Can Automation Displace Women's Work in the Apparel Industry?

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Abstract

Supply chains linked to manufacturing have been instrumental in creating a pathway to economic progress in the Asia-Pacific region. Chief among the sub-sectors has been the apparel industry – with its promise of employment generation for women and largely uninterrupted supply chains with a global reach. The sector, however, has become highly specialised and competitive. With fast fashion trends and the pressure to keep up, the labour-intensive sector is fast replacing its simple cut-make-trim model with technological innovations. The pandemic and the resultant pressure to reduce costs may have given the necessary impetus for the sector to accelerate the automation and digitalisation process. But how well are the respective economies holding up against this digitalisation of their workplaces? What impact does this have on women, who have been traditionally assigned these factory floor jobs? What can be done, at the policymaking level to respond to the possible displacement of female workers from the manufacturing and apparel sector? Informed by feminist thinking on women and technology, this paper uses a sustainable labour lens to review secondary data and literature on the supply chains in a few select countries in the Asia-Pacific, including Sri Lanka, Bangladesh, and India from South Asia. We raise the question of if automation of a labour-intensive sector such as apparels, can displace women's work, and draw out some measures to possibly minimise its impact in the face of rapid introduction of automation.

1. Introduction

Technological innovation and advancements are considered the cornerstones of our present-day societies. They promise to shape the way we view the world, how we interact with each other, as well as our life choices. They also threaten to create new inequalities or compound existing ones and also potentially reshape the social order. One of the critical aspects where technological advancements have had the most impact is work – an aspect that has received much attention since the industrial revolution. While technology may have revolutionised the economies and societies we live in, the constant re-shaping of the workplace demands that workers are able to adapt to these changes and have the necessary skills and knowledge to stay abreast of these changes.

In a landscape where there is a "fear of jobless growth" (de Mattos, Dasgupta, Jiang, Kucera and Schiavone, 2020) precipitated by advanced technology, it is apt to examine how this would affect different types of workers. First, can all workers adapt as necessary? Are job losses not imminent or "natural" when technology replaces human labour? Does automation mean replacement of human labour completely, or a more hybrid version? While these questions have been raised many times before, the prolonged pandemic and its direct impact on production lines, are visited in this paper, especially in relation to the apparel industry, to understand how accelerated automation impacts female workers in particular, and the possible ways in which the negative impacts of such displacement of work can be reduced.

Globally, the fourth industrial revolution (4IR) is set to revolutionise our lives, including our work and workplaces. Artificial intelligence (AI), the internet of things (IoT), robots, quantum computing, nano and biotechnology, and other technologies that allow for increased digitalisation and the creation of increasingly complex and high-value outputs define the 4IR (Foreign Affairs, 2016). But the speed at which countries and regions adopt such advanced technology will also be determined by the infrastructure in place, the ability to raise capital and the demand for such adaptability. While the nexus between society and technology receives greater attention now, in this paper, we focus mostly on work in general, and the jobs of women in the labour-intensive apparel sector in the Asia-Pacific. The objective is to consider how technological innovations and increased automation have or can potentially impact women's jobs on the factory floor. While we recognise that the impact of digitalisation would vary on the type of work, the sector, and the skills adaptability; by focusing on the so-called bottom of the barrel, we seek to highlight how governments can set up measures to better prepare women for the changes underfoot.

The focus on the apparel sector in the Asia-Pacific is warranted by the types of conversations taking place in relation to automation and reshoring. The historical trajectory of the apparel sector and its 'migration' (Minian, Martinez and Ibanez, 2016) across different regions supports the argument that apparels may undergo yet another major shift in the coming years, especially as near-shoring and off-shoring become commonplace. As part of a global value chain (GVC), making critical contributions to national economies, focusing on the apparel sector workers, and the risk for labour to be replaced by machines, is therefore, a timely conversation.

The reason to focus on women is multi-fold. Technological transformations tend to be gendered, as argued in the 'Women, Gender and Work' (2017) publication of the International Labour Organization. Industrialization was largely a gendered process that drew on cheap, available, and 'malleable' labour. This trend appears to continue, as the apparel sector exemplifies. But as technological advancements reshape manufacturing processes, women may experience job losses. This also raises the question of "what is best for whom",

especially in relation to the introduction of technology.

This paper, therefore, draws on feminist thinking on women's relationship to technology to ground the available data and evidence on how automation would impact the labour-intensive garments industry in some countries in South Asia (i.e., Bangladesh, India, Sri Lanka) and Vietnam and Cambodia in Southeast Asia and thereby, evaluate the possibilities for sustainable labour to be achieved in the sector.

In this context, sustainable labour denotes that all workers will enjoy universally accepted minimum standards of work and adequate wages that enable them to balance their work and personal lives. Achieving these minimum standards also mean that workers are protected when job losses are experienced or allow for workers to aspire to lateral and vertical migration of the career ladder. However, the transnational nature of capital flows and the growth of global value chains that transcend national borders, as illustrated in the case of the apparel industry, can make reaching these standards of work more challenging. Hence, our focus on critically reviewing the capacity of the GVC to meet such standards in the face of automation.

2. Troubled Relationship with Technology? Feminist Perspectives

Theorising on how technology affects our lives points to the uncomfortable relationship we have with the 'unknown', but also the lessons that have learned over generations on how change can have differential impacts based on social class, ethnic, and religious identity, as well as gender. It is in this context that feminists approach the question of technology. As Wajcman (2006) argues, some adopt a pessimistic opinion in relation to technological advancements as it is seen to reproduce the social inequalities women already face, whereas others view the spread of technological advancements and progress as liberating for women. While the former is based on traditional and historical marginalisation women have faced, the latter points to the new possibilities that have emerged as a result of the anonymity online platforms offer, especially for opening up space for gender blindness and fluidity. Similarly, advancements in bio-technology are viewed as favourable to expanding women's decisions on reproductive rights.

In the face of increasing adoption of online platforms for work, it was women who were initially believed to be better prepared: women in the developed world were initially seen to be more adept and prepared for a shift to this virtual space as they were better-educated and more independent (Wajcman, 2006). In contrast, the mid-twentieth-century changes to the factory floor were detrimental to men whose jobs were increasingly under threat of being replaced by automated systems (Wajcman, 2006). That women were more prepared for the 'shift' however, appears to stem from a western-oriented ideological stance, as women in the Global South, despite advancements in literacy levels and educational attainments, have not been able to progress significantly beyond semi-skilled, low-wage work.

But women's 'troubled' relationship with technology is also grounded in the patriarchal structures that determine access to education and work. First, women are already culturally disadvantaged in terms of accessing and using technology. Women continue to lag behind men in Science, Technology, Engineering, and Mathematics (STEM) education, with the gap persisting both in the developed and developing worlds. This has been attributed mostly to long-held cultural notions that women do not possess the necessary skills or the capacity to understand complex scientific ideas and therefore, are disadvantaged in the sector (Wajcman, 2010). Despite the lack of conclusive evidence, Horwath, Kronberger and Appel (2014) argue that young women are considered to be cognitively weaker in STEM subjects. This leads to girls experiencing subtle yet powerful discrimination in the classroom – a characteristic that appears to follow them to the job

market. These cultural notions are widely embedded into patriarchal institutions which implicitly uphold these normative understandings by discouraging women from pursuing education or jobs in such male-dominated sectors. Therefore, achieving parity in terms of access to education remains the first hurdle women have to overcome.

Notably, evidence also indicates that young women in the developed world have reached parity in terms of access to higher education and jobs in technological fields but they lack representation at higher management levels. For example, research among engineers suggests that women are already conveniently 'boxed' into the feminine and not considered as capable of doing a man's job (Faulkner, 2014) – an invisibility paradox "whereby women engineers are simultaneously highly visible as women *yet invisible* as engineers" (Faulkner, 2014, p.189). In challenging these notions, Faulkner argues, women are forced to comply with men's perception of a feminine woman but also maintain the duality of being considered one of the 'guys'. This kind of peer pressure is considered to keep women away from re-entering the engineering sector, especially after maternity breaks.

Technology itself is considered "a source of male power" which is imbued with masculinity and especially, white-male dominance. This has effectively led to the marginalisation of women from engaging more proactively. This argument is not misplaced as technological innovations were initially developed by men for men. Given the absence of women in these streams of work, men considered the users of the product to mirror themselves. Hence, evidence points to how innovations by predominantly male-dominant sectors "actually inscribe this gendered background and knowledge, their concerns and attitudes into the technology", inadvertently marginalising women (Bath, 2014, 64).

The absence of women in technology has far-reaching individual as well as societal impacts. Citing work of other researchers, Bath (2014) points out how planning to make public spaces accessible to all becomes embedded in a male understanding of utilisation when women are absent in the design phase. At the same time, the concern is that the end users are *expected to adapt* to the technology, rather than developing systems that respond to differential user experiences – a key concern with regard to automation of factory floors in the apparel sector which shall be discussed later in this piece.

But such a static view of technology as over-powering and women as mere subjects has also been questioned, as both power and agency have come to be understood as more fluid concepts.

> Gender relations can be thought of as materialised in technology, and masculinity and femininity in turn acquire their meaning and character through their enrolment and embeddedness in working machines. Such a mutual shaping approach recognises that the gendering of technology affects the entire life trajectory of an artefact…The gendering of technologies can then be understood as not only shaped in design, but also shaped or reconfigured at the multiple points of consumption and use (Wajcman, 2010, p. 149).

This perspective thus, attributes the power of men and women to shape and in turn be shaped by technology, thus offering a more responsive insight that challenges technology as a powerful artefact solely determining people's relationships and interactions through its many manifestations. That such a perspective comes at a juncture when women's presence in technological fields is being encouraged is important to take note of, especially given the historical marginalisation of women in these traditionally male-dominant fields (Abir-Am, 2010). It is also important in the current context when automation and advanced robots are introduced to the workplace.

Most research conducted on the relationship between technology and women, tends to centre on technological advancements and gender only as an element impacted by technology. It lacks a nuanced understanding of how women's marginalisation, as feminist writers have so rightly pointed out, from the different phases of technological development can impact their career prospects and their work lives (Bath, 2014). In short, feminist thinkers raise two questions that are pertinent to how women are affected by the introduction of automation. First, is their absence in the design and planning phase which marginalises women as creators/designers and as users. As discussed, second is the equally serious consideration of the mutual reconfiguration of women and machines as their interactions become more common. In the context of this paper, both concerns matter, especially as these two phases shape women's perception of and their access to work.

Given the malleability of new technologies and the spaces to adapt these through interactions, measures to reach a degree of equilibrium have been proposed. For Trojer (2014), these include what is called the "triple helix experience" which sees new innovations being mutually developed. This includes "process-oriented development through a broader understanding and technology development; enforcement and integration of situated knowledges and technology development; and emphasising the importance of power relations and their impacts, including complex understanding of gender structures" (Trojer, 2014, p. 180).

These considerations would facilitate the development of technology that would not necessarily be top-down but is sensitive to gendered differences. More importantly, they would have the power to lower the barriers that keep women away or prevent them from assuming work that is socially perceived as unsuitable. In the case of the apparel industry, these considerations become critical at this juncture as the threat of machines replacing human labour gathers momentum.

These considerations are important as historical evidence also points to why women may be at the losing end of automation. As agriculture and small industries became increasingly more 'productive' as a result of the introduction of technology, evidence points to women's displacement from work, especially in the face of mechanisation of farms and the introduction of green technology (Ahmed, 1994), thus having far-reaching impacts on the well-being of their children and their families. That such displacement has almost always had an impact on sectors where women play a significant role, further compounds the fears that the Fourth Industrial Revolution would indeed have the same, if not even more, devastating impacts on women.

3. Working Conditions and Challenges for Sustainable Labour

The apparel industry has created millions of employment opportunities over the years, in both formal and informal settings. It is estimated that the textile, garment, and footwear industries employ 60–75 million people (ILO, 2019). A key feature of the sector is the visible high rates of female participation (Clean Clothes Campaign, 2021).

Off-shoring of key manufacturers has allowed developing countries to capitalise on this opportunity to create jobs. While it has led to a decline in the American labour force concentrated in the apparel and footwear sectors, countries such as China, Bangladesh, Vietnam, India, and Indonesia now employ over 15 million workers in the same sector (Kucera 2020, p. 26). The apparel sector, therefore, has been a key driver of economic growth in Southeast and South Asia. Historically, countries like Japan and Thailand were strong players in the global value chain as major exporters to the European and American market, but have since become net importers (Esho, 2014). They have been joined by countries like China, Indonesia, Cambodia,

and Vietnam taking the helm. Analysis of historical data illustrates the shifting of the geographies, which are presently concentrated in South Asia's Bangladesh, India, and Sri Lanka. These shifts have led some to call this sector prone to migration.

Sustaining a competitive edge over other vendors/producers in the GVC lies in the particular economy's ability to offer cheap labour and ensure that the production costs remain minimal. In the recent past however, another key factor has become equally important: the speed at which the production line can produce new fashion as a result of the growing popularity of fast fashion (Hammer and Plugor, 2019). All of these factors underpin the need for cheap and available labour that can be relied upon to carry out these tasks at speed and at little cost. Hence, the industry relies on the promise of jobs for young female workers.

The growth of the industries and their importance to the national economies is evident in the country-specific data on employment in the sector. India's textile and garment sector employs approximately 38 million people (Shetty, 2001) and is one of the world's largest manufacturer and exporter of these products (Business and Human Rights Resource Center, 2022). It accounts for 4% of the Gross Domestic Product (GDP) and constitutes a fifth (20%) of the manufacturing output and over 30% of export earnings (Shetty, 2001). In Bangladesh, the apparel sector has a manufacturing output of 40%, accounts for 85% of exports and provides employment for 7% of the total workforce (Moazzem, Khatun, Hewage, Ahmed and Pathirana, 2021). Similarly, in Sri Lanka, apparels are the largest export industry, accounting for over 40% of total industrial exports and producing USD 5.6 billion annually. The export clothing sector employs 400,000 people directly and another 700,000 indirectly (Sri Lanka Apparel, 2020). The majority of garment manufacturing takes place within special economic zones established to promote investments; migrant women from rural regions make up a significant portion of the workforce (Hewamanne, 2003).

In Vietnam the industry employs over 4.6 million people of which 74% are women. It is the third largest garment exporting country by volume (behind China and Bangladesh), and accounts for 15% of the country's total exports (Asia Garment Hub, 2022). Similarly, the apparel industry in Cambodia accounts for 74% of total exports amounting to USD 8.6 billion per annum and employs over a million workers, of whom an estimated 80% are women (Asia Garment Hub, 2022).

This region, therefore, comprises the key manufacturing countries in the apparel GVC providing a pathway for women to enter the labour force. However, such employment is marked by low wages and difficult working and living conditions. In terms of labour conditions, the countries have seen the introduction of few progressive changes. While national-level legislations have sought to institute minimum wages in many of the countries (i.e., India, Bangladesh, Sri Lanka), these do not necessarily constitute a living wage (Asia Floor Wage Alliance, 2021).

Beyond the concern about low wages, the working conditions have also received closer scrutiny. Excessive working days or hours, hazardous work, non-adherence of labour laws or signed contracts, the absence or non-enforcement of social protection schemes and wage manipulations are some of the characteristics commonly cited in relation to the industry (Anner, 2015; Ruwanpura, 2016; Bhattacharjee, 2019). These are further compounded by the regimented work routine and the repetitive nature of the tasks assigned and the intra-competitiveness built into ensuring that workers meet their targets. They add pressure on the workers to outperform each other as well as compete against one another and prevent the workers from gaining transferrable skills (Fernando, Arambepola, Niles and Ranawana, 2020; Mezzadri, 2016). The levels of pressure the workers have to endure results in their refusal to consider moving up the production ladder to a supervisory position (Fernando et al., 2020).

Despite evidence of these major shortcomings, the sector continues to offer women an entry-point to the labour market. But evidences from countries like Sri Lanka also suggests that unless the sector changes its working model and relationship to the workers, young women shun the industry (Madurawala, 2017). Social stigma and labelling attached to young women in the sector (Hewamanne, 2003), as well as the difficult working conditions, have had a knock-on effect of discouraging young women from joining the sector; the availability of similar-waged jobs in the retail sector appear more appealing as they perhaps offer more flexibility and no stigma attached to such 'decent' work (Hewamanne, 2008).

As the workers organise to demand higher wages and national governments institute minimum standards, however, the cost of labour will increase. This factor, coupled with labour shortages, as well as a growing discourse in the Global North to shift manufacturing closer to the retailers (i.e., reshoring and near-shoring) to reduce the cost of logistics, may give the impetus to automate the factory floor.

4. Automation and Changing Nature of Work in the Apparel Industry

The question of replacing cheap labour with automation is not new but the scale of the apparel industry can potentially have far-reaching effects on how labour is reconstituted in this new workplace. Technological advancements however, are also shaped by the demands of the GVC, especially its current demand for fast fashion with minimum lead times and cheap, disposable clothes.

Automation is not a new phenomenon but what makes this new iteration concerning is the potential for machines and robots to replace human labour completely. The apparel industry is a peculiar case study: researchers and producers all identify that the sector cannot be fully automated, not in the same way that automobile production has been (Nayak and Padhye, 2018; Fernando et al., 2020). However, human involvement can be reduced, in any of the key stages – preproduction, production, and post-production (Nayak and Padhye, 2018). While automation has been introduced at the pre- and post-production stages (i.e., cutting, ironing), the production process remains a challenge. The complete automation of sewing is considered challenging as hand-eye coordination and nimble fingers are required to manufacture clothing (Fernando et al., 2020). Machines lack the dexterity to manage the different patterns and the intricate sewing that is required. Similarly, the raw material (different types of fabric) is considered too sensitive to be treated via machines. Hence, most parts of sewing remain untouched by automation.

> Wages tend to be low in the industry, creating less incentive to automate, but a fundamental impediment is technical. This results from the pliability of fabrics, pieces of which need to be accurately aligned before they are sewn, something the human hand and eye can readily accommodate but which poses daunting challenges for automation. This challenge is exacerbated by the vast range of apparel products, the rapid changes in product demand (witness fast fashion), the varied properties of different fabrics, and the range of sizes in which any given product must be produced (Kucera, 2020, p. 30).

While evidence is scarce of automation resulting in significant job losses, this alone cannot be taken as a sign that automation is not happening. The lack of consensus on the extent of job losses resulting from automation and the absence of standardised means of tracking job losses, make it far more challenging to locate the nexus between automation and job losses. While attempts have been made, the evidence does not support contention and remains mixed (ILO, 2020, Acemoglu and Restrepo, 2019; Andersson et al., 2018).

Instead, it is argued that rather than the complete replacement of human labour, at this stage, automation is only seeking to support the workers to carry out their tasks. This argument however, distracts from how the introduction of automation can undermine the workers' capacity to learn and retain new skills. For example, in a case study carried out in Sri Lanka, the factory-floor workers had mastered only a few specialised skills in sewing as the process had been fragmented across multiple workers and machines. In the absence of comprehensive knowledge and a varied set of skills in sewing, such workers struggle to find comparable work outside of the factory (Fernando et al., 2020).

But the potential impact of a de-skilled workforce is not the main consideration. Rather, the focus appears to be on productivity gains, leading to some global entities to continue experimenting with new technologies. A fully-automated sewing factory has been established in the United States but only with the capacity to sew a simple clothing item such as a T-shirt. Similar instances are reported from Italy where firms seek to introduce semi-automated or fully-automated machinery (Kucera, 2020) where the boundaries of sewing as a human task, are being tested.

As the Global North experiments with fully-automated apparel manufacture, the countries in the GVC are adapting to a semi-automation production phase. Evidence from Sri Lanka points to traditional sewing machines being replaced or transformed: women must move around multiple machines to complete a task which makes being seated redundant (Fernando et al., 2020). Even though the machines are supposed to be ergonomically tested, the introduction of the new modality of work did not involve a consultative process thus, leading some women to consider exiting the sector.

At the design level however, technology has allowed leading manufacturing firms to move away from the simple cut-make-trim (CMT) model to the original design manufacture (ODM) model. The former refers to a phase where the inputs such as the materials and the design are provided. The latter refers to a phase when the manufacturer has a larger decision-making role to play. In this phase, the manufacturers "offer a full range of services to customers encompassing product development, pattern-making, finishing, sourcing, manufacturing, and delivery" (Athukorala and Ekanayake, 2018). This is again reflected in Sri Lanka where cutting-edge technological innovations have led the companies to maintain a competitive edge over other manufacturers, and to some degree, shape the design process by providing new forms of material for manufacturing (Fernando et al., 2020). Hence, at the design stage, technological innovation has enabled some select firms to weather some of the pressures to produce fast fashion using cheaper labour.

At face value, automation may seem a sound decision, enabling the GVC to respond to the demands placed by fast fashion for shorter lead times. Naturally, automation is considered to increase productivity and reduce the time spent on producing the end-product. On the other hand, it has the potential to render safer working environments for workers, especially by assuming the more difficult and riskier tasks in the factory and by reducing the pressure on the workers to reach ambitious targets. Automation is also viewed as supporting production for niche markets and enabling more customised apparels to be produced in smaller quantities.

But as the apparel industry indicates, the introduction of automation is not a given, as multiple factors shape this decision. Key among these is the significant initial investment required to automate the processes. As simple CMT entities within the GVC, the manufacturers lack access to substantial capital that is required. Unless the lead firm is prepared to channel investments with the promise of longer-term purchasing from these entities, they may not find enough financial incentives to automate (Parschau and Hague, 2015). On the other hand, the lack of the required infrastructure, trained personnel, and the policy commitment to

transform industries via automation can hinder its adoption (Parschau and Hague, 2015).

Aside from these factors, the nature of human labour also has a considerable impact in this decision to automate or not. The requirement for machinery that can manufacture more intricate designs and clothes and its capacity to adapt quickly to different styles and material is a key factor holding back automation of the sewing stage (Nayak and Padhye, 2018). In contrast, human labour is able to perform these tasks with dexterity. Moreover, as long as human labour is plentiful and inexpensive, the cost of automation remains high. Hence, to some extent, protecting the workers on the factory floor from experiencing loss of employment. But such decisions can undergo change especially as the external environment is thrown into flux (De Mattos, Eisenbraun, Kucera and Rossi, 2021), as evidenced in the case of the Covid-19 pandemic. In this instance, restricted access to the cheap labour force highlighted a blind spot for the industry as the production processes had to be halted or staggered in the face of the pandemic. While these factors are rooted in the conditions of the manufacturing countries, a key factor that may determine the decision to automate is the trend of reshoring or near-shoring businesses. The former concentrates on re-establishing factories in the country where the brand is located, thus reducing lead times and logistical delays in reaching the key market and also establishing a brand identity of being manufactured locally and helping keep jobs 'at home' (Andersson, Berg, Hedrich, Ibanez, Janmark and Magnus, 2018). A commonly cited example of reshoring is Adidas shoes, which opened a new 'speed factory' in Germany, equipped with highly automated systems (Salahuddin and Lee, 2022). Near-shoring refers to the shifting of production closer to the markets, a strategic option gaining traction in the post-pandemic era of manufacturing (Colamatteo, Cassia and Sansone, 2021).

But automation or the threat of it, can also become a powerful tool in the hands of the employers. Automating the production process can reduce the bargaining power of the workers, thus limiting the space for them to seek fairer wages and improved working conditions including working hours. Quoting a Wall Street Journal article, Kucera (2020) points out how factory owners threatened union leaders with automating the jobs unless the workers agreed with the management plans. On the other hand, women workers are particularly vulnerable to such relocation threats, as they are less mobile than men and have less flexibility in searching for different occupations (Luginbühl, 2019)

A combination or any of these factors therefore, can make automation not an immediate reality for the apparels GVC. However, semi-automation may become a more permanent feature in the factory floor (Kucera and de Mattos, 2020). But as the ILO (2020) points out, "the more readily and cheaply that work in these industries can be automated, the less readily can developing countries retain their competitive advantage based on lower labour costs".

5. Automation and its Impact on Women's Work

The nature of the apparel industry may yet slow down the process of automation but as the examples of attempts to introduce fully-automated processes illustrate, innovation and investments into automating and digitalisation will lead to machines assuming some or most of the tasks in the production process, eventually (Fernando et al., 2020). Hence, while women may not have to face potential job losses en-masse in the next few years, the reality of machines replacing their labour is not too far away either.

In the short-term, even if automation is not an immediate reality threatening the jobs of women on the factory floor, the risks of reshoring or near-shoring will remain more immediate. Even if jobs are made

available to skilled workers, women's ability to take up those jobs is limited. Women's mobility in general is restricted as a consequence of having to manage unpaid care responsibilities at home. Hence, moving where the factory shifts will not be realistic nor practical. The access to social safety nets, therefore, is urgently needed in the face of such immediate threats of job losses.

What is important to draw out is the disparity between educated and/or skilled women and those seeking factory-floor jobs as low-paid, semi-skilled workers. Both groups may face gender discrimination at the workplace and experience an inability to move forward in their professional career path. The former category however, is better placed to take advantage of technological advancements and steer their careers and professions to fit into the new avenues opening up due to digitalisation. This advantage may not be present for the women on the factory floor. As indicated previously, the wages earned, despite not constituting a living wage in most cases, are a lifeline for these women and the households that rely on them. The loss of work can produce devastating effects at the individual and household levels, pulling them back into poverty and having ripple effects on children's education and overall well-being. The lack of access to education, retraining, and re-skilling, will push these women further into precarity. The loss of employment and the ability to adapt is therefore not uniform but will have varying impacts on the basis of skills, the social capital and access to financing to support reskilling.

On the other hand, there are fears of increased casualisation of work as a result of digitalisation. Women and men both would experience precarity in wages, labour conditions, and access to social protection. An indirect impact of such casualisation is access to adequate coverage of occupational health and safety issues (Min et al., 2019). Even though automated systems may be assigned, the more dangerous tasks in a factory floor, its introduction in varying forms can have associated impacts on the mental and physical well-being of the workers who have to work alongside them. As evidence from Sri Lanka indicates, having to constantly walk between multiple machines was seen as detrimental to women's health and overall well-being (Fernando et al., 2020).

The polarisation of work and access to decent work conditions in the face of increased casualisation also means that lower-skilled workers where women are mostly concentrated, may also lose out on any access to social protection schemes. This is more country-specific and will have varying impacts across the region. In countries like Sri Lanka and India, not having access to unemployment benefits or any form of comprehensive safety net would impact women negatively as they may experience a phase of no employment, where the lack of wages would be most seriously felt.

A key argument in technological advancements is also that while traditional jobs may disappear, new ones would appear. But the question is who can take these jobs and whether women are prepared for the demands of such skilled work. Evidence indicates that both men and women would experience job losses as a result of 4IR. However, women would be disproportionately impacted as the types of jobs available for their skills and experience may become obsolete (McKinsey Global Institute, 2019). The accompanying concern is that women may be left behind in attempting to access jobs that require specialised skills and knowledge of automated systems. On the other hand, women's access to education in STEM fields alone will not ensure they have an equal footing when seeking jobs in the relevant fields. They would still have to encounter patriarchal structures and sentiments that frame them as unsuited for jobs that involve technology.

One possibility commonly cited is increased access to work as a result of platformisation. Seeking work through digital platforms can provide the much-needed flexibility for women, so that their unpaid care work can be arranged and managed with their work commitments. The ability of Global South women in

particular, to shift to a virtual arena to secure work or an employment source will be difficult. But as the Covid-19 pandemic has also exposed, digital workplaces do not necessarily offer the flexibility women wish for as they can be professionally disadvantaged, especially in relation to career promotions and recognition; flexibility can also lengthen the workday for women, as balancing the demands of work and unpaid care work may not always synchronise (Chung and van der Horst, 2020). A more pressing question is who has access to such platforms? In the case of factory-floor workers, their access to digital spaces and appropriate work may be limited by technological skills and knowledge. This leaves them on the sidelines of capitalising on this emerging trend as well.

Since automation is yet to take a complete hold on the apparels GVC, at least in relation to the tasks assigned to women in the production process, there is still time for the policy environment to take note of these impending changes. The aim of policies at the national and regional level therefore, should be to not only prepare the women for such transformation but also rethink how best the existing public structures can be developed to protect women's right to decent work and ensure that automation does not result in major disruptions to their lives as workers/professionals.

6. Pathways to Protect Women's Work

> Innovation is the collective bet on a common fragile future and no side, neither science or society, knows the secret of how to cope with its inherent uncertainties. It has to be done in some sort of alliance and a sense of direction which is shared (Nowotny, 2005 as quoted in Trojer, 2014).

As previously discussed, the transformation of the manufacturing industry as a result of digitalisation and automation is at varying degrees of being operationalised, and therefore remains a little difficult to predict. While many believe that significant change is on the way, that unprecedented changes will move the industry to the next level, others believe that significant change is already here. Within the apparel industry, however, a shift to complete automation or replacement of human labour may not be achievable, as yet. If any predicted changes do occur, it is critical to reduce their effects on the overwhelmingly female workforce. The threat of automation has perhaps offered us a window of opportunity to address concerns related to women and their access to work in a more holistic manner. The measures and policy considerations discussed below are not limited to state intervention alone. These include pathways that the manufacturing sector could also adopt, especially in strengthening transparency and constructive dialogue with workers on the impact of technological innovations.

Support to upskill: A key policy measure that government and international agencies suggest to prepare the workforce for 4IR is upskilling. The recommendation has merit – when workers are being displaced from their jobs, the space available to learn a more advanced skill that corresponds with the technological changes would help these workers find employment. However, the limitation placed on women in this regard has been raised as well (Fernando et al., 2020). In the current race to the bottom, women in the apparel industry cannot afford to upskill as a majority of their time is committed to work, overtime or, as discussed previously, supplementing their incomes by assuming an additional work. If women are offered such opportunities to upskill, two conditionalities must be fulfilled: women must have financial assistance during this phase so that they are adequately incentivised to reskill, and second, that access to quality child and elder care facilities are ensured. Since many of the leading manufacturing countries in the region provide no comprehensive unemployment benefits packages, such upskilling programmes must be complemented by responses to these key concerns.

Considering the differential impacts on women: A major setback of the policy measures proposed by many in relation to mediating the impact of women's displacement from work due to the 4IR is the treatment of women as a homogenous group. Policy measures targeting women's potential displacement from work must acknowledge how social class, ethnic, and racial identities, as well as their gendered experiences intersect to create multiple forms of exclusion. Recognising these particularities is key to providing workable and targeted interventions to support women to transition from the factory floor to other work streams.

Linking women with decent work alternatives: A more meaningful and practical means of connecting women, who have upskilled, with jobs in the labour market must be introduced, if the effects of potential displacement is to be minimised. Unless there is a considerable restructuring of the economy of the respective country, women's ability to find work after upskilling would remain challenging. This returns to the question of asking why women seek work in the apparel industry: the lack of alternative employment opportunities, the proximity to work and the limitations on mobility for work as a result of caregiver responsibilities, may still be serious considerations women would have to grapple with, even once they have upskilled.

Facilitating access to decent work in digital platforms: Another commonly cited measure is to direct women towards seeking and accessing work via digital platforms. However, much groundwork needs to be done to ensure that women have digital literacy, have access to such digital platforms, and receive adequate protection and decent wages. The lack of access to a digital device as well as stable internet connection and the knowledge on how to seek work through such platforms are some of the primary concerns. Whether such platforms can offer women decent work however, remains questionable. On one hand, freelancing or working through a less-regulated system will inevitably increase the risks that women face in terms of ensuring a steady income source and some basic protections from the existing labour laws. On the other hand, the same questions that have been raised regarding the uncomfortable relationship women have with technology will come into play here as well. Regularising platform work or the 'independent contractors' is a difficult task, especially when such work is not tied to national borders and therefore, national legislation. How far governments can be responsive to introduce labour legislation to ensure that workers are not discriminated against, in these platforms, requires collaboration at a regional level.

Addressing cultural barriers to women in technology: The continued concern around displacement of women's labour from these low-paying, poorly protected jobs in the manufacturing sector due to automation also suggests a deeper analysis at the structural factors that prevent women from being adequately prepared for technological changes. While changing attitudes towards women and their relationship to technology requires rethinking of cultural norms and attitudes that shape young women's choices, at the core is the need for structural changes especially in education. Introduction of affirmative action that responds favourably to including women in technological streams are required if these gendered barriers embedded into the educational systems are to be broken. This would in turn enable young women to test their own reservations and be more attuned towards shifts that may be underway in the labour market. Changing attitudes among employers, educators and even policymakers is therefore a timely yet necessary undertaking, if women are to be ably equipped to keep up with these predicted changes to the labour market.

Meaningful support on responding to reproductive labour: Key to this 're-organising' of female labour is to respond more comprehensively to the perennial 'problem' of women's roles within their households. As the primary caregiver to young children and the elderly, women have to balance their breadwinner role with that of the caregiver. Recognising the dual roles that women play in society is thus an important step. This

must be followed by an awareness that, in order to overcome gender gaps, more affordable yet quality care (for the elderly and childcare), greater flexibility in work-life is essential (Fernando et al., 2020), especially for the socially and economically disadvantaged groups such as women who work in the apparel industry.

Adherence to minimum labour standards: This also raises the question of the role of the employer. As discussed, the GVCs add pressure on the firms for quick turnaround times and high-quality products. Just as these companies respond to these demands, so must they institute mechanisms that establish adherence to basic and minimum labour conditions. While the GVC may also come under pressure by more 'aware' consumers who seek labels that are ethically sourced and manufactured, meeting minimum standards of labour protections must be universal. This would provide women with some form of protections that ensure they are not easily dismissed without remuneration and social welfare benefits in the face of automation.

Consultative, transparent engagement with workers: Another significant way in which the firms in the sector must adapt to the introduction of changes to the production process is to include the workers, especially women, in the consultations prior to the introduction of new machines and technology. As feminists have pointed out technology itself is not static and can change as a result of interactions with workers. Maintaining transparency regarding the changes to be instituted as well as open communication on why such changes are being affected, will set the grounds for workers to be prepared for such adjustments. As indicated in the case study on Sri Lanka (Fernando et al., 2020), the introduction of technology to a traditional factory floor disturbs the workers, and the absence of meaningful engagements and a constructive feedback loop makes the production floors tense and stressful. Hence, the firms need to change the way they 'do business' and seriously consider how the introduction of automation can be a mutually constitutive process. Such measures however, also entail rethinking the value firms place on semi-skilled workers and acknowledging their central role to the GVC via the production process.

Data and evidence to support a just transition for women: As indicated in the literature, very little is still known of the long-term implications if women are displaced from these jobs which are mainly concentrated on the factory floor. Hence, an important step is to supplement existing economics-based projections on the 4IR with more nuanced and in-depth analysis of how women are at the forefront of experiencing job losses and the long-term impacts of loss of employment. Building on the work of previous scholars who have examined and critiqued the displacement of female labour will help rethink of what the future holds for women in general and the largely disenfranchised, at-risk female workers in the manufacturing sector. Such research must ask critical questions: How far will technological advancements impact women's access to work? What feasible alternatives are available for women in terms of work and how can the policy arena respond by supporting women with their unpaid care work? But more importantly, how can young women be better prepared to respond to the barriers that prevent them from engaging proactively with science and technology streams?

Conclusion

As part of the GVC, workers may be more exposed to the impacts of external political and economic dynamics as illustrated by the Covid-19 pandemic. Similarly, political decisions that add fuel to re-shore manufacturing means that jobs can be reassigned but in locations that are inaccessible for Global South workers. Of these threats, it is automation and digitalisation that the GVCs may have to address, more immediately. Even if the transformation of the garments factory floor is relatively slower and has not as yet resulted in significant jobs losses and displacement, the window remains open for such change to take effect.

Such changes, therefore must be responded to, with measured and meaningful policy responses, especially where the existing labour and regulatory framework is weak and cannot support the women-heavy sectors to retrain and reskill. Such meaningful changes however, can only be achieved if structural changes are made and women are enabled – at least, in the near future – to take on new jobs that will become available. This means returning to the drawing board and considering why and how women are discriminated against in the labour market and what meaningful and impactful actions need to be taken at the local and regional level to support them. Such a tall order, as discussed in this paper, requires governments and private sector actors to commit considerable investments to effect changes where it is required so that women are not left behind in this newest iteration of technological transformation.

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