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Abstract

Despite the recognition of the significance of the crafts industry for inclusive development, its informal, disaggregated and disenfranchised nature poses several problems for the rural artisans, who are often forced to live in poverty. Extant approaches to address the industry's problems have involved siloed attempts, wherein interventions were appropriated to resolve issues within parts of the supply chain, resulting in persistence of the issues. Using Self-Help-Group women in rural India as a case in point, the paper adopts a discovery orientation and action research alignment to evolve the design principles of an ICT driven peer-to-peer collaborative, decentralized supply chain model known as Nex-Gen Cottage Industry as a means to organise the industry. The results of a pre-pilot study in a village Kandi have been discussed along with the implications of this research for academia and the society.

Keywords: Artisans, ICT, Supply Chain, Action Science, Nex-Gen Cottage Industry

Introduction

The economic and social significance of the crafts (handicraft & handloom) industry in India can be highlighted by the fact that it is the second largest source of rural employment after agriculture (Ghouse 2012). The criticality of the industry lies in its omnipresence in the form of different crafts across India and its contribution towards the economy of the nation (Jadhav 2013). However, it is also an industry that is highly informal and disenfranchised, where the most of production happens in small household workspaces and where sales are limited to the inconsistent and unpredictable local markets (Menon and Gupta 2011). The artisans are perennially trapped in the vicious cycle of low investment capacity, low productivity, weak market linkages, low-value proposition leading to inconsistent revenues and low risk taking ability (Abirami et al. 2017). As a result, the latent human capital of the artisans remains mostly underutilised and often drives them to live in poverty.

Researchers have argued that the problems faced by the artisans are due to the absence of/access to well-developed markets due to the different market separations they face from the same like physical distance, information asymmetry and financial ability (Singh et al. 2015). In this context, we argue that the amplification of the effects and sustained existence of the market separations faced by the

rural artisans in India are due to the inadequacies in the current organisation of its supply chain practices. Hence, we posit the need to go beyond siloed attempts and evolve process innovations that address the problems in the supply chain practices in an integrated manner (Makhitha 2015). Further, we add that while certain elements of the current crafts industry's supply chain are a challenge, the industry's other inherent features like its peer-to-peer, collaborative and decentralised character offers a great opportunity to cultivate community driven Information and Communication Technology (ICT) based approaches that can help the artisans navigate through the different problems they face. Hence, we examine the research question "What is the nature of the ICT based process innovation(s) required in the supply chain of the crafts industry to address the market separations faced by the artisans and thereby aid in their livelihood enhancement?"

To address this question, we delve deeper into the current status and structure of the crafts industry's supply chain in West Bengal (in India), by interviewing the artisans at different local handicraft fairs. Based on the interviews, we elucidate the factors that impede market development in our context, through the application and extension of Bartels' (1968) theory of market separations. Subsequently, we invoke the tenets of the Sharing Economy (SE) (Sundararajan 2016) to introduce the concept of the 'Nex-Gen Cottage Industry (NCI)' as an ICT driven peer-to-peer collaborative, decentralized supply chain model to organize the different stakeholders of the crafts industry and outline a framework for the same. Next, we validate the NCI framework through a pre-pilot study that was conducted for six months with a woman named Rama (name changed) from Kandi (a remote town in WB) wherein we utilised ICTs to streamline the supply chain for the crafts she produced and thereby reduced the market separations she had faced.

The study makes the following academic contributions to the IS and marketing literatures. First, we extend Bartels'(1968) theory by finding evidence for two new market separations in our context as will be detailed later. Second, we postulate an Internet-enabled decentralised platform as a means to re-structure the current supply chain practices of the artisan industry (*Nex-Gen Cottage Industry Platform*) and validate how it reduces the market separations faced by the artisans. Thirdly, we show how this platform supports a peer-to-peer collaborative work organisation as an alternative to the brick & mortar, hierarchy-based factory model and provide pointers on similar contexts in which it may be applicable. For practitioners, we show the need to identify situated local conditions in order to evolve approaches to address the market separations in their context and aid market development.

Literature Survey

In this section, we first delineate the problems faced by the artisans in the crafts industry. Next, we discuss the notion of market separations and its manifestations in the crafts industry context and cull out research on the same in the IS domain. Finally, we describe the problems with the extant interventions in India and motivate the need to better understand the current supply chain practices of the artisan industry, in order to reduce the market separations they face.

Problems and Perceptions of the Crafts Industry in India

Crafts can be defined as products in which hand driven processes account for a significant part of the value added to the same (they may or may not have a functional value/utility) (Abirami et al. 2017; Makhitha 2015). The crafts industry accounts for a major chunk of the livelihood opportunities available to the marginalised groups in developing nations, especially in the rural regions of countries in South Asia and Africa (London et al. 2010). Further, with production processes that involve low carbon footprint through the use of naturally available raw materials and use of indigenous methods, it is an industry that attempts to leave minimal damage to the environment. Despite the promise it holds, the artisans in the industry face a number of problems that threaten the industry's very existence. At the root of the issues faced by the artisans is the fact that it is largely informal and unorganised, with a majority of the artisans working as independent craftsmen/women (Ghouse 2012). The fallout of this is the inability of the artisans to leverage the benefits that organized entities enjoy, creating a number of hurdles in the process like: (i) lack of/limited access to quality raw materials and tools required compete in global markets (Scrase 2003)**;** (ii) their lack of awareness about the wants of people

beyond their local markets (Nagori 2012)**;** (iii) their limited abilities to satiate the needs of global customers (Rogerson and Sithole 2001; Shah et al. 2017)**;** (iv) limited ability to affordable capital procurement (Rogerson 2010; Sonne 2012) and (v) their limited/lack of access to global markets (Harris 2014; Nagori 2012). These barriers impede their aspirations to sustainably follow their trade and force them to look out for alternate options for their living, thus endangering their current livelihood options and the future of indigenous talent and culture.

Market Separations in Rural Contexts and the Role of ICTs

Building on extant research, we believe that one way to characterise and understand the problems faced by the artisans is to view the same from the theoretical lens of market separations. Bartels (1968) posited that the facilitation of market development in any industry required the bridging of separations between the producers and the consumers that existed on multiple dimensions. He added that these separations may be of four types: "spatial (physical distances), temporal (time difference between production & consumption), informational (concerned parties having different/unequal knowledge about products and market conditions), and financial (buyers not possessing purchasing power at the time they have willingness or buy" (Bartels 1968, p. 6). Let us now delve into work that has happened at the intersection of ICTs and market separations and understand the theoretical linkages between the same.

Tarafdar et al. (2013) delineate how ICT enabled product and process innovations at the BoP could facilitate market development in the same. Basing their analysis on interviewing consumers/producers and managers involved in ICT based innovations across different sectors in India, the authors examine the relationship between ICTs and reduction of the four market separations posited by Bartels. Here, the authors unravel the theoretical linkage between of use of ICTs and the development of market outcomes in the BoP by elucidating how ICTs' automate-informate-transform properties help reconstruct business processes through the re-engineering of relationships between actors and thereby contribute to market development (Tarafdar et al. 2012).

Singh et al. (2015) based on their study of Chanderi weavers in India, found how the Digital Empowerment Foundation leveraged ICTs to reduce the four market separations faced by weavers through the development of Chanderi Weavers ICT Resource Centre (CWICTRC). The authors explain how the CWICRTC bridged gaps in the producer value chain like the use of ICTs to produce new designs, procurement of good quality raw materials and in the marketing of their produce through the creation of an ecommerce interface. The authors also found evidence for a new dimension called social separation which included practices like overbearing social customs that may impede producer's capacities and advance the need to factor in the same in order accelerate market development at the BoP (Singh et al. 2015). Let us now look at the extant interventions in the crafts industry in India and understand the problems associated with the same.

Extant Interventions in the Crafts Industry in India

Despite the lack/limited amount of thrust placed on the crafts industry by policy makers, there have been other players who have tried to address the problems within the same. However, each of these interventions has suffered from different limitations as follows. To begin with, entrepreneurial ventures like FabIndia (https://www.fabindia.com/), while serving as bridging enterprises and contributing significantly towards the upliftment of their target communities (Ramachandran et al. 2012), have remained limited in their inclusivity within their regions of operation and their scalability across other regions. On the other hand, digital technology-driven approaches have involved siloed attempts, wherein ICT based interventions were appropriated to resolve problems within parts of the supply chain (Leong et al. 2016). For instance, E-commerce platforms like GeM, India Handmade Bazaar, Crafts Villa, etc. are marketplace models that provide dedicated online storefronts for the artisans to display their products, thereby helping them bypass multiple layers of middlemen and earn better margins for their products. However, it has been observed that the multifaceted problems faced by the artisans cannot be adequately solved through fragmented attempts like providing them access to passive e-commerce interfaces (Cecchini and Scott 2003). Finally, NPO interventions like ones by

Banglanatak (http://banglanatak.com/) and Digital Empowerment Foundation (http://defindia.org/) (with &without ICT) have attempted system-wide changes and have made significant contributions to the communities in which they operate. However, they have relied heavily on models that are donor dependent and hence have remained limited in their scalability and sustainability (Singh et al. 2015). Hence, we believe that there is a need to take a more holistic approach to deal with the problem of market separations and thereby assert the need to delve deeper into the limitations of current supply chain practices to understand the reasons and possible remedies of market separations.

The Baseline Study

We began our qualitative field inquiry by attending (starting early 2017) different handicraft fairs held at West Bengal (WB), India by the Government and NPOs like Banglanatak dotcom, and talking to/interviewing the artisans who were present in the same. The objective of the visits was to gain a deeper understanding of the current status of the crafts industry supply chain. In all, we spoke to around 120 artisans (where each interview was audiotaped and lasted for 15-45 mins) and transcribed the same for our analysis. (Sample questions asked include: 1.) Do you make the products on your own or employ other artisans in the process? 2.) How do you get the ideas for new designs? 3.) From where do you buy the raw materials? 4.) From where do you get the orders for making products? 5.) Do you know the amount at which your buyer resale your product? 6.) How do you carry your products to the customers?)

Analysis of the Baseline Study

The transcriptions were analysed using the theoretical lens of Bartels' (1968) theory of market separations and utilised the Gioia et al. (2013) methodology to derive the themes and aggregate dimensions. As illustrated in table1, besides the four market separations postulated by Bartels (1968), we also found evidence for two new market separations in our context. We discuss the manifestation of these market separations in WB's crafts industry and then illustrate how the deficiencies in the current supply chain contribute to the sustained existence of the separations in the next section.

Discussion on Market Separations in the Artisan Context

Spatial Separation- Location of artisans in remote villages in India serves as a barrier for them to connect with different consumers in cities and access export markets (Ghouse 2012). Though artisans use different channels to overcome this market separation, they face different kinds of issues due to the limitations in the supply chain. For instance, the dearth of logistics providers forces the artisans to individually travel to customer locations, thereby causing them to lose out on economies of scale. Alternatively, if they participate in handicraft fairs, they need to spend 10-15 days in the same location and run the risk of not covering expenses through sales (Singh et al. 2015). Finally, when artisans sell to middlemen who pick up their products near their home, the inability of the artisans to ascertain the actual selling price of their products allows the middlemen to get the products at prices well below the market rates.

Financial Separation- In the context of producers, it refers to the lack of/ shortage of access to affordable capital to the artisans. It has several implications. To begin with, it impedes artisans' aspiration to buy technological machinery and hence reduces the possible quantity and quality of their produce (Shah et al. 2017). Financial crunches at times serve as a hurdle for the artisans to participate in trade fairs that are long distances away (but maybe profitable). Also, financial issues caused by usurious money lenders often puts the artisans into a debt trap (Sonne 2012).

Informational Separation- Limited use of communication platforms (especially smartphones) coupled with the spatial separation of artisans from the customers inhibit the artisans to gauge the market demands, both in terms of quantity and type of produce. Accordingly, it makes it difficult for the artisans to plan their production schedules (Singh et al. 2015). The intermediation by different agents also leaves them with little opportunity to know the feedback about their products and to know about the wants of customers (Ghouse 2012).

Table1. Data Structure

1st Order Concepts[1]	2nd Order Themes	Aggregate Dimensions
"I have learnt this art primarily from my mother-in-law. Since those designs have become a bit out-dated, sometimes I try to innovate new designs on my own. I innovate them based on my existing skill and knowledge."	1. Design know-how & Skill Building issues	Spatial Separation (Bartels 1968) (7+8+9) Financial Separation (Bartels 1968) (12) Informational Separation (Bartels 1968) (1+3+9+11) Temporal Separation (Bartels 1968) (2+5+7) Capability Separation (Singh et al. 2015) (1+2+3+10) Capacity Separation (2+13)
"We only use polish machine in terms of technology. There are machines which cost between Rs.5000-50000 which obviously I cannot afford. If I have such machines I can increase my production many folds.	2. Technological Hurdles	
"Though i save the bills, i don't have any formal mechanism to handle my accounts..."	3. Deficiencies in Business Management	
"I need a store house where I can keep the products safe and for future sale."	4. Scarcity of Warehousing & Packaging	
"The products are mainly carried by us in most of the cases... Some customers do pay us the transportation cost…, while majority do not provide any transportation cost. The customers often tell us that it is a part of our business to incur the transportation cost…"	5. Dearth of logistics support	
"Banglanatak, with the help of internet and other social media, only highlights upon few rich artisans and therefore they have a healthy income. But a large number of workers are out of the limelight and has to suffer a lot of adversities."	6. Scale Issues with Extant Interventions by NGOs	
"I have participated in the Hasta-Shilpa Mela. We had to stay in the place of the fair for at least 24 days."	7. Issues in existing Sales Channels	
"They (the middlemen) resell it at a much higher rate, almost thrice to what they pay me for my products."	8. Middleman induced Monetary Costs	
"The customer feedback confirms the quality. I maintain no record of quality feedback or product sale. Middlemen maintain all sorts of record like product details, sale record, quality record and client feedback record through there"	9. Middleman induced Non-Monetary Costs	
"Raw material availability and cost is also a major problem that I am facing. Raw materials needed for the product may not be available…"	10. Issues with Quality of Raw materials	
"Yes. Because I don't have a smart phone, I am unable to receive the exact pictures of the products that the customers require. The technological gap makes the process of the business slow."	11.Information/ Knowledge Gaps	
"Financial aspect contributes to be the biggest problem. Often we apply for loans but since it never gets sanctioned on time, perpetual economic crisis rule our business."	12. Shortage of/Issues in Credit Facilities	
"Yes I like it. The only problem I face is meeting the demands of the customer. Compared to the demand of the products that we make, the rate of supply and production is low..."	13. Limitations in Capacity	

Temporal Separation – It refers to the time-lag between production and consumption which necessitates the creation of durable products, good packaging and warehousing facilities (Tarafdar et al. 2013). Remote location of artisans, poor infrastructure like rugged roads & poor transportation options, dearth of use of modern technology in the design & production of crafts, dearth of logistics providers, etc. contribute to the increase in time difference between production & consumption, adding to the costs that need to be borne by the artisans.

[1]Only one representative quote provided for each concept. The entire list of quotes is with the author and will be given on demand.

Capacity Separation- In this context, it refers to the difference between the quantities of the product demanded by the customer and the producer's time-bound capacity to satisfy the same. The field visits revealed cases wherein business opportunities were lost because big retailers had ordered for a large quantity of a certain produce and the producers did not have the capacity to meet the same. The distributed and disaggregated nature of rural life meant that a single/group of artisans had limited possibilities to coordinate among themselves to satisfy bulk orders even if they receive it.

Capability Separation- Artisans often learn their trades from their family members and preserve the same by passing it on to subsequent generations. Despite possessing sound core skills in their respective trades, the demands of the modern consumers require them to innovate on aspects like the design of their products, use existing skills to create new innovative products that are valued by contemporary clients, use technology to improve quality, etc. (Tarafdar et al. 2012). However, lack of exposure leaves them to manufacture the same old products that may be out-dated in the market.

The Current Structure of the Crafts Industry Supply Chain

Besides attending handicraft fairs, we also undertook field visits to different artisan villages, in a bid to obtain a more situated understanding of their trade, including the current structure of the supply chain. The questions were similar to those asked in the handicraft fairs but involved more casual conversations to get a sense and feel of their trades and daily life. In all, we visited about five villages in different districts within West Bengal and had conversations with 80 artisans. The current organisation of the crafts industry supply chain can be seen in figure 1 given below.

The left side of the diagram illustrates the linkages between the different actors in the current supply chain. Since there is no usage of ICT, all the linkages are mostly local, and information flow is manual. The producer (artisan) acts as a focal the actor in the supply chain and is involved in nearly every aspect of value addition within the same. The artisans often buy raw materials from local markets and find it difficult to purchase better quality materials from cities owing to the dearth of logistics providers. The artisan then uses aides from family or neighbourhood to produce the crafts and again travels to the customer's (often not the end consumer) site for delivery of the same. The artisans often need to contact micro-financer to get money for buying raw materials.

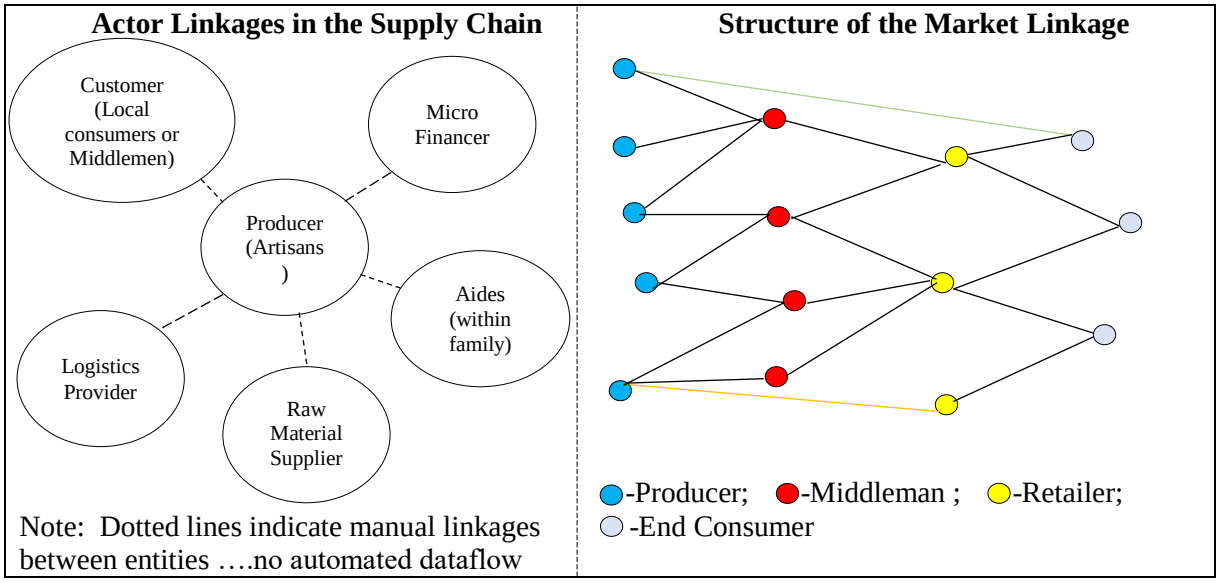

Figure1. Organization of the Current Supply Chain

The right side of the diagram illustrates the market linkages between the producer and consumer in the current supply chain. The artisans have very few options with regards to market linkage and are mostly proximity based. Most artisans have ties only up to one level that have several implications like: (i) artisans do not know who the end consumer is and feedback from the same; (ii). the existence of many levels increases time between production & consumption; (iii) a large chunk of the value is

captured by the intermediaries. Also, the artisans themselves are not linked beyond their neighbourhood, creating overall capacity constraints and curbing knowledge flow.

Based on these factors, we posit the need to re-organize the current crafts industry supply chain practices in WB (including adding new actors) and propose an Internet-enabled collaborative decentralized platform (termed as NexGen Cottage Industry (NCI) Platform) in the next section as a means to reorganize the same and reduce the market separations faced by the artisans.

NCI: A Collaborative Peer To Peer Platform for Re-organizing the Supply Chain

Motivation

The flow of *value* in the traditional *pipeline* business model is linear from a producer to a consumer, and this is the model of the industrial era where supply chain practices in industries have followed a pipeline structure. "Pipeline businesses create value by controlling a linear series of activities—the classic value-chain model. Inputs at one end of the chain (say, materials from suppliers) undergo a series of steps that transform them into an output that's worth more"(Alstyne et al. 2016, p. 4).With the advent of the internet and mobile technologies, a new economic model has emerged creating a profound impact on the existing business model: it is called the **Platform Economy**. A *platform* presents the digital infrastructure and rules for a marketplace that connects producers and consumers. Examples are: Uber, Airbnb, Amazon, Apple and similar companies that disrupted the markets. The main asset of a platform is its network of producers and consumers. In contrast to pipeline strategies, "*resource orchestration* is more important than *resource control*, and facilitating interactions and managing relationships have a higher priority than internal optimization"(Alstyne and Parker 2017, p. 3). Platform businesses create an ecosystem comprising of four components:

- *Owners* of the platform (e.g. Uber owns Uber Platform and not the cars)
- *Providers* who serve as the platforms' interface (e.g. mobile device running Uber Apps)
- *Producers* who create their offerings (e.g. Car with drivers in Uber)
- *Consumers* who use those offerings (e.g. the passengers who hire the car as and when needed)

Sharing economy is a form of platform economy that may be defined as "any marketplace that brings together distributed networks of individuals to share or exchange otherwise underutilised assets"(Koopman et al. 2015, p. 4). It is a paradigm that deals with access based consumption where prosumers exchange under-utilised physical assets, for or without a monetary benefit (Belk 2014). Extant Research on the Sharing Economy (SE) has posited that SE based ventures had four commonalities between them: 1) focus on leveraging idling capacity of assets, 2) belief in the commons, 3) trust between strangers, and 4) critical mass (Botsman and Rogers 2010). Through the use of social technologies, especially mobile apps and Web 2.0, researchers believe that it has ushered a new era of ***crowd-based capitalism*** that could enable marginal producers to enter the mainstream economy by collaborating their efforts (Sundararajan 2016).

Applications of sharing economy are mostly focussed on urban spaces (e.g. room sharing or ride sharing services) which houses asset-rich (people with an abundance of assets which may remain underutilised) and time-poor people (who face time crunch in their daily life and needs faster and cheaper access to resources). Typically goods like cars and homes that by nature provide owners with excess capacity are the ones shared in the urban spaces. On the contrary, rural India in general houses asset-poor time-rich people, where the rural artisans do not possess a large number of assets (except human capital), and they have spare time which remains underutilised. Given this research context, we aim to cultivate 'people-centric' SE practices (Deng et al. 2016), wherein we seek to better utilise human capital (a function of idle time and expertise). The motivation of our NCI Platform is derived from Platform Economy in General and Sharing Economy in particular. Whereas the architecture of our platform re-organising the supply chain is based on the principles of Platform Economy, the peer-to-peer work organisation and work norms in NCI is derived from Sharing Economy principles.

Re-organizing the Supply Chain: The NCI Platform

The organization of the NCI Platform to transform supply chain practices can be seen in figure 2. The left side of the diagram illustrates the linkages between the different actors in the transformed supply chain. Here, the artisans can focus on their core skills (production of crafts) and may be relieved from other value adding (but time-consuming & expensive) activities owing to the strengthening of the connections and plurality of actors. The NCI Platform provides an opportunity to enhance value addition to the products by bringing every entity in a connected network: raw material suppliers, designer/trainers, logistics providers, sales & marketing among other things. The important aspect is that each of these actors is from the crowd (NCI community) and is not fixed and may change their roles from one business opportunity to another.

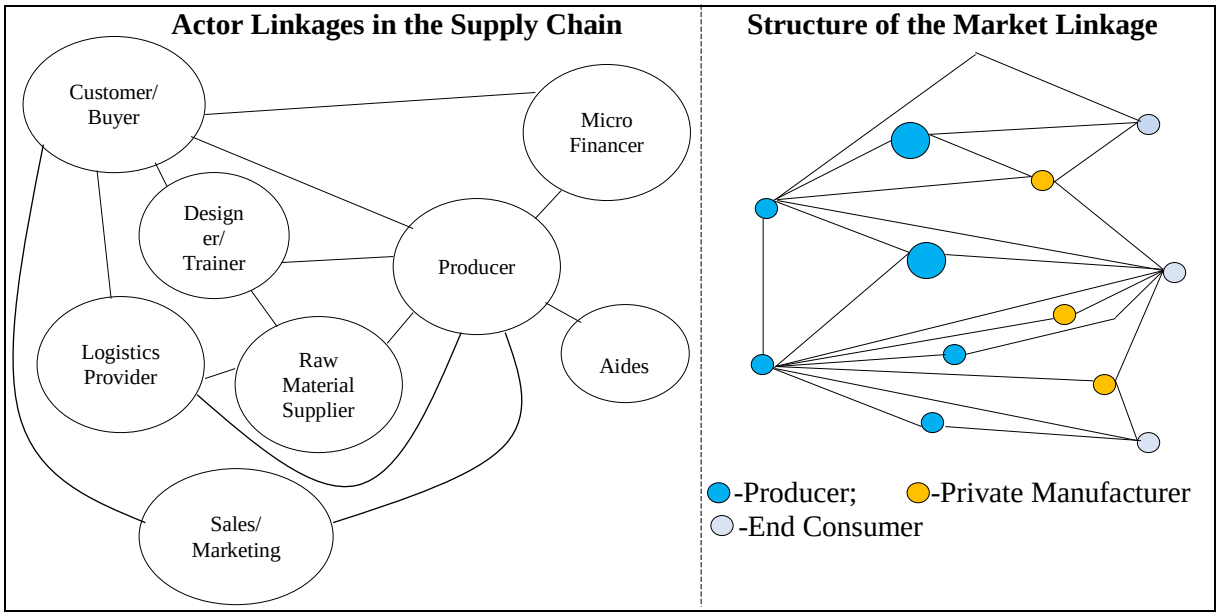

Figure 2. Organization of NCI Platform: Re-organizing the Supply Chain

The right side of the diagram illustrates the market linkages in the reorganised form. From the diagram, it is apparent that the network here is denser (than it is in the current supply chain), where each actor has more options. The producers (artisan) have direct access to the private manufacturers/end consumers (linkages beyond level 1); thereby bypassing the middlemen and helping them overcome the associated deficiencies. Finally, the artisans themselves are linked to each other beyond their neighbourhood resulting in knowledge transfer and capacity increase.

Collaboration and Supply Chain Visibility

Collaboration can be understood as the act of working together to produce outputs that may be beneficial for all the participating actors/entities. Information and Communication Technology (ICT) facilitates the flow of information to support collaborative work. In this context, e-collaboration has been defined as "business-to-business interactions facilitated by the Internet"(Johnson and Whang 2002, p. 8). These interactions are beyond simple market transactions and can be better described as relationships. It includes activities like information sharing, process sharing, decision sharing, and resource sharing (Mattos and Laurindo 2015). Researchers have indicated that in a supply chain context, "e-collaboration facilitates coordination of various decisions and activities beyond transactions among supply chain partners"(Lee and Han 2009, p. 1).

As illustrated in figure 2, networking of supply chain partners using NCI platform will not only improve e-collaboration but also improve supply chain visibility that would eventually lead to improvements in operational performance. Supply chain visibility has been defined as: "the extent to which actors within a supply chain have access to or share information that they consider as key or useful to their operations and that they consider will be of mutual benefit" (Barratt and Oke 2007, p.

2). Visibility can provide benefits, not only in terms of operations efficiency (Flynn et al. 2010), i.e., increased resource productivity, but also in terms of planning effectiveness (Barratt and Oke 2007).

A Functional Description of NCI Platform

In general, the NCI facilitates communication, collaboration and trade between multiple actors in the system. Specifically, it promotes transactions between producers, consumers and other stakeholders by providing a standardised, flexible and open platform that not only improves productivity but also ensures fairness and financial benefits to all. The collaboration allowed by this platform ensures transparency and helps to optimise the positions of all stakeholders in the business. Thus, the NCI platform (figure 3) can be defined as a temporary association of autonomous crowd workers who establish dynamic peer-to-peer connections to collaborate with each other through a coordinated sharing of skills, resources, information, risks, costs and benefits in order to satiate a given business opportunity.

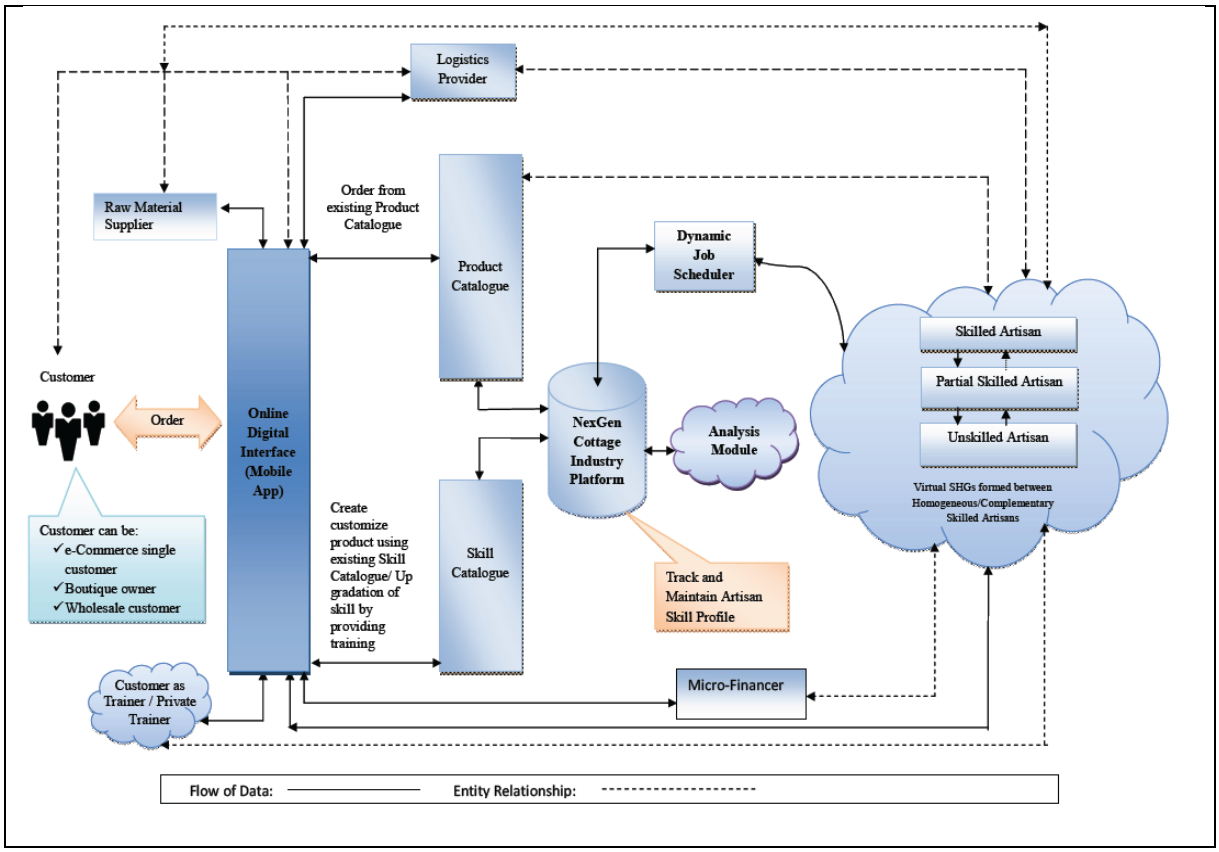

Figure 3. Functional Diagram of the NCI Platform

The function of NCI Platform (figure 3) is based on peer to peer micro-manufacturing that employs a large number of independent artisans along with other related entities like raw material providers, logistics providers, designers/ trainers, micro-financers, etc. NCI platform enables them to coordinate in a decentralised manner. The functional description of each entity is given below:

Functionalities of Artisans: 1) They advertise their product details, skill details, contact details, production capacity and other personal details including experience, which will be maintained as a digital catalogue (product catalogue and skill catalogue). They are connected to NCI Platform via online digital interface on their mobile phones (Mobile Apps). 2) They can coordinate with other entities via NCI platform. They can view the list of different raw material suppliers, logistics providers and micro-financer with all necessary details. The platform not only maintains these lists but also recommends the artisans, helping him/ her to select the necessary agents dynamically in the supply chain to fulfil the order.

Functionalities of customers (product Buyers): 1) They view the product details, contact details, skill sets, production capacity and product feedback of any artisan from the digital catalogue. 2) They order selected products online, and after receiving the products they can provide online feedback and rating for the product; if an ordered quantity cannot be delivered by a single artisan, the platform helps him/ her to select multiple artisans who are offering the similar product.

Functionalities of customers (Service / Skill Buyers): 1) A private manufacturer (e.g., a boutique owner) may need to customise a selected product/ design, to cater to a sizable market need. In that case, (s)he may need to train the artisans to make that customisation and then place an order for the customised product through the same module. A private manufacturer can access the training module to select suitable trainers to train the selected artisans online / offline. 2) Customized products maybe added to the product catalogue, and skill sets of the trained artisans will be updated in the skill catalogue for possible future use.

Functionalities of Raw materials supplier: 1) They advertise their stock of raw materials, contact details, price, delivery time etc., which will be maintained as a digital catalogue in the platform. They are connected to NCI Platform via an online digital interface on their mobile phones (Mobile Apps). 2) If an order is placed and the platform selects artisan(s) to execute the order, order details will be sent to the mailbox of possible raw material suppliers dealing with the ordered product. Subsequently, the supplier will acknowledge with pricing, delivery time etc. and deliver the materials, if needed.

Functionalities of **logistics providers** and **micro-financers** are similar in nature. Digital catalogues are maintained to record their details including availability, and their services will be availed on demand.

Functionalities of Analytics Module: The product demands, customer comments, feedbacks, product ratings etc. for individual artisans / SMEs will be fed into this module which will be analysed to suggest the scope of improvement in the business of an artisan.

Functionalities of Dynamic Job Scheduler (DJS): The Core Module of the NCI Platform: *Scheduling* is a process of allocating work to available resources. In production/manufacturing process, scheduling is needed to distribute and control work to available resources (machinery, human, financial) and to optimise workloads (load-balancing). *Dynamic scheduling* is a form of scheduling where priorities of assigned tasks and available resources are calculated at runtime. The objective of dynamic scheduling is to ensure optimal allocation of resources at runtime (Pinedo 2008). In our context, ***Dynamic Job Scheduler (DJS)*** is responsible for carrying out the scheduling activity after an order is placed. The DJS module examines the order, polls for relevant actors' availability, coordinates and selects relevant actors to form an instance of a supply chain to process that particular order. This is fundamentally similar to any sharing economy platform (e.g. Uber), where the platform selects and schedules a resource dynamically (a car with driver in case of Uber) to carry out a task (transportation need of a customer). However, the difference is the multi-party nature of the problem-space, where our platform requires engaging multiple actors (artisan(s), raw material provider(s), logistics provider(s), trainer(s) and micro-financer(s)) to carry out a task (order fulfilment). Thus, the DJS module here needs to do some kind of *resource orchestration* rather than *resource control*. DJS may aim at one or more of many goals, for example:

- *Efficient Load Balancing*: keeping all available resources uniformly busy
- *Ensuring quality of service*: Selecting resources to ensure QoS.
- *Minimizing Response Time*: Time from work becoming enabled until it is finished
- *Maximizing fairness*: Granting equal opportunity to all users according to the priority and workload

In practice, these goals may often be in conflict with each other (e.g. QoS versus Fairness). Hence, the scheduler would employ a suitable compromise and implement optimisation techniques to perform task scheduling.

Our Intervention: Research Context and Study Design

The chosen research site for our intervention based study was Kandi, a remote town in West Bengal, India. Since we intended to use ICT interventions to understand the peer-to-peer decentralised supply chain practices, we adopted a discovery orientation and action research alignment. Action Research is a legitimate scientific method that is participatory and reflexive, where in the researcher uses multiple action-reflection cycles to cull out useful knowledge while addressing a practical client's problem (Baskerville 1999; Greenwood and Levin 2007). The intervention began in June 2017. We completed the pre-pilot study in early February 2018.

We were introduced to the Self-Help-Group (SHG) Federation in Kandi by an NGO named SPADE in Kolkata SHGs are groups that are predominantly formed by the marginalised sections of the society and usually consist of 12-15 members (particularly women) (Savitha and Rajashekar 2014). Savings and credit activities act as binding forces for them in most cases. The SHG women associated with the Kandi Federation leveraged their general household skills and engaged themselves in activities like tailoring, handicrafts making, painting, embroidery, etc. However, due to the different market separations they faced, most of the SHG women's skills in Kandi remained under-utilised, leaving them with little to do beyond financial transactions with the SHGs. After initial rapport building (during July 2017) and interviewing some of the SHG women, we identified one woman named Rama (name changed) who was enthusiastic about making products and began our field studies with her.

Implementing the NCI Framework: A Pre-Pilot Study

Rama, who was a semi-skilled artisan, was given initial design inputs & product idea training (using an expert trainer) that focused on improving her existing skill sets. The first interaction was face-to-face, followed by a series of online training sessions using Zoom, a video-based conferencing tool. Subsequently, our team procured a series of time-bound real customer orders (using online channels) that were offered to and accepted by Rama. The raw materials required for the order were either given by the customer or were supplied by designated raw material providers. The timeliness and quality of the produce were monitored periodically. The primary objective of this study was to understand and demonstrate how internet-enabled social technologies could be utilised to 'remotely' drive every aspect of order fulfilment including order procurement, raw materials sourcing, design inputs, production scheduling, monitoring, logistics and order fulfilment as discussed below.

The first order required Rama to make 280 photo frames with ethnic designs that had to be delivered in two weeks. Once the raw materials reached her, she started the work with the help of two of her family members. While she spent the initial few days figuring things out, she started producing about 40 cards every day after that. Any doubts regarding the product were discussed over WhatsApp, and we requested her to maintain a daily diary about her progress and other details, a digital copy of which was sent us every day. When the deadline approached, Rama hired a person from her neighbourhood and paid her on-demand basis. Finally, Rama's brother acted as logistics provider and travelled to our institute to deliver the products and collected the raw materials for the next order. The customer feedback was very positive, and the customer payment ensured reasonable profitability.

The second order required her to make earrings as part of a wedding gift. Rama also wanted help to make pillow covers and a few other items for her upcoming handicraft fair. For both these requirements, a series of online training sessions were organized. WhatsApp played a very big role in our daily conversations. Most of the queries were solved in WhatsApp. We took the more complex ones on video call sessions or also requested her to make videos explaining the problem she was having and send the same through WhatsApp. We used the recently incorporated feature of using drawings and texts on images in WhatsApp quite often. For instance, it was used to show the nitty-gritty of making the earrings (figure 4). Rama successfully delivered this order too and also participated in the handicraft fair with her new products. After completion of these orders, we helped her set up an online shop on Instagram where she displayed her new products. We continued sending her new designs and product ideas and trained her wherever needed. We also observed that she slowly started improvising and created her own new designs.

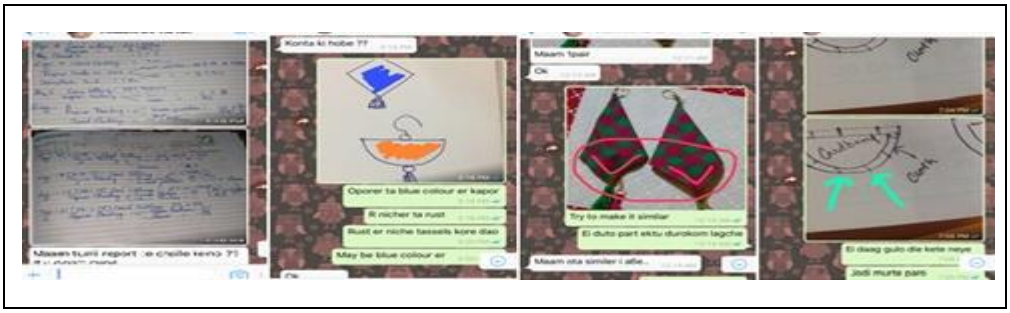

Figure4. WhatsApp Interactions with Rama providing Training and Feedback

Discussion

The experiment with Rama demonstrated how the market separations faced by her could be reduced by organising the supply chain of her produce. To begin with, the spatial separation faced by her was countered by reducing the need for physical movement of trainers and end-customers through the appropriate use of social technologies. The digitisation of the workflows ensured that the need for physical travel just for getting the order and coordinating the production process was almost nil. The WhatsApp groups also enabled easier forging and coordination of partnerships between Rama, Kandi Federation, consumer and our team to enable last mile delivery of services by each stakeholder. The daily digital diary by her enabled our in-house coordinator to monitor the timeliness of her produce, which facilitated us to speed up the time between production and consumption and hence address temporal separation. We were also able to seamlessly arrange for the financial inputs from the consumer during the pre-pilot. Her foray into online shops including Instagram enabled her to receive a lot of traction from local and foreign users, where she got to know potential buyers and hence contributed to the reduction of the informational separation she had faced. Finally, the different features of WhatsApp like phone calls, drawings on figures, etc. helped us provide her constant assistance to upgrade her skills and tackle the capability separation she had faced. Hence, in principle, the pre-pilot indicated how the NCI framework could be implemented and sowed the seeds for the construction of our information system.

Beyond the Experiment: Scaling the Pre-Pilot

Our eight-month experience with Rama demonstrated how social technologies could be leveraged to reduce some of the market separations faced by the rural artisans. However, to exhibit the bridging of issues like capacity separation, we knew we had to scale the pre-pilot and engage many other artisans in the process. We thus engaged twelve other women in the pre-pilot and provided them with online training sessions, wherein an expert from Kolkata trained the women. Each person was requested to make products based on their core expertise and provided with the required raw materials and continuous remote assistance. Parallely, our team is also developing an information system to realise NCI platform (figure 3) which would soon be pilot-tested with the women in the near future.

Implications for Research and Practice

Firstly, we find evidence for and extend Bartels'(1968) Theory of Market Separations by adding two new dimensions called capability and capacity separations and underscore the meaning of the same in our context. We also postulate an ICT based framework called the Nex-Gen Cottage Industry that would re-organise the supply chain to address these separations faced by the artisans. Secondly, Lazerson (1995), in his seminal paper on putting out, hinted at how (information) technologies could be provide an alternative model to the centralised factory system by reducing the different transaction costs associated with commons-based peer production systems. In line with his predictions, we have indicated how our SE based Virtual Production System could organise the efforts of the marginal producers and then be aggregated in order to satisfy bulk orders (Sundararajan 2016). Finally, for practitioners working in rural contexts of developing country, we posit the need to go beyond the deterministic view (Tarafdar et al. 2013) that ICTs could serve as the panacea for all problems and highlight the need to figure out the situated conditions in order to appropriate them successfully.

Additionally, the NCI platform may encourage practitioners to develop and implement a similar platform for improving life and livelihood of the rural population.

Conclusion

This paper highlighted the need to understand and reformulate the supply chain of the crafts industry in order to address the market separations faced by the artisans and proposed (&validated) an ICT based framework for the same. The next steps would involve the piloting of the information system in Kandi during the scaled pilot and then the embedding of social elements like trust, transparency, etc. into the architecture of the information system through several action reflection cycles.

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