockchain technology, there's a unique opportunity to thoroughly record data, addressing transparency issues and establishing accountability among the entities in the supply chain. This approach significantly enhances trust among supply chain members, effectively reducing the negative effects of conflicting goals (Pournader et al., 2020). Thus, blockchain emerges as a crucial element in creating a transparent business environment free of intermediaries, fostering trust through the combined use of digitization, cryptocurrencies, and smart contracts. Additionally, the application of blockchain-powered smart contracts enables the verification of agreement data, automatically triggering payments. This innovative feature streamlines transaction processes, ensuring prompt payment to suppliers (Kayikci et al., 2020). Beyond simple financial transactions, blockchain also supports a variety of operations, such as the

issuance of goods, creation of invoices, and confirmation of pickups, all conducted effortlessly without the necessity for manual checks.

Although managers recognize the potential benefits of blockchain, a considerable number are reluctant to invest in the technology, primarily due to uncertainties regarding the specific benefits it promises (Hald & Kinra, 2019). Despite widespread acclaim for its advantages, blockchain's adoption is hindered by several obstacles, including high costs of implementation, concerns over privacy, and a need for more technical know-how (Kamble et al., 2019). Additionally, academic research on the practical applications of blockchain and its effects in real-world scenarios is limited (Queiroz et al., 2019), leading to a gap in understanding its impact on business outcomes (Treiblmaier, 2018). Therefore, there is an urgent need for more research focused on exploring and developing concrete solutions (Wang, Singgih et al., 2019).

6.2.2 Digital Supply Chain Management: Enhancing Business Value

Supply Chain Management (SCM) and its strategic implementation play a critical role in the success of manufacturing entities, as there's a direct link between the cost and quality of purchased goods and services and those being sold (Koh, Demirbag, Bayraktar, Tatoglu, & Zaim, 2007). SCM affects key competitive elements like product availability, the timeline from order to delivery, costs, and support services (Tan, K.C., 2001; Omar, I. et al., 2022). The Global Supply Chain Forum delineates the supply chain as an integration of essential business operations that span from end consumers to the original providers, facilitating the delivery of products, services, and information that increase value for customers and other interested parties (Lambert & Cooper, 2000). These operations aim at integrating business activities from the final users back to the initial suppliers, ensuring the provision of products, services, and information that boost value for consumers (Burt, Petcavage, & Pinkerton, 2012; Mangan, Lalwani, Butcher, & Javadpour, 2012; Trott, 2012:412).

A research conducted by Beheshti, Hultman, Jung, Opoku, and Salehi-Sangari (2007) investigated how small businesses leverage the Internet for Supply Chain Management, finding a significant use of the Internet for procurement purposes, with customer service and order processing also being notable areas of application. The Internet is identified as a cost-effective means for executing business activities (De Klerk & Kroon, 2005), providing a wide range of benefits including email for communication, customer engagement, online presentation of company and product information, access to product and component data, search for new

vendors, evaluation of current suppliers, dissemination of information to suppliers, gathering of competitive insights, and facilitation of online transactions (Cloete, Courtney & Fintz, 2002; Osmonbekov, Bello, & Gilliland, 2002). It also allows suppliers to digitally share their product details, helping businesses efficiently manage orders, improve product delivery, and enhance service quality (Gilmore, Gallagher, & Henry, 2007). The Internet has become an essential medium for artisans (United Nations Educational, Scientific and Cultural Organisation, 1997), providing benefits to those artisans who are prepared and able to integrate it into their marketing and operational activities (Batchelor & Webb, 2002).

6.2.3 Utilizing Blockchain Technology to Enhance Traceability in Handcrafted Products

Blockchain technology has emerged as a transformative force for supply chains in diverse sectors. According to Narayanan et al. (2018), blockchain's ability to create an unchangeable and visible ledger of transactions enhances data accuracy and diminishes fraud risks. This feature is particularly appealing for areas requiring high levels of traceability and authenticity, like rural handicraft production. Handicrafts from rural areas frequently need help with traceability, ethical sourcing, and genuine craftsmanship. Kshetri (2018) points out the importance of verifying material origins and artisanal methods to preserve the intrinsic value and cultural significance of these items. Blockchain's secure and immutable ledger could overcome these obstacles by documenting a verifiable history of the product's journey from creation to end-user.

The clarity blockchain brings could significantly boost consumer trust in the genuineness and quality of rural handicrafts. Kuno (2018) argues that modern consumers demand transparency in supply chains, seeking details about the sources, manufacturing processes, and ethical standards. Blockchain technology can meet this demand by offering a blockchain-based ledger that is both accessible and authenticable, thus enhancing the relationship between artisans and buyers and aiding in the preservation of rural handicraft sectors.

Furthermore, blockchain's capability for executing smart contracts offers prospects for ensuring equitable pay and empowering rural artisans. Böhme et al. (2015) describe how smart contracts could guarantee artisans are compensated fairly when certain agreed-upon conditions are fulfilled, minimizing dependence on intermediaries and encouraging ethical trading practices. This feature is particularly relevant to achieving the socio-economic objectives associated with the production of rural handicrafts.

6.3 Blockchain-based Traceability Framework in Community-Driven E-Commerce Platform

The Blockchain-based traceability framework includes the following functionalities ;

1. *Establishing Distinct Digital Profiles for Artisans and their items on the Blockchain*
2. *Enrolling Authenticated Artisans into the Blockchain Ecosystem*
3. *Cataloging Artisans Authentic Products within the Blockchain Framework*
4. *Linking Potential Buyers with Sellers via an Online Marketplace*
5. *Allowing Potential Buyers to Confirm Product Authenticity*
6. *Facilitating the Sale of Goods with Secure Transfer of Funds and Ownership*

6.3.1 Establishing Distinct Digital Profiles for Artisans and their items on the Blockchain

The envisioned traceability framework will leverage a specific kind of Non-fungible token (NFT) designed atop a blockchain network. NFTs authenticate the ownership of distinctive digital assets within the blockchain. They are particularly suited for the trading of digital items like artwork, ensuring the authenticity and originality of these assets.

NFTs are created on decentralized networks like Ethereum through tokenization, a process that entails the development of a smart contract encapsulating the digital asset's distinct characteristics. This contract issues a token representing the digital item on the blockchain. Every NFT transaction, whether it's its minting, transfer of ownership, or sale, is documented on the blockchain, ensuring a transparent and immutable record of its history. Tracking NFT transactions enables stakeholders to verify the asset's integrity, confirming its uniqueness and authenticating its provenance. This proves especially valuable in the crafts supply chain, where the transaction history of an NFT can provide a detailed account of a product's journey from its creation by artisans to its final sale and ownership changes.

The Ethereum Foundation has introduced two widely recognized NFT standards: ERC-721 and ERC-1155. For our specific aim of enhancing supply chain traceability in handicrafts, we suggest adopting the ERC-1155 standard. Contrary to ERC-721, which delineates each token as unique, ERC-1155 facilitates the creation of various token types under a single contract, each distinguished by unique characteristics. This multi-functionality allows for the efficient management of diverse crafts by a single artisan, such as different types of Kantha embroidered

items, within one smart contract. The ERC-1155 standard's ability to manage multiple token types in one contract simplifies the system, lowers transaction fees, and reduces complexity. Moreover, its capacity for batch transfers streamlines operations for multiple crafts, enhancing efficiency in managing diverse artisan products.

- *Factory Child Pattern for NFT-based smart contract development*

The Factory-Child pattern, or the Factory pattern with child contracts, stands as a prevalent architectural design in the development of smart contracts. It facilitates the dynamic generation and deployment of child contracts from a master template, known as the factory contract. This method is particularly advantageous for deploying distinct ERC-1155 contracts for various artisans within the crafts supply chain, offering an effective and scalable framework. The core of this pattern is the factory contract, which outlines the structural and operational blueprint for the child contracts. Upon the need for a new ERC-1155 contract for a given artisan, the factory contract is invoked to create a child contract tailored to the specific requirements or conditions. This approach allows for each artisan to possess a bespoke ERC-1155 contract that accurately represents their unique creations and transactions. Key functionalities of the factory contract include initializing and customizing the child contracts as they are deployed. This could involve inputting the artisan's information, establishing supply chain protocols, or incorporating any particular customizations needed for each contract. Moreover, the factory contract maintains a registry of all the child contracts it has deployed, serving as a centralized directory for easy access and management of each artisan's specific ERC-1155 contracts. This centralized system not only simplifies the management of multiple contracts but also enhances the overall efficiency and scalability of the deployment process, making it an ideal solution for managing diverse artisanal products in a blockchain-based supply chain.

An example Factory-Child pattern contract in solidity is as follows:

```
contract Factory {
	Child[] children;
	function createChild(uint data){
		Child child = new Child(data);
		children.push(child);
	}
}
contract Child{
	uint data;
	constructor(uint _data){
	data = _data;
	}
}
```

In this setup, the deployment of numerous child contracts is facilitated through the createChild method within the factory contract. Moreover, an array named children is utilized to maintain a comprehensive list of all deployed contracts. This methodology allows for effective monitoring, administration, and personalization of contracts tailored to the needs of each artisan, thereby guaranteeing precise documentation of every artisan's products, transactions, and supply chain engagements. This structured approach not only streamlines the process of tracking and managing individual contracts but also ensures that each artisan's unique requirements and product specifics are accurately reflected and preserved within the blockchain. The ability to customize and update contracts through the factory contract adds a layer of flexibility and scalability, making it an optimal solution for dynamic and evolving supply chains in the artisan sector.

6.3.2 Enrolling Authenticated Artisans into the Blockchain Ecosystem

The artisan registration procedure marks the initial phase in deploying a blockchain-facilitated supply chain for crafts. Its objective is to authenticate and confirm the identities of artisans, ensuring their legitimacy and establishing a basis for precise record-keeping. The process commences with artisans presenting their officially issued artisan cards for validation. This card encompasses essential details like the artisan's Name, Contact Number, Address, Birth Date, Artisan Identification Number, and a photo for visual recognition. Upon submission of the artisan card and associated information, it is securely saved in a centralized backend database. This acts as an exhaustive repository for all artisan registration entries, facilitating efficient data management and retrieval.

The registration begins as unapproved, indicating that the application awaits evaluation. The following verification phase is vital, where designated officials conduct thorough investigations to confirm the validity and precision of the information provided by the artisan. This process includes cross-referencing the submitted data with government-issued identification documents and executing background investigations, with the artisan card's photo serving a key role in verifying the artisan's identity. Once the verification is completed, the artisan's registration status is updated to approved, signifying their qualification to participate in the supply chain. At this juncture, the factory contract is initiated to generate an ERC-1155 contract tailored for the authenticated artisan.

Upon registration, artisans' key details, such as name and address, are integrated into the ERC-1155 contract, offering them a personalized and secure presence on the blockchain. This ensures traceability and security for their transactions and crafts. The ERC-1155 contract acts as a digital ledger for the artisan's products, facilitating transparent transactions and maintaining an immutable record of their craftsmanship. This entire registration mechanism is incorporated within the blockchain infrastructure, negating the reliance on external systems or platforms. A visual depiction of the artisan registration process can be seen in Figure 6.3, illustrating the streamlined procedure from initial submission to the deployment of individualized ERC-1155 contracts on the blockchain.

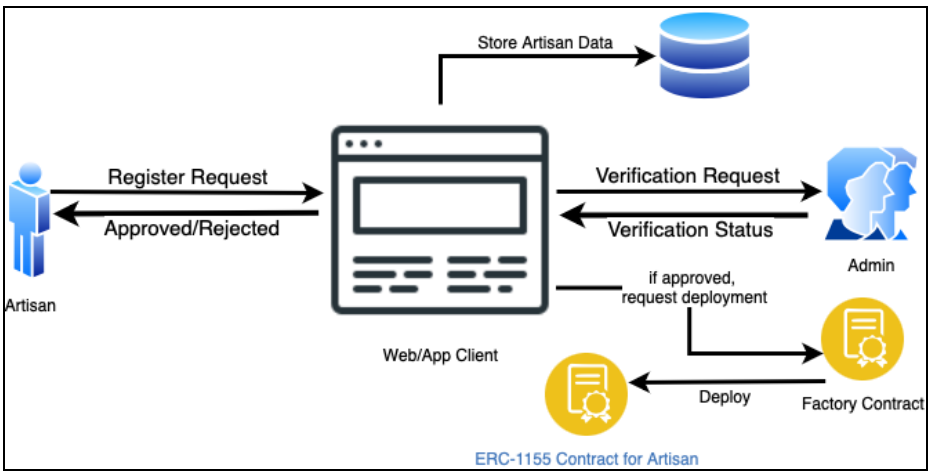


Figure 6.3. Artisan Registration

For efficient management and easy access, the contract address alongside the artisan's account address is documented and conserved within the centralized backend system. This setup facilitates the straightforward retrieval and reference of artisan-centric contracts and accounts pertinent to supply chain operations. Through this thorough and precise registration procedure, the study constructs a solid foundation for authenticating artisans' genuineness and rolling out specialized ERC-1155 contracts tailored for them. This structure ensures that every artisan's digital presence and transactions within the blockchain-enabled crafts supply chain are securely managed and easily traceable, thereby promoting transparency, authenticity, and efficiency in the artisanal marketplace.

6.3.3 Cataloging Artisan's Authentic Products within the Blockchain Framework

The process of registering products is a vital aspect of the blockchain-enhanced crafts supply chain, facilitating the secure and transparent administration of genuine artisanal items. Following their registration and approval, artisans are entitled to submit a request for product creation. This request encompasses detailed information essential for the verification of authenticity, including receipts for the purchase of threads, cotton, and other materials used in the crafting process. The artisan is required to submit images of these receipts, which are then securely uploaded to a cloud server for subsequent analysis. Importantly, the blockchain does not directly interact with the cloud server; instead, it records the file's cloud server location. This record allows both our application and third-party applications to retrieve and view the file locations as needed.

Concurrently, comprehensive details about the product, such as its description, images, the artisan's name, and the creation date, are cataloged in a specialized database. This repository of information is instrumental in the thorough management and traceability of products across the supply chain. By implementing this procedure, the system ensures that all registered artisan products are managed securely and transparently, bolstering confidence in the authenticity and origin of each item throughout its journey in the supply chain.

The subsequent phase involves a meticulous verification of the submitted bills and product details, a critical juncture for ensuring trust within the supply chain. This verification, carried out manually by an appointed administrator, entails a detailed comparison of the bills against the listed product details alongside comprehensive checks to affirm the validity of the purchases. This step is fundamental in maintaining the supply chain's transparency and integrity, thereby instilling confidence among consumers and other stakeholders.

After the verification is completed, unique Non-Fungible Token (NFT) metadata is created for the associated ERC-1155 contract tied to the artisan. This metadata includes critical information like authenticated images of the purchase bill, product images, a detailed product description, the artisan's name, the date of creation, and other relevant details. Generating metadata for individual products, such as Kantha crafts, plays a crucial role in the blockchain-augmented crafts supply chain, introducing a level of resilience to data management by removing any single point of failure.

The use of the InterPlanetary File System (IPFS) for uploading the metadata introduces a unique content identifier (CID) link, which serves as a permanent reference for accessing the metadata. The CID, a cryptographic hash, ensures that any alteration to the metadata would result in a new, distinct CID, thereby guaranteeing the metadata's immutability. Once the metadata is uploaded to IPFS, altering it without changing its CID is impossible.

Utilizing the specific content identifier link, the process for creating an NFT is activated via the artisan's dedicated ERC-1155 NFT contract. This essential minting phase definitively associates the metadata with the freshly minted NFT, creating a fixed record that connects the artisan and the authenticated product information to the blockchain token. This smooth fusion of NFTs with the ERC-1155 contract highlights the system's commitment to maintaining the authenticity, uniqueness, and traceability of every product in the craft supply chain, providing a clear and secure framework for all involved parties. The detailed product registration process outlined in this document represents a significant shift towards a model where transparency is paramount, and verifiability forms the foundation. This innovative strategy protects the genuineness of artisanal products and fosters a strong sense of trust among consumers. The integration of cloud server storage, extensive metadata, the secure IPFS protocol, and the flexible ERC-1155 NFT contract places artisans at the cutting edge of the blockchain-enhanced crafts supply chain.

Figure 6.4 presents a graphical illustration of the product registration workflow, augmented by an example of representative code.

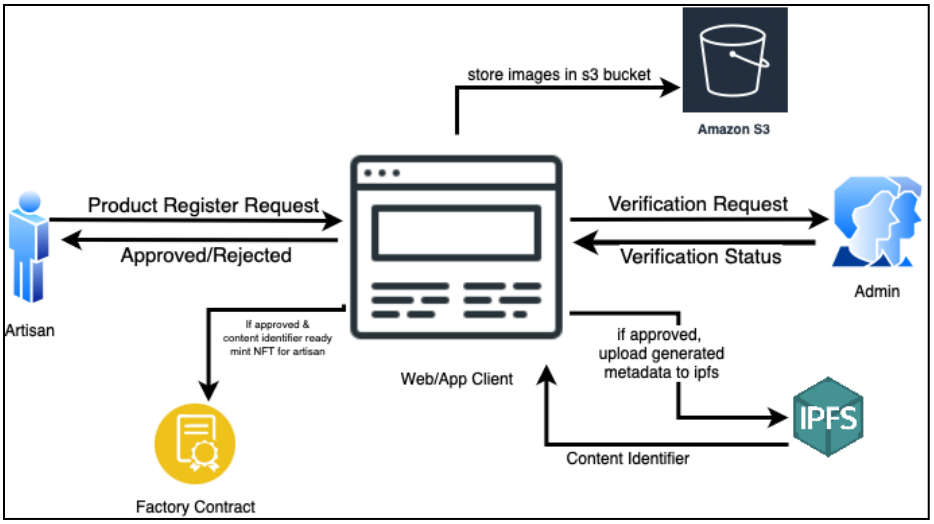


Figure 6.4. Product Registration

```
{
	"description": "Khadi Silk Patchwork Kantha Stitch Table Runner",
	"image": "https://example.com/puffs/3.png",
	"name": "Table Runner",
	"attributes":
	[
		{
			"display_type": "date",
			"trait_type": "creation",
			"value": 1546360800
		},
		{
			"display_type": "image",
			"trait_type": "cotton bill",
			"value": "https://example.com/bills/3.png"
		},
		{
			"display_type": "image",
			"trait_type": "thread bill",
			"value": "https://example.com/bills/4.png"
		}
	 ]
}
```


6.3.4 Linking Potential Buyers with Sellers via an Online Marketplace

Upon the successful creation of the NFT, the product is then listed in the application's internal marketplace. This digital marketplace acts as a conduit for artisans to connect with potential purchasers, showcasing the distinctive items they have for sale. Artisans can utilize this platform to present their crafts, draw in customers, and conduct transactions directly. Furthermore, based on the permissions set by the artisans, their products might also be listed on external applications or platforms, increasing their reach and potential customer base.

To feature a product in the marketplace, artisans utilize their specific ERC-1155 NFT contracts. Through these contracts, artisans create unique NFTs for their products, incorporating crucial metadata such as images of the product, detailed descriptions, and links verifying the purchase of materials. This metadata is then securely stored on the InterPlanetary File System (IPFS), ensuring that it is kept in a decentralized and accessible manner. Prospective buyers navigate the marketplace through an interface that connects with the blockchain, using tools like ethers.js or equivalent libraries. This allows them to browse through the listings, applying filters such as the name of the artisan, type of product, or price range to find what they're looking for. For those

interested in the authenticity of the raw materials used in the products, the associated metadata—including links to the bills—can be reviewed. The content identifier from IPFS acts as a key to accessing these bill images, thereby promoting a transparent verification process for the authenticity of the materials used.

6.3.5 Allowing Potential Buyers to Confirm Product Authenticity

The application not only showcases products but also incorporates features for user verification and monitoring the invoices of raw materials used in the creation of products. This transparency enables consumers and other interested parties to verify the legitimacy of materials, thus enhancing trust throughout the supply chain.

Within the app's interface, users can view the Non-Fungible Token (NFT) metadata associated with each product. This metadata contains links to the invoices of raw materials, simplifying the process of authenticating the materials' origins. By clicking on these links, users can examine the purchase records to confirm that the raw materials align with what the artisan has stated. This process supports ethical trade practices by equipping consumers with the necessary information to make purchases that are informed by the traceability of material sources. Furthermore, it encourages artisans to maintain transparency regarding their use of materials, advocating for ethical sourcing and enhancing support for sustainable practices.

6.3.6 Facilitating the Sale of Goods with Secure Transfer of Funds and Ownership

Initiating a purchase within the e-marketplace triggers a detailed technical procedure designed to ensure a smooth and secure transaction. The platform's user interface works in tandem with blockchain-based smart contracts, offering a streamlined and safe purchasing experience. For those preferring fiat currency, the marketplace incorporates a payment gateway that connects with conventional financial systems for effortless fiat transactions.

Here's how the process unfolds:
Product Selection: Buyers use the marketplace interface to explore and choose the product they wish to buy.

- **Cryptocurrency Payment:** For those opting to pay with cryptocurrency, the next step involves connecting their digital wallet to the platform. This action initiates a cryptocurrency transaction facilitated by a smart contract tied to the product's Non-Fungible Token (NFT),

safeguarding the ownership transfer from the artisan to the buyer. The payment typically occurs in a common cryptocurrency like Ethereum (ETH).

- **Fiat Payment Option:** Buyers preferring fiat currency are directed to use a dedicated payment gateway. This gateway interfaces with traditional banking and payment systems, allowing transactions with fiat currencies via bank transfers or credit cards. After selecting the fiat option and providing payment details, the transaction is securely processed through the payment gateway, which then confirms the payment with the marketplace's backend.
- **Completion and Ownership Transfer:** Upon successful payment—be it via cryptocurrency or fiat—the smart contract updates the NFT's ownership details to reflect the buyer's wallet address. This NFT serves as proof of ownership and authenticity for the purchased item. The blockchain records this ownership change, ensuring the transaction is immutable and transparent.

This entire mechanism leverages the power of smart contracts for ownership transfer, while the integration of blockchain technology guarantees that the transaction process is transparent, immutable, and secure.

6.4 Development and Testing of Prototype Environment

Blockchain-oriented testing frameworks and environments are essential in validating the durability and security of smart contracts, and decentralized applications (dApps) intended for Ethereum and other EVM-compatible platforms. These resources allow developers to rigorously test their code under various conditions prior to its live deployment on the Ethereum network. Such initial testing phases are critical for detecting and addressing potential vulnerabilities, guaranteeing that the applications function securely and as expected in the production environment. Conducting tests in a controlled environment aids in identifying and fixing any flaws or security weaknesses, thus enhancing the applications' reliability and protecting them from potential risks. Through meticulous testing, developers can ensure their applications not only meet expected standards but are also resilient against attacks, contributing to the overall stability and trustworthiness of the blockchain ecosystem.

6.4.1 Traceability of Handicraft Products by Creating Unique Digital Identities for Artisans and their Products

- Local Ethereum Virtual Machine (EVM)

Local Ethereum Virtual Machine (EVM) platforms, like Ganache, provide developers with an efficient and economical approach to creating a private Ethereum blockchain on their own devices. Ganache enables the emulation of various network conditions, such as transactions, the deployment of contracts, and interactions with smart contracts, in a safe and separate environment. This capability is especially beneficial for developers, as it speeds up the development and testing stages of smart contracts by avoiding the gas fees usually incurred on the main Ethereum network. With Ganache, developers can conduct exhaustive tests on their applications to ensure they operate correctly and reliably before launching them on the actual blockchain, thus optimizing the development workflow and minimizing expenses.

- Testing Frameworks

In the realm of Ethereum development and testing, industry-standard frameworks like Hardhat and Truffle play pivotal roles. Hardhat, highlighted in this discussion, offers a comprehensive development environment equipped with an internal EVM for executing and examining smart contracts. It integrates with widely used testing libraries such as Mocha, enabling developers to craft detailed test suites for their smart contracts. Hardhat's additional functionalities, including console logging, deployable scripts, and native smart contract development support, render it a preferred tool among Ethereum developers.

Conversely, Truffle serves as an essential development framework that eases the compilation, deployment, and testing phases of smart contract development. It incorporates testing tools like Chai and Chai-as-Promised to create tests that are both clear and expressive. Truffle further simplifies contract deployment and interaction across various Ethereum environments, encompassing testnets and the Ethereum Testnets and Dev Wallets.

Ethereum testnets, accessible public testing platforms, mimic the main Ethereum network, offering developers a practical environment for deploying and testing smart contracts. This setup aids in the identification and rectification of issues prior to mainnet deployment. Notable testnets include Ropsten, Kovan, and Rinkeby.

For seamless testnet interactions and testing, developers leverage Dev wallets such as MetaMask. This browser extension facilitates the connection between decentralized applications (dApps) and Ethereum networks, supporting account management, network switching, and testnet transactions without real Ether, thus creating a safe testing environment.

Developers also utilize faucets within testnets to obtain test tokens, which are essential for simulating transactions and smart contract interactions without expending real Ether.

Together, these blockchain-oriented testing tools and environments, encompassing local EVM configurations, Hardhat and Truffle frameworks, Ethereum test networks, development wallets such as MetaMask, and faucet systems, furnish developers with the necessary utilities to craft, evaluate, and polish secure and effective smart contracts and decentralized applications for the Ethereum blockchain.

- REMIX for Rapid Prototyping

Remix stands out as a critical component in the Ethereum ecosystem, functioning as a web-based Integrated Development Environment (IDE) designed specifically for the crafting and testing of smart contracts. Developed by the Ethereum Foundation, Remix provides an intuitive interface enabling developers to seamlessly write, compile, deploy, and engage with smart contracts right from their web browsers.

One of the standout features of Remix is its remarkable accessibility. As an online IDE, it requires no software downloads or installations, enabling developers to access it via a web browser. This feature makes Remix platform-independent and conveniently usable across different operating systems. It incorporates a built-in Solidity compiler, offering seamless smart contract compilation and real-time feedback on compilation errors. This immediate error reporting helps developers quickly identify and fix issues before deploying their contracts.

Remix additionally distinguishes itself by accommodating various versions of Solidity, offering developers the versatility to select the language version most suitable for their project requirements. Moreover, it enables effortless integration with diverse Ethereum networks, permitting developers to conveniently transition between different environments, such as local EVM setups and Ethereum testnets, for testing and debugging objectives.

In addition to its development functionalities, Remix boasts a robust testing environment. Developers can leverage Remix's built-in testing framework to compose and execute unit tests for their smart contracts, providing a convenient means for conducting preliminary assessments prior to advancing to more complex testing frameworks such as Hardhat or Truffle. With these capabilities, Remix positions itself as an essential, adaptable, and all-encompassing tool for the development, testing, and deployment of smart contracts in the Ethereum blockchain ecosystem.

6.4.2 Development of a Prototype Traceability Framework

During the prototype stage, a comprehensive testing procedure was carried out to evaluate the proposed framework's effectiveness and interoperability. The Sepolia Testnet of Ethereum was chosen for this purpose due to its compatibility with Ethereum 2.0 functionalities. The testing encompassed the deployment and examination of smart contracts, interaction with Non-Fungible Tokens (NFTs), and the execution of diverse transactions.

The Solidity contract showcased in Figure 6.5 embodies a modified version of the ERC1155 standard, incorporating additional functionalities specific to our framework's needs. Utilizing Remix, this contract was deployed to the Sepolia Testnet, where it was allocated a distinctive address. This step in the process was crucial for verifying the contract's performance and interoperability within the Ethereum ecosystem, particularly in the context of the upcoming Ethereum 2.0 upgrades. Through this deployment, the team was able to simulate real-world operations and interactions, providing valuable insights into the framework’s practicality and potential for future applications.

```
// SPDX-License-Identifier: MIT
pragma solidity ^0.8.9;

import "./token/ERC1155/ERC1155.sol";
import "./access/AccessControl.sol";

contract Artisan is ERC1155, AccessControl {
    bytes32 public constant MINTER_ROLE = keccak256("MINTER_ROLE");
    mapping(uint256 => string) private uris;
    string public name;

    constructor(string memory _artisanName) ERC1155("ipfs://") {
        _grantRole(DEFAULT_ADMIN_ROLE, msg.sender);
        _grantRole(MINTER_ROLE, msg.sender);
        name = _artisanName;
    }

    function mint(address account, uint256 id, uint256 amount, string memory _uri)
        public
        onlyRole(MINTER_ROLE)
    {
        _mint(account, id, amount, "");
        uris[id] = _uri;
    }

    function mintBatch(address to, uint256[] memory ids, uint256[] memory amounts)
        public
        onlyRole(MINTER_ROLE)
    {
        _mintBatch(to, ids, amounts, "");
    }

    // The following functions are overrides required by Solidity.

    function supportsInterface(bytes4 interfaceId)
        public
        view
        override(ERC1155, AccessControl)
        returns (bool)
    {
        return super.supportsInterface(interfaceId);
    }

    function uri(uint256 tokenId) override public view returns (string memory) {
        return(
            string(abi.encodePacked(
                "ipfs://",
                uris[tokenId],
                "/metadata.json"
            ))
        );
    }
}
```

Figure 6.5. ERC1155 Custom Smart Contract

Subsequently, the contract underwent verification on Etherscan, a widely-used blockchain explorer for Ethereum, to confirm the successful deployment of the contract and the verification of the contract's source code. The Artisan contract enhances the ERC1155 standard token contract by integrating access control features, as detailed further below.

- *MINTER_ROLE:* A constant variable is defined to represent the role necessary for minting new tokens, assigned the *keccak256* hash of the string "MINTER_ROLE."

- *mapping (uint256 => string) private URIs:* A private mapping is utilized to store the Uniform Resource Identifiers (URIs) for each token, where URIs act as descriptors and images for the tokens.
- *constructor():* The constructor initializes the contract by setting the base URI for all tokens to "ipfs://." Additionally, it assigns the DEFAULT_ADMIN_ROLE and MINTER_ROLE to the contract deployer, identified by msg.sender.
- *mint():* A function is implemented to permit users possessing the MINTER_ROLE to mint new tokens and allocate them to a specified address. This function requires parameters for the recipient's address, the token ID, the quantity of the token, and the URI for the token's metadata. Additionally, it updates the URI mapping for the token that has been minted.
- *mintBatch():* A function analogous to *mint(),* designed to enable the minting and assignment of multiple tokens to the same recipient within a single transaction, is provided. This function streamlines the process of issuing various tokens simultaneously, enhancing efficiency.
- *supportsInterface():* An override function is incorporated, as mandated by the ERC1155 and *AccessControl* contracts, to denote the interfaces supported by the contract. This function ensures compatibility and compliance with the standards set forth by these contracts, facilitating interaction and integration within the Ethereum ecosystem.
- *URI ():* An override function is essential as per the ERC1155 standard, designed to furnish the URI for a particular token. This function is responsible for delivering the complete URI path necessary to access a given token's metadata, formulated by utilizing the stored URIs associated with the respective token ID.

This customized ERC1155 contract, “Artisan,” allows minting and managing NFTs representing the handicraft products, each with its own unique metadata accessible through IPFS-based URIs. Additionally, the contract implements access control, ensuring that only authorized accounts with the MINTER_ROLE can create new tokens, providing robust security and governance features for the framework.

Upon deployment on the Ethereum blockchain, the transaction associated with the contract's

deployment is recorded and made publicly accessible through Etherscan. This platform provides transparency, allowing anyone to inspect transaction specifics, contract addresses, and other vital data pertinent to the Ethereum network. The visibility of these deployment transactions on etherscan (as shown in Figure 6.6) is a testament to the blockchain's transparency and verifiability, offering users and stakeholders the ability to track and validate the deployment and operational integrity of the smart contract within the ecosystem. This level of transparency is crucial for building trust and ensuring the authenticity and reliability of the deployed contracts and the NFTs they represent.

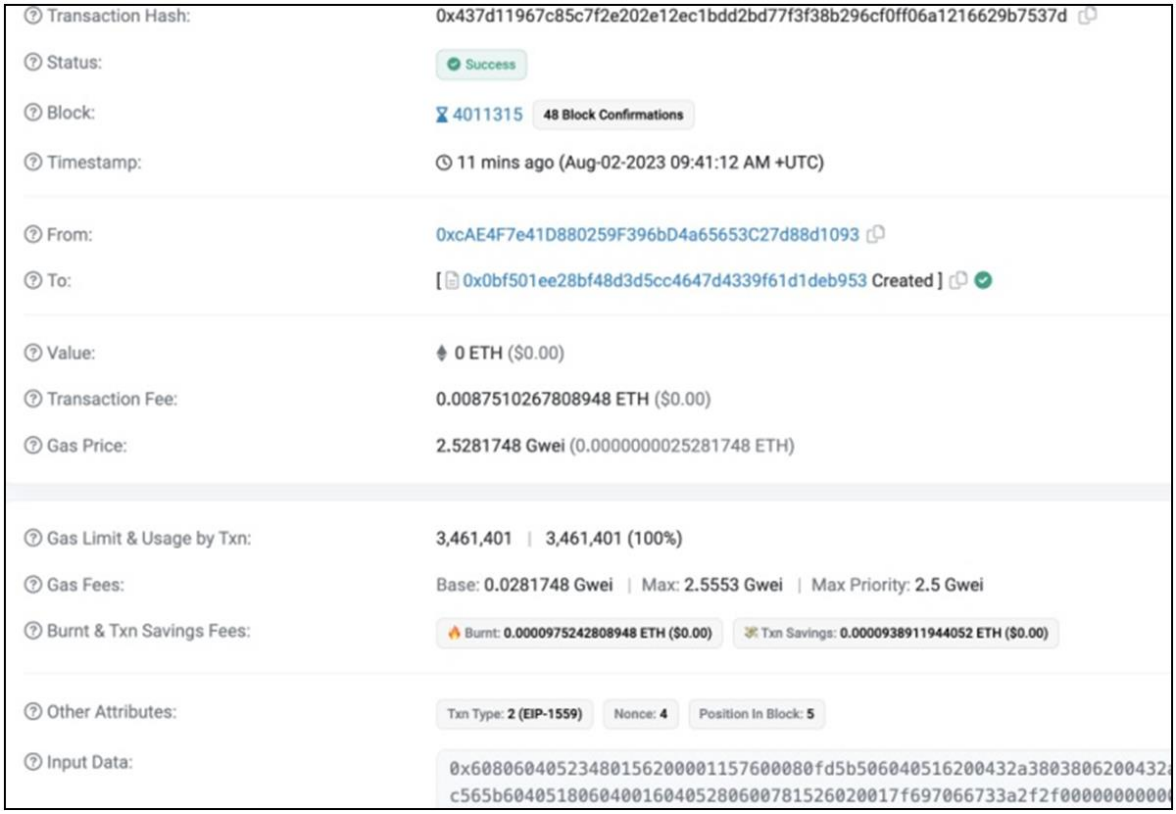


Figure 6.6 Deployment Transaction in Testnet

When a smart contract is deployed on the Ethereum blockchain, several key details are recorded and can be viewed on platforms like etherscan. These details provide transparency and traceability for transactions within the Ethereum ecosystem:

- **Transaction Hash**: A unique identifier for the deployment transaction. It is a long alphanumeric string and serves as a reference for accessing the transaction details on etherscan.

- **Block Number:** The block number in which the deployment transaction was included. This indicates the block in which the contract's bytecode and other deployment data were stored.
- **Timestamp:** The date and time when the deployment transaction was confirmed and included in a block on the Ethereum network.
- **From**: The Ethereum address of the sender who initiated the contract deployment transaction. This address corresponds to the wallet used to deploy the contract.
- **To**: The "blank" address. Since the deployment transaction creates a new contract, the "To" address is empty, indicating that the transaction is not directed to an existing address.
- **Value**: The amount of Ether (ETH) sent with the deployment transaction. For contract deployment, this value is typically zero, as the contract's creation does not involve sending Ether directly.
- **Gas Price**: The price of gas paid by the sender for each unit of gas used in the transaction. Gas is the computational resource used to execute the contract code, and its price affects the transaction's speed and priority on the Ethereum network.
- **Gas Limit**: The maximum amount of gas that the sender is willing to consume for the transaction. This limit ensures that the transaction does not run indefinitely and protects the sender from unexpected high gas usage.
- **Input Data**: The hexadecimal data containing the contract's bytecode and any additional parameters provided during the deployment. This data represents the smart contract's source code and is essential for contract creation.
- **Contract Address**: The newly created Ethereum address assigned to the deployed contract. This address is generated based on the transaction sender's address and the nonce of the sender's account.

In the effort to embed blockchain technology into the supply chain for rural Kantha artisans in Birbhum, meticulous metadata was constructed and utilized to create a Non-Fungible Token (NFT) representing a unique Kantha product. This minting process was executed through the use of a mint function within a custom-designed ERC-1155 contract. This action required several

inputs: the address of the recipient (representing the artisan or the current holder of the Kantha piece), a unique token ID for the NFT, the quantity of tokens to be minted (usually one to represent each singular item), and the metadata URI linking to the previously prepared sample metadata.

Following the mint() function's activation, the NFT, emblematic of the Kantha product, was successfully generated on the Ethereum blockchain. This process endowed the NFT with a unique token ID and a specific token address, thereby establishing its unique identity and ensuring its distinction from other tokens within the network.

Illustrated in Figure 6.7, the blockchain minting transaction reveals two key activities: the initial deployment of the contract and the subsequent minting of the NFT. This demonstration not only highlights the technical steps involved in leveraging blockchain for authenticating and representing handicraft products but also underscores the potential of blockchain technology in enhancing transparency, authenticity, and traceability in traditional crafts supply chains.

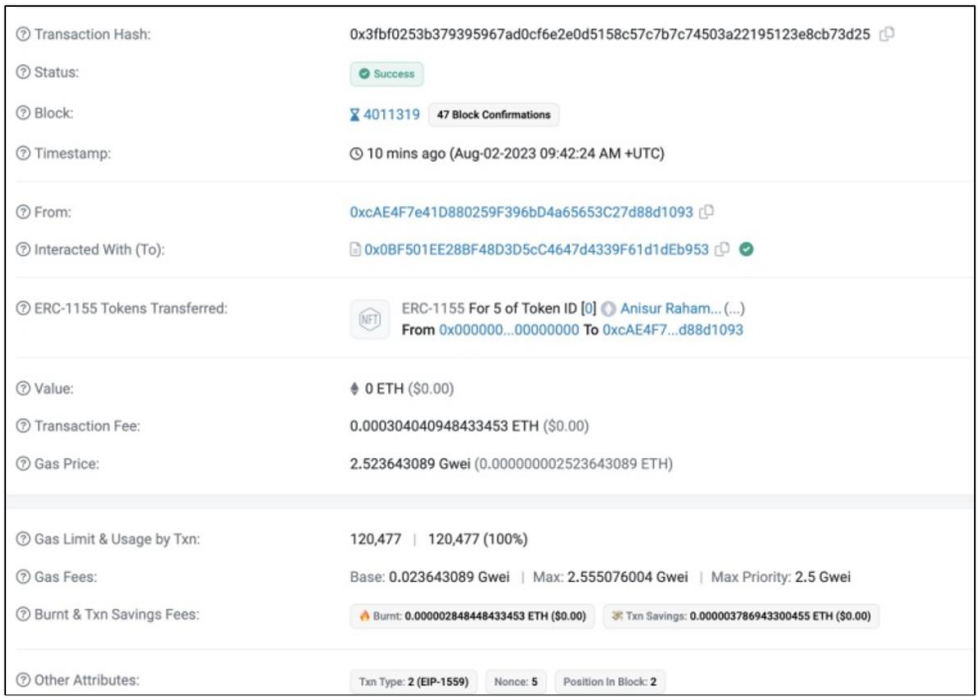


Figure 6.7. Minting Transaction over Testnet

Accessing our platform or any third-party platform that incorporates our contract now allows users to view the minted NFT, which represents the Kantha product, complete with all its details. This feature exemplifies how blockchain technology can be utilized to digitize and authenticate traditional crafts, offering a transparent and immutable record of each item's provenance and

characteristics.

Moreover, the design of having each contract dedicated to a single artisan means that the contract's page effectively functions as the artisan's digital storefront or profile. This arrangement not only facilitates the direct association of products with their creators but also enhances the visibility and accessibility of the artisan's work. Consumers can explore an artisan's range of products, understand their craft, and verify the authenticity of each piece through the blockchain record. This approach promotes a deeper connection between artisans and buyers, fostering trust and appreciation for the craftsmanship behind each Kantha product.

In essence, the integration of blockchain into the crafts supply chain for Kantha artisans of Birbhum demonstrates a forward-thinking application of technology that benefits both creators and consumers by ensuring authenticity, promoting transparency, and supporting the cultural heritage of craft communities.

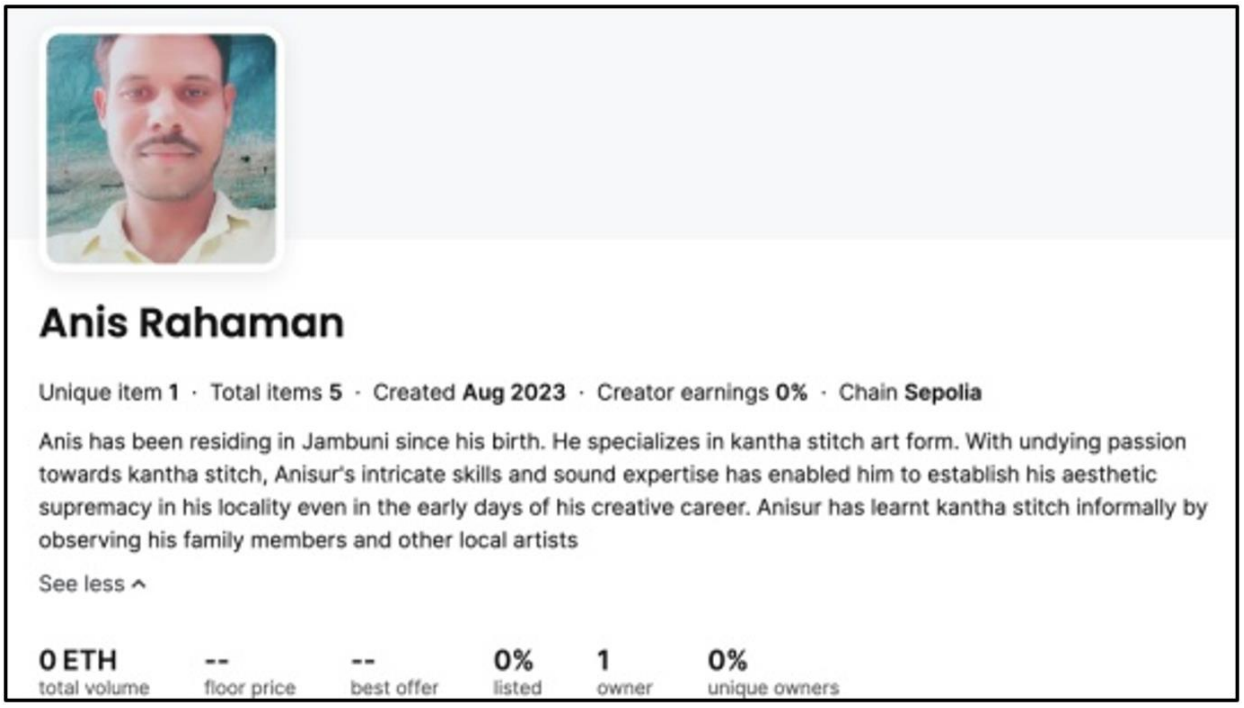
Figure 6.8 All transactions in our contract

The integration of the customized ERC-1155 contract into our platform, as well as its potential adoption by third-party platforms, represents a pivotal achievement. This development allows users to access and view NFTs that symbolize Kantha products, complete with extensive details, as showcased in Figure 6.9. This capability underscores the transformative potential of blockchain technology in enhancing the digital representation and authentication of traditional crafts.

By leveraging this smart contract, each Kantha product is not only digitized as an NFT but also enriched with metadata that details its origin, materials used, artisan's information, and other unique attributes. This digital representation offers a new dimension of transparency and provenance verification, previously unattainable in traditional e-commerce or craft exhibition settings.

Furthermore, the ERC-1155 contract's flexibility in handling both fungible and non-fungible assets under a unified architecture means that artisans can manage their inventory of crafts more efficiently. At the same time, consumers enjoy a seamless and informative buying experience. The direct link to the blockchain ensures that all product details are immutable and verifiable, enhancing consumer trust.

This milestone in integrating blockchain technology into the crafts sector not only promotes the visibility and authenticity of artisanal products but also paves the way for a more sustainable and equitable market, where artisans retain greater control over their work, and consumers are assured of the quality and origin of their purchases.



.Figure 6.9 Artisan Page

The implementation of blockchain technology in showcasing Kantha products through NFT minting significantly enhances the visibility and authenticity of these artisanal items. As depicted in Figure 6.9, each product listed on the artisan's page is accompanied by the number of NFTs minted for it, indicating the available number of that specific product. This quantity is dynamically updated as the artisan mints more NFTs, offering a real-time inventory of their creations.

Further details are elaborated in Figure 6.10, where comprehensive information about the

product, including the artisan's details, is displayed. This data is dynamically sourced from the InterPlanetary File System (IPFS), ensuring the information's immutability and legitimacy for users. The detailing extends to the type of raw materials used, such as Tassar silk, and the threads employed in the creation of the Kantha product. Links to the bills of these materials are also included, allowing buyers to verify the authenticity and quality of the raw materials used. Additionally, the production date, the artisan's name, and the unique contract address representing the artisan are prominently featured, providing further assurance of the product's authenticity.

This unique contract address for each artisan, also visible on the artisan's page, underscores the decentralized and secure nature of the system. By leveraging IPFS for data storage, the system ensures that all product and artisan details remain immutable and transparent.

The integration of blockchain and IPFS technologies into the crafts supply chain represents a significant advancement for traditional artisans. It not only facilitates their access to a global marketplace but also instills confidence among buyers regarding the authenticity and quality of the products they purchase. The successful test results of this framework illustrate its considerable potential in transforming the artisan community and the broader crafts supply chain, empowering artisans with technology to showcase their work better and ensuring transparency and trust throughout the purchasing process.

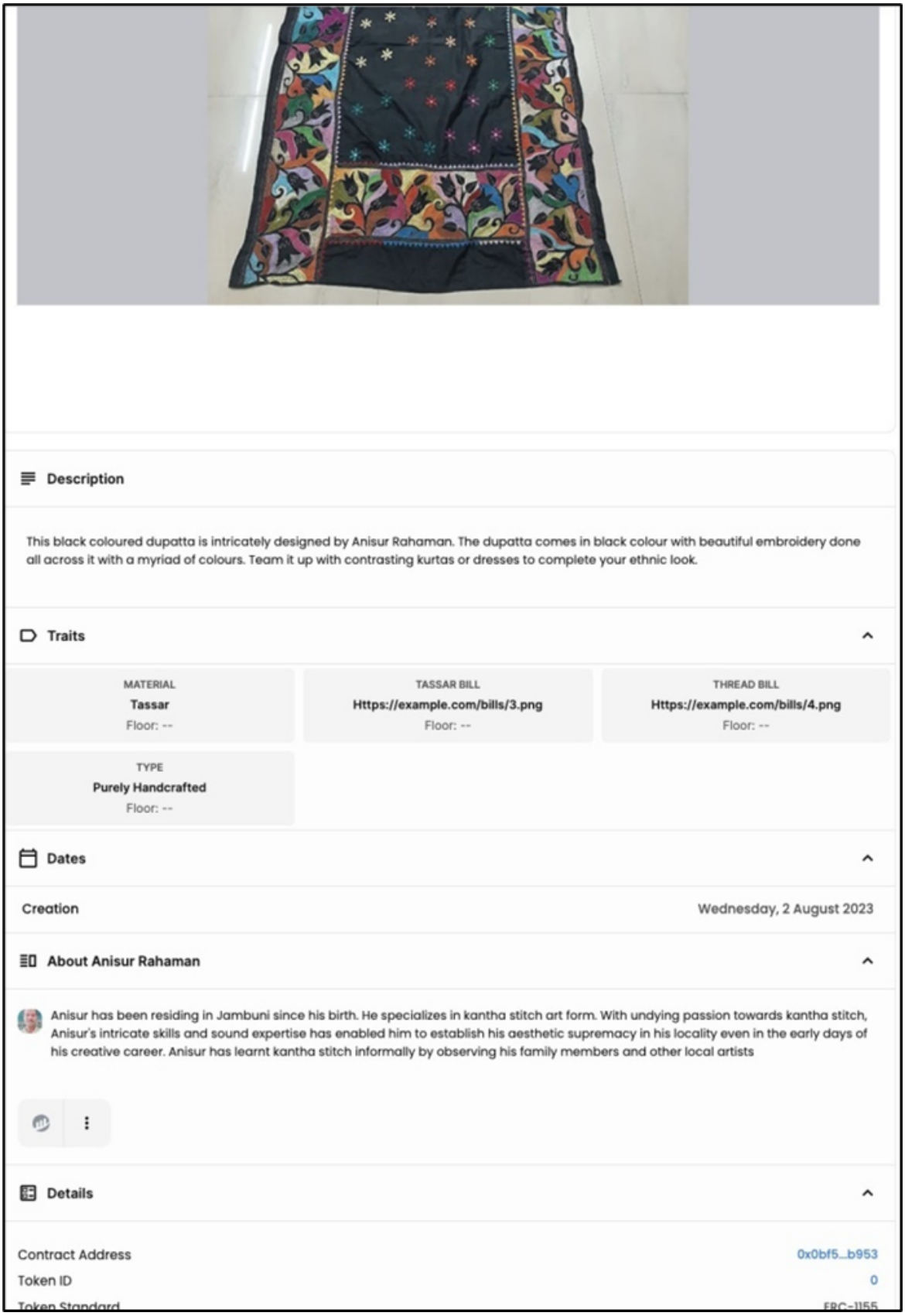


Figure 6.10. Product details page

6.5 Conclusion

The chapter titled "Blockchain-Enabled Community-Driven Rural E-Commerce Platform: An Innovative Implementation Approach for Digitization of Assets" culminates in highlighting the transformative power of blockchain technology in revolutionizing rural e-commerce, particularly through the digitization of traditional crafts such as Kantha products from Birbhum's artisan community. The successful integration of a customized ERC-1155 contract into a blockchain-enabled platform demonstrates not only the feasibility but also the substantial benefits of leveraging blockchain for the authentication, representation, and transaction of handicrafts in a digital marketplace. The implementation of Non-Fungible Tokens (NFTs) to represent unique Kantha products has proven to be a significant advancement, ensuring the traceability, transparency, and immutability of each item's provenance and transaction history. Through the deployment of smart contracts and the utilization of IPFS for storing detailed product and artisan information, the system provides a robust framework for authenticating the quality and origin of artisanal products. This not only enhances consumer trust but also empowers artisans by giving them direct control over the presentation and sale of their work. Moreover, the dynamic updating of product quantities as NFTs are minted, along with the provision of comprehensive product details and material authenticity via IPFS, showcases the potential for a highly transparent and user-friendly e-commerce ecosystem. The unique address assigned to each artisan, serving as both a digital identity and a storefront, further personalizes and secures the transaction process, ensuring that artisans can directly benefit from their creations. This chapter has underscored the remarkable potential of blockchain technology in creating a community-driven, decentralized e-commerce platform that can significantly benefit rural artisan communities. By providing a secure, transparent, and efficient mechanism for digitizing and transacting handicraft products, the proposed framework not only supports the preservation and promotion of traditional crafts but also contributes to the economic empowerment of rural artisans.

In conclusion, the innovative approach of integrating blockchain technology into the rural e-commerce domain presents a scalable and replicable model that could revolutionize the way traditional crafts are valued, traded, and preserved in the digital era. This research not only contributes to the academic discourse on blockchain application in e-commerce but also provides a practical blueprint for empowering rural communities through technology.

Chapter 7

Conclusion and Future Work

The journey of this thesis has been a profound exploration of the intersection of traditional craftsmanship and modern digital solutions. It aimed to understand the nuanced challenges rural artisans face and proposed a robust, community-driven e-commerce platform as a solution to these challenges. This initiative not only seeks to empower artisans by enhancing their market access and visibility but also endeavours to preserve and promote the rich cultural heritage embedded within rural artisan communities.

The research findings underscore the significant socio-economic benefits that can be achieved through the integration of rural artisans into the digital economy. By harnessing the power of community-driven platforms, we can facilitate a more inclusive and equitable economic model. The NCoRe platform, developed as part of this thesis, exemplifies how technology can be leveraged to create a sustainable ecosystem for rural artisans, offering them the tools and resources necessary to thrive in a global marketplace.

7.1 Review of Research

This thesis embarked on an exploratory journey to address the multifaceted challenges faced by rural artisans in India. It proposed an innovative solution through the development and implementation of a community-driven e-commerce platform, NCoRe. The research was grounded in a comprehensive study of the rural artisan community, identifying the cultural significance, economic contributions, and the various hurdles that limit their growth and sustainability. Central to this investigation was the realization that traditional market access routes are insufficient and technologically backward, thereby necessitating a digital intervention.

A detailed literature survey laid the groundwork by mapping the evolution of information systems tailored for rural producers, highlighting the transition from unidirectional information dissemination to multidirectional knowledge collaboration, and the potential integration of blockchain technology for enhanced transparency and trust in community information systems.

Building upon this foundation, the thesis proposed a conceptual framework for creating virtual communities of practice and purpose within rural environments. Through field research involving Self-Help Groups (SHGs) and rural youth, the study demonstrated the practical feasibility and positive impact of cultivating such communities to bridge market separations and foster a more inclusive digital economy for rural artisans.

The architecture of NCoRe, a community-driven e-commerce platform, was then elaborated, showcasing its potential to mitigate knowledge and market divides through a user-centric approach that prioritizes ease of access, community engagement, and market integration. The platform was validated through field observations and simulations, underscoring the significant role of blockchain technology in ensuring authenticity and trust in online transactions.

7.2 Future Research Directions

This research opens several avenues for future exploration, key among them include:

- **Scalability and Sustainability of NCoRe:** Investigating strategies to scale the platform to a national or global level while ensuring it remains economically viable and self-sustaining.
- **Blockchain Integration:** Further exploration into the integration of blockchain for secure, transparent transactions and the potential for smart contracts to automate aspects of the artisan-buyer interaction.
- **Impact Assessment:** Long-term studies to assess the socio-economic impact of NCoRe on the rural artisan community, particularly focusing on income levels, market reach, and empowerment.
- **Technological Inclusivity:** Developing more intuitive and localized interfaces to make the platform accessible to artisans with limited digital literacy.
- **Cross-Cultural Studies:** Expanding the research to include rural artisan communities in other regions and countries to explore the universality of the NCoRe model and adapt it to diverse cultural contexts.

7.3 Concluding Remarks

In conclusion, this thesis contributes significantly to the understanding of the challenges faced by rural artisans. It offers a viable solution through the development of **NCoRe**, a **Community-Driven E-commerce Platform**. NCoRe goes beyond merely selling rural handicrafts; it engages artisans directly, inviting them to share their views and shape the platform's growth. This approach guarantees that NCoRe effectively addresses the real needs of the rural artisans.

Additionally, this dissertation introduces a novel **blockchain-based traceability framework** within NCoRe to ensure the authenticity of the artisans' handicrafts. This feature not only enhances the trustworthiness of the products but also builds confidence among consumers, opening up new global market opportunities for rural artisans with a guarantee of their product's authenticity.

The development and implementation of NCoRe illustrate the significant potential of applying technology to solve specific challenges faced by rural artisans. It shows how digital platforms can be powerful tools for economic empowerment, allowing artisans to engage with and influence the emerging digital economy. The emphasis on **engaging rural artisans in providing opinions** on the platform has been critical, ensuring that their voices are central to the platform's development and that it genuinely represents their interests and values.

Apart from that, this research not only bridges a critical gap in the literature but also presents a practical framework that can be adapted and scaled to benefit rural artisan communities globally. The potential of such platforms to transform the rural economy is immense, paving the way for a more inclusive, equitable, and sustainable digital future for artisans worldwide. The journey of NCoRe, from concept to implementation, underscores the transformative power of technology when applied with a deep understanding of the community it aims to serve.

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