Unconventional Wisdom from Below:
Understanding Social and Technical Determinants of Ergonomic Risk
in the Indian Informal Textile and Clothing Sector

By

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ABSTRACT

In many parts of the Global South, including India, a significant number of informal workers, particularly women in the informal economy, engage in sewing, embroidery, and other forms of manufacturing work within informal segments of the textile and clothing sector. Despite substantial progress in labor rights and workplace safety regulations, the persistence of hazardous workplace conditions renders such workers vulnerable to potentially disabling forms of ‘Repetitive strain injuries’. ‘Repetitive strain injuries’ frequently result from poor ergonomic design of workplace equipment. This thesis on India’s informal textile and clothing sector studies the usage characteristics of workplace technologies at the organizational and individual levels, and their interactions with broader social and institutional arrangements that characterize informal sewing units. In partnership with Usha International Ltd. and SEWA (Self Employed Women’s Association) Bharat, the thesis demonstrates how context-sensitive ergonomic interventions can be developed for and with those working within the informal textile and clothing economy. The thesis achieves this by studying ergonomic risk from the bottom-up by using focus group discussions and key informant interviews, with the goal of (1) collecting both qualitative and quantitative information and (2) facilitating the unveiling of hidden rationalities that influence workplace decision making and studying their implications for technical and policy solutions.

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1. INTRODUCTION

1.1. Textile and Clothing Industry in developing countries: A broad overview

In an age of globalized markets and international supply chains, the textiles and clothing industry has become a prominent contributor to the economies of many developing countries. The World Trade Organization (WTO) Agreement on Textiles and Clothing, in effect since 2005, has not only facilitated migration of this industry’s production and manufacturing activities to Asia, Africa, and Latin America but has also boosted manufacturing for domestic needs. In 2014, textiles and clothing made up 88.7% of annual exports of Bangladesh, 56.9% of Pakistan’s annual exports, 16.5% of the annual exports of Vietnam and 10.9% of India’s annual exports; the global value of textile and clothing exports as of 2014 was $314 billion and the contribution of developing countries such as China, India, Turkey, Pakistan and Indonesia were $112 billion, $18 billion, $13 billion, $9 billion and $5 billion respectively (World Trade Organization, 2015).

In order to minimize labor costs, reduce prices and optimize profits, many firms in developing countries frequently minimize their formal workforce and subcontract work to the informal sector (Moreno-Monroy, Pieters and Erumban 2014). ‘Informal sector’ or the ‘unorganized sector’ can be defined as the segment (or segments) of the national, regional or local economy that is comprised of economic activities, enterprises and jobs not regulated, protected or documented by any form of government. Informal workers in the textile and clothing industry are consequently primarily employed in financially constrained household enterprises, unincorporated industries and other such micro-entrepreneurial initiatives (M. A. Chen 2001). Informal economic activities also exist along a spectrum of varying degrees of formalization, ranging from unpaid home-based workers on one end to semi-formal voluntary associations and
self-help groups to organized factory-based employment on the other end.

Across developing countries, women employees are critical to the performance of this labor-intensive industrial sector. Women represent on average 68% of the workforce in the clothing industry and 45% in textiles (International Labor Organization 2014). Such women are disproportionately represented in the production of clothes and apparel through the heavy and repetitive use of sewing machines.

1.2. Workplace Ergonomics and Repetitive Strain Injuries

An issue central to this thesis is the idea of decent work within the informal economy. The International Labour Organization (ILO) views ‘decent work’ as a normative goal that can be defined by the present of seven ‘essential’ securities in the context of work and employment: labor market security, employment security, job security (protection of a niche designated as an occupation or “career”), work security (with relevance to workplace/occupational health and well-being), skill reproduction security, income security, and representation security (in terms of negotiation, bargaining power and advocacy) (International Labour Office 2002).

This thesis is centered on the idea that workplace ergonomics plays an important role in securing such conditions of ‘decent work’. As such, informal economic activities were, and continue to be associated with unsafe and potentially hazardous workplace conditions that result in various forms of accidents, illnesses, and disabilities; images of ‘sweatshops’ and the lived experience of workers in such conditions, have arguably been responsible for a slew of workplace, industrial, and labor regulations in most countries that had to engage with rapid industrialization and/or informal economic practices. However, despite such progress, the lack of workplace
ergonomics arguably forms a hidden barrier to the realization of ‘decent work’, primarily due to the propensity of non-ergonomic workplace settings and equipment to lead to repetitive strain injuries (RSIs). Repetitive Strain Injuries (RSIs), also known as cumulative trauma disorders, are a family of occupational health disorders that arise from the repetitive or strenuous nature of work performed; they are characterized by “inflammation, pain, or dysfunction of the involved joints, bones, ligaments, and nerves” (U.S National Library of Medicine 2016). Repetitive Strain Injuries are generally associated with workplace activities that require repetitive movements, forceful exertions, sustained awkward positions, overexertion and exposure to vibrations and mechanical compression; in the long run, they have the potential to cause lasting and permanent disability and reduction in both quality of life and personal socioeconomic productivity (Occupational Safety and Health Administration 2000). The bucket of ‘Repetitive strain injuries’ comprises of a number of discrete and distinct disorders with varied etiologies, ranging from Carpal Tunnel Syndrome (CTS), Cubital Tunnel Syndrome, various forms of Tendonitis, and Low-back Pain.

The importance of addressing repetitive strain injuries in the context of occupational health and well-being is borne out in statistics provided by the United States Bureau of Labor Statistics. According to BLS, for the year 2015, over 31% of total non-fatal workplace injuries were related to musculoskeletal disorders; furthermore injuries resulting from overexertion and repetitive movements amounted to 44.5% of injuries, and injuries relating to overexertion and repetitive movements amounted to median absences of 12 and 22 days respectively, compared to the overall median of 8 days (Bureau of Labor Statistics 2016). To this end, repetitive strain injuries not only disrupt the lives of victims but are also likely cause economic burden for employers as well. Even though there are no readily available statistics for informal sectors in India (and the global South in general), the rates of incidence of repetitive strain injuries and their
disruptive impacts on personal lives and economic productivity are likely to be higher, given generally lax enforcement of workplace regulations as well as inadequate avenues for injury reporting.

1.3. The Indian Context

The thesis particularly focuses on the textile and clothing industry for two reasons. First, India’s Textile and Clothing industry is a key contributor to the national economy, providing employment to over 45 million people directly and 60 million people indirectly and generating exports worth $41.4 billion over 2014-2015; the industry is the country’s second largest employer after agriculture - its market value is estimated to be around US$ 108 billion and is expected to reach US$ 223 billion by 2021 (India Brand Equity Foundation 2016). India’s textile and clothing industry is also home to a wide spectrum of informal work. Statistics compiled by the Government of India show that as of 2009, there were 1.755 million units involved in commercial apparel activity (most of which are small-scale units), 8.97 lakh units involved in weaving activity and around 23,000 units in knitting and crocheting activity; of these units, 60.5%, 45.2% and 40.9% of units respectively do not have access to electricity (a possible indicator of informality) (Bedi, et al. 2009). To this end, this thesis, by focusing on India, hopes to make a robust contribution to understanding informal economic activities in one of the world’s most vibrant economies, and also explore how undesirable workplace conditions can be addressed.

Second, there are multiple organizations working within India’s informal textile and clothing sector that make such a study possible in the first place. For example, a key partner of this study, SEWA (Self-employed Women’s Association), is India’s largest trade union of
informal workers and counts nearly 1.9 million members throughout the country. SEWA has an exhaustive understanding of the informal textile and clothing market in India and in fact, runs a number of co-operative women-led garment manufacturing units throughout the country. Furthermore, SEWA’s enormous technical, social, economic and cultural knowledge makes research in an otherwise data-scarce environment possible. Another key partner of the study, Usha International Ltd., is among the largest manufacturers of domestic appliances (including sewing equipment) in India. Without their presence and support, studying dynamics within the textile and clothing informal sector would be difficult.

1.4. The Role of Gender

Gender is a secondary focus of this thesis because its utility as a unit of analysis in the context of informal work has a major role in shaping conclusions. The vast majority of informal textile and clothing workers happen to be women: a trend that can be traced back to a process of labor feminization possibly resulting from the fundamentally vulnerable, low-income nature of such jobs, as well as socially embedded gendered discourses of work. As mentioned earlier, a number of anecdotal and survey-based sources indirectly allude to the numerical predominance of women in the textile and clothing informal sector. For example, the P.A.C.E Program initiated and piloted by Gap Inc. in India (and later, in 4 other countries) contends that over 80% of workers in this industry are women (Nanda, et al. 2013).

However, assumed or real numerical predominance does not automatically imply equitable gender relations. Rather, in the Indian context, the vast majority of informal positions occupied by women provide for lower wages on average, offer wages on a piece-rate basis,
require more repetitive activity and often do not provide opportunities for upward social mobility (Mohapatra 2012). Furthermore, these positions tend to require low-skilled work, meaning that employment security is not guaranteed and that women workers employed in such positions are easily replaceable (Mohapatra 2012). Furthermore, in many parts of the country, women working in the textile and clothing industry are part-time workers in that they either hold multiple jobs to support themselves and their families and also undertake responsibility for managing their households. Employment insecurity, combined with added social stressors, ostensibly make such women substantially more vulnerable to negative healthcare outcomes.

1.5. Objectives of this thesis

For those who live in poverty and work in the informal sector, especially women, context-sensitive technologies can determine whether or not they will have access to decent work (Sustainable Development Goal #8), and whether or not development solutions designed for such a context engages with unique situation-specific challenges relating to ergonomics and affordability. For manufacturers, distributors and users of sewing products, understanding product usage characteristics and working conditions can enable better market capture (in this case, a section of the ‘Base of the Pyramid’ or BoP market) (S. Silverthorne 2007). Furthermore, such understanding can help manufacturers and employers channel corporate social responsibility efforts into areas (such as ergonomics) where substantial social impact can be achieved. To this end, this thesis, by studying the socio-technical factors influencing the incidence of repetitive strain injuries, in the context of informal sewing units in a specific geographical region in India (northwest India) hopes to not only establish some correlations and causal links, but also attempt to suggest mechanisms (technical, policy-based, or otherwise) that can adequately recognize and address such issues.
2. LITERATURE REVIEW

A literature review of the theoretical underpinnings of the informal sector is necessary to understand and explore occupational health challenges in the context of this thesis. The following literature review attempts to address key topics relevant to this thesis in the following manner:

2.1. Informal Economic Activities and their varied forms

The idea of an informal sector is fairly recent, and introduced decisively by an International Labour Organization report in 1972. Currently, there are four prominent schools of thought that classify the informal sector and address their needs in different ways.

The Dualist school of thought holds that the informal sector is distinct from the formal sector, and further suggests that informality is a result of exclusion caused by demand-supply mismatch (International Labour Organization 1972). Individuals who are not served by opportunities in the formal sector then, are relegated to the informal sector. The Dualist school not only challenges the idea that the informal sector is unproductive, but also valorizes it as a sector that is defined by a set of activities and characteristics that are provide gainful and resilient employment opportunities in the development context, and are able to provide a wide range of “low cost, labor intensive and competitive goods and services”. This school draws attention to
the lack of linkages between the formal and informal sectors and consequently, suggests that more economic and employment opportunities have to be created, preferably by the state, to compensate for the ‘deficiencies’ present in the informal sector. (International Labour Organization 1972) for example, calls for a strategy of redistribution from growth by creating linkages between formal and informal sectors, and by providing opportunities for labor-intensive technologies in the informal sector as well as measures to generate demand for products and services generated in the informal sector.

Further to the left are the Structuralists, whose arguments respond and react to the premises of the Dualists. They suggest that attempts by formal firms to reduce labor costs and increase competitiveness results in informal workers being subordinated to the interests of capitalist development. They insist that formal and informal sectors not be seen as different from each other, and that informal enterprises and workers be given adequate property rights and civic services to help them tide over structural barriers. For example, (Castells and Portes 1989) argue that the informal economy, rather than being defined by a set of activities, is the result of a social definition of state intervention. By rejecting the notion of duality, they suggest that informalization would undermine the organizational and bargaining powers of organized labor and would promote segmentation of informal labor on the lines of gender, age and ethnicity that may be inimical to the goal of a classless society.

The Voluntarist School is a more recent development that promotes the idea of self-employment in the informal sector. It seeks to explain informality as a deliberate attempt by individual workers to voluntarily participate in the informal sector, due their own rational self-
interests and preferences, and at times, to escape taxation and regulatory burden in the formal sector. Scholars such as (Maloney 2004) argue that informal jobs offer a degree of autonomy and dignity that formal jobs cannot, and that the sector should be seen as urban micro-enterprises that are able to choose their optimal amount of participation in formal institutions. A variant of this school of thought pays little attention to the linkages between the formal and informal sectors and instead, portrays informality as a financial burden on the state. The World Bank, for example, while recognizing that informality provides “a cushion” for workers looking for jobs, it also considers the phenomenon to be detrimental to state finances, state provision of public goods, and ultimately government capacity; it claims that when “a large share of the population is openly ignoring laws, regulations and taxes can weaken the respect citizens have for the state” (The World Bank 2013).

The Legalist school of thought suggests that the informal sector is comprised of micro-entrepreneurs who are burdened and therefore, alienated by a hostile and cumbersome legal system. This school supposes an exclusion of informal workers from formal legal and regulatory systems and consequently, places the responsibility of inclusion on the state. At the individual level, it focuses on strengthening property rights through formalization and titling. This is best represented by Hernando de Soto, who suggests that legal titling could provide informal entrepreneurs substantive access to their assets so that they may escape socioeconomic marginalization.

More recent models are comprehensive in that they shun reductionism and posit that solutions to challenges should necessarily be multi-faceted. WIEGO has developed and
institutionalized a six-segment model that not only includes the theories mentioned earlier but also introduces new categories (Chen, Vanek, et al. 2005). The model not only represents a synergy of literature developed by the Dualist, Voluntarist, Legalist and Structuralists schools of thought, but adds gender and social dimensions the six segments of informal employment thus identified by (Chen, Vanek, et al. 2005) and furthermore, tested empirically in six countries. Within this framework, people employed in the informal textile and clothing economy are categorized as: Informal Employees and Industrial Outworkers (in the case of opportunities created by subcontracting) and as Own Account Operators (in the case of self-employed women).

Furthermore, the holistic model accepts the causal theories of the four dominant schools of thought as valid, and suggests that informality in work and employment can be created through exclusion (resulting from demand-supply mismatch), barriers to entry (due to hostile legal environments), exploitation (subordination to capitalist interests) and exit (voluntary preference for remaining independent from formal institutions).

2.2. Types of Informality

It follows from the WIEGO model that there exists a spectrum of informalization, involving diverse categories of informal economic activities, their causal mechanisms, and factors that sustain them. In this case too, there is rich conceptual diversity. (Cobb, King and Rodriguez 2009) propose a spectrum-based model that categorizes enterprises and more generally, firms, on a formality-informality spectrum. (Cobb, King and Rodriguez 2009), after studying informal economic activities among Mexican immigrants in the United States, they concede that those employed in informal settings not only make extensive use of their social networks to obtain
employment, but also work in jobs, or multiple jobs, that transcend the formal-informal dualism. In doing so, the authors suggest the adoption of the term “semi-formal” to explain such complexity, and to also introduce the concept of a spectrum. They also propose a model of such a spectrum based on characteristics of enterprises/firms, as follows:

![Spectrum Diagram]

(Kanbur 2009) proposes a different model that sees formality and informality in relation to economic activity, in the presence of relevant regulations. According to (Kanbur 2009), four conceptual categories that define informality in the context of regulations include: (A) regulation applicable and compliant (involving complying with and staying within the ambit of regulation), (B) regulation applicable and non-compliant (activity within the ambit of regulation, but not compliant), (C) regulation non-applicable after adjustment of activity (adjustment of activity to move outside of the purview of regulation) and (D) regulation non-applicable to the activity (activity is beyond the ambit of regulation). In this case category A represents formality, while B, C, and D represent different degrees of informalization, that are spatially, politically and socially dependent on capacity and efficiency of regulatory enforcement.
A third theory that emphasizes such spectrum thinking is embedded within the WIEGO framework that has been discussed in (Chen, Vanek, et al. 2005). By dividing the set of informal economic activities into six segments, the WIEGO framework also develops a ‘holistic’ hierarchy of informal active based on the degree of formalization, as depicted below:

In the WIEGO classification, poverty risk (the likelihood that a worker in any one of these segments is from a poor household) and average earnings are used as indicators of hierarchical ordering. To this end, formal ‘employees’ are at the top of the pyramid, followed by (a) informal workers with predictability and security in terms of work, employment and pay, (b) ‘Own account Operators’ who often self-employed and may/may not have adequate economic resources, (c) causal workers, (d) home-based workers and industrial outworkers, who work on a piece-rate basis, have irregular work, irregular payments and who also may be responsible for provision and upkeep of workplace, equipment and utilities, and (e) unpaid family workers (M. Chen, Informalization of Labour Markets: Is Formalization the Answer? 2009).
2.3. Vulnerabilities: A Broad Analysis

A discussion of occupational health challenges would be incomplete without the recognition that broader institutional arrangements, legal structures, and organizational patterns would influence healthcare outcomes. This section, therefore, seeks to review the broad nature of vulnerabilities in the informal sector among women in the informal economy. This thesis defines ‘vulnerabilities’ as arrays of social, economic and political conditions that impede workers in the informal economy from exercising their autonomy, from having access to decent work and from furthering their quest towards dignified livelihoods. ‘Dignity’, in this context, is to be defined in the progressive spirit of the Universal Declaration of Human Rights. Thus, from the vantage point provided by the WIEGO framework, one can explore and distil such vulnerabilities.

Entry Barriers: Access to Credit and Statutory Formal Laws

At the Individual level, Barriers to Entry exist primarily in the form of lack of access to credit and statutory formal laws. This is particularly applicable to categories of informal women workers who are self-employed and/or engaged in micro-entrepreneurial initiatives. As such, women in the textile and clothing informal economy require access to credit in order to invest in sewing machines, workspaces and sewing accessories such as table, chairs and professional scissors. Even if it is assumed that machines and workspaces are used on a shared basis, obtaining credit to purchase raw clothing material and to engage in transactions with customers is essential. Informality restricts access to this kind of capital because informal women workers are unable to establish their creditworthiness – they lack titled assets and documented collaterals in general (Barwa 2015). Lack of access to capital, in turn, not only prevents these women from furthering their entrepreneurial activities, but also renders them unable to access communication
technologies (such as mobile phones), technical training for enhancing vocational skills, legal services as well as social networks that may introduce them to new customers (Barwa 2015).

Statutory formal laws also present a barrier to entry because they are less responsive to the conditions of women (and by extension, to a broader set of informal workers) in the informal economy. For example, (Balkenhol and Schutte 2001) suggest that informal workers without land titles, purchased assets with joint liability, or other assets find it difficult to obtain bank loans due to regulatory restrictions, ostensibly because high costs associated with collecting pledged collateral relative to the size of micro-loans are cited by banks as an obstacle. Furthermore, (Balkenhol and Schutte 2001) suggest that banks either frequently impose “unrealistically high” collateral requirements or perhaps, simply cite such constraints as a reason to not deal with small and medium scale, often informal, borrowers.

Exclusion of Informal Textile and Clothing Workers: Subcontracting and Social Norms

Exclusion from the formal economy is another mechanism by which women in the informal textile and clothing industry are rendered vulnerable. Such exclusion is manifested in two distinct ways – first, through the nature of outsourcing and sub-contracting to the informal economy and second, through discriminatory social norms relating to gender.

On subcontracting, (Tilly, et al. 2013) suggest the presence of a tiered structure to the production of garments and textiles – they suggest that the top of the hierarchy is represented by formal entities that delegate work to smaller factories or workshops, that in turn delegate aspects of production to even smaller workshops or home-based workers. (Tilly, et al. 2013) further
suggest that these small factories then delegate work to even smaller garment workshops, which then contract out to home-based workers. Unsurprisingly, the tiered transition from formality to informality also results in a parallel increase in vulnerabilities – as one goes down the hierarchy, labor laws become more irrelevant and difficult to enforce. For example, (Tilly, et al. 2013) demonstrate how Special Economic Zones in India - self-contained zones that possess infrastructure and regulatory frameworks designed to increase productivity and export-oriented activity - ironically incorporate informality as a means to increase productivity. They argue that in some of these zones, workers’ ability to organize, advocate and litigate are limited through a process of regulatory exclusion.

Gender and social norms also pave the way for exclusion – this is particularly visible in the segmentation of labor markets along the lines of gender, caste, religion, and ethnicity. According (Carr and Chen 2004) in Ahmedabad, women are over-represented in the informal economy relative to men: over 80 % of women workers are engaged in the informal economy, compared to 65 % of male workers. (Carr and Chen 2004) further demonstrate that most women are either casual workers, homeworkers or unpaid family workers in a disproportionate sense – so much so that the share of women who are homeworkers is almost ten times that of men.

In doing so, (Carr and Chen 2004) demonstrate that among Muslim women and upper-caste Hindu women, social obligations relating to household duties and childcare prevent them from working outside their homes or localities. They claim that nearly 70 % of women, compared to less than 10 percent of men, work in their own or their employer’s home, that less than 8 % of women, compared to over 27 % of men, work on the streets or at construction sites, and that
less than 22% of women, compared to nearly 60% of men, work in factories or offices.

*Exploitation of Informal Textile and Clothing Workers: Wages, Social Security and Healthcare*

Gendered influences on activities in the Indian textile and clothing industry, as described before, make women in the informal economy vulnerable to forms of exploitation that take away from their dignity and right to decent work. Given that bargaining power in the informal context generally rests with those higher on the chain of the subcontracting hierarchy, discrimination in wages, nature of work, availability of work and on the basis of gender are very common (Centre for Development Policy and Research, SOAS 2014). (Geetika, Singh and Gupta 2011) report that in the case of women garment workers, the majority of those who are employed by informal enterprises face insecurity due to erratic demand and unpredictable income. They also report that such employees are paid on a piece-rate basis and that the average return after a day’s work is around Rs. 70-100 ($1-1.5) - bordering on the income threshold of absolute poverty.

Low wages also imply that social security (such as access to healthcare, unemployment protection, maternity leave and disability benefits) is minimal or absent. For example, 89% of informal women garment workers in and around New Delhi report having no access to formal or informal social security while the other 11% report having to rely on informal social networks for assistance (Centre for Development Policy and Research, SOAS 2014).

2.4. Repetitive Strain Injuries

Repetitive strain injuries or RSIs (sometimes called work-related Musculoskeletal
Disorders or MSDs) are cumulative trauma disorders directly caused by uninterrupted repetitive activities, awkward motions such as twisting the arm or wrist, overexertion and strain-inducing posture (such as ‘dorsiflexion’). Such RSIs are widely classified into two groups: Type 1 RSIs that present with clearly defined syndromes (such as the widely recognized Carpal Tunnel Syndrome), and Type II RSIs that produce diffuse symptoms like intense pain, numbness, and paresthesias (tingling sensations caused by nerve damage). A meta-analysis of 37 studies has found that risk of developing Carpal Tunnel Syndrome, using a conservative definition involving nerve conduction abnormalities and associated symptoms, was associated with vibration ((OR 5.40; 95% CI: 3.14, 9.31) hand force (OR 4.23; 95% CI: 1.53, 11.68) and repetition (OR 2.26; 95% CI: 1.73, 2.94) (Barcenilla, et al. 2012).

Long-term consequences of RSIs, though understudied, have the potential to cause permanent and irreversible damage to soft tissues and nerves of affected regions - affected individuals may face disability, dependency on sources of income that do not cater to their needs, financial insecurity and disturbing loss of dignity. A study of 1038 Finnish men demonstrated that physical job strain, musculoskeletal strain, and repetitive or continuous muscle strain were significant predictors of disability retirement; the effect persisted even after adjusting for socioeconomic factors, prevalent diseases, and health behavior (Krause, et al. 1997). More recently, conducted in Thailand demonstrated that among 805 home-based informal handicraft workers, ergonomic risks resulting from the physical nature of the workplace environment (such as excessive heat and poor lighting) and working methods (such as manual operation, awkward postures, repetitive movement and long working hours) had statistically significant correlation with greater prevalence of mental agony, anxiety disorders and occupational burnout.
(Tangkittipaporn and Jiangsathaporn 2017). In terms of costs: a study using the Liberty Mutual Workplace Safety Index’s claims data to estimate direct cost burden of workplace injuries in the USA showed that as of 2010, overexertion led to a burden of $9,469,258,776 and repetitive stress led to a burden of $1,402,019,815 (Marucci-Wellman, et al. 2015).

Several clinical studies in developing countries point to the widespread prevalence of RSIs among women sewing machine operators. Notably, in a study involving one group of 243 sewing machine operators and another control group of 357 women engaged in non-repetitive work, the overall incidence of myofascial pain syndrome and rotator cuff tendinitis - both RSI syndromes - was 15.2% and 5.8% among sewing machine operators compared with 9.0% and 2.2%, respectively, among controls (Kaergaard, A 2000). In a 2012 study among 1058 female sewing operators in Sri Lanka, the prevalence of RSIs stood at 15.5% (Lombardo, et al. 2013).

2.5. Context-sensitive Technologies

Solutions for occupational health concerns within the textile and clothing industry have historically been in the form of organizational interventions (such as time and workload management), legal and institutional interventions (such as fair wage laws and Environmental Health and Safety regulations) or even the use of context-specific, small-scale, decentralized ‘appropriate technologies’ for development. While institutional and organizational interventions, (such as national and international labor law reforms, tax reforms and engagement with trade unions) are popular, they continue to be challenged by lax regulatory enforcement, limited state capability, legal loopholes and resistance from some business interests (Deshingkar 2009).
Context-sensitive technologies or ‘Appropriate Technologies’ can be defined as technologies - products and services - that are not ends in themselves, go beyond satisfying immediate individual needs and actively contribute to promoting greater social well-being (Peterson 2008). In the age of the Sustainable Development Goals agenda, manifestations of the appropriate technology movement are widespread: they are visible in the attempts of various social enterprises operating in developing countries to “bundle entrepreneurial attitude with the passion to design and implement inclusive business models targeting the basic needs at the Base-of-the-Pyramid (BoP)” (Goyal, Sergi and Jaiswal 2015). Social enterprise seeks to reach out to a group of people who are seen by traditional enterprises as insignificant opportunities; therefore, these attempts inevitably involve not only designing, but also scaling up and disseminating appropriate technologies (Jue 2010).

Appropriate technologies, then, not only provide an alternative route for addressing the issues at hand but also present possibilities for undercutting a number of existing challenges. Yet, they also have their limitations: attempts by development organizations and social enterprises to reach out to the informal ‘Base of the Pyramid’ or BoP market in a financially sustainable manner have faced repeated challenges – the *mantra* of “low price, low margin, high volume” has required impractical market penetration rates and unexpected operational expenses, causing many such ventures to fail (Simanis 2012).

The theories of ‘appropriate technologies’ have responded to these limitations. Over the past several years, this idea, especially in India, has moved from discursive theory to theories of practice, and from being intellectual exercises to products, services, and processes
institutionalized in the form of government programs, private sector ventures and non-profit initiatives (Pattnaik 2015). Crucially, this process has strengthened the understanding that 'appropriate technologies' are socially-embedded, and that technology development and adaptation strategies need to be studied at the grassroots level (Pattnaik 2015).

One such approach relates to the Suitability-Scalability-Sustainability framework designed and developed by the Comprehensive Initiative on Technology Evaluation (CITE) at the Massachusetts Institute of Technology; the CITE process involves conducting extensive qualitative and quantitative testing of product usage characteristics from a user-centered perspective to design and develop affordable, usable and adaptable technologies (Comprehensive Initiative on Technology Evaluation 2016). Alternative approaches involve user-centered design that also prioritizes usage characteristics and usability goals in a narrower context of design, and participatory or co-design, which emphasizes the active involvement of the intended beneficiaries in the narrower context of product design processes.
3. METHODOLOGY

3.1. Theoretical underpinnings

Acknowledging the idea that development is a multi-faceted concept, this thesis seeks to understand decision-making modalities at the organizational and individual levels, and their interactions with broader social and institutional arrangements. In doing so, this thesis not only seeks to understand workplace conditions and product usage characteristics among women in the informal economy, but also understand, from the bottom-up, how affordable and context-sensitive ergonomic products can be developed for the informal textile and clothing economy. Exploring this topic from the bottom-up allows for (1) collection of quantitative information within a field as eclectic as India’s textile and clothing informal sector, and (2) facilitates the interpretive unveiling of hidden rationalities that influence workplace decision making and their implications for technical and policy solutions.

To this end, this thesis is presupposed on the idea that hidden rationalities exist within the informal economy, which in turn is rooted in idea that people exhibit “bounded rationality” - that their decision-making capabilities are constrained by their own cognitive limitations and that they are not generally cognizant of costs and multiple payoffs in the course of decision-making (Simon 1955), “bounded willpower” - a tendency by people to take actions that are supposedly not in their long-term interest, and “bounded self-interest” – alluding to the possibility that people may sacrifice their own self-interest to help others (Mullainathan and Thaler 2001).

When considering such ‘hidden rationalities’, it is essential that an appropriate research method would have to be sensitive to not only reported information, but also to themes, narratives, and ways of perceiving events, people, and environments, that emerge from reported information.
A second core assumption, as mentioned before, relates to the role of usage characteristics in understanding the extent to which workplace technology is context-sensitive. ‘Usage characteristics’ as a concept can be construed as very broad: it not only involves technical parameters such as efficiency, cost, and functionality over time, but also social parameters such as whether or not a certain type of technology responds to the lifestyles and preferences of end users as well as broader social and institutional structures that influence their lives. ‘Usage characteristics’, then, are closely associated with the first core assumption in that they are context-sensitive and dependent on the ‘hidden rationalities’ of different individuals, actors, and rationalities. This implies that a thorough understanding of workplace conditions would have to take into account the voices and opinions of not only informal workers, but also factory supervisors, managers, and topical experts familiar with the informal sector. As theorized by (Ettlinger 2003), such an approach considering multiple perspectives associated with multiple rationalities can be leveraged to obtain “power to construct changes in the practice of work” that can challenge and change unsatisfactory work practices.

3.2. Making ‘Textile and Clothing’ tangible

As per the literature review, the category of ‘Informal Textile and Clothing Industry’ is extremely broad and is inclusive of several types and segments of informality. However, given the client-based and prescriptive nature of this thesis, studying all of these groups is not feasible because (1) not all segments of the textile and clothing industry are connected to global value chains; home-based workers, for example, cater to markets that are often limited to their own neighborhood, (2) in practice, in a country such as India, researcher access to some segments of the textile and clothing industry are challenged/constrained not only by the maze of organizational
and bureaucratic hoops, but also the ability of workers at those levels to provide their informed consent; therefore, it is feasible to obtain access to only levels of informality that are affiliated with project partners, and (3) the nature of informality and associated activities are not geographically arbitrary: for example, characteristics of apparel products and associated manufacturing techniques used by informal workers in Bengal (use of jute, Kantha stitch techniques, low levels of mechanization) differ from that used by informal workers in Tamil Nadu (high levels of mechanization, predominance of products for export, predominance of cotton and silk, use of techniques that are not only indigenous, but also borrowed from around the world). Identifying informal units that avoid many of these confounding factors, is a sampling challenge.

Therefore, for the purpose of sampling ease, this thesis narrows the definition of ‘textile and clothing’ to levels of informality that are intermediate to the difficult to access home-based workers on the one hand, and more formalized factory-based workers who generally have substantially more access to legal resources and healthcare support. This level of informality could then be characterized by ‘informal sewing units’ that, while frequently catering to the global value chain, also do not meet labor and workplace standards, and are staffed by informal workers who do not have long-term job stability and are paid on a piece-rate basis.

To this end, the primary research question is as follows:

In what ways do social and technical determinants of ergonomic risk affect the prevalence of repetitive strain injuries and cumulative trauma disorders, among informal workers employed in ‘informal sewing units’?

Two secondary, but nevertheless important concerns of this thesis are:

1. How are social and technical determinants (i.e. the independent variables) defined and
identified?

2. What does the relationship between the dependent and independent variables reveal about what interventions work in practice?

3.3. Research structure

The standing objective was to conduct between 10-15 focus group discussions in urban, and rural areas, with an estimated sample size of 7-13 people per focus group. Focus group discussions were appropriate for the context for several reasons:

1. Compared to one-on-one interviews alone, focus group discussions would allow for obtaining a larger sample size, given the number of researchers and support staff available.

2. Focus group discussions would allow for ease of research, not only for the researcher, but also for research subjects; this is particularly important given that informal workers have unpredictable and often, highly variable daily schedules, and that respecting their time and lifestyle is essential for the collection of useful data.

3. Focus group discussions would enable conducting interviews in sewing units that are located at great distances, often tens of miles, from each other. Conducting one-on-one interviews in such circumstances would not be feasible.

This did not preclude the use of one-on-one interviews however. In order to account for some informal workers wanting to participate in private interviews, and for interviews with key persons of interest, the Key Informant Interview option was also used. IRB approval was obtained
from MIT’s COUHES for a research protocol that included informational interviews, focus group discussions and collection of photographic and audio data (Protocol attached in Appendix I).

The research plan was as follows:

<table>
<thead>
<tr>
<th>Phase</th>
<th>Title</th>
<th>Location</th>
<th>Duration</th>
<th>Methods</th>
<th>Objectives</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Scoping Study</td>
<td>Cambridge, MA, USA</td>
<td>Early Fall 2016</td>
<td>Key Informant Interviews</td>
<td>To better understand nature of informality in the space and to identify study priorities</td>
</tr>
<tr>
<td>2</td>
<td>Study Strategy</td>
<td>Cambridge, MA, USA</td>
<td>Late Fall 2016</td>
<td>Development of early framework and study strategy</td>
<td>To develop context-specific and client-specific research questions that can be tested in the field</td>
</tr>
<tr>
<td>3</td>
<td>Detailed Fieldwork</td>
<td>India</td>
<td>January 2017</td>
<td>Focus group discussions and informational interviews</td>
<td>To further develop questions and to collect empirical data to inform recommendations</td>
</tr>
<tr>
<td>4</td>
<td>Data Analysis</td>
<td>Cambridge, MA, USA</td>
<td>Spring 2017</td>
<td>Data processing and interpretation</td>
<td>To convert findings into actionable recommendations</td>
</tr>
<tr>
<td></td>
<td>Deliverable</td>
<td>Cambridge, MA, USA</td>
<td>End of Spring 2017</td>
<td></td>
<td>Final report with summary of research, findings and recommendations</td>
</tr>
</tbody>
</table>

To this end, in January 2017, Focus Group Discussions and Key Informant Interviews were conducted to build an elementary understanding of usage characteristics in the context of technical, market and social perspectives. Focus group discussions and key informant interviews allowed for a thorough qualitative understanding of sewing practices in the informal economy, and for capturing key narratives that governed the lifestyles of informal workers.

3.4. Ensuring data validity, research accuracy, and privacy

The decision to use focus group discussions could be challenged by questions regarding data validity, research accuracy, and privacy. As such, focus group discussions involve collecting
information in the context of a group. Power dynamics within the group and between informal workers and supervisors may hinder the collection of data this is accurate and truly representative of conditions within the workplace, and may also make some reluctant to share information. In order to avoid such a situation, the following safety precautions were undertaken:

- In accordance with MIT’s COUHES procedures, participants were explicitly informed of their rights as research participants. This information was provided in the local language.
- Written consent of participants was obtained before the start of focus group discussions and key informant interviews.
- Data collected during focus group discussions was anonymized and processed to remove most forms of personally identifiable information (PII), with the exception of gender.
- Group leaders and sewing unit supervisors were requested in advance to ask informal workers about participation in focus group discussions and were further requested to encourage free and open discussion (among those who consented to participate).
- Audio recording of interviews was done only with the consent of everybody present during focus group discussions.
- Discussions were conducted in such a manner that all participants were given direct opportunities by the researcher to voice their ideas and opinions (in order to ensure that no single person or group of persons dominated the conversation).
- When requested by participants, people in positions of greater perceived power, such as supervisors, were requested to leave the discussion location.
- The Key Informant Interview option was used to collect information in private from those who felt reluctant to share information within a group setting.
3.5. Research Partners

The thesis was conducted in partnership with two organizations in India: SEWA Bharat (Self-Employed Women’s Association) Bharat and Usha International Ltd, a leading domestic appliances manufacturer in India. SEWA Bharat is India’s largest trade union of informal workers, with over 1.9 million members. Established in 1984, SEWA Bharat is a national federation of various SEWA-affiliated organizations that is tasked with geographical expansion and coordination efforts. SEWA itself was founded in Gujarat in 1972 with the assistance of the Textile Labor Association, as a trade union of informal women workers; SEWA subsequently expanded to most states in northern India, including Rajasthan, Bihar, West Bengal and Delhi. SEWA, being a decentralized organization, does not have a hierarchical organizational structure; rather local SEWA units are autonomous and are connected with each other through SEWA Bharat. For the purpose of this thesis, research collaboration was limited to SEWA Bharat’s unit based in Delhi.

Usha International, on the other hand, is one of the largest manufacturers of sewing equipment in India. Usha also manages the Silai School program, through which the company has established over 10,000 sewing training centers in all the states and union territories of India. The Silai School program, similar to SEWA, has a strong emphasis on inclusive economic development and socioeconomic empowerment of women workers, especially those in the informal economy. After completion of training, most Silai School participants continue to use the program’s services to engage in manufacturing activities. To this end, research participants were selected from a pool of informal workers who are currently employed either in SEWA-affiliated self-help-groups (SHGs) or are participants in Usha’s Silai School program.
3.6. Research Location

Given the complex nature of partnership with two organizations, locating appropriate informal sewing units was a challenge. The following set of criteria were used:

1. Units are representative of an intermediate level of informality, also referred to as ‘home-based workers and industrial outworkers’ in the comprehensive WIEGO model.

2. Units are located in geographical proximity to each other, such that research can be conducted within the available timeframe, and such that broad regional variations in the nature of manufacturing (such as the type of apparel produced) are minimized.

3. Units that are capable of/are in the process of manufacturing products for a regional, national or a global value chain (that is, not limited to the locality or the neighborhood)

4. Units that have sufficient internal or external administrative oversight such that informed consent of study participants can be obtained.

Using these criteria, a set of 10 informal sewing units were identified in New Delhi (5 units), Rajasthan (3 units), and Haryana (2 units).
4. RESULTS

This section is divided into three parts: Stakeholder analysis, Descriptive analysis and thematic research findings. The objective of the Stakeholder Analysis section is to map the various actors (institutional and individual) who stand to benefit or be substantially influenced by the results of this thesis on ergonomic risk within the informal workplace. The objective of the Descriptive analysis section is to provide a qualitative overview of the study environment, apparent social patterns, as well as lifestyles and preferences of informal workers. The objective of the section on thematic findings is to provide a detailed overview of individual findings or themes that have relevance for future interventions in the domain of ergonomic risk.

4.1. Stakeholder Analysis

<table>
<thead>
<tr>
<th>Stakeholder</th>
<th>Relevance of solutions for stakeholder</th>
<th>Reasons for support</th>
<th>Trade-offs for stakeholder</th>
<th>Resources</th>
</tr>
</thead>
<tbody>
<tr>
<td>MIT CITE (Comprehensive Initiative on Technology Evaluation)</td>
<td>Recommendations and off-ramps would reflect the research group’s methodology and sociotechnical expertise</td>
<td>CITE wants to demonstrate the role of its 3S approach (Suitability-Scalability-Sustainability) in evaluating technology in the context of development and add tangible value to decision-making strategies employed by development agencies, non-profits and those wanting to market to the BoP segment</td>
<td>CITE is open to experimenting with novel methods of evaluating technology and use characteristics, and also transcend the 3S model. CITE is also very open to focus on questions of institutions and policy: how can technical solutions be combined with policy options? How can knowledge be transferred to partners?</td>
<td>Thought leadership and established expertise in evaluating technologies from social, market and policy perspectives (thesis supervisor is the Director of CITE); CITE is also a channel of communication and source of networking with SEWA Bharat, one of the main partners.</td>
</tr>
<tr>
<td>MIT Tata Center for Technology and Design</td>
<td>The Tata Center at MIT seeks to find innovative solutions to challenges of the developing world in the form of affordable products and</td>
<td>The thesis topic falls under the category of Health, one of Tata Center’s focal themes.</td>
<td>The Tata Center is open to ideas and solutions that are grounded, context-sensitive, and capable of producing tangible results. The center is also open to understanding how such ideas lead to further innovation or can inspire other kinds of technical and policy solutions.</td>
<td>Financial support for research, travel support, access to a community of students, faculty members and scholars at MIT who are interested in the topics of international</td>
</tr>
</tbody>
</table>

34
<table>
<thead>
<tr>
<th>Stakeholder</th>
<th>Description</th>
<th>Influence</th>
<th>Trade-offs</th>
<th>Development and Social Impact</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>SEWA Bharat</strong></td>
<td>As India’s largest association of informal workers, SEWA is involved in multiple partnerships and projects. The findings of this thesis would add value to their work on evaluating decentralized technologies for development.</td>
<td>SEWA Bharat is strongly interested in a solution that combines technical observations with policy options. SEWA Bharat is interested in understanding how such solutions can positively impact the organization’s supply chains and ongoing informal manufacturing operations.</td>
<td>Usha is likely to exert influence in this thesis, in their capacity as one of India’s largest domestic appliances and sewing machine manufacturers. The scale of Usha’s operations incentivizes the project to be as creative and innovative as possible.</td>
<td>SEWA Bharat has offered to provide access to its manufacturing units in and around Delhi, in order to facilitate fieldwork.</td>
</tr>
<tr>
<td><strong>Usha Intl. Ltd.</strong></td>
<td>Usha would provide the technical and organizational knowhow for the roll out of this project. Furthermore, any working solution is likely to add game-changing value to the company’s sewing machine business.</td>
<td>Usha’s trade-offs are likely to be centered on questions of profitability and product sustainability. Can ergonomic redesign add value in terms of greater sale volume, market appeal, and pricing strategy? Furthermore, can ergonomic products actually deliver on what they promise over time?</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Informal Workers</strong></td>
<td>Any kind of ergonomic redesign or policy suggestion would potentially alleviate a large number of occupational health issues and add to the socioeconomic empowerment of informal workers.</td>
<td>Informal workers may be concerned about issues of privacy. Therefore, it would be necessary to follow ethical guidelines of the highest standards.</td>
<td>Informal workers influence the outcome of the study because they are in close proximity to the technologies that this thesis seeks to evaluate. Their perspectives and opinions are resources.</td>
<td></td>
</tr>
</tbody>
</table>

**Discussion**

As can be seen from the chart presented above, there are five major stakeholders: CITE, MIT Tata Center for Technology and Design, SEWA Bharat, Usha International Ltd., and Informal workers themselves. CITE (Comprehensive Initiative on Technology Evaluation) is a
research group based at the Massachusetts Institute of Technology, that has developed the 3S (Suitability-Scalability- Sustainability) approach to evaluating and rating a wide variety of ‘appropriate’ or context-sensitive technologies in the global South (Comprehensive Initiative on Technology Evaluation 2016). Relevant in its capacity as a thought leader in the space of technology evaluations in development, and a pioneer of the 3S methodology, CITE’s approach has provided a blueprint for the development of research methodology for this thesis. To this end, CITE is an important stakeholder because the results of this research would be relevant to their own objectives, and also because CITE would provide a platform for furthering the findings of this thesis.

The MIT Tata Center for Technology and Design seeks to facilitate large-scale sustained social and economic impact in the developing world by converting innovative ideas into affordable products and services, policy tools, and entrepreneurial ventures. The Tata Center is a key stakeholder because of their financial support, travel support, and resources for connecting with research partners on the ground.

SEWA Bharat and Usha International Ltd. are key partners responsible for providing on-the-ground support; SEWA Bharat, in the context of sewing and sewing-related products, is a firm-level supplier and user of sewing products in that they not only procure products in bulk from manufacturers, but also assist in distributing them to various informal sewing units under their indirect jurisdiction. Furthermore, SEWA Bharat is willing to experiment with ergonomic redesign in order to improve operations within its garment domestic manufacturing units, and is currently in the process of better understanding technology evaluation, with the assistance of
CITE. SEWA Bharat is also responsible for granting researcher access to informal sewing units under their jurisdiction; without their support, reaching research participants would have been difficult.

Usha International Ltd., as mentioned before, is a major domestic appliance and sewing products manufacturer and distributor in India; Usha is greatly interested in expanding its outreach and business operations to the Base-Of-Pyramid (BoP) market, with the intent of both improving profitability and market presence, as well as furthering social impact among informal textile and clothing workers through the development of context-sensitive technologies. Given that Usha International Ltd. also manages the Silai School program, access to research participants would have been difficult without their support.

Finally, informal workers, as a group, are major stakeholders. Informal workers, especially women, are the primary intended beneficiaries of the results of this thesis. Their inputs and their perspectives on using workplace technology are extremely valuable components of understanding what interventions work in practice. More importantly, without their active participation and informed consent, this research would not be possible.

4.2. Descriptive Analysis: The Urban Experience

Of the 10 sewing units studied, 5 were located in and around the city of New Delhi, and within the borders of India’s National Capital Region (NCR). Such units were also located in neighborhoods that were characterized by (1) predominantly low-income residents, (2) widespread presence of informal economic activities, including hawking, street vending, street
side bartering and informal manufacturing, (3) informal patterns of settlement, including incomplete buildings, housing units built with visibly low-quality cement and bricks, and scarce, if not absent, waste disposal and sanitation infrastructure, and (4) more visible presence of region-specific minority communities, including Dalits and Muslims.

Informal sewing units in Delhi were not representative of the stereotypical image of a factory floor with arrays of sewing workstations; rather, they were compact in terms of area and were not larger than an average one-bedroom single family apartment. The largest such unit was comparable to a 3-bedroom apartment; the smallest unit was comparable to a studio apartment. The majority of units appeared to have a maximum capacity of around 30 individuals. Despite their small sizes, they were adequately ventilated and were equipped with a steady source of electricity (and diesel generators in case of power failure), compact fluorescent lighting, open spaces and chairs for seating administrators and staff, first aid supplies, and storage spaces for raw materials, manufacturing supplies and finished products.

In terms of manufacturing equipment, none of these units possessed heavy industrial or large scale equipment; rather, most manufacturing activities in Delhi involved the use of hand-based sewing techniques, hand embroidery or limited use of domestic sewing machines. This is primarily attributable to the role of SEWA’s units Delhi in the broader scheme of SEWA’s product value chain. SEWA units in Delhi obtain unprocessed clothing material from SEWA-affiliated units in eastern India (such as in Bihar) or unfinished apparel from external manufacturing units; they convert them into furnished and market-ready textile items, for which heavy machinery is not necessarily required. Furthermore, products manufactured using hand
embroidery techniques have added value, especially in international markets.

To this end, owing to the lack of heavy machinery, ambient noise and noise-related hazards were neither observed, not reported by workers to be major concerns. For the same reason, workers also did not report fabric dust and indoor air quality as major causes of concern.

4.2.1. Lifestyles of Informal Workers: Urban

In Delhi, research respondents working at SEWA-affiliated informal sewing units were primarily female. This was not surprising given SEWA’s focus on women empowerment. The vast majority of them were also home-makers in that they were engaged in running household errands, preparing meals, and caring for their children on a daily basis. Some others were simultaneously engaged in the process of pursuing academic degrees in a variety of fields, ranging from Political Science to Fashion Design. To this end, the vast majority of women reported waking up early in the morning, between 5:00 to 6:00 A.M in order to start cooking. After sending their children to school and preparing lunch for their husbands (if married), or for other family members, they reported that they would start work on their daily stitching and sewing tasks, after arriving at the SEWA-affiliated center around 9:00 AM. At the center, these women would be allocated work on a piece-rate basis, depending on outstanding orders and market demand.

In principle, informal workers were expected to work until 5:30 PM. However, given that their payment was on the basis of the number of finished products produced, such women reported not having fixed or set hours of work. They reported having the flexibility to take time off as needed during the course of the day, for activities such as preparing evening snacks and dinner
home, accompanying children to academic coaching classes, and to carry out other household activities. At the same time, however, given that the payment system did incentivize some women to complete as many pieces of finished product in the shortest time period possible, they occasionally worked until late in the night.

While at work, informal women workers preferred to work sitting on the ground in a rough circle, and facing each other. Women in some sewing units opted to use cushions and pillows for this purpose. They were particularly averse to the idea of organized ‘Fordist’ forms of seating; they claimed that sitting on the ground allowed them to have conversations with their co-workers regarding a variety of issues, ranging from personal issues to workplace grievances. They also claimed that the workplace arrangement allowed them to escape what they considered to be monotonous practices and routines (such as daily cooking and household work) in their lives. Some women also suggested that being seated on the ground allowed them to repeatedly flex or move their legs, and that this was much more comfortable for them when compared to being seated on chairs.

4.3. Descriptive Analysis: The Rural Experience

Of the 5 sewing units that were located outside of Delhi, 3 were located in Rajasthan, and 2 were located in Haryana. Such units were located in areas that could neither be classified as completely urban nor be classified as completely rural; while their locations were not within the limits of urban bodies, they were located in very close proximity to some (this thesis defines them as ‘rural’ for the lack of a better descriptor). They were also in proximity to a variety of resources (such as banks, ATMs, and governmental offices) that one would not expect in
traditionally rural areas. In terms of physical space, the locations where these sewing units were located, were village-like, consisting of haphazard street alignment, houses made of bricks, plastered mud, or occasionally concrete, and open sewers. Agricultural activities were pervasive throughout these settlements: houses were interspersed with farms and cropped fields, and animals for agricultural use (such as bulls and horses) could be found in households.

In these settlements, informal sewing units were supported and indirectly administered by Usha International Ltd.; they were prominently marked with banners and signboards. Such units were similar to ones found in Delhi in that they were compact and about the size of an average one-bedroom apartment unit; some units were located in open-air decks of residences, while some others were located in separate buildings that were themselves parts of farms or other manufacturing units. Like urban units, these ‘rural’ units did not have major concerns or reported concerns with fabric dust, noise, and air pollution. However, many unit lacked adequate lighting; some were non-electrified, and some others did not have regular, sustained access to electricity. For units with electricity access, daily power cuts lasting several hours, greatly diminished their productivity (especially during evening hours).

Consequently, technologies used within such units did not require electricity for their operations, by design. Unlike units in Delhi where hand-embroidery and hand-based techniques were dominant, rural units, with Usha International Ltd.’s assistance, were equipped with hand-based sewing machines. Participants in the Silai School program were eligible to purchase sewing machines from Usha International Ltd. on the basis of micro-credit or a standard loan. Usha International Ltd. also provided some of these informal workers with the requisite networks and
linkages needed to sell products manufactured by them. Some units also possessed programmable electric sewing machines; however, their use was disincentivized by unpredictable power supply.

4.3.1. Lifestyles of Informal Workers: Rural

Respondents in the rural informal sewing units had a lifestyle that was qualitatively different from those in Delhi. Most married women reported waking up early in the morning, between 4:00 AM and 5:00 AM, to start cooking for the day and to feed cattle and other domestic animals. During the day, they turned their attention to sewing activities; they continued working until the late afternoon beyond which they had to return to household work, attending to the needs of their children, and performing miscellaneous agricultural work. Women who were not married were primarily engaged in attending college; during their spare time, they regularly engaged in sewing activity not for the purpose of employment, but for the purpose of skill development. These workers also considered stitching and sewing activities as a means of future earning and financial self-sufficiency, especially after marriage. However, this trend appeared to not simply a function of personal preference. When asked about plans for the future, most women workers reported wanting to open either textile or tailoring businesses or set up beauty parlors. Subsequent informational interviews conducted with sewing unit managers revealed that heteronormative belief systems were highly prevalent in these locations and that sewing activities were not only seen as being ‘womanly’ but were considered valuable skills in local matrimonial traditions.

At work, most informal workers preferred to perform workplace activities while sitting on the ground in a roughly circular pattern. Like informal workers in Delhi, they reported that the seating arrangement enabled them to engage in personal as well as professional conversations.
with their colleagues. Some workers used pillows and cushions to support their backs; some others preferred to rest against walls as needed.

Rural workers relied on hand-operated sewing machines as the primary manufacturing equipment. These sewing machines were designed such that they could be operated using a crank and did not require the use of a pedal or other forms of actuation; therefore, their use was possible given the preferred seating arrangement. Finally, workplace activity in the rural sewing units was affected by fluctuating product demand: even though many of these units produced textile products, they found it difficult to obtain bulk orders. Informal workers and center managers attributed this to remote location, and to competition from more formal sewing units located near urban centers. To this end, workers were supportive of mechanization and the introduction of technologies that would enable them to make finished products at a faster rate.

4.4. Thematic Analysis

As mentioned above, 10 focus group discussions were conducted in different parts of New Delhi, Haryana and Rajasthan. Data was anonymized to remove name, place, age, address, and other potential forms of individual identification. Research was conducted in January 2017 with the support of the MIT Tata Center. The characteristics of focus groups were as follows:
5 out of 10 focus group discussions were conducted in New Delhi (affiliated with SEWA Bharat), whereas the remainder were conducted in rural areas in Rajasthan and Haryana (affiliated with the Usha Silai Schools program). In total, 88 individuals participated in the 10 focus group discussions. In addition, 10 key informant interviews were also conducted.

After data collection using focus group discussions and interviews, information was evaluated for common themes, patterns, and recurrences. This was done using a systematic and iterative process of coding qualitative data, and identifying themes and sub-themes.

4.4.1. Identifying Dependent and Independent Variables

Based on qualitative and quantitative data collected during focus group discussions and
key informant interviews, the following variables were identified after reviewing and processing interview notes. Some variables were omitted from thematic analysis because the set of dependent variables did not necessitate their study. For example, 'Wrist Posture' as an independent variable was omitted because of the lack of an established causal link or correlation with three most common workplace conditions reported.

The following section seeks to provide detailed information regarding some of these dependent and independent variables, including Work-related health conditions, Nature of Work, Health Awareness and Health Services, Type of workplace equipment, Repetitive activities, Neck posture and Back posture.

**Work-related Health Conditions**

Work-related health conditions prevalent within these groups were as follows:
The most prominent health condition reported by respondents was low-back pain, prevalent in 75 respondents or 88.2% of the sample size. Shoulder pain was prevalent among 50 respondents (58.8% of the sample size), while eye-strain was present in 45 respondents (52.9% of the sample size). Miscellaneous health concerns (such as occasional headache and wrist pain) were prevalent in 34 respondents (40% of the sample size).

Informal workers reported low-back pain during different kinds of sewing activity, as well as hand-embroidery activity. They described them as ‘aching’ and often lasting well into the evening and night hours. Upon requesting them to describe their symptoms in greater detail, informal workers said that back pain began about 15 to 30 minutes after starting work, and that pain was localized to the lower portions of their backs. Very few respondents reported any form of upper back pain. Furthermore, they reported that low-back pain hindered them from effectively carrying out several daily tasks, such as cooking at home, carrying out household errands, catering to the educational needs of children, and often, effectively performing sewing and embroidery.
tasks themselves. Respondents also reported that they were occasionally forced to take long breaks during work hours, and at times, absent themselves from work. Two respondents in Delhi expressed concerns that their back pain had led to several days of absence and that their monthly earnings were declining as a result. Upon enquiring about whether respondents had ideas about why they suffered from low-back pain, they cited sitting on the floor as a major reason. As mentioned in the previous section, most informal workers sat on the ground in circles and in some places, used pillows and cushioned mattresses. Nevertheless, the majority of respondents were not willing to change or substantially modify their position: claiming to be familiar with their style of working, they were reluctant to perform the same tasks in a different position.

The second most prominent health condition was shoulder pain. Respondents reported shoulder pain during different forms of sewing activities. Shoulder pain also occurred regardless of the height of sewing equipment: reported incidences of shoulder pain during hand-embroidery activities was more or less the same as reported incidences with hand operated or manual sewing machines. Informal workers who reported shoulder pain described their symptoms as a source of distraction that prevented them from being productive, quick, and nimble while working. They also reported that shoulder pain forced them to take frequent breaks during the course of work; however, this did not result in significant absences from work. The lone exception was that respondents using mechanized/automated sewing machines and associated tables and seating arrangements did not report any shoulder pain.

The third most prominent health condition was eye-strain. Eye-strain is not a repetitive strain injury in the traditional sense, given that it does not involve musculoskeletal dysfunction
on the lines of other known RSI syndromes. However, it was included in the list of conditions observed because it was widely reported. Respondents reported that eye-strain manifested, on average, ten to fifteen minutes after the commencement of sewing and stitching activity; they further reported that their eyes turned red, sore and weepy after prolonged work. A number of respondents reported using spectacles and prescription eye drops to relieve their condition; they further suggested that eye strain was greater when they worked with darker shades of fabric. It was unclear from interviews as to whether these were prescribed for a specific medical condition such as myopia. A handful of respondents reported a gradual decline in the quality of their eyesight (over several years) after beginning sewing work. They also reported that they were considered legally blind and ‘disabled’ as a result of poor eyesight. It was not clear if these vision-related issues were directly related to sewing activities.

Comparing urban versus rural sewing units, the prevalence of repetitive strain disorders was surprisingly similar. This was true for low-back pain, shoulder pain as well as eye strain. During the process of processing data collected during fieldwork, this finding was completely unexpected, given that the expectation was to find greater prevalence of repetitive strain injuries in urban settings where manufacturing demand is known to be higher and where work hours are known to be longer.
RURAL VS URBAN DIFFERENCES: REPETITIVE STRAIN DISORDERS

Nature of Work

In terms of nature of work and occupation, 36 out of 88 respondents reported working primarily in the Textile and Clothing sector. 34 respondents reported primarily working as homemakers, meaning that their primary daily occupation was centered on managing household affairs. However, they also undertook garment and sewing on a part-time basis. 15 respondents report being employed as beauticians, school teachers, and miscellaneous part-time workers. 3 respondents reported working primarily in agriculture.
In terms of income, informal workers in New Delhi reported amounts from Rs. 5,000 per month to Rs. 15,000 per month, with a rough average of Rs. 7,000 per month. In Rajasthan and Haryana, the amounts ranged from Rs. 4,000 to Rs. 8,000, with some outlying responses around Rs. 15,000. The average, in this case, was around Rs. 5,000. Upon enquiring about their motivations to find employment in the textile and clothing sector, the vast majority of informal workers hinted at an economic rationale: they believed that they would be able to contribute to their family’s earnings by participating in informal sewing, tailoring, and embroidery work. Several others believed that working in the textile and clothing sector was the most expedient choice for their personal and professional lives: given that many of them were married and had children, they believed that working in this sector was one way of balancing financial needs and tasks at home in their capacity as homemakers. Over 70% of respondents also replied that
participating in such provided them financial and social autonomy, as well as an enduring set of friends and social connections. Respondents opined that in doing so, they were able to feel a greater sense of social belonging.

**Estimated Hours of Work Per Week**

Many informal workers reported that working for longer hours at a stretch made them experience more symptoms of pain and discomfort. Based on individual accounts of daily life provided by informal workers during the course of focus group discussions, and key informant interviews with sewing unit managers, an estimate of the number of hours worked by respondents on sewing and sewing-related tasks was calculated. The results were as follows:

<table>
<thead>
<tr>
<th>Hours Worked Per Week</th>
<th>Number of Informal Workers</th>
</tr>
</thead>
<tbody>
<tr>
<td>&lt; 20 hours per week</td>
<td>43</td>
</tr>
<tr>
<td>20 - 40 hours per week</td>
<td>31</td>
</tr>
<tr>
<td>&gt; 40 hours per week</td>
<td>14</td>
</tr>
</tbody>
</table>

43 out of 88 informal workers reported working less than 20 hours per week. 31 informal workers reported working between 20 - 40 hours per week. 14 informal workers reported working
more than 40 hours a week, including on weekends. However, caution is required in interpreting this data because the number of hours worked is dependent on demand of products. The vast majority of data points for ‘< 20 hours per week’ was derived from rural units; given that rural units also reported difficulty in obtaining orders, demand for products could be a confounding factor. Furthermore, informal workers affiliated with SEWA informed that they were nominally expected to work from around 9 AM in the morning until 5.30 PM in the evening, even though their work schedule was highly flexible.

HOURS WORKED PER WEEK (RURAL VS URBAN)

Health Awareness and Healthcare Services

Another emergent theme was related to Health Awareness and Health Services. When asked about the actions that informal workers took regarding their health conditions, the vast majority (80%) of respondents replied that they were reluctant to seek treatment. Such reluctance was ascribed by supervisors and unit managers to primarily, (1) a lack of awareness that work-
related disorders existed, and that they could be treated and remedied, and (2) a perception that such issues were trivial and not warranting of medical attention. Many informal workers themselves reported that they did not perceive their work-related health conditions to be of concern. Some others reported facing financial difficulties on a regular basis, and as a result of apprehension relating to healthcare expenditure, were dismissive of health concerns. In particular, two informal workers had concluded that their health conditions were an accompaniment to their jobs and that they simply had to be tolerated; they mentioned that despite having sought treatment in the past, they feared the financial consequences of seeking further treatment. At the same time, nearly 55% of respondents reported taking occasional breaks from work in order to rest and recover. Around 17% of respondents reported using some form of medication (including over-the-counter analgesics and pain reliever rubs) to relieve their symptoms; this was also similar to the percentage of respondents (nearly 14%) that reported visiting a doctor for the health issues they reported.

![Engagement with Healthcare](image)

Furthermore, when comparing data from urban and rural sewing units, it was amply evident that respondents in urban areas (i.e. neighborhoods of Delhi) were more likely to seek
medical help and to take breaks from work as needed. Respondents in Delhi were also much more likely to visit a medical professional, and take medication for their health concerns. One potential explanation in this regard is that SEWA offers free health check-ups for informal workers in SEWA-affiliated unit. Another explanation could point to social norms regarding seeking help for medical conditions; seeking medical help, especially for poorly recognized work-related health conditions, may be seen as more acceptable in urban areas than in rural areas (where they could be seen as extraneous and wasteful initiatives).

**URBAN VS RURAL**

<table>
<thead>
<tr>
<th>Percentage of Respondents</th>
<th>Rural</th>
<th>Urban</th>
</tr>
</thead>
<tbody>
<tr>
<td>Use Medication As Needed</td>
<td>14%</td>
<td>3%</td>
</tr>
<tr>
<td>Take a Break From Work</td>
<td>34%</td>
<td>12%</td>
</tr>
<tr>
<td>Visit a Doctor</td>
<td>2%</td>
<td>10%</td>
</tr>
</tbody>
</table>

**Types of Equipment Used**

Technology usage within these groups was as follows:
Of the 88 respondents, 31 respondents were familiar only with hand-embroidery techniques. 55 were trained in using manual and hand-operated sewing machines, while only 2 were equipped in using mechanized sewing machines. There were no respondents who reported being trained only in hand operated machines, without knowing hand-embroidery techniques.

Respondents not familiar with any kind of sewing technology were well-versed in hand embroidery and associated manual stitching and sewing activities. In terms of hand-embroidery techniques, there was no predominant form of training or method. Rather, tools (such as hand-embroidery needles), techniques and, styles were highly dependent on the region, local sources of sewing knowledge, and traditional, often inherited, practices. Designs and styles were also influenced by the needs of clients and market trends.

55 respondents were familiar with the use of manual or hand-operated sewing equipment, including domestic sewing machine products belonging to Usha, Singer, and other brands. Only 2 respondents were familiar with the use of mechanized or automated sewing machines. In terms of hand-operated sewing machines, the vast majority of informal workers used sewing machines that were placed on the ground and were operated using a hand crank mechanism.

Upon enquiring about why many of those performing hand embroidery were not inclined to learn how to use hand-operated or manual sewing machines, many informal workers indicated that they were apprehensive of bringing about drastic change in their working styles. They were not able to articulate further. Furthermore, upon asking whether informal workers would prefer automatic sewing machines, two different streams of response emerged. Respondents in New
Delhi opined that hand embroidery was what differentiated their products in the highly competitive textile and clothing market; they feared that automation would ultimately disrupt their livelihoods by reducing their incomes due to decreased demand, and by displacing them from their jobs. On the contrary, respondents in Rajasthan and Haryana were open to mechanization; they opined that they would be able to manufacture more products per unit time and would be able to better perform their domestic responsibilities if they had access to automated machines. Some feared that the lack of regular electricity supply in rural areas would disrupt the manufacturing process.

**Repetitive activities**

Repetitiveness of tasks was inferred from key informant interviews and answers elicited during focus group discussions; obtaining direct information was a challenge because of many informal workers were unable to articulate or provide specific answers. For measuring repetitiveness, this section borrowed guidelines from the Assessment of Repetitive Tool (ART) on Arm Movements and Repetitiveness of Tasks (Health and Safety Executive 2015). The tool was designed to be completed by an observer. The variables were defined as follows:

<table>
<thead>
<tr>
<th>Arm Movements</th>
<th>Low</th>
<th>Some intermittent movement</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Medium</td>
<td>Regular movement with some pauses</td>
</tr>
<tr>
<td></td>
<td>High</td>
<td>Almost continuous movement</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Repetitiveness of Tasks</th>
<th>Low</th>
<th>10 times per minute or less</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Medium</td>
<td>11–20 times per minute</td>
</tr>
<tr>
<td></td>
<td>High</td>
<td>More than 20 times per minute</td>
</tr>
</tbody>
</table>
Repetitive tasks were found to be substantially more strenuous than arm movements; this trend also correlated with informal workers using hand-operated machinery.

**Neck and Back Posture**

Using reported information, neck and back posture was assessed using a binary classification system. Upright position while engaged in sewing tasks was rated as ‘Unflexed’ while positions involving bending and twisting were rated as ‘Flexed’. As expected, findings were consistently higher for flexion for both the neck and the back.
A correlation was observed between Back Flexion and all three of the work-related health conditions, across rural and urban sewing units, implying that it may be a common factor in precipitating nearly equal incidences of repetitive strain injury in disparate locations. As can be seen below, posture among respondents was similar between rural and urban units.

### NECK AND BACK POSTURE: RURAL VS URBAN

<table>
<thead>
<tr>
<th></th>
<th>Rural</th>
<th>Urban</th>
</tr>
</thead>
<tbody>
<tr>
<td>Neck Flexed</td>
<td>29</td>
<td>30</td>
</tr>
<tr>
<td>Neck Unflexed</td>
<td>8</td>
<td>11</td>
</tr>
<tr>
<td>Back Flexed</td>
<td>28</td>
<td>29</td>
</tr>
<tr>
<td>Back Unflexed</td>
<td>9</td>
<td>12</td>
</tr>
</tbody>
</table>

#### 4.4.2. Conclusions

Summing up, processing of data collected during fieldwork revealed distinct workplace arrangements, preferences and lifestyle-based adaptations that informal workers prioritized during the course of their daily activities. In particular, among informal workers, three different clusters of health conditions: low-back pain, shoulder pain and eye strain were common. Data also revealed some of the benefits and shortcomings of workplace technologies currently used by informal workers. Furthermore, data demonstrated that informal workers were generally very reluctant to seek medical care for their health concerns; this was due to a variety of reasons ranging from a lack of awareness that such issues could be medically addressed, to fears that healthcare costs would be prohibitive and disruptive to their finances.
5. IMPLICATIONS FOR INTERVENTIONS

The section presented above has revealed several persuasive findings that can be summarized under four categories:

- Interventions in Engagement with Technology healthcare services
- Areas for Intervention
  - Repetitive Activities
  - Posture

The objective of this section is to briefly consider some off-ramps that could build on the findings and the conclusions of this thesis.

5.1. Making Workplace Technology Context-Sensitive

Considering the category of ‘Interventions in Technology’, the analysis presented in the previous section demonstrates a possible link between the three most common health conditions observed, and the use of both hand embroidery and hand-operated sewing machinery. The analysis also demonstrates that these health conditions do not substantially vary with changes in the type of technology used. These results must be interpreted with caution because there is no implied causality. Furthermore, results for mechanized sewing machines are likely challenged by the extremely small proportion of respondents (n = 3) who actually used them.
In the domain of technical interventions within the workplace, possible off-ramps include solutions that prioritize the use of decentralized and scalable technology, convenient for deploying in informal sewing units. Such technologies may not only represent a novel Base-Of-Pyramid market opportunity for companies like Usha International Ltd., but may also provide for an opportunity to tie the competing goals of product affordability, meaningful ergonomic support, and profitability for manufacturers, wholesalers, and retailers. Based on focus group discussions and informational interviews, one such solution involves researching and developing context-specific 'embroidery workstations' that would allow for informal workers to be (1) seated in a posture-corrected position capable of addressing low-back pain and shoulder pain concerns, (2) seated in well-lit environment that provides adequate lighting in order to ease eye strain, and (3) able to socialize and engage in conversations at the workplace in accordance with their preferences, and (4) be able to bridge their lifestyles with the workplace environment, through use of ancillary options for workplace convenience.

A second approach involves developing incremental, affordable and distributable workplace products to supplement existing sewing machines and hand-embroidery equipment (such as needles and scissors), in order to provide necessary musculoskeletal support. For example, ergonomic glove prototypes developed and tested by (Muralidhar, Bishu and Halbeck 1999) offered a balance between hand dexterity and ergonomic protection. Similarly, a wearable weight support device designed to reduce shoulder fatigue, developed by (Park and Cho 2017) and tested within a small sample, demonstrated efficiency in decreasing variation of muscle activation when compared to controls.
5.2. Addressing Repetitive Activities

In terms of ‘Repetitive Activities’, a variety of organizational and technical solutions are possible. One finding of this research was that many informal workers around or above 40 hours every week performing repetitive activities and that they performed, on average, 10-20 repetitions of tasks per minute without substantial breaks. Given that the literature on ergonomics widely supports a causal link between the duration and intensity of repetitive activities and prevalence of repetitive strain injuries, a readily implementable organizational solution involves the introduction of required breaks during the course of work. For example, a stretch-break program study was conducted by (Martins, Zicolau and Cury-Boaventura 2015), which revealed that after 6 months, musculoskeletal complaints significantly decreased, and hand and shoulder flexibility significantly increased. However, during one of the key informant interviews, some sewing unit supervisors noted that the pace of production had to be maintained in order to successfully deliver orders and meet client needs. Therefore, the application of this policy intervention would have to be balanced with firm-level manufacturing capacity and demand for products.

A technical solution targeting repetitive activities, in order to alleviate shoulder pain and low-back pain, involves the replacement of hand-cranks in manually operated sewing machines (a design feature in use for the past seven decades) with ergonomic and automated actuation mechanisms. This could involve currently existing small-scale battery-operated mechanisms or other forms of actuation that are beyond the scope of this thesis.

5.3. Addressing Posture

In terms of posture, a major technical intervention intended to alleviate low-back pain and
shoulder pain involves the design and development of sewing tables that are height-adjustable. Currently, such tables are available in countries such as the United States, primarily for use in specialized assistive technology workstations, where they have been proven to be very effective. However, no affordable technical alternative exists. The development of low-cost tables for sewing activities can theoretically ameliorate strain induced by back and neck flexion and by excessive arm movement. Till date, height-adjustable desks have been studied for issues concerning sedentary workplace activity and for circumstances where workers many have to alternate between sitting and standing positions. However, given this study’s finding that back and neck flexion were present in circumstances where workers sat on the ground, height-adjustable tables with the ability to control height in small increments can offer a pathway to posture correction. Such desks would also have to be accompanied by context-sensitive ergonomic chairs; however, the design and development process of such chairs needs to take into account this study’s finding that informal workers prefer to sit on the ground for various reasons, including socializing during work.

5.4. Engagement with healthcare services

Finally, considering engagement with healthcare services, one potential organizational and policy solution can entail a comprehensive health screening and awareness program aimed at not only yearly or bi-yearly medical screening tests, but also provision of education material on repetitive strain injuries, their causes, long-term effects, and preventive solutions. Such a solution is intended at targeting the strong tendency of informal workers to not seek treatment or remain reluctant to seek treatment due to a variety of economic an social pressures. At the moment,
SEWA provides healthcare coverage to affiliated informal workers. However, they appear to be limited to therapeutic services, as opposed to preventative services and preventative medical advice. Therefore, such a program would have to be supplemented with healthcare screening programs, preferably provided by organizations such as Usha and SEWA, through which trained medical experts could not only provide essential care with regards to repetitive strain injuries, but also prescribe measures on an individual basis for the prevention of repetitive strain injuries.
6. LIMITATIONS

This study has a number of limitations that may impact generalizability of findings and applicability in other contexts. First, even though the textile and clothing sector has been well studied, obtaining information on informal manufacturing within this sector, particularly in India, was a challenge. To this end, conducting research in a data-scarce environment posed difficulties in terms of reaching out to a greater number of informal workers, and in terms of obtaining detailed statistics on the current state of informal textile and clothing manufacturing in India.

Second, a more rigorous quantitative study using surveys was not conducted. Towards the middle of thesis research, feedback from field partner organizations implied that the set of dependent variables themselves were not clear. As a result, the use of survey instruments was ruled out in favor of more qualitative and exploratory research methods. Furthermore, even though focus group discussions and informational interviews provided a large amount of individual and group-based data, a fairly small sample size (n=88 and 10 FGDs) was limiting.

Third, even though the research methods employed tried to be cognizant of power structures and social hierarchies within and between informal sewing units, a comprehensive study of power dynamics involving different actors was neither possible within the available time period for research (around 10 months) and within the scope of the non-traditional client-based nature of this thesis. However, the analysis presented in the previous sections do preliminarily identify power hierarchies and power dynamics; these can be used as foundations or starting points for future research.
7. CONCLUSIONS

Using a predominantly qualitative approach with quantitative elements, this thesis attempts to understand the social and technical determinants of ergonomic risk within informal sewing units. Using data obtained from fieldwork conducted in January 2017 with the support of the MIT Tata Center for Technology Design, Usha International Ltd., and SEWA Bharat, the thesis demonstrates the widespread prevalence of three different work-related health conditions. By understanding the nature of technology used within informal sewing units, as well as the lifestyles of informal workers, the thesis attempts to suggest a number of recommendations that could be used by partner organizations as implementable interventions or as foundations for future research. As mentioned before, this thesis does have a number of limitations relating to the scarcity of secondary data and sample size. Nevertheless, the thesis offers the takeaway ‘repetitive strain injuries’ in the context of work are not merely distractions or discomforts, but health concerns that are highly disruptive to informal workers’ livelihoods as well as productivity of sewing units. The thesis also serves to reinforce the idea that studying usage characteristics of workplace technology from the bottom-up can serve as an empathetic approach to understanding context-sensitive technologies and that such an approach can lead to the understanding of workplace conditions and dynamics in ways that have not been seen otherwise.
WORKS CITED


Simanis, Erik. 2012. "Reality Check at the Bottom of the Pyramid." June.
APPENDIX 1: RESEARCH PROTOCOL

CONSENT TO PARTICIPATE IN FOCUS GROUP DISCUSSION

STUDY TITLE: “Studying technical and social determinants of product usage characteristics within informal sewing units in India: Recommendations for designing and developing ergonomic sewing products”

You have been asked to participate in a research study conducted by Jaswanth Madhavan from the Department of Urban Studies and Planning at the Massachusetts Institute of Technology (M.I.T.). The purpose of the study is to understand how sewing products are used within sewing units in India, so that healthier sewing products can be designed and developed. The results of this study will be included in Jaswanth’s Masters thesis. You were selected as a possible participant in this study because of your involvement in the informal textile and clothing sector. You should read the information below, and ask questions about anything you do not understand, before deciding whether or not to participate.

• Participation in this focus group discussion is voluntary. You have the right not to answer any question, and to withdraw from the discussion at any time or for any reason. I expect that the entire discussion will take about 45 minutes.

• You will not be compensated for participation.

• Unless you give us permission to use your name, title, and/or quote you in any publications that may result from this research, the information you tell us will be confidential.

• I would like to record this discussion so that I can use it for reference while proceeding with this study. I will not record without your permission. If you do grant permission for this conversation to be recorded, you have the right to revoke recording permission and/or end the interview at any time.

This project will be completed by May 31st 2017. All interview recordings will be stored in a secure work space until 1 year after that date. The tapes will then be destroyed.

I understand the procedures described above. My questions have been answered to my satisfaction, and I agree to participate in this study. I have been given a copy of this form.

(Please check all that apply)

| I give permission for this focus group discussion to be recorded. |
| I give permission for the following information to be included in publications resulting from this study: |

| my name | my title | direct quotes from this interview |

Name of Subject _______________________________

Signature of Subject __________________________ Date ____________

Signature of Investigator __________________________ Date ____________

Please contact Jaswanth Madhavan (jaswanth@mit.edu) with any questions or concerns.

If you feel you have been treated unfairly, or you have questions regarding your rights as a research subject, you may contact the Chairman of the Committee on the Use of Humans as Experimental Subjects, M.I.T., Room E25-143b, 77 Massachusetts Ave, Cambridge, MA 02139, phone 1-617-253-6787.
SAMPLE FOCUS GROUP DISCUSSION PROTOCOL (TENTATIVE)

Date:
Location:
Number of Participants:

Consent forms to be distributed at the beginning.

Facilitator Prompt: Hello, my name is Jaswanth Madhavan. I am a researcher and a student at the Massachusetts Institute of Technology, USA. Thank you for taking the time to participate in this focus group. This focus group is part of a larger study that seeks to understand how sewing products (such as sewing machines) are used on a day-to-day basis. By speaking with all of you today, I hope to understand the social and technical challenges that you face while using sewing products. In doing so, I hope to come up with designs and ideas for sewing products that are easier, healthier and safer to use. This discussion will last for approximately 45 minutes.

1. Let us go around and share our names and our occupations.
2. What kind of sewing products do you use on a daily basis?
3. Can you describe in detail how you use such products? What is the standard usage procedure?
4. What are your experiences using them?
   a. Do you find any of these products to be particularly difficult to use? If yes, why?
   b. Have any of these products caused you any kind of pain or discomfort? Muscular stress? Sprains and strains? If yes, how so?
   c. Have any of these products caused other kinds of health difficulties?
   d. Do you believe that these products can be improved in any way? Do you have ideas that you’d like to share with me today?
5. We have been talking about products that we all use during our work. Now, let’s talk about our daily lives.
   a. Does your work provide you with enough money to lead a comfortable life? If yes, how so? If no, how so?
   b. What are some of your concerns regarding your work? Conversely, what are some reasons that make you satisfied with your work?
   c. How do you balance the demands of work with the demands of family and relatives? How easy is it for you to do what you aspire to do?
6. Finally, if you could name and describe one aspect of your life that you want to see greatly improved, what would it be?

Thank you all for your time, consideration and support. I assure you that I will make the best possible use of this interview to help understand how better workplace products can be developed.
INFORMATIONAL INTERVIEW CONSENT FORM

CONSENT TO PARTICIPATE IN INTERVIEW

STUDY TITLE: “Studying technical and social determinants of product usage characteristics within informal sewing units in India: Recommendations for designing and developing ergonomic sewing products”

You have been asked to participate in a research study conducted by Jaswanth Madhavan from the Department of Urban Studies and Planning at the Massachusetts Institute of Technology (M.I.T.). The purpose of the study is to understand how sewing products are used within sewing units in India, so that healthier sewing products can be designed and developed. The results of this study will be included in Jaswanth’s Masters thesis. You were selected as a possible participant in this study because of your involvement in the informal textile and clothing sector. You should read the information below, and ask questions about anything you do not understand, before deciding whether or not to participate.

- This interview is voluntary. You have the right not to answer any question, and to stop the interview at any time or for any reason. I expect that the interview will take about one hour.

- You will not be compensated for this interview.

- Unless you give us permission to use your name, title, and / or quote you in any publications that may result from this research, the information you tell us will be confidential.

- I would like to record this interview so that I can use it for reference while proceeding with this study. I will not record this interview without your permission. If you do grant permission for this conversation to be recorded, you have the right to revoke recording permission and/or end the interview at any time.

This project will be completed by May 31st 2017. All interview recordings will be stored in a secure work space until 1 year after that date. The tapes will then be destroyed.

I understand the procedures described above. My questions have been answered to my satisfaction, and I agree to participate in this study. I have been given a copy of this form.

(Please check all that apply)

[ ] I give permission for this interview to be recorded.

[ ] I give permission for the following information to be included in publications resulting from this study:

[ ] my name  [ ] my title  [ ] direct quotes from this interview

Name of Subject ________________________________

Signature of Subject ____________________________ Date ____________

Signature of Investigator _______________________ Date ____________

Please contact Jaswanth Madhavan (jaswanth@mit.edu) with any questions or concerns.

If you feel you have been treated unfairly, or you have questions regarding your rights as a research subject, you may contact the Chairman of the Committee on the Use of Humans as Experimental Subjects, M.I.T., Room E25-143b, 77 Massachusetts Ave, Cambridge, MA 02139, phone 1-617-253-6787.

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SAMPLE INFORMATIONAL INTERVIEW PROTOCOL (TENTATIVE)

Date:

Location:

Occupation Category: Group Leader, Manager, Topical Expert, Government Official, Other

Prompt: Hello, my name is Jaswanth Madhavan. I am a researcher and a student at the Massachusetts Institute of Technology, USA. Thank you for taking the time to participate in this interview. This interview is a part of a larger study that seeks to understand how sewing products (such as sewing machines) are used on a day-to-day basis by informal workers. By speaking with you today, I hope to understand the social and technical challenges that many informal workers face, while using sewing products. In doing so, I hope to come up with designs and ideas for sewing products that are easier, healthier and safer to use. This discussion will last for approximately an hour

Questions

1. Can you tell me more about your occupation and your role in understanding the informal textile and clothing economy/industry?

2. What prompted you to take up your current position?

3. Before I move to denser topics, I would like to ask you about how you classify work within the textile and clothing informal industry. As in, what do you think are distinct segments and categories within this sector?

4. In your opinion, what consists of the informal economy or the unorganized sector? In what ways can this sector be distinguished from the formal sector?

5. Now, let us move to some questions that are specific to my research topic. What are, in your opinion, major issues confronting the textile and clothing informal economy/industry these days?

6. In what ways do these issues affect textile and clothing informal workers? What are some major issues faced by informal workers themselves?

7. At the level of the workplace:
   a. Can you give me an overview of the different kinds of sewing products in use?
   b. What are some health issues that informal workers face while using sewing products (such as sewing machines and embroidery machines)?
   c. Are repetitive strain injuries and musculoskeletal disorders (such as sprains and strains) at the workplace a cause of concern? If yes, how?
   d. I am aware that a disproportionate number of informal workers in the textile and clothing economy/industry are women. Does being a woman make these issues easier or harder? What are some social and gender issues that influence such outcomes?

8. What kind of changes, do you think, would lead to the mitigation of some of these issues?

9. Specifically:
   a. Would redesign of sewing products work?
   b. Would policy and legal changes instituted by the government work?
   c. How about workplace and organizational reform?

Finally, can employment/skills training and awareness programs make a difference?