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"Digitalization and female workers? The apparel industry in Bangladesh."

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This Master thesis builds partly on research on the effects of digitalization on workers in the apparel industry in Cambodia that I conducted in the course of the research seminar. The parts of this research that were relevant for this thesis were considerably adopted and expanded. These are the theoretical part on global value chains, social upgrading and digitalization of labour, the part on the digitalization of the apparel sector and the mapping of the apparel value chain, and the part on policies and strategies to overcome the negative effects of digitalization. I also used the interviews that I conducted during the research seminar for the analysis in the Master thesis.

Abstract:

In 2011, the German government declared the new era of the digital industrial revolution under the name industry 4.0, which is marked by the rapid development of artificial intelligence and related automation processes. Automation is expected to considerably reduce the need for human labour in the Global North and the Global South. Specific sectors and segments of production are expected to be particularly affected – such as routine tasks in manufacturing, services and agriculture. Most positions in these sectors and segments are filled by female workers who potentially face massive job losses in the nearest future with women in the Global South expected to be affected most strongly.

This research aims to assess the impact of digitalization on female workers with a focus on the apparel export sector in Bangladesh in the context of existing gender inequalities in production and global value chains. It further aims to identify policy measures that can be undertaken in order to improve the position of female workers in the face of digitalization. Theoretically, the thesis combines global value chains and social upgrading approaches with a materialist feminism perspective focusing on feminization of labour and gender-based segregation of labour and with the literature on digitalization of labour. Research methods include document analysis, global value chain-mapping, semi-structured expert interviews and trade data analysis.

The research demonstrates that gender-based segregation of labour contributes to gender inequality in global value chains and the restricted access of female workers to better-paid jobs and social upgrading. These inequalities are expected to worsened due to automation processes related to digitalization. This is particularly relevant for the apparel global value chain where women are concentrated in labour-intensive low-paid jobs, which are most prone to automation. The participation of women in the apparel export sector in Bangladesh already decreased from 80-85% to 60-65%, and further reductions are foreseen. However, the slow speed of automation in Bangladesh gives time to adapt to the changing production processes and labour demand. It is crucial to develop gender-specific measures that help female workers to transit to working in the context of Industry 4.0, but without addressing the deeply routed gender-based segmentation of labour in Bangladesh and the apparel global value chain, these measures will have limited impact.

Key words: digitalization, automation, feminization of labour, gender-based segregation of labour, materialist feminism, GVC, apparel industry, female workers, Bangladesh

Abstract (deutsch):

Im Jahr 2011 hat die deutsche Regierung die neue Ära der digitalen industriellen Revolution unter der Namen Industrie 4.0 erklärt, die durch schnelle Entwicklung der künstlichen Intelligenz und zusammenhängenden Automatisierung gekennzeichnet wird. Wie man erwartet, reduziert Automatisierung den Bedarf an der menschlichen Arbeit im Globalen Norden und dem Globalen Süden beträchtlich. Spezifische Sektoren und Segmente der Produktion werden besonders betroffen - wie manuelle Arbeit, Dienstleistungen und Landwirtschaft. Die meisten Stellen in diesen Sektoren und Segmenten werden von Frauen besetzt, die die massiven Arbeitsplatzverluste in der nächsten Zukunft erleben können. Am stärksten werden Frauen im Globalen Süden davon betroffen.

Diese Forschung hat zum Ziel: 1) die Auswirkung der Digitalisierung auf Arbeiterinnen in der Bekleidungsindustrie in Bangladesch im Zusammenhang mit der vorhandenen Geschlechtsungleichheit in den globalen Wertketten zu bewerten, und 2) politische Maßnahmen zu identifizieren, die übernommen werden können, um die Position von Arbeiterinnen angesichts der Digitalisierung zu verbessern. Theoretisch verbindet die Masterarbeit die Theorien über globale Wertketten und sozialen Upgrading, Materialistenfeminismus mit dem Fokus auf die Feminisierung der Arbeit und die geschlechtbasierte Arbeitstrennung und mit der Literatur über Digitalisierung der Arbeit. Die Forschungsmethoden schließen Dokumentenanalyse, Handelsdatenanalyse, GVC-mapping und semi-strukturierte Experten Interviews ein.

Die Forschung demonstriert, dass die geschlechtbasierte Arbeitstrennung zu Geschlechtsungleichheit in globalen Wertketten und dem beschränkten Zugang von Arbeiterinnen zu besser bezahlten Jobs und sozialen Upgrading beiträgt. Das ist für die globale Bekleidungsindustrie besonders wichtig, wo Frauen in arbeitsintensiven Niedriglohnjobs konzentriert werden, die für die Automatisierung am anfälligsten sind. Die Teilnahme von Frauen in der Bekleidungsproduktion in Bangladesch hat bereits von 80-85 % bis 60-65 % abgenommen, und die weiteren Reduzierungen werden vorausgesehen. Jedoch gibt die langsame Geschwindigkeit der Automatisierung in Bangladesch Zeit, um sich an die ändernden Produktionsprozesse und Arbeitsnachfrage anzupassen.

Schlüsselwörter: Digitalisierung, Automatisierung, Feminisierung der Arbeit, geschlechtbasierte Arbeitstrennung, Materiallistenfeminismus, globale Wertkette, Bekleidungsindustrie, Arbeiterinnen, Bangladesch

Abbreviations

AI	artificial intelligence
ATC	Agreement on the Textiles and Clothing
BGMEA	Bangladesh Garment Manufacturers and Exporters Association
BKMEA	Bangladesh Knitting Manufacturers and Exporters Association
CAD	computer aided design
CEDAW	the UN Convention on the Elimination of All Forms of Discrimination Against Women
CMT	cut and trim model
CPPS	Cyber-Physical Production Systems
CSR	corporate social responsibility
FDI	foreign direct investment
FOB	full package manufacturing
FY	fiscal year
GDP	gross domestic product
GPN	global production networks
GVC	global value chain
HDI	human development index
HEAL	health, education, administration, and literacy
ICRW	International Center for Research on Women
IGO	international governmental organisation
ILO	International Labour Organisation
IMF	International Monetary Fund
IoT	Internet of things
IT	information technologies
L/C	back to back letter of credits
LCD	least developed country
MatFem	materialist feminism
MDG	millenium development goals
MFA	Multi-Faber Arrangement
MSDs	musculoskeletal disorders
NGO	non-governmental organization
NGWF	National Garment Workers' Federation

NIFT	National Institute of Fashion Technology
OBD	original brand manufacturing
ODM	original design manufacturing
OECD	Organisation for Economic Cooperation Development
OEM	original equipment manufacturing
OPEC	Organization of the Petroleum Exporting Countries
R&D	research and design
RMG	ready-made garments
SAP	structural adjustment programs
SDP	sustainable development goals
Sewbot	Sewing robot
STEM	science, technology, engineering, mathematics
WTO	World Trade Organization
UBS	universal basic income
UDHR	Universal Declaration of Human Rights
UNIDO	United Nations Development Organization
UNO	United Nations Organisation

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1. Introduction

The three industrial revolutions have generally led to an increased automation of labour. The first industrial revolution introduced steam-engined machines into yet agrarian societies and spurred urbanization at the end of the 18th century. The second industrial revolution was marked with mass production and rapid development of science in the late 19th and the beginning of the 20th centuries. The third industrial revolution started in the mids of the 20th century and was named "digital revolution" when the first digital technologies were adopted at workplaces (*"The 4 industrial revolutions"*, 2017). In 2011 the beginning of the fourth industrial revolution was proclaimed by the German government and was named Industry 4.0 (Sabattini, n.d.). Since then robots, machines and different kinds of computer programs are being massively inserted in different aspects of human lives, replacing people at jobs and helping them in accomplishing diverse activities. One of the most obvious substitutions of the human labour force that people have already experienced is cashier replacement. Shops and fast food industries have also integrated digital systems into their working processes, minimizing social interactions and maximizing profits for the companies' owners. Aside from the positive effects, digitalization also brings new challenges with it. Scholars all over the world are trying to determine what problems a modern digital society will have in the nearest future to find solutions to address these issues.

The critical problem is that digitalization[1] may lead to an increase in long-term unemployment. First of all, digitalization is expected to replace workers in labour-intensive sectors of production, such as manufacturing work (McKinsey, 2017). This kind of labour does not demand any special skills and therefore, is performed manually and routinely and is easily replaceable. There are, however, diverse types of occupations in manufacturing that are hardly replaceable by machines, for example, the sewing stage of production in the apparel industry (McKinsey, 2018). Nevertheless, the number of people performing low-skilled labour all over the world is still high, and most of them are located in the Global South. Therefore these countries are more disadvantaged by the prospects of digitalization than the countries of the Global North (Schlogl/Sumner, 2018).

Scholars widely state that the unemployment issue can be resolved through better education. People who have secondary education and especially PhD are more immune to job loss caused by

1 After having studied multiple literature, researches and reports for the study I found out that the terms "digitalization" and "automation" are used to describe the same phenomena – the insertion of advanced technologies (soft and hard automation/digitalization) in the production process that lead to optimization of production and reduction or replacement of human labour with the help of either digital programs or coded machines. Thus in this thesis I also use words "automation" and "digitalization" interchangeably.

digitalization than those who have no or only primary education (World Bank, 2019). But the lack of education opportunities and difficult living conditions in the Global South lead to an early occupation which may have negative consequences in the times of Industry 4.0. Countries in the Global North do face similar problems related to education and job replacements but in smaller quantities. According to the World Bank statistics, the percentage of people who may be affected by digitalization in the USA and the UK is around 47% (in comparison to 60-80% in the Global South) (Loesche, 2016).

Digitalization of labour also has gender implications because it affects male and female workers differently. Gender discrimination remains a reality in different fields – from women rights to payment gaps and female poverty and intensification of these problems can occur due to digital innovations. The digitalization, first of all, affects low- and mid-skilled labour as in manufacturing and service and these positions are mostly occupied by women. The International Monetary Fund provides the following results: "Given the current state of technology, we estimate that 26 million female jobs in 30 countries (28 OECD member countries, Cyprus, and Singapore) are at a high risk of being displaced by technology (i.e., facing higher than 70 percent likelihood of being automated) within the next two decades." (IMF/SDN, 2018: 4). If we transfer this 70% in numbers, we will see that around 180 million of female jobs will be substituted globally in the following time (IMF, 2018).

High-skilled jobs, which require complex cognitive abilities, are less prone to digitalization. Therefore a higher level of education can result in employment stability. However, for millions of women who do not have a possibility to get a primary and secondary education for diverse reasons, low-skilled/middle-skilled jobs are the only employment opportunity. More than that, women all over the world are underrepresented in STEM sectors (science, technology, engineering, and mathematics) which are mostly occupied by men (W20, 2019). The World Economic Forum's study (2017) shows for STEM-jobs eliminated due to digitalization, there are more new jobs created in this sector for men than for women. "If current gender ratios remain the same until 2020, according to the World Economic Forum's study of more than a dozen advanced economies, for every twenty jobs lost to automation, men working in Stem will see five new jobs and women just one." (*"100 Women: Who's going to lose out from automation?"*, 2017).

The roots of the problem lie in historical processes and practices of women exclusion from intellectually intense fields of studies, politics, social life, paid labour and education as well as gender discrimination and female unpaid labour exploitation by capitalistic society. At the time

when women were integrated into paid labour activities, their skills were often devaluated and naturalized, that further led to a lack of access to better job conditions and less payment, as well as gender-based segregation of labour and an employment bias (Akorsu, 2016).

It is necessary to take into account that the state of women differs from country to country due to history, social structure, religion and many other factors that at the end influence the position of women in the labour market. Women are also not a homogenous group and their challenges have to be analyzed regarding their real living conditions using intersectional approach (Adkins, 1995). Given the widespread gender discrimination, gender-related issues in the world of technologies are crucial and need to be addressed.

In this master thesis, I investigate the effects of digitalization on female workers in the apparel sector in Bangladesh, using global value chain (GVC) and social upgrading approaches linked with literatures on material feminism with a focus on gender-segregation and feminization of labour and also on digitalization of labour. I analyze in what way digitalization of the apparel sector impacts women employed by this industry in Bangladesh, what challenges female workers face due to digitalization of the apparel industry in the country and discuss measures, which are offered for solving these issues.

Thus, I pose the following research questions:

1. What impact does the digitalization have on the global apparel sector and on female workers employed in the industry?
2. How does the digitalization affect the apparel industry and female workers in the RMG sector in Bangladesh?
3. Which measures are suggested to improve the position of female workers facing negative effects of digitalization in the apparel industry in Bangladesh? What are the limitations of these measures?

This research is highly relevant given the rapid development of intelligent technologies and the changing structure of the labour market in the world due to the insertion of artificial intelligence and intensive automation of labour. Technology is evolving faster than predicted and therefore scholars, politicians and economists are lagging in responding to emerging problems that this progress brings with it. Digitalization has different impacts across sectors in the countries of the Global South and the Global North, and on male and female workers. Thus it is necessary to conduct research on the subject looking at the global, local and gender dimensions of the issue.

The implementation of the intersectional approach is necessary by conducting the research, as it acknowledges the diversity among women and addresses problems of each group of women regarding their specific characteristics and challenges they face. The findings of this research can be used for developing support programs as well as various country policies for women affected by digitalization and helps to attract more attention to this issue.

As it was noticed above, the effects of digitalization vary depending on country and industry. Therefore, I decided to concentrate on the apparel sector in this research for the following reasons:1) the apparel sector is one of the largest industries in the world economy, employing millions of people and mostly women (Clean Clothes Campaign fact sheet, 2015), 2) the digitalization of the apparel value chain will lead to a reduction of employment, and it may have serious implications on economies of different countries, most of all in the Global South, which is concentrated in low-value-added labour-intensive stages of apparel manufacturing, 3) the digitalization of the sector is going relatively slow in comparison to other industries, giving more time to identify the impacts of advanced technologies and find possible solutions/develop policies to protect people from negative effects of digitalization (McKinsey, 2018).

For the case study I have chosen Bangladesh for several reasons: 1) the country is one of the top 5 largest producers and exporters of apparel in the world, meaning the apparel industry plays a very important role in the country accounting for up to 80% of total country exports, making the country's economy very dependent on apparel production; 2) Bangladesh has around 5.000 apparel factories and employs around 4,5 million workers, the largest part of whom are women (War on Want, 2011); 3) although automation of the apparel industry appears to be slower than in other sectors, it is still going more rapidly in Bangladesh than in other countries of the region, except China; 4) almost the whole sector is owned by local companies, making it a more interesting case for analysis because local owners have decision-making power in the country and more embedded compared to foreign owners with head-quarters abroad (Asadullah /Talukder, 2019).

This master thesis consists of an introduction, theoretical approach, methodology, analysis of the digitalization of the global apparel value chain and its effects on female labour, the case study on the digitalization of the apparel sector in Bangladesh and its impacts on female employment and a conclusion. The theoretical part of the paper represents a combination of three literatures – global value chains and social upgrading with a gender focus, materialist feminism with a focus on gender-based segregation of labour and feminization of labour, and

digitalization of labour and its impact on female workers. The GVC approach explains the international division of labour and its characteristics. Social upgrading with a focus on gender depicts the challenges workers face in GVCs and discusses specific problems of female employees in it. Materialist feminism with a focus on gender-based segregation of labour and feminization of labour explains the roots of the existing gender inequalities in the global labour relations. It also underlines the importance of intersectional approach by the analysis of the situation of female workers showing that the problems women face in the Global North and the Global South are different and thus should be addressed depending on the local characteristics, culture, ethnicity, etc. The digitalization of labour explains the ongoing changes in the structure of the labour market globally due to the implementation of the advanced technologies in the work of GVCs and its impacts on male and female workers specifically. These literatures give a profound theoretical ground for answering the research questions.

In the methodology part, I describe the methods I apply in this research – document analysis, trade data analysis, mapping of the apparel value chain and semi-structured expert interviews. I conducted 9 interviews in total with the persons, who possess knowledge of the research phenomena – local Bangladeshi apparel company managers, female/workers' rights activists from local and international NGOs and experts on the digitalization of labour. For the document analysis, I identified key documents, which provided detailed information on the subjects under question complex industry knowledge. I also discuss the limitations of the study and the challenges I faced during the research.

The first part of the thesis regards the global apparel value chain, its automation prospects with a table of already existing technologies fully or partially implemented in the chain, gender issues in the chain and effects of digitalization on female workers in the apparel industry.

The second part of the research is the case study on the apparel sector in Bangladesh, its digitalization and impacts on female labour. It offers a detailed overview on the development and current state of the apparel industry in Bangladesh, gender-specific issues that female employees confront with working in the sector, the prospects of digitalization of the apparel industry in the country and already adopted technology and its effects on female employees.

The third part represents a discussion about suggestions and possible measures that could be undertaken to help workers to adapt to labour market changes caused by automation/digitalization found in the literature and reports as well as expert interviews. It is divided into three sub-parts – gender- and sector-neutral policies, gender-specific sector-neutral

policies and gender-specific policies for the apparel industry in Bangladesh. In this chapter, I argue the limitations and challenges of these measures.

The conclusion introduces a summary of the research and its main findings: 1) gender-based segregation of labour and automation of labour worsen gender inequality in global value chains in general and in the apparel industry in particular, 2) the competitiveness of the local industry depends on automation of labour, 3) the digitalization of labour has already significantly reduced female workers' share in the apparel industry in Bangladesh.

2. Theoretical approach

2.1. Materialist feminism with a focus on gender-based segregation and feminization of labour

The long-lasting history of women's oppression at home and work gave birth to multiple feminist movements and theories. Having studied directions of feminists' thought, I found materialist feminism the most applicable theory for the analysis of the relationship between gender-segregated labour, division of labour in global value chains and technological progress.

The roots of materialist feminism go back to the 1970s to works of Rosemary Hennessy, Chrys Ingraham and Christine Delphy. There is a certain confusion among scholars interested in feminist's literature because a lot of them cannot see the difference between materialist feminism (MatFem) and Marxist feminism. These two theories are interconnected, but materialist feminism addresses problems of women in modern capitalistic society more targeted, especially when it comes to the gender-based division of labour – both industrial and domestic and female paid labour in particular. It does not reduce the problematic of women's oppression to only class contradictions and capitalist economic relations in society (Jackson, 2001) but recognizes the material influence of other contradictions as well as contradictions within gender ideology, which have material representation in real life. Hennessy and Ingraham (1977) consider MatFem to be the blend of diverse feminists' thoughts that grounds on Marxists' understandings of historical materialism and class struggle from one side and the socialist's feminism on the other side (Hennessy/Ingraham, 1997). The theory dovetails different categories of life and science such as biology, technology, environment, history, etc. in order to understand the roots of women's oppression and finding the ways to change existing unequal social relations between men and women, but also among women themselves.

One of the main advantages of MatFem in comparison to other feminisms, is that MarFem doesn't see women as a homogeneous entity but distinguishes differences between women applying intersectionality as one of the most important theoretical tools in modern feminists' studies. MatFem unveils the importance of the difference between women, countries they come from, their understanding of sexuality, the history that lies behind these constructions, for example, colonialism, and other categories that (re-)produce unequal material relations between women (Landry/Maclean, 1993). Christine Delphy, more than other MatFem theorists, underlined the importance of analysis of material roots of oppression and inequalities between men and women. Such categories as gender, race and nationality are socially constructed, and these social constructions produce material relations of oppression and discrimination based upon these categories, which are reflected (for example) in limited access of women to better jobs and less financial rewards at the workplace (Delphy, 1977).

Materialist feminism recognizes the existence of hierarchy between women within societies referring to a class analysis, where women of the upper class suppress working women (Case, 1988). This suppression further reflects in the division of labour between women from the Global North and the Global South (for example, babysitters and cleaning ladies from the Global South working for west-european women) and different cultural, social and political realities that surround women from different regions and continents (Jackson, 2001). Hennessy and Ingraham (1997) claim that capitalistic modes of production and class struggle are not reduced to nation-states, but exist as a worldwide system of exploitation, hierarchical relations between states and division of labour not only within states but between states, that was created through the ideologies of colonialism and racism (Hennessy/Ingraham, 1997). The authors write: "The socially produced differences of race, gender, and politics, nationality are not distinct from class, but they play crucial role-both directly and indirectly in dividing the workforce, ensuring and justifying the continued availability of cheap labor, and determining that certain social groups will be profoundly exploited while others will be somewhat cushioned" (Hennessy/Ingraham, 1997: 2). Thus, MatFem tries to investigate, analyze and solve problems of women addressing their real economic and social conditions, recognizing the difference between women, their realities and identities.

Hennessy (1993) states that the analysis of modern capitalistic society cannot blind out the existence of female labour – paid and unpaid – because both are crucial for the development of capitalism dividing women and men, and women with each other. It is well-known that the core

of capitalism is the exploitation of the workforce. Female unpaid labour such as care work, nursing, child-raising and keeping household has been unnoticed and ignored for centuries, as these tasks were prescribed to women as biologically determined. Women have been prevented from proper education, politics, decision-making processes, having no bargaining power at home and in society and thus objectified. But political and social shifts made it possible for women to get access to paid labour and education almost everywhere in the world. These shifts caused such a phenomenon as “feminization of labour”, that nowadays turned into a field of study (Hennessy, 1993).

The term “feminization of labour” is used to describe and explain a change of labour structure worldwide starting in the 1980s and meaning that jobs, which initially were performed by men and were well paid, turned into female jobs (for example jobs in service sector, manufacturing, etc.) and at the same time financially devalued (Sassen, 2002). These shifts in the labour market structure happened due to neoliberal economic globalization and free trade. The neoliberal free-market started a rally for the cheap labour force and launched the changes in the structure of labour market inventing part-time jobs, temporary contract work, home-based work, etc. making it possible for women to engage in paid labour without sacrificing their family duties (Akorsu, 2016). Women initially were ready to work for a less financial reward as men as well as being more flexible and loyal at the workplace, therefore pushing men out from certain occupations or even labour sectors (ibid.). “Women's cheap labor (guaranteed through racist and patriarchal gender systems) is fundamental to the accumulation of surplus value-the basis for capitalist profit-making and expansion. (Hennessy/Ingraham, 1997:3).

Guy Standing (1999) states that successful industrialization of many countries happened due to (low-paid) female labour. The income insecurity pushed women to accept any work available; deterioration of working conditions (irregular payment, lack of employment protection, etc.) and job insecurity made the downsizing and dismissal procedures easier for the companies. Thus the precarious work positions were filled more with women because men accepted insecure jobs only rarely. Another important factor of increased female participation in paid labour is technological progress and absence of need in employees with “craft” skills obtained during apprenticeship that were usually performed by men (Standing, 1999).

Saskia Sassen (2002) developed the concept of “feminization of labour” to “feminization of survival” claiming that the financial crisis of 1980, neoliberal turn in the world politics, introduction of SAP programs and male unemployment contributed to feminization of labour and

made entire communities, countries and regions dependent on female labour for mere survival. The author notes that the internalization of labour led to offshoring manufacturing production to low-wage countries (prevailing garment industry and electronic assembling), devaluating this activity and creating female proletariat in the Global South (Sassen, 2002). These processes were fostered by the following factors: 1) the growth of export-oriented economy that was prevalent in newly industrializing countries which employed low-paid female workers to make the export costs low and thus attract more buyers, 2) the management of labour costs by TNCs which offshored their production in order to cut production costs, 3) the policy of market deregulation, which forces women to enter low-paid working positions with precarious conditions of employment (Prasad, 2018). From the employer's point of view, the feminization of specific sectors can be seen as a method for raising productivity and reduce possibilities of social unrest at work as women are considered to be more stress-resistant and docile (Caraway, 2005).

The feminization of labour didn't occur evenly all over the world and in all industries at the same time. Chang *et al* (2011) write that some industries adopted female labour faster than others and while in some regions female share in paid labour increased rapidly, in others it declined or stayed unchanged (Chang *et al.*, 2011). It proves that the phenomenon of digitalization of labour and its effects on female labour should be analyzed applying the intersectional approach and on a case-study basis. As labour force composition depends on an industry and a country due to the global division of labour, local realities – cultural, economic and political has to be regarded in order to assess the situation of female workers in a given country and prospects of automation of industries where female labour constitutes the majority.

Access to paid labour also has positive effects for women such as empowering, improving their bargaining power at home, making women more independent and visible for the economy, fostering gender-equality due to increasing property rights and financial stability of women as well as the promotion of women's rights, etc. However, it also has negative effects because it didn't reduce women's commitment to unpaid reproductive labour and household activities, making the total labour time higher (Chang *et al.*, 2011).

Women still face lots of problems at work such as gender discrimination, pay gaps, under-representation of women in leading positions, sexual harassments, etc. (Kreimer, 2004). Therefore it is important to investigate another phenomenon that was sharpened by the process of feminization of labour – gender-based segregation of labour which occurs due to high concentration of female or male workforce in certain occupations, sectors, positions. The scholars

distinguish between three types of gender-based segregation of labour: 1) horizontal segregation -"…under- (over-) representation of a given group in occupations or sectors, not ordered by any criterion". For example, in the sphere of medicine, women are usually associated with nurses. In apparel manufacturing, the sewing process is accomplished mostly by women, 2) vertical segregation shows under-(over)-representation in occupations or sectors according to such criteria as income, job stability, prestige, etc. For example, women are underrepresented in STEM sectors, which are usually paid better, estimated in society as prestigious, less prone to digitalization meaning such jobs are more secure. 3) hierarchical segregation denotes under-(over)-representation in sectors and occupation in top positions (European Commission, 2009).

According to the report of European Commission (2009), there are four main factors that can play a crucial role in the choice of future occupation by women and thus (re-)produce gender-based segregation at work nowadays: 1) field of study, 2) unequal care burden, 3) covert barriers in organizational practices and 4) stereotypes (European Comission, 2009). The points 1 and 2 can explain the horizontal segregation of labour that is being reproduced by the following spheres: a) behavioral patterns taken from the family via socialization processes when a girl learns that combining career and motherhood is necessary to be viewed as successful, and career is less important for a girl; b) school via reproduction of stereotypes about genders that can further explain over-representation of female workers in the fields compatible with family duties; c) real job opportunities offered to women (ECLAC, 2013). The choice of vocational education and the field of study for women plays a vital role in the future distribution of jobs on the labour market between women and men. Motherhood and keeping household lead to shorter working hours. Many women fail to pursue a career or accept a full-time job because of unequal care burden, which prevents them from access to better jobs and limit their chances to succeed in their profession. Part-time occupation and parental leave may be negatively estimated by employers as an employee may lose its professional qualities and experience due to irregular practicing of the former (World Bank, 2012).

The points 3 and 4 refer to discriminative strategies of segregation in labour market and mostly result in vertical and hierarchical segregation of labour hoarding female workers from better working positions and remuneration putting a "glass ceiling" above them. "The glass ceiling" includes invisible barriers such as gender stereotypes and prejudices, hostile corporate cultures that tacitly exclude women from informal communication networks, and scant opportunities to gain managerial experience. Other factors include labour policies that view caring for dependent

family members as women's work, as a corollary of their other duties in the home" (ECLAC, 2013:15). The "sticky floor" metaphor is used to describe the situation of women who got stuck in low-paid jobs because of the lack of education or training opportunities and lack of affordable care burden (ECLAC, 2013).

With regard to the countries of the Global South, Seguino and Braunstein (2019) argue that targeted exploitation and exclusion are the main mechanisms of preventing female workers from decent employment. Exploitation mirrors in high rates of female employment in labour-intensive export-oriented industries, where the firms have high bargaining power in suppressing wages and thus increase profits. Exclusion is achieved via limited access of female workers to "good" jobs by the dominant group. It intensifies if the supply of decent jobs is low and is facilitated by *norms* and *stereotypes* (ascribed certain qualities to workers based on their gender) (Seguino/Braunstein, 2019). "The concentration of women in lower categories of work and lower value chain tiers reflects deeply embedded gender norms that undervalue their contribution and position in the interface of paid productive and unpaid reproductive work." (Barrientos, 2019: 78).

Biblarz *et al* (1996) also state that the main cause of segregation at the labour market is gender-based discrimination. Women are ascribed certain "qualities and talents" that follow them in their professional lives (Biblarz *et al.,* 1996). Elson and Pearson (1981) state that women are predominantly occupied in specific sectors because the tasks they accomplish are regarded as "female tasks" by employers. For example, jobs in the care sector or industrial sewing considered to be women jobs just because women usually fulfil care duties and sew at home (Elson/Pearson, 1981). This argument is further developed by Caraway (2005) with reference to Foucault's notion that discourse produces material relations. The author claims that not only prescribing women certain qualities but also thinking in binary oppositions women-men give birth to unequal representation of female and male workers in diverse sectors (Caraway, 2005). I want to complement this thought by adding that not only binary thinking in labour relations construct segregation, the "female" qualities are being characterized as subordinated to and less valuable as male qualities. Such stereotypes (re-)produce material relations of inequality and domination between men and women in labour market relations and contribute to its continuance.

Kreimer (2004) argues that gender-based segregation of labour is used as an ideological tool to maintain existing hierarchical patriarchal social relations and specifies the following segregation practices: 1) limitation of women in power positions and high-paid and high-qualified labour

sectors, 2) health and safety regulations preventing women from entering certain occupations, 3) marriage bars, when women are prohibited to work after marriage or lack employment opportunities because of their unpaid reproductive labour (Kreimer, 2004).

World Bank report (2012) states that formal (labour market regulations and policies) and informal (social and cultural norms) institutions play a significant role in female employment. Countries where legislation is more profitable to men than to women and where social practices are more supportive for men and restrict freedoms and rights of women, gender disparities in labour market are higher than in countries which promote female occupation (World Bank, 2012). Although due to feminists' activities, women empowerment policies and human rights/ gender equality promotion in some parts of the globe the situation of female workers improved significantly, especially in the Global North. However, in traditional societies and traditional households, these occupational barriers still challenge social transformation on the way to equality.

It was already discussed above that one of the most important analytical tools of MatFem is the intersectional approach to gender-specific issues. Therefore, a closer analysis of the gender-based division of labour must include intersectional dimension. Gendered segregation of labour has its national and international dimensions, underlining that the intersectionality is highly relevant for the analysis of existing power relations in the global labour market in global value chains. There are familiar characteristics of gender-based segregation of labour that are universally applicable (gender pay gap, domination of male workers in leading positions, etc.). Still, the thorough examination of occupational segregation must have a closer national and regional focus. Mary Mills (2003) writes that gender-based segregation of labour can explain the hierarchical relations in power distribution considering race, ethnicity, class, nationality and region as analytical categories. "Gender inequalities represent one dynamic within a global labor force that is also segmented by class, ethnicity and race, nationality and region, among other factors" (Mills, 2003: 42).

Gender-based segregation at work has very serious impacts on the future of gender equality and women's rights. One of the most important implications of gender-based segregation of labour is widening of the gender pay gap. It further results in continuance of gender discrimination in private and social life, making women subordinated to men and dependent on men for survival, exclusion of potential female workers from certain occupational fields, bias by employment, undervaluation of female labour, further women's oppression, deepening female poverty, etc.

(Kreimer, 2004). Seguino and Braunstein (2019) with regard to the globalization of labour relations and worsening working conditions write: “Gender has become an unfortunate aspect of how inequality manifests and persists. The employment losses associated with structural and technological change have been especially costly for women’s access to the higher-quality jobs associated with industrial sector work in developing countries” (Senguino/Braunstein, 2019:1002).

This short introduction in materialist feminism and feminization of labour shows the ways capitalistic patriarchal society profits from gendered division of labour and deepens inequalities between gender and between women from different countries. The analysis of feminization of labour and gender-based segregation of labour is essential to define, which sectors and what jobs are mostly occupied by women in global value chains. In combination with the further analysis of digitalization of labour, it will be possible to determine what types of jobs will be automated in future and how it will affect female paid labour. This theoretical approach also explains the inferior position of female workers in the apparel industry in Bangladesh in terms of working conditions, promotion possibilities and access to social upgrading, which can help women adapt to the ongoing digitalization of the sector.

2.2. Digitalization of labour and its impact on female workers

Automation and digitalization of labour are not new phenomena, but with the rapid development of advanced technologies and their adoption in the work of GVCs, these subjects are gaining increased scientific relevance. Having studied multiple literatures, researches and reports on these phenomena, I came to the conclusion that these terms are used by scholars interchangeably meaning the (partial or total) replacement of human workforce by digital technologies. Digitalization of labour is the process of transition to and widespread usage of digital technologies in organizing business, personal life and production. “The digitalization of labor markets can be understood as a far-reaching process, which includes the penetration of value-added chains and productive processes (including in the service sector) mainly by internet-based technologies.” (Eichhorst *et al*., 2017:299). Digitalization makes production processes automated based on computer/internet technologies capable of complete substitution of the human labour force. Automation is not a new process, but nowadays it performs not only replacement of boldly routine manual tasks by the insertion of machines into production processes, but nowadays digital technologies used to automate human labour can also perform cognitive tasks with the help of algorithmic control of machinery (Eurofond, 2018). This transition to the usage of digital

technologies in production, thus eliminating the need in human labour is planned and fostered by the fourth industrial revolution - Industry 4.0.

The term Industry 4.0 was first introduced by the German government in 2011, referring to the strategy of computerization of all the production stages and minimizing human interactions. This aim has to be achieved by promulgating the usage of artificial intelligence, robotics and the Internet in production work (UNIDO, 2017) "…(I)ndustry 4.0 describes the organization of production processes based on technologies and devices autonomously communicating with each other (through PCs or virtual models) along the whole value chain" (Sabattini,n.d, p.18). With the help of Cyber-Physical Production Systems (CPPS) and Internet of things (IoT) it is possible to eliminate the necessity of human decision-making and direct human interaction in manufacturing, making control over processes more centralized (Beyerer *et al.*, 2015). Schöning (2018) notes: "Industry 4.0 also covers the whole life cycle of a product, from design, production, usage, maintenance to recycling" (Schöning, 2018:121), meaning that all these processes are supposed to be digitalized in the near future. The combination of CPPS and IoT in production is called "smart factory". "Smart factories" are supposed to function without or with only minimal human supervision through direct communication between machines and the products they produce not only within the supply chain but between all the participants, capturing the whole business eco-system including the logistics (Schöning, 2018). The Sabattini report (n.d.) and the UNIDO working paper (2017) also name other technologies making the fourth industrial revolution possible – Big Data and Analytics, Autonomous Robots, Simulation, Horizontal and Vertical System Integration, Cybersecurity, Cloud, Additive Manufacturing, Augmented reality (UNIDO, 2017).

Digital technologies are diverse and complex, but there are two main kinds of it – artificial intelligence and robotics. Both – AI and robotics – are widely used in production and service fields. AI is one of the branches in computer science which develops programs to resolve complex tasks where otherwise human intelligence would be needed (Tecuci, 2012). AI represents programs and algorithms while robots are programmed machines which can handle autonomously or semi-autonomously following the logic of their programs but being unable to act outside a coded algorithm. Most of the robots are not intelligent and coded to perform specific repetitive tasks. They cannot accomplish creative tasks or react correctly on situations in life-time analyzing information and offering solutions. To become "intelligent" robots have to be endued with artificial intelligence (Huang/Rust, 2018).

The scholars occupied in the fields of artificial intelligence and labour market distinguish between four types of digital technologies according to the development history of the latter: 1) mechanical that performs simplest repeated standardized tasks and react repetitively (widely used and implemented in GVCs); 2) analytical are more complex and include the performance of analytical, rule-based, systematic complex tasks which require logical thinking in decision-making; 3) intuitive AI accomplish complex, chaotic and idiosyncratic task. It learns and adapts intuitively based on understanding; 4) empathetic learns and adapts empathetically based on experience, can read emotions and interpret them and is highly interactive (Huang/Rust, 2018:156-157). These types of technologies are being further developed and adapted in the work of GVCs replacing and reducing human labour force, therefore having a significant impact on labour market structure, especially in the Global South, which is occupied with low-value-added processes in GVCs.

Frey and Osborne (2017) argue that every activity accomplished by people now can be automated in the future. Most of IGOs reports on automation as well as other researches using the method developed by these two authors that helps to calculate possible prospects of digitalization and its effects on employment (Frey/ Osborne, 2017). The World Bank implemented the Frey-Osborne method to develop its statistics on labour automation came to the following results: up to 47% of workforce will be automated in such countries as the USA (especially male unskilled workers) and Great Britain and up to 80% in the countries of the Global South (Loesche, 2016). Still, the ILO Working paper (2019) says that these numbers are exaggerated and the real percentage of workforce displacement will be much lower, and it is necessary to constantly observe the changes caused by the adoption of advanced technologies (ILO, WP 356, 2019).

The following types of jobs are considered to be most susceptible to automation – low-skilled, low-paid, intensive, routinely performed manual labour that doesn't require education or only minimum on education, and also mid-skilled labour (service). These types of jobs are prevalent in manufacturing, accommodation, food service, and retail trade (McKinsey, 2017). According to the research investigating the workforce decline in the USA, 13 % of the job losses in manufacturing resulted from trade and the rest from technological innovations. Offshoring of the production to countries with low-waged labour also led to a dramatic reduction of the workforce in manufacturing (Krause/ Sawhill, 2017). At the same time, due to the offshoring and the decline of employment in high-waged countries, millions of jobs were created in the Global South. The automation of labour may bring plants back to the Global North again taking jobs away from

low-income countries. Thus such shifts and dynamics in employment have different impacts on the global and on the local levels. For example, the envisaged digitalization of supply chain management that is called Supply chain 4.0 can help to reduce transaction costs, making business more profitable and customized and at the same time significantly reducing the need for human labour globally (World Bank/WTO, 2019). The Supply chain 4.0 is being piloted and adopted by many industries across the world but its application is still rather uneven (World Bank/WTO, 2019). Nonetheless, the implementation of this business model will lead to automation of GVCs eliminating millions of working places and be the reason for mass unemployment. The process of human labour replacement by machines that may prevent people from finding a job is called technological unemployment (OECD, 2016).

The jobs which require complex cognitive skills, technical skills or empathetic skills are much harder to digitalize, but the number of such jobs is also smaller than the number of low-skilled occupations. The supporters of techno-deterministic approaches state that the automation of labour is inevitable and will help eliminate dangerous and unpleasant occupations, giving people access to more creative and interesting jobs. Nonetheless, this approach doesn't consider social implications of digitalization that people who lose their jobs to machines will not be able to find another employment because there will be fewer jobs available and also that managerial tasks at firms will be accomplished by machines which may have negative effects on human workers, making working process more controlled (De Stefano, 2019:3).

To other negative impacts of digitalization on human labour force belong growing inequality among people who are employed and those unemployed, and also growing gender inequality. The development of gig-economy and short-term contracts will increase stress levels and work intensification. The difference between low-income and middle-income/high-income households are supposed to raise, leaving the former in a very precarious position in a digital society, because even now low-income households have limited access to digital innovations and education, which cannot be overlooked (Degryse, 2016).

The digitalization of labour will affect male and female workers differently. Gender-based segregation of labour plays a vital role in the analysis of labour market restructuring due to ongoing automation. The scholars are concerned that digitalization may further widen gender employment gap as rates of female employment vary drastically between states and female occupations will be digitalized in different scales across countries and sectors having different implications on women from the Global South and the Global North. Local economic, political

and cultural dimensions will inevitably influence grades of automation in a state and its effects on female employment. The gender impact of digitalization will be felt stronger in societies where competition for “good” jobs, stereotypes about “female” and “male” characteristics and responsibilities are strong and care burden is considered exclusively female task. If the job offers become scarce due to digitalization, employment bias (favouring men over women) may have dramatic effects on gender employment parity, especially in the countries where this index is already low (Kenny, 2019).

According to the International Monetary Fund (IMF) report (2018), around 180 million female jobs will be replaced by digital technologies in the nearest future worldwide. The report states that women perform mainly routine and predictable codify-able tasks at jobs requiring less or no analytical skills across all sectors and in all occupations, making them a vulnerable group in the digital age. Complex cognitive jobs will be more resistant to automation than low-skilled and mid-skilled labour. Less educated, older (over 40 years old) female workers and workers performing clerical, sales and service tasks are more exposed to automation. The shortage of women in managerial and leading positions concerns experts as well as the under-representation of women in STEM (science, technology, engineering, mathematics) because the demand on specialists in these fields is increasing and female workers can have good prospects of employment there (IMF, 2018).

Technological change may sharpen or renew skill-bias by employment with it and widen the gap and discrimination between skilled and unskilled people (Krause/ Sawhill, 2017). It is estimated that across the European Union, 90% of jobs now require technical skills and 66 million of the EU citizens lack necessary skills for successful transition and participation in the Industry 4.0. (European Commission, 2019). The women of the Global South will be most disadvantaged by this process as they don't have sufficient financial capabilities for complex technological education and lack of self-certitude as well as employment gender bias. Female workers from the Global North are better positioned because of the diverse supporting mechanisms from states, IGOs and NGOs promoting gender equality and gender quotas in companies. Still, 85% of machine learning workforce is done by men, and there is a need to increase the percentage of women in this field (ibid.).

Despite the susceptibility of female jobs to digitalization, overall results show that female and male occupations can both be automated almost in equal scales (McKinsey, 2019). The average risks of automation vary across industries and countries. Male workers are over-represented in

sectors where routine physical force is needed, and female workers dominate in sectors with routine cognitive jobs. These types of tasks can be fully automated. For example for the year 2017, almost 30% of all jobs in service sector (female job) has been lost and at the same time health care sector created 25% of new jobs, and 40% of machine operators and craft workers (male sector) were eliminated, and 25 % of jobs in manufacturing were gained (McKinsey, 2019). The OECD policy paper (2017) also states that traditionally male sectors such as manufacturing and agriculture are more prone to automation nowadays than traditionally female jobs (OECD, 2017). Yet there are different types of manufacturing jobs in different industries and the global correlation of male to female employment in this sector is 27% to 18% proving that women in manufacturing will be displaced in high rates too, especially taking into account the countries of the Global South where offshored garment manufacturing and business process outsourcing are female-dominated and have high prospects of automation (Kenny, 2019).

Sectors that traditionally employ more women than men and vice versa are both susceptible to automation and may reduce its labour force disregarding gender. The main challenge of digitalization is not the possible job loss but the transition possibilities to new occupations which is much easier for men to achieve than for women (McKinsey report, 2019). Even regarding the fact that women and men will face job loss at almost the same quantities- both around 50% (a bit less for women than for men globally), for every three jobs lost to automation men gain one job. For the female workers, it is one job for every five lost (Faith, 2017). Thus it is important to concentrate on policies and measures that will help women to succeed in Industry 4.0[2]

Female workers in the Global South will be affected by automation more than women in the Global North due to lacking social protection policies and specialization on low-skilled activities in GVCs. Offshoring and outsourcing created diverse job sectors that mostly employ women, and nowadays these services can be fully automated or onshored/nearshored, having a negative impact not only on local economies but directly influencing female bargaining power at home and position in society, thus raising gender inequality and reproducing discriminative norms and stereotypes devaluating female labour (Faith, 2017).

Negative effects aside, digitalization also have positive impacts on female workers. Jobs which require empathetic and interpersonal skill are supposed to expand – health care, social services and education. These jobs are much harder to automate, and these occupations are considered to be traditionally female (OECD, 2017; INF, 2018; G20, 2017). Another interesting fact found by

2 The discussion on suggested measures and policies follows in the section 5.4 of the thesis

Krause and Sawhill (2017) regarding US decline of employment is that due to cultural perceptions unemployed men refuse or may be unwilling to take jobs in HEAL sector (health, education, administration, and literacy) considering them „pink-collar"and „women's work" prescribing these occupations inferior position in comparison to traditional male's jobs, while women proportion in STEM professions is slowly growing due to encouraging mechanisms of state and IGOs/NGOs (Krause/Sawhill, 2017). This example also shows that women have better chances to adapt to the technological transition than men. The growing gig-economy offers lots of diverse, flexible employment opportunities which can be preferable for women allowing them to complement job and household duties (IMF, 2018). Alongside positive effects of such employment, its quality, security and remuneration are put under question. Developing of favourable infrastructure and policies, making these jobs safer is a priority for states nowadays as the gig is expanding rapidly (OECD, 2017). The digital fluency and adoption of digital technologies will also have positive effects on female employment. Work from home office or using Internet-based technologies offering new opportunities for self-employment is considered to be a great advantage for female workers with care burden (Accenture, 2016). Home office or running a business from home using digital technologies will create a safer environment for female workers in regions where daily commutation to work facilities is unsafe (burglars, sexual violence, etc.) (G20, 2017).

Data provided by diverse researches have to be assessed carefully because they mostly present global results implementing their methodologies without a closer country and sector focus. The gender employment gap varies across countries, and informal employment in the countries of the Global South and modernizing states prevent the scholars from obtaining reliable data. Therefore it is possible to conclude that prospects of automation and job loss across countries and between genders depend dramatically on the local and regional context. In this regard, the McKinsey Institution report (2019) compares agriculture in Mexico and India showing that Mexico employs mostly men in this sector and it is one of the top three occupations where men lose their jobs, but it's not even in the top ten for women. In India, women mostly work in agriculture, and 28% of women face a risk of losing their job to automation in comparison to 16% of men in the same sector (McKinsey, 2019). This example shows that the adequate estimation of digitalization scales requires to conduct case studies, investigating the current labour market situation and gender participation rate across occupations in a country of interest as well as economic situation, its industrial development and its main employment sectors.

The digitalization/automation of labour plays an important role in GVCs in terms of economic upgrading as it helps to optimize the production process and reduce labour costs. At the same time, it is a problematic issue regarding social dimension, especially female paid employment because automation leads to displacements at work and women represent a vulnerable group in this regard because of the gender-based segregation of labour and high participation of female workers in occupations, which are prone to automation. Thus it is necessary to look closer at automation in GVCs to assess its approximate impacts on female paid labour and timely adapt to ongoing changes in the labour market structure.

2.3. Global value chains approach and social upgrading with a focus on gender

The second half of the 20th century paved the way to increased globalization processes and rapid development of relations between countries. In efforts to gain economic profits, companies from the Global North started to look for the cheap labour force and competitive modes of production transferring production in countries of the Global South by means of outsourcing and offshoring, thus creating the complex system of labour relations and production. In order to analyze these relations, the world system theorists Wallerstein and Hopkins introduced in the 1980s the concept of commodity chains. The scholars tried to explain through the term "commodity chain" ''a network of labour and production processes whose end result is a finished commodity'' (Wallerstein/Hopkins, 1986:159). Hopkins and Wallerstein considered that these production networks reproduce hierarchy between countries of the Global North and Global South and saw their relations as subordinated (Bair, 2005). The ideas of world system theorists were further developed into global commodity chains by one of the most prominent theorists in the field Gary Gereffi, depicting and analyzing the global connection and links of all the processes within any commodity chains and later the concept of global commodity chains evaluated to global value chains and global production networks (Henderson *et al.*, 2002).

The dimensions of value chains analysis include the following steps: 1) input-output structure, which shows how the raw materials are transformed into final goods, depicting all the processes constituting the value chain from design to marketing and retailing; 2) a geographical scope of the chain; 3) a governance structure, that helps to understand how the value chain is controlled and depict power relations in it; 4) an institutional context depicting institutions and regimes which influence the work of the chain (Gereffi/ Fernandez-Stark, 2011).

The analysis of the governance system of the chain is vital for understanding the control mechanisms and power relations between the actors in it. There exist several different approaches

to the analysis of the governance of value chains. The first one was offered by Gary Gerrefi in 1994. The author considers that value chains are driven by lead firms in two different ways – by producer or by buyer. These types of governance are called "governance as driving". There are also other concepts of governing of value chains – governance as coordination and governance as normalization (Gibbon *et al.*, 2008). Governance as normalization is more a discursive approach and based on convention theory. It tries to find certain standards that can be translated into norms in relations between firms within the chain and would be applicable to other chains. The governance as coordination can be further divided into five types – market, modular, relational, captive, hierarchy. This approach explains which principals coordinate the relations and production processes between lead firms and suppliers. Governance as coordination is not stable and can shift from, for example, captive to market or hierarchy to relational. The role of lead firms in these new types of governance is presented differently as in Gerrefi's "governance-as-driving" approach. It is not always an exclusive leadership of the upper firms of the chain over its suppliers, and power relations here are highly contested between firms (ibid.). The governance of the chain plays a crucial role for all the actors embedded in the chain.

Another important concept in GVCs analysis is the upgrading within the chain. Upgrading helps companies in the lowest stages of the chain to improve their bargaining and financial positions on different levels and therefore enter new stages of the value chain. There are four types of economic upgrading – product (production of more sophisticated goods), process (introduction of innovative technologies by production or new modes of production), functional (developing new skills) and inter-sectoral upgrading (moving to new but related activities) (Gereffi/Fernandez-Stark, 2016). Economic upgrading, especially the process upgrading, is closely tied to insertion of advanced technologies in and digitalization of the chain, because it helps to reduce paid labour force and increase outputs on production levels, also ameliorating the quality of production by the elimination of human error. The digitalization of process of production means the reduction of manual steps by adopting new digital tools (Parviainen *et al.*, 2017). Automation is being widely applied in all of the segments of value chains from design to marketing, improving the productive and financial performance of chains. The easiest and fastest insertion of digital technologies occurs in labour-intensive stages of production, which usually employs low-skilled workers. For example, according to the McKinsey Institution report (2018), only in the apparel sector expected automation makes up to 82% in manufacturing stages where low-skilled labour is applied (McKinsey, 2018). Other stages of the value chains such as R&D and retail and merchandising can also be improved by means of soft and hard automation.

It's important to note that labour in GVCs used to be considered only in terms of productivity (types of employment, quantity of workers and working hours etc.) and didn't include social perspective (Barrientos *et al.*, 2010). Nonetheless, employees play a crucial role in the work of value chains. Therefore researchers started to unveil and develop another important type of upgrading in the chain – social upgrading. Barrientos *et al* (2011) define social upgrading "as the process of improving the rights and entitlements of workers as social actors and enhancing of the quality of their employment" (Gereffi/Lee, 2014:26). In order to ameliorate the conditions of workers social upgrading has two different dimensions: 1) the improvement of measurable standards as wages, working hours, social protection, 2) and non-quantifiable aspects (promoting human rights as freedom of association, non-discrimination, empowerment, etc.). The concept of social upgrading derives from the Decent Work Agenda of ILO that was introduced in 1999. It embeds four aspects- employment, social protection, workers' rights and social dialogue (Bernhardt/Pollak, 2016).

Social upgrading can happen in two different ways – either bottom-up (workers' initiatives, trade unions) or top-down (enterprises' initiatives, the role of government). The two approaches to social upgrading – bottom-up and top-down – should not necessarily compete with each other but can complement each other (Selwyn, 2013). The possibilities, promotion and outcomes of social upgrading depend drastically on the type of value chain governance and its structure because the participants of the chain are also influenced by international and national regulations and policies (Gereffi/Lee, 2014). National labour regulations and work of trade unions play an essential role as well because it can offer workers educational opportunities for acquiring new skills that can further lead to better employment and better working conditions (Selwyn, 2013). Other factors that can influence the success and possibility of economic and social upgrading are "the position within the value chain, the type of work undertaken, and the status of workers within any work category" (Barrientos *et al.*, 2010: 7). The type of working contract plays a decisive role for workers in terms of access to social upgrading, because permanent workers have better labour conditions than temporary and casual employees, let alone informal workforce (Gereffi/Lee, 2014). Alongside social upgrading, in order to cut costs of production and raise competitiveness, firms may turn to social downgrading that results in longer working hours, less payment, more exploitative working praxes, deteriorating working conditions, raising gender inequality and discrimination, etc. (Barrientos, 2019).

In social upgrading, it is necessary to consider that labour in the GVC varies in relation to skills requested, labour conditions, social protection, remuneration, etc. Barrientos *et al* (2010) elaborated the following typology of labour force in GVC: 1) small-scale household and home-based work, 2) low-skilled, labour-intensive work, 3) moderate-skilled, varied labour-intensity work, 4) high-skilled, technology-intensive work, 5) knowledge-intensive work. As was noted above the contract of employees defines the grade of social protection and rights they can enjoy. There is a big difference between regular and irregular workers as well as people occupied in the formal and informal sector. The low-skilled and moderate labour force is easily replaced in comparison to labour force exercising complex cognitive abilities. The first three types of the labour force are highly susceptible to automation and insertion of digital technologies in manufacturing and services. That raises the issue of the necessity of social upgrading, helping people transfer from one occupational field to others, which are less prone to digitalization or develop their skills to be promoted in their firms (Barrientos *et al.*, 2010).

As the low-skilled labour force is more than other types exposed to automation, Barrientos *et al* (2010) offer three trajectories of social upgrading for employees: 1) small-scale worker upgrading (employees stay occupied in a home-based production but still can enjoy better payment and secure working contracts, etc.), 2) labour-intensive upgrading (workers move towards better types of labour-intensive production with better wages and better working conditions), 3) higher skill upgrading (workers move towards better employment and change of occupational field through training and education) (Barrientos *et al.*, 2010).

Another critical aspect of social upgrading is gender. Jobs distribution across value chains is not gender-neutral. Labour relations in GVCs worldwide are gender-segregated and have diverse gender-specific issues that have to be acknowledged and addressed. Women are disadvantaged and face many gender-based constraints in access to better jobs and better payment. Female workers are overrepresented in lower stages of production in GVCs, whereas men are dominating in higher value-adding activities with better conditions and payment (Tejani/ Kucera, 2014). Here we are dealing with the phenomena of feminization and gender-based segregation of labour, that have been discussed in the previous section and show that labour conditions, access to labour and rights of female workers differ not only in comparison to male workers but also the situation of women in the Global North and the Global South vary significantly from each other. Local and regional political, economic and cultural contexts influence female positions in GVCs, thus underlining the necessity of case studies and

intersectional analysis. Although female workers face some similar challenges in labour market (gender-pay gap, employment bias, restricted access to better jobs, etc.), women are not a homogeneous group, they have diverse identities (age, race, and ethnicity) and therefore implications of additional factors vary in its extent and consequences (Staritz/Reis, 2013). In order to adequately apply social upgrading measures and improve positions of female workers, it's first necessary to recognize that women have specific problems at work and second – that these issues also differ between regions, countries and value chains.

Women working in GVCs (especially in the production end of the chain) are often lacking employment rights, paid less and face exploitation more often than men. They are also a subject to discrimination, sexual harassment, etc. From this perspective, social upgrading plays a vital role for female workers in terms of empowerment, raising social protection, increasing wages and improving working conditions. "Gender analysis (of GVC) unpacks the societally embedded gendered institutions that shape an accepted division of labour whereby women's work is undervalued, and protection of women's welfare needs and rights premised on their subordinate role" (Barrientos, 2014:4). A gendered analysis of GVCs and social upgrading within it should pay special attention to unpaid reproductive labour of women that restricts upgrading possibilities for female workers. For example, often, vocational training is offered in the evening when women are engaged in their care burden and household duties. Also, safety issues of transportation and attending courses, interacting with male teachers may be restrictive for female workers' upgrading (Staritz/Reis, 2013; Bamber/Staritz, 2016). Local social relations and cultural norms also influence women's engagement in GVCs and reflect in unequal pay, more intensive work measured by the same standards as job done by men but less remunerated, devaluation of professional skills, etc. (Barrientos, 2019).

The problem of social upgrading for women, especially in the Global South, is further ravelled by the high percentage of informal unemployment, making female employees literally invisible for trade unions and lead firms, thus excluding them from enjoying basic workers' rights (Bolwig *et al.*, 2010). Women and temporary workers find themselves in a very precarious position because they are often engaged in informal and unsecured sectors of labour and cannot profit from social upgrading opportunities (Gereffi/Lee, 2014).

"Social upgrading can be refined to link women and men's participation in GVCs with respect and protection of gender equitable conditions and rights. This involves formal equality at every level of upgrading whereby improvements in conditions and rights benefit women on an equal basis to men. It also involves gender equitable opportunities for women to be able to upgrade to higher levels at all value chain nodes." (Barrientos, 2014:6).

Thus social upgrading has to be more gender-focused and specifically address female workers' issues and problems, as they differ from those of their male counterparts and blinding out these issues may have a dramatic impact not only on women and gender equality but also on economic development of society and its prosperity.

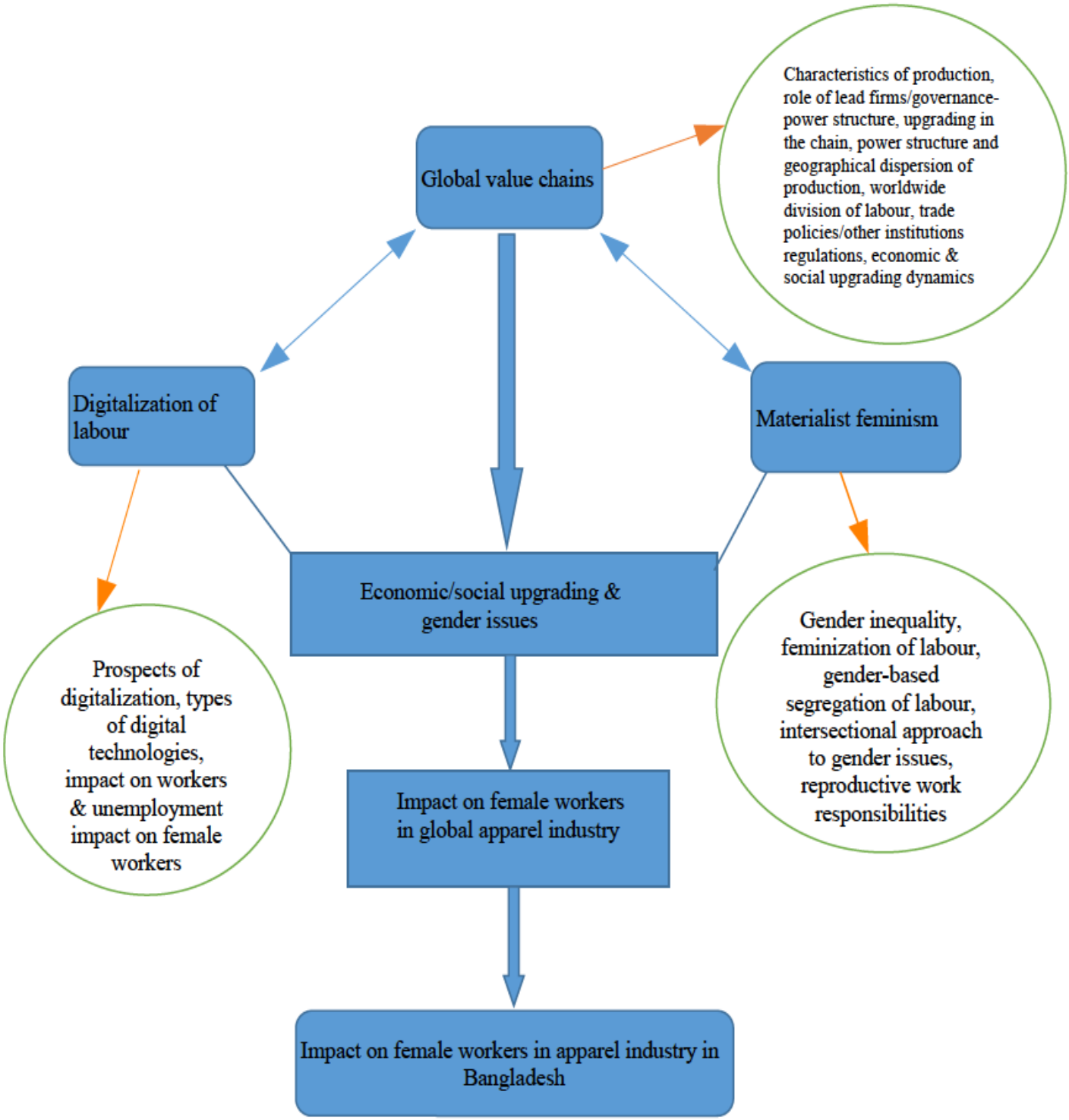
The ongoing digitalization and automation of GVCs increase the importance of social upgrading, especially for the low-skilled labour force, that can be easily replaced by machines, and very often performed by women. The research conducted by Tejani and Milberg (2010) proves that economic upgrading to high-tech manufacturing and digitization in Southeast Asia lead to partial "defeminization" of the labour force (Tejani/Milberg, 2010). Another study by Tejani/Kucera (2014) shows that defiminization of labour in the apparel sector takes place simultaneously with the increasing demand on male workers with technological education, who need to operate the machines (Tejani/Kucera, 2014). Bamber and Staritz (2016) argue that gender-based stereotypes in labour market favour men when it comes to technological better-paid skills and assigns women with "nimble fingers" low-paid activities. Thus when it comes to process and product upgrading that require higher technical skills in operating advanced technologies, men are preferable workers (Bamber/ Staritz, 2016).

A gendered approach to social upgrading on state and firms level should be implemented in order to help women not only save their jobs but also get higher positions in the chain through training, better access to education and better social protection, as well as raise interest among women to STEM sector jobs and education in the field to obtain better employment chances in the future. Increasing numbers among managers and company leaders will help to attract attention to female problems in GVCs and make social upgrading more gender-focused. It is necessary to protect female employment from adverse effects of digitalization.

2.4. Synopsis on theoretical approaches

In order to answer the research questions posed in this master thesis, I combine the three different literatures discussed above. Figure 1 depicts the connections between the literatures and phenomena in question graphically.

Figure 1. Literature linkages



The GVC approach serves as a starting point for this research. To answer the research questions, it is necessary to understand the characteristics of production in specific sectors and VCs, governance structures and power dynamics, upgrading possibilities and geographical scope of production, the hallmarks of the division of labour between the Global North and the Global South, as well as between men and women in global value chains.

In this thesis, I concentrate on process and social upgrading. Process upgrading can be achieved through integrating advanced technologies in the process of production, managing, designing, etc., meaning full or partial automation of these processes. The social upgrading concept was developed to highlight the existence of workers in the chains as important actors and to improve their working conditions. Social upgrading with a gender focus helps to distinguish between male and female workers in the chains and the differences and challenges both face at the workplace, addressing gender-specific issues of employees in the chains.

Materialist feminism with a focus on feminization of labour is of relevance to the GVC approach because of strong gender-based segregation of labour in value chains. Men and women in different sectors have unequal wages, unequal opportunities in access to employment, unequal rights as employees, as well as unequal positions in the sectors, because of gender bias by employment existing in the value chains. Thus, I apply material feminism with a focus on feminization of labour in connection to the GVC approach to address and explain gender-specific issues in GVCs, gender inequality and gender-based segregation of labour and its roots that restrain the access of women to better life chances, education, rights and jobs, etc. Materialist feminism acknowledges the importance of the intersectional approach to gender problems, showing that women cannot be understood as a homogeneous group; women around the world have different problems and different realities. Therefore the intersectionality is of great importance for this study concerning the position of female workers in the GVCs and disadvantaged situation of female employees in the global South and in the apparel sector Bangladesh.

The literature on digitalization and automation of labour is connected with the GVC approach via economic upgrading of value chains, and process upgrading in particular and implications of automation on labour and social upgrading. As lead firms in the chains aim at profit maximization and reduction of the labour force, adoption of robotics/machines and fully or semi-automated production becomes a priority for firms, but only if digitalization proves to be cost-effective. It results in job losses for people. As it was mentioned above, the most precarious

jobs to automation are those, which require low and mid-skilled labour, and due to the feminization of labour and gender-based segregation of labour, these types of jobs in GVCs in the countries of the Global South are mostly performed by women, meaning female workforce is more exposed to negative effects of digitalization than male workforce. Considering the segregation of labour and ascribing gender "specific talents" (male workers with technological skills and physical activity, female workers with "nimble finger" activity), digitalization of labour favours men over women offering the former better working opportunities and more jobs in Industry 4.0.

Intertwining these literatures provides a solid theoretical ground for answering the research questions, as each of them gives an important input in understanding the phenomena under question – functioning of the GVCs, gender-based segregation of labour and automation of labour. In this thesis these theories will be applied to 1) explain how the advanced technologies are being integrated in GVCs and how digitalization affects female workers, that already face multiple economic and social issues at the workplace, 2) elaborate on the apparel industry and gender-specific problems in it as well as digitalization of the apparel sector and its implications for female workers and 3) to analyze the apparel industry in Bangladesh, its digitalization prospects and already adopted technologies, gender issues at workplaces, the effects of digitalization on female workforce and possible solutions of negative impacts of digitalization on female employees.

3. Methodology

In order to answer the research questions, I conducted an empirical study using qualitative methods, i.e. semi-structured expert interviews, document analysis, GPN-mapping as well as quantitative methods such as trade data analysis.

The literature on digitalization of (female) labour as well as on digitalization of the apparel sector is manifold and offers general information on the subjects. However, the academic literature and reports from IGOs/NGOS on the digitalization of female labour in the apparel sector are quite rare, making this specific research innovative and timely. Thus, for the document analysis, I identified key documents, which included not only general academic knowledge of the subjects but provided complex industry knowledge and looked at the phenomena under question in details. I needed to link the data from the documents and had to identify:1) what types of jobs are prone to automation, 2) what stages of the apparel production are to be digitalized, 3) what percentage of female workers is employed at these stages, 4) what impacts the digitalization will

have on women employed by the industry. The steps 2-4 are also relevant for the analysis of the RMG sector in Bangladesh in particular.

First, I analyzed documents concluding information specifically on digitalization and female labour. As the gender issues attracted attention lately, reports and articles combining these two phenomena are manifold. I have chosen the documents that provide information on: 1) the impact of digitalization on female employment, 2) the future of female labour in a digital society, 3) possible policies of tackling the problem of unemployment and gender inequality and 4) reasons that led to the exclusion of women from (better) employment opportunities. The information obtained from these resources was partially used in the theoretical part of the paper and in the part discussing possible measures for female workers negatively affected by the automation of labour: 1) the report of the IMF „Gender, Technology, and the Future of Work" (2018), 2) the study of the G20 Forum „The Effects of Digitalization on the Gender Equality in the G20 economies"(2017), 3) the OECD Policy Brief on the future of work „Going Digital: The Future of Work for Women" (2017), 4) the Accenture group report „Getting To Equal How Digital is Helping Close the Gender Gap at Work" (2016), 5) the report of the Regional Conference ON WOMEN in Latin America and the Caribbean (2013) „Women in the digital economy Breaking through the equality threshold" and 6) the McKinsey Global Institute Report (2019) "The future of women at work: Transitions in the age of automation".

Data on digitalization of the apparel sector was obtained from the following documents: 1) the McKinsey Report (2018) "Is apparel manufacturing coming home? Nearshoring, automation and sustainability – establishing a demand-focused apparel value chain", 2) the ILO Working paper (2017) "How technology is changing jobs and enterprises", 3) K.-S. Chin *et al* research (2004) „Adoption of automation systems and strategy choices for Hong Kong apparel practitioners", 4) the ILO Working paper (2016) "ASEAN in transformation. Textiles, Clothing and Footwear: Refashioning the future" and 5) WTIN (2018) "Digital Transformation Outlook. Global textile and apparel value chains". All of the selected documents provide the information on prospects of automation of the apparel industry, which is relevant for this research. The documents mentioned above had to meet the following selection criteria: 1) it should be either reports from respected international sources or scientific researches, 2) it should provide information on a) potential of automation in the apparel industry and the changes it brings in the industry, b) technologies developed in the apparel sector and c) limitations of automation in apparel. The additional two criteria were not compulsory – 1) possible impact on workers and 2) solutions for workers.

The literature on the apparel sector in Bangladesh is manifold. Though aspect of automation/digitalization is rather rare or vaguely discussed in this literature, making this specific research necessary and valuable. Still, many Internet articles and interviews are discussing this issue. The literature on process upgrading gives insights into the implementation of advanced technologies in the sector and on the impacts of automation on the labour force. The analysis of the Bangladeshi RMG sector and the analysis of automation prospects in this industry, as well as the expert interviews, made it possible to define what kind of advanced technologies are implemented in the sector, what implications digitalization already has on female workers and predicted to have in the nearest future.

Trade data analysis provides figures on the apparel sector globally and in Bangladesh, as the country under question. To receive trade data, I use the World Integrated Trade Solution (WITS) database of the World Bank, based on the UN Comtrade data. I received data on three queries which 1) global apparel exports for the years 2000-2018 (to show the dynamics and the growing importance of the sector for the global economy); 2) total exports of apparel for Bangladesh (to see the development and state the importance of the sector for this specific country in the years 2008-2018); 3) top 10 apparel import countries of Bangladeshi apparel for the year 2018 (to define the main trade partners of Bangladesh for the last year available). I created a new product group to include all the apparel products using the codes 61 and 62 of the Harmonized System (HS) 1996. The results are downloaded as mirror data.

GPN-mapping of the apparel value chain gives a graphic overview on input-output structure, institutional context, governance and geographic scope of the chain, what countries are the key players in the apparel export and what types of actors play a crucial role in the question of automation and social upgrading in the apparel value chain. It also includes female workers dimension and depicts its linkage with other dimensions of the chain.

As I lacked the possibility to conduct field research in Bangladesh, I conducted interviews with local Bangladeshi apparel company managers and female/workers' rights activists to get an inside view on the digitalization of the sector and gender-specific issues, and experts in digitalization of labour. The questionnaire was equal for all the interview partner. The semi-structured interviews help to look at the problem from different angles and shed light at additional problems and issues of the subject in question. This type of interview gives speakers enough room to express their ideas and develop them and at the same time, offers a clear structure of the process that helps to coordinate an interview (Dannecker/Vossemer, 2014) The

interviews were transcribed and coded in order to build categories of themes, facilitating further analysis. Expert interviews have such flaws as submission of biased information or subjective views on problems that are determined by personal experience, education, specific features of research, etc.

I had nine interviews in total. Two interviews were given by the experts from the IAB (Institut für Arbeitsmarkt und Berufsforschung) and the Aachen University in Germany, which discussed the prospects of digitalization of production and its impacts on the human labour generally as well as measures to protect employees. Other three interviews were conducted with the representatives of the Bangladeshi apparel companies – the PDS Multinational Group, the DBL Group and a medium-sized apparel company[3]. These interviews provided insight into the digital development of the apparel industry in Bangladesh and its impact on female workers. Other four interviews were conducted with representatives from NGOs, who occupy themselves with female workers' rights in Bangladesh and focused on the apparel industry – Awaj foundation, CPD center, Shimmy foundation and a local NGO[4]. The experts from these institutions gave valuable information on the current situation of female workers in the apparel industry in Bangladesh, on the impacts of the digital transformation of the sector and discussed possible measures that they undertake to help women make a successful transition to the Industry 4.0. In the analysis part, the interview partners are referred to as follows – first, the name of the institution they represent is complemented by the word "expert". Repeated statements and pieces of information from different experts are identified with the word "experts" without naming institutions they represent.

Limitations of the study

This study tries to interconnect the phenomena of digitalization of the apparel industry and its impact on female labour with a country focus on Bangladesh. The joint investigation of these phenomena is rather rare because the problematic of digitalization of labour has attracted scholars only recently, and multiple sources are discussing the issues separately from each other thus providing enough data which can be intertwined to reply the research questions. There are many reports on digitalization of labour (gender-neutral and gender-focused), showing what jobs will be replaced first of all and offering measures to tackle the problem; literature on the RMG sector in Bangladesh and female workers position in the industry globally and Bangladesh. The

3 The name of the company is not revealed as was demanded by the interview partner

4 The name of the NGO is not revealed as was demanded by the interview partner

literature on the digitalization of the apparel industry in Bangladesh is scarce. Still, there are many online articles and interviews given by diverse representatives of the apparel companies in Bangladesh.

The expert interviews are an important source of information in this thesis, helping to answer the research questions. Nonetheless, there was a certain mistrust in relation to company managers' interviews and their narration of the situation as I had an interesting observation while talking to male experts and female experts. Compared to female interview partners, male experts were reluctant to talk about female rights' abuse, sexual harassment and specific female issues - like sanitation, childcare and gender-based violence. They ignored the issues or changed the subject. The reason for that could be either lack of awareness about gender-based problems and reluctance to recognize them or the fact that the interview partners represented RMG companies and were afraid to admit negative sides of their working process.

I need to underline the difficulty of establishing contact with apparel company owners and managers in Bangladesh. I contacted more than 80 persons and received an answer only from five high profile managers and had an interview only with three of them afterwards. The information provided by the company managers was analyzed in close connection with the results of scientific literature and the interviews with representatives from NGOs in Bangladesh.

4. Global apparel value chains, digitalization and female labour

In this section, I analyze the global apparel value chain implementing the GVC approach and look closer at the dimensions of the chain such as input-output structure, governance/power relations structure, geographical scope and institutional context to understand the functioning of the chain and its dynamics regarding economic and social upgrading, but also the workforce composition, which is essential for this research. This detailed introduction into the global apparel industry gives a profound overview of the chain and its main characteristics. It further helps better understand the Bangladeshi RMG sector, its development and specifics with regard to digitalization and its effects on female workers.

The discussion of working conditions with a gender focus in the global apparel value chain is essential for understanding the issues female workers confront with being employed by the chain and making these problems visible in terms of social upgrading. It proves that through feminization of labour and gender segregation of labour, which were introduced in the theoretical part, female workers are devalued at the workplace in comparison to their male colleagues. Due

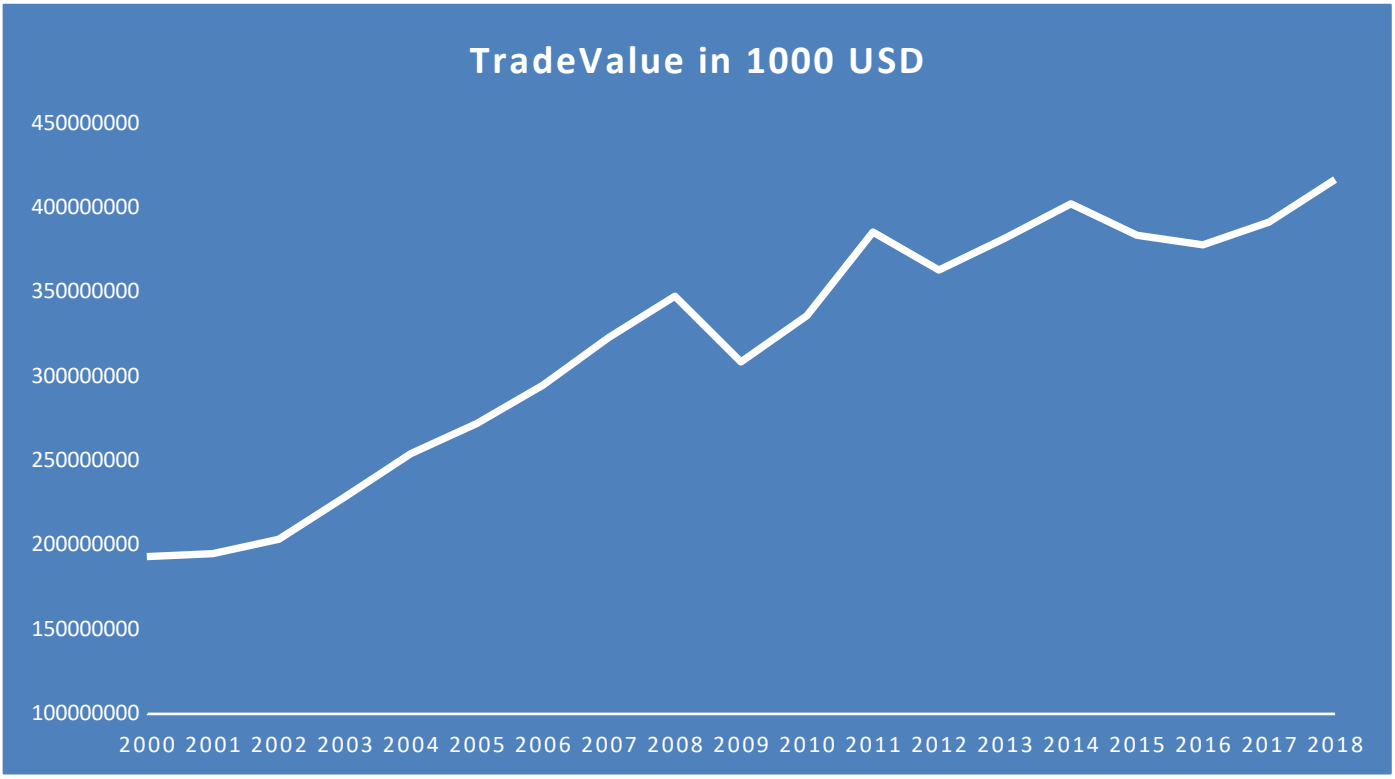
to this devaluation, women accept precarious jobs (fixed-term contracts, informal employment, etc.) with poor working conditions, which contribute to physical and psychological suppression. This suppression further on results in disempowerment among women in the industry and (re-)produce material discriminative relations favouring men over women. Thus, female workers lack the self-confidence to struggle for promotions, better employment in the industry and social upgrading opportunities offering vocational training that can help to keep a job in the sector when it gets digitalized.

The third part of this section discusses the digitalization of the global apparel value chain, showing the technologies that are being inserted in the work of the chain globally and its impacts on female workers particularly, suggesting that among negative effects as workforce replacement, female workers may face improvement of working conditions if they receive more access to social upgrading that may change power relations in the sector due to promotions of female workers on positions requiring technical and managerial skills.

4.1. Apparel value chain

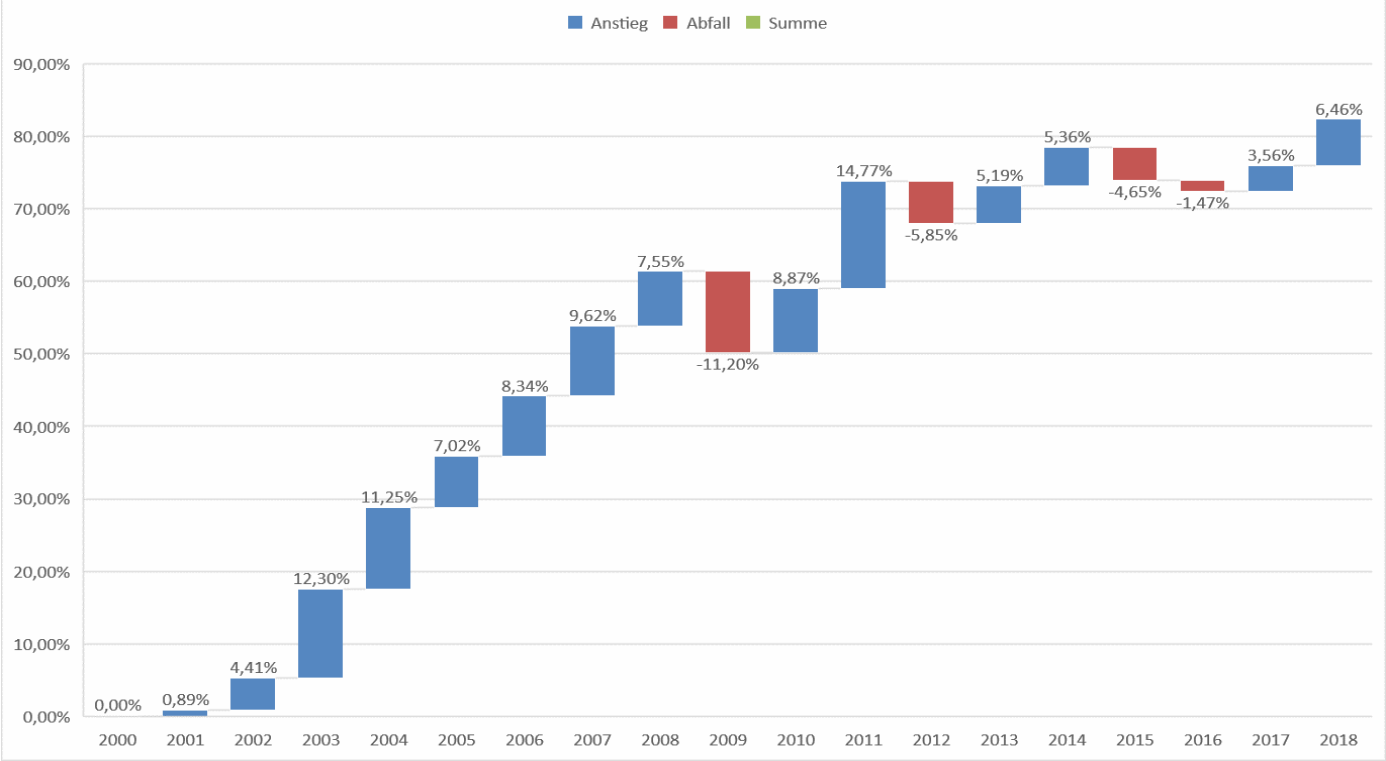
The apparel sector is one of the largest industries in the world with high import-export rates and constantly increasing trade volumes (Figure 2). The sector is characterized by the global division of labour with the prevailing quantity of the apparel manufacturing plants finding themselves in the Global South, where leading firms offshore their production because of the abundance of the low-cost labour (ILO, ACT/EMP, n.d.). According to the statistics provided by WTO, the leading exporters of the apparel products for the year 2018 are China, the EU, Bangladesh, Vietnam, India, Turkey, Hong Kong, Indonesia and the USA (Scheng Lu, 2019). Although the apparel industry shows the impressive trade growth from 2000 to 2018, Figure 2 also shows that in the years 2008-2009 the import-export volumes declined and there were also recessions in 2012 and 2015-2016. Figure 3 depicts the increase and decrease in the garment trade in percentage in the years 2000-2018 in %.

Figure 2. The dynamics of import-export of apparel globally for the period 2000-2018.



Source: United Nations Commodity Trade Statistics Database (UN Comtrade). Note: Apparel represented by Harmonized Commodity Description and Coding System (HS) 61 and 62. The following charts in this thesis are made using the same data source.

Figure 3. The dynamics of import-export of apparel globally for the period 2000-2018 (%)



The garment industry is a labour-intensive sector, and according to typology developed by Gary Gereffi (1994), refers to as a buyer-driven value chain. Gereffi and Memedovic (2003) describe buyer-driven value chains as "…those in which large retailers, marketers and branded manufacturers play the pivotal roles in setting up decentralized production networks in a variety of exporting countries, typically located in developing countries" (Gereffi/Memedovic, 2003:3). It means that big retailer companies (H&M, Wal-Mart) as lead firms of the chain specialize on high-profit stages of production such as design and marketing while outsourcing and subcontracting manufacturing work to the countries with cheap labour force. Simply put, "Global buyers determine what is to be produced, where, by whom, and at what price" (Fernandez-Stark, 2011:7). Frederick and Staritz (2012) distinguish between four types of lead firms in the apparel sector: 1) mass merchant retailers (sell diverse array of products of their own label/ national brands in their stores), 2) specialty retailers (private labels that sold in special stores), 3) brand marketers (coordinate the activities of the chain, but don't own manufacturing plants), 4) brand manufacturers (own manufacturing plants, coordinate and control other activities of the chain) (Frederick/Staritz, 2012).

The industry is being shaped and structured within the frames of a complex institutional context represented by many diverse trade agreements (uni-/bi-/multilateral, transnational), local/regional and multinational policies, control and pressure mechanisms from diverse IGOs and NGOs. Two of the most significant policy instruments in the latest history of the garment industry are the Multi-Faber Arrangement that was valid from 1974 to 1994 and was superseded by the Agreement on the Textiles and Clothing that operated till 2005. Both were supposed to curb the imports from the Global South into the countries of the Global North, thus having a great impact on the industry and the economies in the Global North. The termination of the MFA/ATC led to the liberalization of trade, the rapid expansion of the garment production and made a significant contribution to the development of the apparel sector in the Global South spurring the competition between manufacturers (Lopez-Acevedo/Robertson, 2012; Yusuf, 2012).

In the UNIDO working paper Gereffi and Memedovic (2003) describe five main parts that compound the apparel value chain: 1) the supply of raw materials - as natural and synthetic fibres, 2) provision of components – yarns and fabrics produced by textile companies, 3) production networks made up of garment factories, 4) channels of export established by trade intermediaries; 5) marketing networks for the retailing (Gereffi/Memedovic, 2003:4). The production and preparation of fibres and yarns are considered to be more capital intensive stages

of production and demand higher-skilled labour force. Therefore textile production mainly remains in the Global North and in the middle-income countries. The manufacturing includes labour-intensive activities such as sewing, cutting and assembling which don't require special skills, cost less and are mostly offshored to the Global South (Frederick/Staritz, 2012).

The garment production can be divided into four types: 1) cut and trim model (CMT), where manufacturers import fabrics and produce apparel for further export, 2) original equipment manufacturing (OEM) where the manufacturer performs all production services, finishing, and packaging. It is also called full package manufacturing (FOB), 3) original design manufacturing (ODM) where the apparel supplier is additionally occupied with design of products and coordinates all the OEM activities, 4) original brand manufacturing (OBD), where the supplier overtakes such tasks as branding and marketing of the final products (Frederick/ Staritz, 2012). The apparel manufacturers, which don't diversify their production and stay only in CMT are less competitive than those developing their business to OEM/FOB and further. Making production more complex may result in increased productivity and higher export rates (Lopez-Acevedo/Robertson, 2012). Still, the prevalent part of the apparel manufacturers concentrates in CMT where the composition of costs as followed – direct materials 40%, direct labour 20%, factory overhead 30%, sales commission 5% and profit of CMT manufacturers 5%. „The CMT business model does not give manufacturers control over cost of materials as they are required to purchase materials from suppliers appointed by buyers. A large portion of cost is thus outside the control of the manufacturers"(ILO, ACT/EMP, n.d., 10). It makes apparel exporting companies be prone to economic and political changes and instabilities globally and locally and to whims of lead firms which can be dramatic for manufacturers affecting their business and resulting in social downgrading in the firms.

At the same time, economic upgrading of the chain and diversification of production require not only more advanced technologies but also a more skilled workforce with a higher education that is scarce in the countries of the Global South (Fernandez-Stark, 2011). The access to finances may also be a challenge for the firms which aim to upgrade their services from an inferior type of production to a superior one as well as the local infrastructure. The more activities a firm wants to accomplish and the more diversified they are, the more complex technologies are required to fulfil the tasks. Lacking infrastructure and unfriendly local policies as well as the reluctance of the governance to timely respond to the needs of the sector may impede the incentives of the firm to upgrade their services (Yusuf, 2012). The apparel value chain has low entry barriers making it

possible for diverse companies to launch their production of garment especially as CMT, therefore the prevalent part of the enterprises in the clothing industry is small and mid-sized. ILO estimates SMEs to be „a major engine for job creation and innovation“(ILO, WP 326, 2019). The industry is very competitive due to the abundance of low-cost labour mostly performed by female workers. Thus to stay on board, the firms struggle to attract buyers by cutting production costs, improving quality of garments, adopting innovative technologies and expanding their services (Lopez-Acevedo/Robertson, 2012).

Fernandez-Stark (2011) identifies six main value-added activities within the apparel value chain that compile each type of garment production model described above, with the lowest percentage on value that falls on manufacturing (CMT) stage: 1) research and new product development (R&D), 2) design, 3) production, 4) logistics (purchasing and distribution), 5) marketing and branding, 6) services (Fernandez-Stark, 2011). Thus in order to increase gains, a garment company has to include new activities in the operation of the chain moving up to more profitable value-adding tasks.

Apparel manufacturing can be further divided into two major segments – woven and knitted garment production. These two types of apparel products use different types of yarn, fabric, machinery, and manufacturing technology. Knitted products are more preferable because they are more labour intensive and less technology demanding, thus cheaper to produce than woven garments (Frederick/ Staritz, 2012).

The apparel and textile industries employ more than 123 million workers worldwide with the following percentage in each stage of the chain: 0,2 % for design and development; 2,9% for transportation; 0,5% warehousing; 12,1 in distribution; 7,6 in supporting services; intermediate material inputs make 47,6%, and 52,5% of the workforce falls for manufacturing (World Economic Forum, 2019). Workforce composition by gender in the sector is rather uneven because 75% of employees are low-skilled uneducated women engaged in labour-intensive low-waged activities (CARE, 2017). This statistical data comes from official sources, and it doesn’t include the information on informal labour that constitutes the garment industry up to 80% depending on a country, as the experts state.

Nowadays, the apparel industry is facing serious changes. Not only the fast-fashion production puts incredible pressure on manufacturers by reducing production life cycle where buyers demand the refreshing of their stocks with increased frequency and in smaller quantities, the introduction and rapid development of digital technologies impact labour composition of the

chain and competitiveness of firms and countries within it (Yusuf, 2012). Companies are concentrated on the high profits which can be gained via process and product upgrading. According to the McKinsey Institution report, up to 60% of jobs in manufacturing will be automated in the nearest future (McKinsey report, 2017). Thus, it is possible to conclude that the workers in the apparel sector will be most affected by it, especially in countries specializing in manufacturing stages of garment production. For example, the report provided by "The textile today" shows that automation already has its impacts on the apparel industry in Bangladesh, reducing its labour force and increasing productivity by the insertion of advanced technologies (Akter, 2018). The emerging problem and its analysis play a crucial role for developing governmental programs and policies within the chain and also outside the chain – by local and regional governments in order to protect labour force that will face technological unemployment.

4.2. Gender issues in the apparel value chain

The apparel industry is considered to be female- and labour-intensive. According to the CARE report (2017), approx. 75% of the workers in the garment sector globally are women, with different concentration among countries (CARE, 2017). Therefore analyzing this value chain from a gender perspective is crucial to identify female-specific issues that characterize the employment in this industry and the role of female workers in the development of the sector. Implementation of the GVC's social upgrading concept with a focus on gender dimension helps to assess working conditions and position of female workers in the sector and develop possible measures to improve the current state of the female employees and promote gender equality.

The rapid expansion of the industry started in the 1970s and became a great opportunity for women to get engaged in paid formal labour, especially in the Global South which entered the path of industrialization (Yusuf, 2012). The employment in the garment sector became for women the way to empowerment and independence. A big part of female workers in the apparel industry come from rural areas, have limited skills and primary or no education and thus have no access to better employment other than in the apparel which is better than agriculture or service jobs[5]. The sector gives these women the chance to earn their living, support family and improve their social and financial status (Rumanpura, 2011; BSR, June 2017).

Although the employment in apparel manufacturing has its positive implications on women, there are still many challenges that have to be addressed. Working and social conditions of women in

5 The roots of these problems were discussed in the section 2.1, explaining the exclusion of women from employment and education based on gender-discrimination and preserving patriarchal power-relations.

the apparel industry are far from ideal. The sector is shaped by exploiting labour relations, gender discrimination, employment bias and lack of career opportunities. Gender-based segregation of labour keeps female workers at the lowest labour intensive positions with a minimum wage, barely giving them a chance for promotion. As most of the manufacturing plants are based in the Global South, local social and cultural relations contribute to the inferior position of women in society and at work, giving male workers more power and better working chances.

Diverse researches, case studies and reports find many gender-specific issues in the functioning of the apparel value chain that need to be addressed in order to achieve healthy physical and psychological environment, promote female empowerment and gender equality regarding social upgrading measurable and non-quantifiable standards. The Better Work program[6] outlined the main gender problems of the apparel industry that it plans to resolve during the years 2018-2022. Among them are occupational segregation, long working hours, sexual harassment, under-representation of women as supervisors, gender-based discrimination by recruitment, the gender wage gap, the necessity of pregnancy related healthcare, under-representation in trade unions. Successful handling of these issues is supposed to contribute to the implementation of SDP goals such as goal 1. No poverty, 5. Gender equality and 8. Decent work and economic growth (Better Work, 2018).

Aside gender-based discrimination and segregation of labour, the roots and consequences of which were discussed in the theoretical section 2.1, one of the important issues retaining female workers from enjoying their social rights is informal employment and fixed-term contracts which is normality in the apparel sector in the Global South. A very high percentage of informal jobs or short-term contracts deprive female workers from access to the basic workers' rights and social benefits such as social upgrading opportunities, paid sick/maternity leave and paid vacation, etc. (Nuon *et al.*, 2011).

The intersectionality approach of MatFem plays an essential role in the discussion about the position of female employees in apparel. As female workers are not a homogeneous group, their identities (migrant background, ethnicities) may contribute to their inferior position in the workers' hierarchy worsening their working and social conditions (Plank *et al.*, 2012).

It's not a secret that women working in the apparel are exploited at work. They have to work long hours and also have to adapt to the demands of fast fashion production (work at night, work on

6 A collaboration between the United Nation's International Labour Organization and the International Finance Corporation (Better Work, 2018).

demand, excessive working hours). Women are being blackmailed and put under psychological pressure if they don't meet the production goals. Often women forced to work overtime without remuneration (BSR, 2017; Rumanpura, 2011; CleanClothesCampaign, n.d.; Better Work, 2018; Barnes/ Kozar, 2008).

The cultural perception of women as "docile" reflects in unfair financial rewards. Female workers are often cheated with payment and paid less than their male counterparts in the same position. For example, according to the HIP's report, male workers in Mexican plants receive 34% higher salaries for the same job than their female counterparts (HIP, 2018). Another report investigating the situation of female workers in Cambodia states that male workers also receive better salaries and get higher raises because managers are afraid that otherwise, men will go on strike (Nuon *et al.*, 2011).The ILO research note on Garment, Textile and Footwear production in Asia (2018) states that the gender wage gap is a serious impediment on the way to gender equality because equal pay for equal work is one of the main principals of international labour standards. In comparison to men, women having higher incomes tend to spend it on child education, health and family needs, thus contributing to better social development and improving human capital (ILO, 2018).

Sexual harassment, gender-based discrimination and violence against female workers remain vital challenges for diverse organizations which are occupied with gender-specific problems in the apparel industry. Many reports from NGOs and IGOs (ClenaClothesCampaign/ Human Rights Watch, etc.) state that women are constantly sexually abused by male co-workers, usually managers, and forced to have sexual relations with managers in order to stay employed. Human Rights Watch underlines the importance of the common ILO convention governing sexual harassment at work because 59 countries don't have any legal regulation to handle inappropriate behavior, but even in countries where such laws exist their implementation often fails to protect victims in reality. Female workers are mostly not aware of their rights and that they are protected against sexual harassment by legislation. Many of them are afraid to claim the cases of sexual abuse because they don't want to lose their job or get the "wrong reputation" in the eyes of co-workers and society. Due to harmful and discriminative cultural norms, sexual harassment is often estimated as "normality", thus stays under-reported (Human Rights Watch, 2019; BSR, 2017; CleanClothesCampaign, n.d.; Better Work, 2018). "The risk of gender-based violence is exacerbated through power differences between a mostly female workforce and majority male management, and deep-rooted social norms and practices that devalue women" (CARE, 2017: 5).

Domestic violence results in a decrease of productivity of almost 35% (CARE, 2017). The lack of safe infrastructure and transportation for secure commutation make women exposed to gender-based violence. Women often have to work till it is dark and most accidents as rape or robbery happen on the way home (BSR, 2017).

Female workers have restricted access to better employment as a result of existing patriarchal relations in society. Male workers usually have better networks and face less bias by employment while women are fraught with gender-based discriminative perceptions that they are suitable only for certain types of work in the apparel („nimble fingers“). Although there is also employment bias against male applicants, who aren't hired in traditionally female sectors, because of the stereotype that men don't possess qualifications for the job and men can be "troublemakers" at work (Pike/ Godfrey, 2014). Under-representation of women in managerial positions and trade unions creates misbalance in power relations in the garment sector. Lack of knowledge and education negatively influence the self-esteem of female workers and may be seen as a restrictive mechanism on the way to better jobs. The BSR report (March 2017) gives an example of a factory that offered training for female workers to become machine operators, but no-one wanted to use this opportunity because of the responsibility to supervise other workers. Lack of confidence and support from managers and supervisors deprives women from personal and career development, making them stuck in the lowest position in the job hierarchy (BSR, 2017). The increased number of female managers may result in better work organization and addressing gender-specific needs of women in the sector, fairer payment, influence hiring decisions, decline possible sexual harassment and empower women to report the cases of sexual misbehavior of their male co-workers (Better Work, 2018; BSR, 2017)

Poor working conditions and insufficient safety at manufacturing plants pose a threat to both female and male employees, but there are more female workers at the factories thus in case of danger, they are more and in more significant numbers exposed to it than men (for example, the collapse of Rana Plaza in Bangladesh) (Rumanpura, 2011). The assembling of clothing presupposes the usage of hazardous materials and substances dangerous for health. The BSR report (March 2017) on Sub-Saharan Africa shows that many plants do not have sufficient protective mechanisms and ammunition for workers, general health recommendations are not respected. Many buildings were reconstructed into factories without compliance with safety prescriptions, having outdated wiring causing fires and expired or absent fire-extinguishing facilities, fire escapes and windows are often blocked thus increasing causalities (European

Parliament, 2014). In comparison to South Asia, most of Sub-Saharan Africa plants don't have on-site medical facilities to timely handle working accidents and render medical help to people in need. It happens because it's not legally prescribed by the local public law that proves the importance of state interference by regulating workers' and social rights. Workers say that even if they have medical insurance it often doesn't cover necessary medicines. Female workers also lack basic knowledge and access to service and information about reproductive and sexual health due to social and cultural norms. As young women often come from rural areas to work in the urban plants, they usually neglect gender-specific health issues and even don't know where to go in case of emergency because they don't have social networks in the cities (BSR, 2017).

Pregnant female workers employed by the industry are especially vulnerable. They may be mistreated by managers who may verbally abuse them, punish them with higher production quotas, longer working hours, assigning them with tasks requiring standing or using a lot of physical efforts. There are also reported cases of forced abortions and forced resignations if found that a woman got pregnant after being employed. Passing a pregnancy test before hiring is a usual practice for manufacturing plants in the Global South (CleanClothesCampaign, n.d.; Barnes/ Kozar, 2008; HIP, 2018). Mainly under local public law female workers are entitled to have a maternity leave (duration differs from country to country), but in practice, governments fail to enforce and control the adequate implementation of laws protecting mothers' rights (Nuon *et al.*, 2011). Lack or absence of attention to female unpaid labour and childcare needs such as paid maternity leave and child-caring facilities at work complicate the situation of female workers who have to work long or excessive hours neglecting their mothering needs (BSR, 2017). Today many IGOs and NGOs are concerned with the situation of female workers in the apparel sector. They develop and implement diverse programs and policies to improve working conditions and social rights of female workers, thus empowering women. BSR report (2017) based on the in-depth research of the apparel sector conducted by the International Center for Research on Women (ICRW) states that the most successful initiatives so-far are the ILO's Better Work[7], BSR's HERproject[8], and GAP Inc.'s P.A.C.E.[9] These programs have several common strategies

7 The Better Work program is the cooperative project between ILO (International Labour Organisation) and IFC (International Finance Corporation) that estimates the companies'compliance with labour standards helping them to meet international labour requirements, but also enhances trainings and capacity building for workers (ILO.org).

8 BSR's HERproject aims at improving the situation of female workers all over the world and empower women addressing gender specific issues in the context of labour relations in global value chains (herproject.org).

9 GAP Inc. P.A.C.E. Personal Advancement & Career Enhancement – the program that started in 2007 to support female workers in the apparel industry by providing them with technical trainings and empower women engaged in the garment production (gapincsustainability.com).

such as: 1) they support the collaboration between brands, suppliers, and NGOs; 2) their main focus are health (reproductive and productive), professional advancement, life skills and financial inclusion; 3) the necessity to promote women's agency and voice for successful empowerment (BSR, 2017). As these strategies have proved to be effective, they can be further adopted by other NGOs and organizations promoting women's rights. Nowadays the embedding of female workforce is a must for economic and social development of countries. Thus requires the creation of a friendly working environment for women and targeted addressing of gender-specific issues at the workplace.

4.3. Digitalization of the apparel industry and its effects on female workers

The apparel industry has very promising prospects for automation/digitalization (up to 82%) across the whole value chain, but still in comparison to other industries the adoption of advanced technologies appears to be rather slow (McKinsey, 2017). Smart factories, smart networks and smart products are considered to be the future of the sector accomplishing the production and distribution processes almost without human interactions over Internet of Things (IoT) that allows machines and digital devices autonomously communicate over the Internet (Bertola/Teunissen, 2018). The lead firms and the largest retailers invest in development and implementation of new technologies in garment manufacturing to bring the production of apparel closer to end markets (ILO, ACT/EMP, n.d.). Nearshoring and onshoring of garment production are supposed to result in higher financial gains for lead firms, and it pushes manufacturers in low-wage countries to slowly adopt modern robotics not only to make the production even cheaper but also to make it faster and more customer-focused (Heinemann, 2018).

The ILO Working paper 326 (2019) underlines the urgent necessity of large-scale investments in advanced technologies in LCDs to support their economic growth and competitiveness (ILO, 2019). Nearshoring may negatively affect the employment rates and the sector growth in the Global South by displacing millions of workers and diminishing export rates (ILO, ACT/EMP, n.d.). To supersede possible loss of end markets to reshoring, China has already started rapid digitalization of the industry with its first smart factories reducing labour force/costs, promoting labour force technological upskilling, continually improving the industry ecosystem, etc. And the other exporting countries have to follow this example if they want to keep their positions in the value chain (ibid.). Yet the reshoring will also create jobs if new plants are opened in such countries as Mexico (for the USA) and Turkey (for the EU). It shows how dynamic the sector is and how the losses of one region may result in gains for another one.

Shahid Yusuf, Chief Economist, Growth Dialogue, George Washington University, says that: "...the (apparel) industry is undergoing a technological renaissance and the more competitive firms will be those that harness new design production and IT technologies and match these with a more skilled workforce" (Yusuf, 2012: 3). Investments in the development of new technologies are growing each year, and many technologies are already being inserted in all the four stages of the chain. The technological development of the sector is slowly changing the entering barriers of the chain – from labour-intensive to capital-intensive. It can also change the role of the lead firms and governance of the chain in the future. Table 1 provides detailed information on different technologies that are already being adopted for the automation/digitalization of the apparel value chain. It was mentioned in the methodology section, the documents do not provide information on the effects of digitalization on female workers specifically but on the employment in the sector in general. Still, as the share of women occupied in the industry is around 75%, it is possible to conclude that female workers are most prone to jobs displacement caused by automation.

Table 1. Automation in the apparel sector

Literature	McKinsey report (2018) "Is apparel manufacturing coming home? "	ILO Working paper (2017) "How technology is changing jobs and enterprises"	K.-S. Chin, K.-F. Pun, H. Lau,Y. S. Leung (2004) „Adoption of automation systems and strategy choices for Hong Kong apparel practitioners"	ILO (2016): ASEAN in transformation. Textiles, Clothing and Footwear: Refashioning the future"	WTIN (2018): Digital Transformation Outlook. Global textile and apparel value chain s
Criteria					
Potential of automation in apparel industry and the changes it brings in the industry	High potential of automation. Brands are investing in technological development to make nearshoring and domestic production possible that may lead to higher revenues.	Very high potential of implementing advanced technologies across the VC. Lead firms in developed countries investing in technologies to make nearshoring and domestic production possible. The costs of technology will be decreasing with time while its capabilities will increase.	High potential of automation across the VC	TCF sector has the highest potential of almost full automation. That leads to reshoring/nearshoring of production, lowering the costs for lead firms and making investments in digital development attractive.	High potential of automation. Reshoring and nearshoring are not the main goals of firms.
Technologies developed	Digitization of processes along all phases of the fashion cycle – from intelligent consumer insights to virtual design and	*Product development:* Digital printing and body scanning technology. *Apparel design:*	*Soft automation*: Apparel management information system, Product data	3D printing, body scanning technology, Sewbots, cutting machines,	Cloud technologies, Data analytics, Artificial intelligence, smart

	prototyping to integrated vendor-management tools and digital sell-in. (Sewbots, CNC cutter tables, spray robots, fabric vision systems, smart tracking and tracing, smart storage solutions, 3D printing, Robotics in intralogistics throughout the production process as well as warehousing, Emerging gluing/bonding technology - seamless production, 3D knitting, automated finishing - lasers, abrasives, etc.)	3D body scanning, computer aided design (CAD) pattern tools. *Production:* Fabric spreader truck, automated cutting machines, and sewing robotics. *Apparel finishing:* Pressing automation	management, Computer-aided design apparel manufacture (CAD), Computer-integrated apparel production scheduling systems. *Hard automation:* computerized marker, computerized spreading and cutting machine -CNC machine, Automated auxiliary sewing tools, computerized ironing and fusing machines, optical sewing sensors, fabric handling and loading machine, garment transporters, garment storage conveyors, automatic packaging machine	computer-aided design (CAD), wearable technology, nanotechnology, environmentally friendly manufacturing techniques, robotic automation	logistics, 3D tools, smart sensors, robotics, E-commerce platform, material and product tracking,
Limitations of automation in apparel	The complexity of technologies and high costs of machines. Lagging in development of	Low-skilled labour in Asia and other countries of the Global South is	The majority of small and medium-sized apparel manufacturers	High costs of technologies. The countries of	A lack of skilled professionals, a lack of clear vision

	advanced technologies. Low-income manufacturers are still competitive.	still more competitive as investing in machines (on the short- to mid-term) Sewbots are yet not capable to handle diverse fabrics and can produce only several types of textile products.	do not have large-scale facilities with advanced equipment and tools.	the Global South lack workforce who can operate machines	and leadership, and necessity for high financial investment
Possible impact on workers	Up to 40% workforce reduction in complex garment production and up to 80% - in simple garment production	Reduction of low-skilled and mid-skilled labour. Increasing demand on high-skilled workers. Changing the labour structure	Decline in manufacturing employment	Displacement of low-skilled workers. (risk in ASEAN up to 88% of workers in apparel) Demand on educated workforce. Changing the labour structure	Transformation of jobs, increase of demand on skilled workers.
Solutions for workers		Investing in human capital, skills-intensive sectors, research and development and high-value products.		Acceleration partnerships with educational and training institutions to prepare the next generation of TCF workers who have stronger technical qualification	Retraining, internal promotions, changing the management, hiring high-skilled specialists, increase investments in upskilling of employees.

Apparel firms have many reasons for the digitalization of the industry. Among them - reduced labour costs, increase of skilled professionals, saving facilities' space, better quality of production, reduced lead time, increased productivity and flexibility, more sustainable and environmental friendly production, better working conditions that lead to reduced pressure from IGOs, NGOs and trade unions (Singh/Prasad, n.d.). Advanced technologies exclude or reduce contact with hazardous materials and chemicals and dangerous production processes (as cutting) thus having a positive impact on occupational safety and health (ILO, 2019).

The automation of the apparel value chain in the times of fast fashion also has a normative side – human rights promotion. Employees in manufacturing have very questionable working conditions, are poorly paid and lack social protection. These factors increase pressure on the lead firms and global buyers because ILO, trade unions and diverse NGOs demand decent work and payment for people. Therefore nearshoring and widespread usage of digital technologies will take the moral burden, pressure and responsibility for infringing human rights away from the lead and supplier firms. Workers who will operate the machines, will be paid better and have better working conditions, meeting the demands of Decent work Agenda or at least to be more in compliance with them than now.

Although the necessity of the automation of garment production is urgent, its proliferation has many limitations today. They lay in high costs of machines, abundant low-wage labour force and lack of workers with tech-skills, making the transition to automation for most of the firms less attractive in short- to mid-term period. First of all, it's relevant for the suppliers from the Global South, while the companies in the advanced economies have necessary resources for automation (finances and skilled labour force).

„Leading brands and buyers, for instance, are well-positioned to make investments in digitalization for improved supply chain management and establishing new digital sales channels. By comparison, supplier firms in the first, second and third tiers of the supply chain are restrained by a lack of access to capital and information about technologies and markets, which in most cases are prerequisites for undertaking large-scale investments in robotics and automation to optimize production"(ILO, 2019:16).

The experts say that business owners realize that to stay competitive and attract buyers, it's necessary to adopt advanced technologies and invest in process upgrading. Although the costs of robotics are high and it will pay off only in years, especially considering the additional spending on maintaining and service rendered for the proper work of machines, making them even less profitable on the short run. Still, large companies do not hesitate to implement the newest machines and software to ameliorate their production as they have enough capital and can

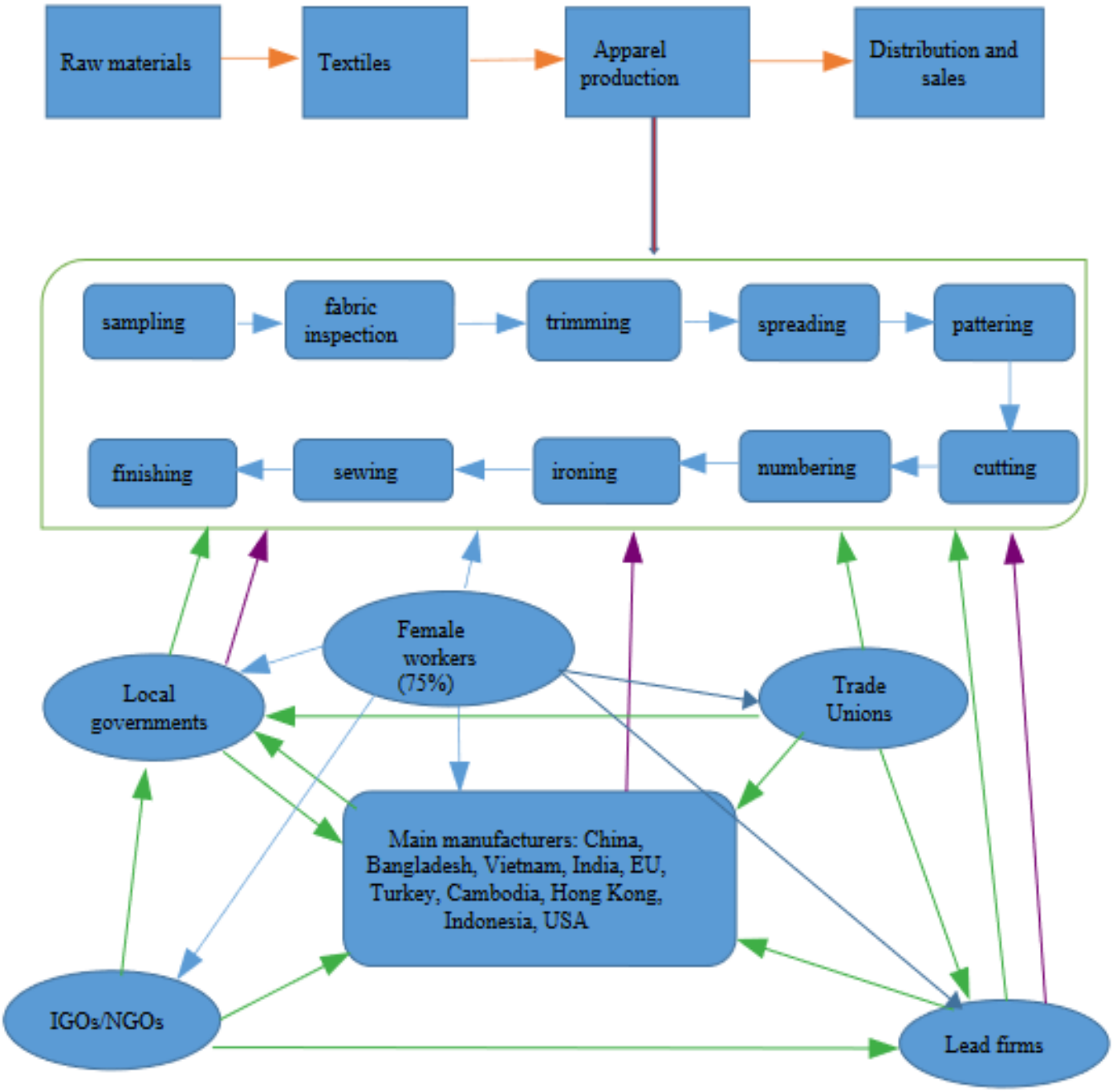
employ skilled workers. The experts also state that with the time the costs of technologies will fall and automation will be the first choice for every manufacturing plant.

Another possible scenario is that low-tech and low-cost production in the Global South will co-exist with the digitalized sector in the Global North (ILO, 2019). Nonetheless, many manufacturers have already adopted digital technologies which partially or fully automate stages of garment production and reduce labour force dramatically. For example, advanced sewing machines, cutting tables, automated knitting, CAD and 3D printing, etc. The leading manufacturers (China, Bangladesh, India, EU, Turkey, Cambodia, Indonesia, Hong Kong and the USA) find themselves in a very tough competition between each other and other manufacturers. Therefore automation is considered to be a necessary step for them to increase production and stay attractive for global buyers. Especially regarding the increasing costs of labour due to pressures from ILO, NGOs and trade unions, who also place a demand on lead firms and manufacturers to do their business under the rules of corporate social responsibility. At the same time, local governments are more concerned with economic growth, and if the automation is more profitable than human labour, then the governments prefer to make the transition to automated labour.

Another challenge on the way to automation is that the digitalization of the sector requires a new working skills composition – the transition from the low-skilled workforce to mid- and high-skilled professionals with technical education. The Global South countries lack an educated workforce who can operate and repair complex robotics; thus the manufacturers have to employ expensive specialists from abroad to accomplish these tasks (ILO, 2017). The increased level of primary and secondary education, especially for women, plays a crucial role in the economic and social development of the Global South.

Digitalization is relevant for all the stages of the apparel value chain from design to marketing and retail, but the most significant impact it will have on labour force on the manufacturing stage of production, which mostly employs women. Therefore, female workers will be affected most of all by the digitalization of the sector. The mapping of the chain (Figure 4) depicts the main parts which compound it with a more detailed description of the manufacturing process. It also shows the main exporters of the apparel products, actors of the chain and interactions between them regarding social and economic upgrading.

Figure 4. Mapping of the apparel value chain with a focus on manufacturing stage of production



Notes: 1) green arrows depict the pressure for social upgrading between actors and on the industry, 2) violet arrows depict the pressure for automation of the sector, 3) blue arrows show the linkages between female workers and other actors of the chain in terms of pressure for better working conditions and social upgrading, and female workers share in the apparel production.

According to the statements of the experts and information provided by various reports, apparel manufacturing is due to be fully automated in the nearest future (10 to 20 years). It may lead to massive job losses for low- and mid-skilled workforce in a simple (up to 80%) and complex (up to 40%) garment production (McKinsey, 2018). South Asian workers dominate the garment sector with 69% of people in the region being occupied by the industry, and the region is estimated to be most affected by the automation due to abundance of unskilled labour (World Economic Forum, 2019).

Manufacturing is the stage of the chain with the highest concentration of workforce. Most of the people engaged in garment manufacturing are low-skilled and uneducated women. The manufacturing in the apparel industry consists of the following processes: sampling, fabric inspection, trimming, spreading, patterning, cutting, numbering, ironing, sewing, finishing (Figure 4). The labour force is distributed rather uneven between them - 65% of all the workforce still falls for sewing (in comparison to 10% in cutting and 5% in trimming), making it the most labour-intensive stage of apparel manufacturing (ILO, 2017).

The automation of the sewing process is supposed to have a significant impact on the workforce (up to 89% of jobs reduction) and on the industry itself. It will change the power dynamics between firms, will most probably give the lead firms and brands the opportunity to reduce the offshoring of their production and bring manufacturing closer to end markets. The problem is that sewing is one of the most complex processes to automate because robots are lacking the capability to handle different fabrics. The following technologies have to be developed to make sewing robot autonomous – automated fabric handling for sewing robotics, wearables in production environment, sewing surveillance vision system (McKinsey, 2018). The most advanced sewing robot existing today is Sewbot. Sewbots are being used for manufacturing shoes, towels, T-shirts and bath mats, completing the whole process. It cannot be yet applied for more sophisticated production, because the technology must be improved and adopted for the handling of diverse types of fabrics and its specific features (Raj, 2018). However, the experts assure that development of Sewbot that can complete the sewing of simple to middle-complex garments is not that far away – 7-8 years from now. Total automation of the sewing process will make the production much cheaper and faster. Therefore the investments in the development of Sewbots are very high. The automation of cutting and knitting stage is already happening, reducing labour force dramatically (one machine replaces 10 to 15 workers) and increasing productivity. Thus the larger firms are equipping their plants with this technology (ILO, 2016).

There are also advanced machines that increase workers' productivity leading to partial automation, not eliminating the need of human workforce but reducing it.

Female workers are being affected by the automation of the industry most of all because 75% of workforce in the apparel sector is composed by women, meaning automation will decrease the total number of women in the sector dramatically (it's important to remember that this is the official statistics and it doesn't reflect the number of informal employees). These workers are low-educated or not educated at all and engaged in labour-intensive production. Thus the automation, especially of the sewing stage will cost jobs to millions of low-skilled female workers. At the same time, the demand for high-skilled labour force will significantly increase, especially for people with technical skills. Under-representation of women in technical studies and STEM professions and lack of secondary education by manufacturing workers may deprive them from employment opportunities. Firms may prefer to hire educated and experienced people with technical skills rather than invest in trainings and re-education for the existing workers. According to the BSR report (2019), the changes in gender make-up of the garment industry are already traceable due to adoption of new technologies and increased automation by bigger apparel firms. Although female workers have high potential in developing and upgrading their skills, companies prefer to hire more men who possess technical skills and knowledge (BSR, 2019). It can also happen due to gender-based discrimination favouring men position in the society over women, employment bias and better-developed networks of men who have social linkages helping them get better jobs.

The Shimmy company, which is occupied with gender-specific issues in the apparel value chain helping women to upgrade their skills and adapt to the automation of the chain, estimates the risks of automation to be most strongly felt by female workers. The rash development of advanced technologies may contribute to the replacement of sewing machine operators who are at large percentage are women. Male breadwinner model and cultural norms favouring men over women will give men more chances to get jobs in case of automation displacement. As manufacturing plants will need more workers with technical and mechanical skills, men will be prioritized because female workers are often overlooked by technical training. Employment bias and gender misbalance in decision-making positions will play a serious role in the times of increased automation (Shimmy, n.d.).

Summarizing the findings of this chapter, these are the main transformations of the apparel industry: 1) the development of advanced technologies raising the necessity of their

implementation across the value chain in order to stay competitive in the times of fast fashion, increasing labour costs and need for higher productivity and better quality; 2) SMEs lack financial capabilities for rapid adoption of digital technologies and 3) the labour skill gap stands on the way of automation in the Global South, relevant for all the firms, as the urgent need of technical education among the population may lead to decrease in export rates in those countries which don't invest in human capital development and technological innovations in the industry; 4) the digitalization already affects human labour force participation in the sector. The high gender-based segregation of the industry (80% women/ 20% men globally) shows that female workers will be displaced in significant numbers in the nearest future and there is already evidence of falling employment numbers of women in the sector; 5) gender-based segregation of labour and bias may impede the future of female employment. Thus it is necessary to develop programs and policies to support women in transition to new occupations in digital society.

5. Apparel sector in Bangladesh, digitalization and female labour

This section discusses the apparel industry in Bangladesh, its digitalization prospects and effects of automation on female workers as well as measures and policies suggested in documents and by the experts to improve the position of women affected by the digitalization of the sector.

The theoretical approach on GVC and the apparel value chain serves to describe and understand the functioning of the sector in Bangladesh regarding the four dimensions of the chain analysis developed by Gary Gereffi. The social upgrading concept in connection with MatFem and gender-based segregation of labour help to explain the roots of the gender-specific issues in the Bangladeshi apparel industry and underline the necessity to resolve these problems in times of increased automation of the sector that is causing massive job losses, mostly among women.

The first part depicts the development of the RMG industry in Bangladesh helping the country become one of the leading garment exporters in the world and evolving from boldly CMT production to more complex types via economic upgrading and governmental policies supporting the industry. It also discusses the division of production in knitted and woven, its specifics and the workforce composition, which proves that female workers make out the prevalent part of the total workforce in the sector but have an inferior position in it in comparison to male colleagues. And the challenges the RMG faces due to lack of skilled professionals, social unrest, lousy infrastructure, etc.

The second part represents a detailed discussion of gender-specific challenges female workers

confront with being employed by the industry – such as poor working conditions, gender bias by employment and promotion, restricted access to social upgrading, unsafe working environment (physically and psychologically), etc. These issues reflect local and global dimensions of gender inequality in the society and the work of GVCs that contribute to ongoing gender-based discrimination and (re-)produce existing unequal power relations among women and men and the Global North and the Global South.

The third part discusses the digitalization of the RMG in Bangladesh and its effects on female employment. It describes the technologies that are already implemented in the sector, challenges that impede the digitalization for different types of companies and explains the necessity to automate the industry. It proves that the automation of the industry has already led to large displacements of female workers and further massive reductions are foreseen. Due to the local and global gender-based segregation of labour and discriminative attitude to women, men are preferred in times of digitalization because they are considered to possess better technical skills.

The last part of this chapter describes measures and policies suggested in the analyzed documents and by the experts that are supposed to improve the position of female workers facing negative effects of digitalization. These measures also have implementation limitations that are discussed below.

5.1. The apparel sector in Bangladesh

The apparel industry in Bangladesh started its rapid development in the late 70s and the early 80s spurred by the entering MFA and increase of investments from East Asian countries (Frederik/Staritz, 2012). The MFA posed export quotas for most of the garment manufacturing countries, but Bangladesh as the least developed country (LDC) had a tariff-free access to the US market and didn't fill all the quotas and later privileged access to the EU market. Thus foreign companies (mainly from Korea) invested in the development of the industry in Bangladesh because they could use its unlimited export capabilities (Islam/Stringer, 2018). The termination of the MFA in 2004 was supposed to negatively affect the Bangladeshi RMG, because of the increased competition, but in reality, the sector grew up significantly after 2004 and continues to expand (Yunus/ Yamagata, 2012). Still, it is necessary to mention that not all of the manufacturers could successfully overcome the effects of the post-MFA period. Big companies who had resources to invest in new equipment and diversify its offer were better positioned than medium and small-sized firms, as some of them had to close (Frederik/Staritz, 2012).

The global economic crisis of 2008 also had its impact on Bangladeshi apparel sector and while many countries struggled with fiscal challenges, Bangladesh could take its profit out of the situation due to the following phenomena- "Wal-Mart effect" and "China effect". Wal-Mart is the biggest importer of Bangladeshi garment, and starting in 2008 it increased its imports because customers turned to cheaper products that came from Bangladeshi manufacturers. The China effect explains the shift of lead firms from China to Bangladesh, because of competitive advantages of the latter resulting first of all from its cheap labour force and low garment prices (Frederik/Staritz, 2012). The Shimmy foundation expert says that today Bangladesh may increase its production and exports to the USA due to trade war between China and the USA that will lead to the further expanding of the industry in the country.

Today RMG in Bangladesh became the main industry of the country constituting more than 13% of GDP (Elahi *et al.*, 2019). The garment exports reach up to 80-85% of total annual exports making the apparel industry vital for the Bangladeshi economy. The country is one of the ten leading apparel exporters in the world, often being the second after China (Islam/Stringer, 2018). Figure 5 depicts the development of the total export rates of the garments from Bangladesh in relation to the export dynamics of the sector for the last ten years globally.

Figure 5. Total garment exports from Bangladesh 2008-2018 in relation to garment exports globally at the same period.

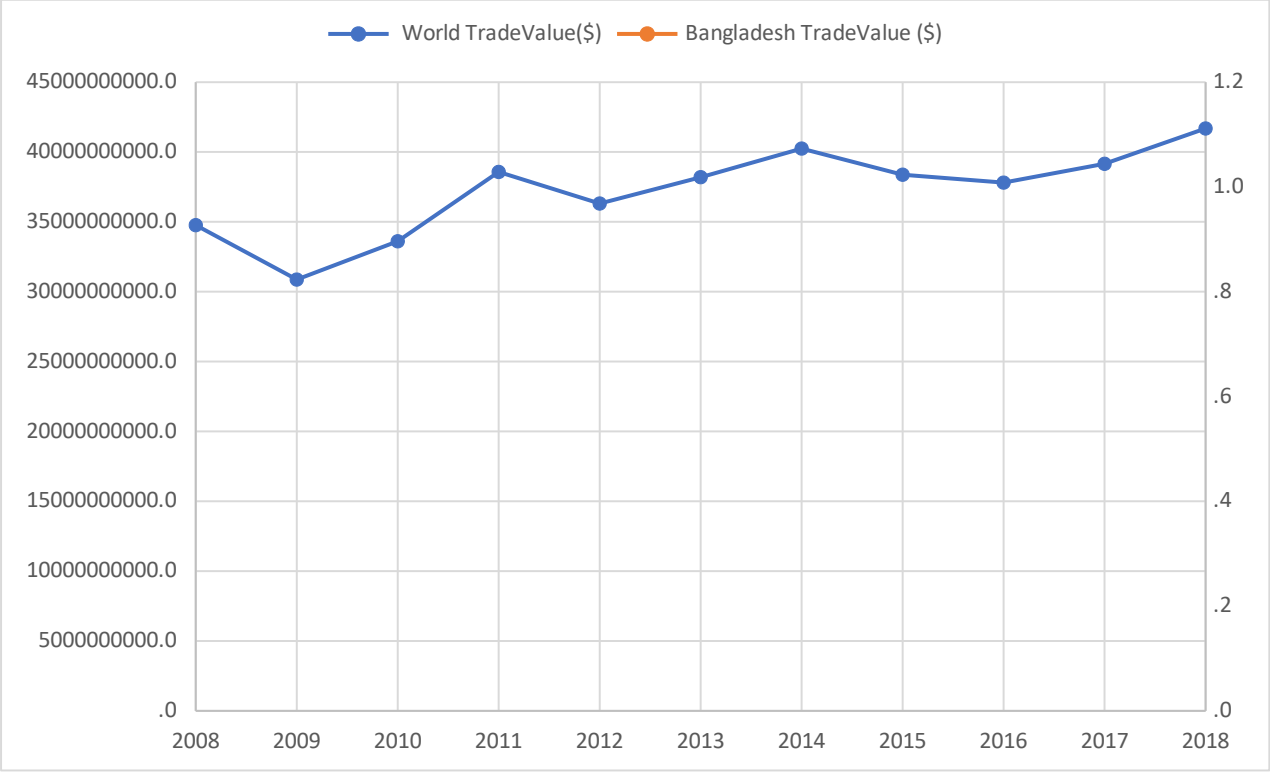
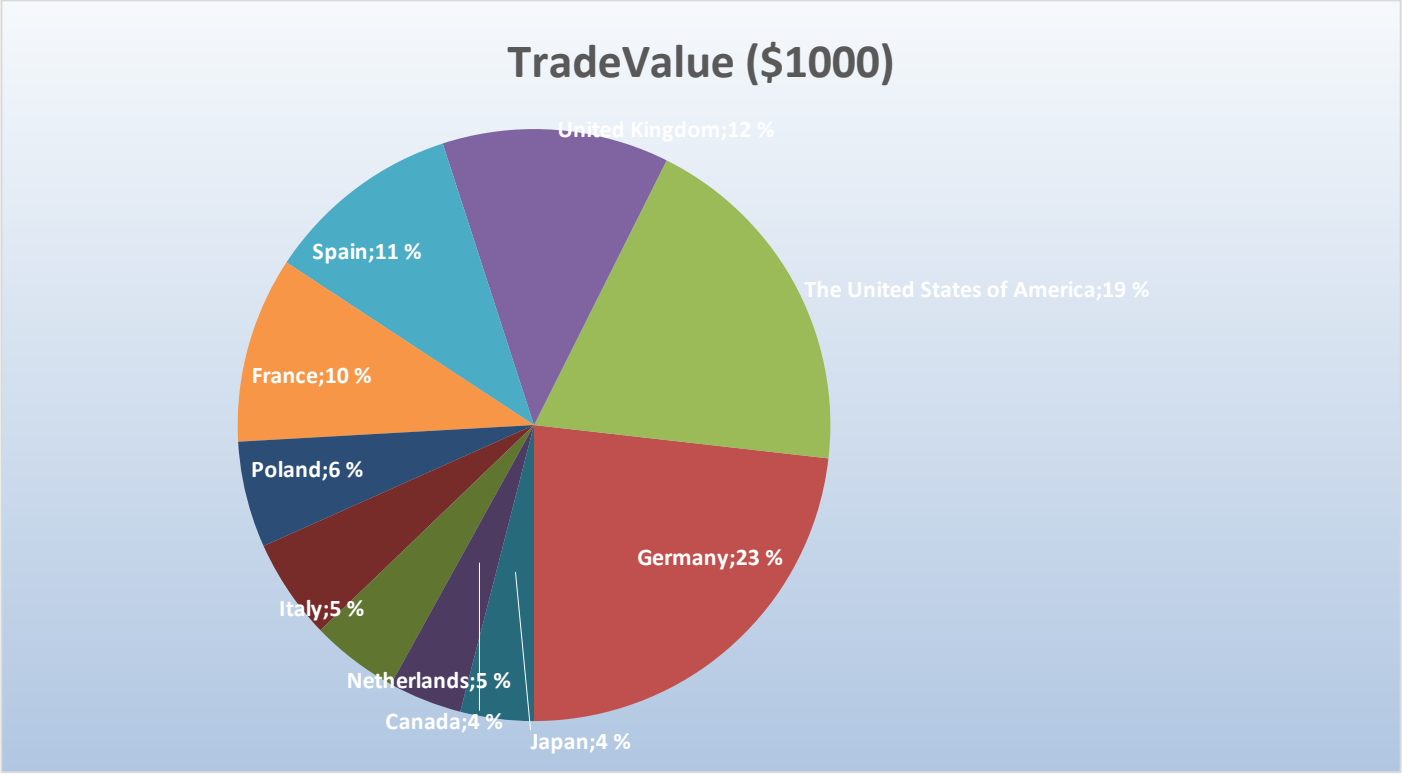


Figure 6 shows the ten major importers of Bangladeshi apparel products. It illustrates the percentage composition of imports by country and proves that the end markets of the apparel exports from Bangladesh are highly concentrated as more than 80% of all the produced garments go to the EU and the USA.

Figure 6. 10 top import countries of the apparel production from Bangladesh.



There are two important bodies that help developing the industry in the country – the Bangladesh Knitwear Manufacturing and Exporting Association (BKMEA) and the Bangladesh Garment Manufacturers and Exporters Association (BGMEA). BGMEA was established in 1982 and plays a vital role in promoting and protecting interests of exporters and manufacturers of the garment production in the country (Yunus/ Yamagata, 2012). It offers diverse vocational programs for workers, encourages local firms to invest in research and design activities and diversify production, involves in government lobbying to improve infrastructure and develop necessary industry-friendly policies to attract FDI and domestic investments (Fernandez-Stark *et al.*, 2011). BKMEA was organized by a small amount of companies in 1996 to promote the business of knitwear manufacturers in the country. Today about 2000 manufacturers and exporters are

members of the association which occupies with different activities to encourage the development of the sector. They include: product diversification and market promotion, consultancy for Green Industry Development and social and environmental compliance factory building, R&D for catering to the recent trend of the global apparel market. Programs to improve productivity on factories, training on firefighting techniques, upskilling for the workforce, and some other (BKMEA, 2019).

At the beginning, almost all of the apparel companies in Bangladesh were involved in CMT production, but with the time it became evident that the industry can stay competitive only if it develops to OEM and FOB offering global buyers more services (Fernandez-Stark *et al.*, 2011). For today around 70% of all the firms are CMTs and others expanded their range of activities (ILO, ACT/EMP, n.d.). Still, there are challenges in design and branding as the prevalent part of the companies don't develop these functions and lack merchandising and marketing capabilities (Frederik/Staritz, 2012). To preserve the competitive potential of the industry, the manufacturers turn to diverse types of upgrading. If functional upgrading goes rather slow lagging in branding and design, the process upgrading is becoming more critical. The new technology that changes machine-to-labour ratios, computer-aided design systems, cutting tables, etc. are widely implemented in the sector to improve the quality of products and reduce lead time, but also to meet customers' needs. The product upgrading is necessary to increase the quality and thus the per-item price that still stays the lowest in the world for Bangladeshi garments (Willem te Velde, 2014). This type of upgrading is also crucial for the country as it produces mostly simple items (T-shirts, trousers, sweaters, jackets, shirts) and there are already technologies that can produce some of these garments without human labour force. Thus in case of nearshoring or onshoring of production, Bangladesh may lose large end markets (ILO, ACT/EMP, n.d.).

The labour force productivity is considered to be the lowest among the largest Asian exporters (ILO, ACT/EMP, n.d.). The scholars and experts argue the importance and necessity of combining economic and social upgrading together because without ameliorated working conditions and successful development of human capital the productivity and efficiency of the sector are put in question on the long-term. The problem of high labour turnover and low-wages contributes to the disinterest of firms to finance vocational training and education for the workers. Nevertheless, due to lack of educated personal, the companies have to employ specialists from abroad for higher wages (Willem te Velde, 2014). The BGMEA states that 70% of the companies don't have resources to invite skilled managers from abroad. Thus there is an urgent need in local

low- and mid-level managers (ILO ACT/EMP, n.d.). The insufficient numbers of qualified workers with technical skills also harm the process and product upgrading because operating the advanced technologies requires specific qualifications.

Low wages of apparel workers make Bangladesh the country of choice for the lead firms. Other competitive advantages include the long history of expertise in the garment production, local ownership of the sector, backward linkages to local textile suppliers (Frederik/Staritz, 2012). Local ownership was aspired by the Bangladeshi government when it adopted the system of bonded warehouse facilities and back-to-back letters of credit (L/C) from the banks thus simplifying the start of a business in the apparel by the local entrepreneurs. Back-to-back L/C allowed the RMG exporters to import goods necessary for their production against export orders from apparel importers. It allows the apparel manufacturers not to invest their capital in financing the production and facilitates the opening of new firms. In the bonded warehouse facilities, the imported goods are cleared from customs also in return to export orders. Thus, the import duty should not be paid (Frederik/Staritz, 2012). Governmental initiatives continue to support the sector by the rationalization of tariffs and taxes on imports of capital machinery(duty-free import), raw materials and the lowering of interest on long- and short-term loans (Yunus/ Yamagata, 2012). “Some other notable initiatives taken by the government are the adoption of conducive investment and industrial policies, encouragement of foreign direct investment, establishing of export processing zones and organizing trade fairs inside and outside the country” (Yunus/ Yamagata, 2012: 16). However, Islam/Stringer (2018) state that governmental initiatives make sense only if they can be rightly implemented, but the high level of corruption and bureaucracy in the sector impedes the positive development of the apparel industry (Islam/Stringer, 2018). The same statement was made in a Quarterly review on RMG report (2019) claiming that despite governmental policies some banks do not follow the prescribed instructions thus the control mechanisms must be strengthened (Bangladesh Bank, 2019).

The industry is divided in knitted and woven apparel production where knitted goods segment is more valued and better waged than the woven sector. Thus employing predominantly men with only 14% of women in this segment (Bamber/ Staritz, 2016). Woven garments production consists of shirts, pants, and trousers and knitted garments include T-Shirts, polo shirts, undergarments, socks, stockings, and sweaters (Rahman *et al.*, 2017). Knitted production developed first in the early 90s (10-15 years later than woven), yet today it constitutes the largest export sector among the garments (Fernandez-Stark/ Frederick/ Gereffi, 2011). The supply chain

for knitted production is much better developed than for the woven. The local industry almost entirely covers the necessary amounts of fabrics and yarns for knitted goods and has its dyeing and finishing sectors which emerged to support the production (Bamber/ Staritz, 2016). Thus backward linkages play a significant role in decreasing lead times at the processing stage, support and develop local textile industry (Moazzem/Sehrin, 2016). Most of the manufacturers concentrate on cotton-based products that make around 80% of all garment exports (Willem te Velde, 2014). The small capacities of non-cotton apparel production are considered to be the weak point of the industry in Bangladesh (Moazzem/Sehrin, 2016). "The RMG industry has not only boosted the growth of spinning, weaving, dyeing and finishing industries, production of accessories and spare parts, but also contributed to some other economic activities such as banking, insurance, real estate, packaging, hotel and tourism, recycling, consumer goods, utility services, and transportation" (Rahman *et al.*, 2017:5). Thus it is vivid that the sustainable growth of the sector is vital for the Bangladeshi economy and that it influences many other industries and services in the country.

For today there are around 4.500 apparel manufacturers in Bangladesh employing more than four million workers (Islam/Stringer, 2018). In comparison to only 384 factories existed in 1984 and almost 7000 in 2012-2013, showing the rapid growth of the sector and at the same time it shrank after the Rana Plaza tragedy (Rahman *et al.*, 2017). The workers in textile and apparel can be divided into three categories: 1) textile technologists, 2) nontechnical workers, 3) general workers (Bamber/ Staritz, 2016). The workforce composition shows that the sector mostly employs low-educated impoverished women- around 80% of the total workforce in RMG, a big part of them coming from rural areas (Islam/Stringer, 2018). Men (around 20%) are concentrated in managerial better-paid positions, while women are occupied in low-waged high-intensive stages of production as sewing. Nonetheless, the sector provided women with paid labour that led to female empowerment and has been helping to alleviate gender-based poverty. The more or less regular income contributes positively to the development of human capital by improving health, nutrition and quality of life (Rahman *et al.*, 2017). It is clear that the living conditions in Bangladesh are complicated, but the last decades show slow but stable amelioration of the situation.

The apparel industry in Bangladesh has many challenges to overcome. Social unrests and strikes are common for the sector because people employed by RMG have poor working conditions, are paid badly, often have to work long hours, can be cheated with wages, constant contact with

hazardous materials affecting health, insufficient safety on manufacturing plants results in labour accidents causing causalities making work in the sector dangerous for life. Fire accidents are common for the sector. For the period from 1990 to 2012, they took lives of 450 people. The deadliest of them took place in Tarzreen Fashion facilities having killed 112 people and injured over 200. The accident became the first urgent wake-up call for global buyers such as Wal-Mart, which terminated its contract with the firm afterwards (Wiersma, 2018). The tragedy of Rana Plaza on 24 April in 2013 cost lives to 1, 132 workers and injured more than 2500 people. Fire incidents on the factories and collapse of buildings are not rare and happen as a result of lack or even absence of adequate facilities' inspection and remaking buildings into factories which do not meet the necessary safety requirements (ILO, 2018). After the Rana Plaza global buyers started to pay more attention to safety conditions in their manufacturing plants. The expert from CPD states that the inspection of the plants, its equipment and safety have improved a lot for the last 5 years. The Bangladesh Accord on Fire and Building Safety (known as "Accord") and the Alliance for Bangladesh Worker Safety (known as "Alliance") signed after these two deadly accidents between the Bangladeshi government, buyer firms, unions and NGOs contributed a lot to the amelioration of safety conditions on factories. These agreements allowed unexpected plants' inspections, and in case the conditions needed to be improved, the costs were to be shared between supplier and buyer. If the supplier refused to overtake the expenditures, the buyer was advised to stop doing business with them (Islam/Stringer, 2018). After the inspection of all the registered companies, less than 2% were closed as they didn't comply with safety regulations (ILO, ACT/EMP, n.d.). The local, as well as international labour standards imposed by the local government and the ILO and its Decent Work Agenda, are mostly disregarded. In spite of the Bangladeshi Labour Amendment Act of 2013 that aimed to inspire the increase of the trade unions, only 10% of the firms have them (Islam/Stringer, 2018). The issues of social upgrading are addressed rather reluctantly, let alone social upgrading with a gender focus.

According to experts and researches, Bangladesh has to tackle the following issues in order to stay competitive in the future as many other countries can replace it from the positions of leading garment exporters. First of all, the country‘s lousy infrastructure may affect the buyers‘ interest in the times of shrinking lead times of production. Lead firms want to see the improvements in routes having better and secure correspondence between cities. The most important highway for RMG transportation exists between Dhaka and Chittagong, which is often overloaded due to bad planning of capacity and demand. Absence of deep-sea harbor increases the fraught time up to 10 days. Gas and electricity interruptions are not rare and impede working processes, especially if

the advanced technologies implemented (Rahman *et al.*, 2017). Thus companies use their own electricity generators to ensure the power supplies to be on the safe side, but that increases the production costs. Another issue is the need for imports of raw materials for the woven garments that increase the lead time. Therefore the development of own woven textile fabrics is the must for the industry, especially regarding the bad infrastructure.

Lack of the educated workforce is another serious problem that negatively affects the sector because it impedes labour productivity and leads to insufficiency of the working process. The company owners have to hire specialists from abroad who are expensive and at the same time discourage local labour force from getting vocational training (Rahman *et al.*, 2017). There are also less educational opportunities to obtain technical professions and graduates prefer to look for the jobs in other sectors as RMG has an unattractive image for young specialists. Thus the researchers note that skill development has to go hand in hand with the wage raise because low salaries in the apparel sector discourage educated people from entering the industry. According to the data provided by the Bangladesh Bank, the government increased the minimum wage for apparel workers starting FY18 to 8000 takas[10] fro month (about 95$), but it's still insufficient as the living costs are raising too (Bangladesh Bank, 2019).

Social instability among workers that results from noncompliance with the imposed labour standards and CSR has to be addressed more targeted. Nowadays with the awareness-raising among customers and social pressure on buyers, manufacturers start to realize that the profitable business depends on compliance with labour standards because if the company doesn't follow the CSR, it can't get orders from good lead firms. Political instability and insecure investment climate may become important restrictions for the buyers and investors forcing them to search for other suppliers (McKinsey, 2011; Elahi *et al.*, 2019). All of these issues have to be timely addressed and resolved in order to ensure the growth continuance and positive development of the sector in the face of ongoing changes in the apparel industry all over the world, especially taking into account the possibilities of onshoring and nearshoring due to advanced technology implementation.

5.2. The apparel sector in Bangladesh and gender implications in it

The apparel sector in Bangladesh employs around 4.5 millions of people, 80-85 % of whom are women. Although, according to the interviews with the experts, the number of female workers has already shrunk to 60% due to the automation of the sector. Diverse reports and research

10 The Bangladeshi national currency

papers state that the prevalent part of women working in apparel in Bangladesh are low-skilled and don't have secondary and sometimes even primary education, they work under high time pressure, are poorly paid, constantly discriminated, lacking basic workers' rights and such rights as maternity or sick leave (Asadullah/ Talukder, 2019).

Gender-specific issues at the workplace as gender-based discrimination by employment and promotions, access to social upgrading, unsafe working conditions – from manufacturing plants to sexual assaults, can be explained by the tools of MatFem claiming that the female oppression and gender-based segregation of labour have material roots and are socially constructed and further reflected in the global division of labour, which places female workers from the Global South in inferior position to women from the Global North and to their male colleagues in the local apparel industry. These relations of oppression are materially reflected and embedded in the working conditions of female employees in Bangladesh and (re-)produce local and global inequalities. Thus, the analysis of gender-specific issues at the work of the apparel value chain in Bangladesh is crucial in terms of providing a healthy psychological and physical climate and ensure access of female workers to social upgrading and technical training, where women can obtain necessary qualifications to stay employed by the industry in times of an increased digitalization. It is also essential for female empowerment that can help women workers develop their organizational capacities and struggle against local discriminative practices and stereotypes.

Many scholars see the problem of high gender-segregation existing in Bangladeshi RMG as an outcome of Islamic patriarchal traditional society that results in women's exploitation, exclusion from basic human rights, power gaining (getting better working and social positions, education, higher salaries) and reproduction of abusive male conduct. Before the independence of Bangladesh and shortly after its proclamation, women were not allowed to work at all (Begum *et al.*, 2010). Their main duties were child -bearing and -raising as well as keeping household. The rapid development of the RMG sector in the country and changing social structures after the gaining of independence allowed women to have a paid job but after centuries of exclusion from education and career opportunities it made it impossible for women, especially from rural areas to obtain decent jobs (Wright, 2000).

Nonetheless, work in garment factories increased women's value in their families. As before only sons were valued and seen as earners and bread-winners. Nowadays parents invest in daughters' education and development, as they can earn money and support family too (Khosla, 2009). Still, women face many challenges working in RMG impeding their personal development and

restricting access to better life chances. Addressing these gender-specific issues is crucial to achieve positive results in social upgrading – measurable (wages, working conditions) and non-quantifiable (human rights, women's rights, empowerment), which will most probably have a positive impact on productivity and sustainable growth of the industry in Bangladesh.

Health issues and safety

Women working in garment factories face lots of problems. The Awaj foundation expert argues that the working conditions in the apparel plants are deplorable – bad sanitation, lack of safety, malnutrition at factories, diverse health problems, long working hours, low salaries, maternity issues, etc. Kabir *et al* (2018) state that working conditions in Bangladeshi RMG are vulnerable for both female and male workers, yet women are much more disadvantaged than their male colleagues for many reasons. First of all, the industry mostly employs women: thus numbers of female workers exposed to adverse working conditions are much higher than those of male workers. Women are occupied in labour-intensive stages of production they are constantly dealing with hazardous chemicals and materials affecting their health, while male workers work as supervisors and managers and have less contact with dangerous essences (Kabir *et al.,* 2018). Women working in the industry are more prone to have respiratory diseases and chronic lung diseases, eye problems and back pains due to long hours of the monotonous job without position changing that lead to various musculoskeletal disorders (MSDs) (Akhter *et al*., 2019). "Women workers also experience stress due to long hours, few breaks, repetitive work and poor working conditions such as poor lighting and ventilation, unhygienic surroundings and inadequate toilet facilities" (Khosla, 2009: 296). Bad hygienic conditions contribute to the proliferation of infections and communicable diseases (UNICEF, 2015).

Female employees are exposed to stress and anxiety at work because of high time pressures, emotional abuse and demanding physical work that weaken psychological health (Kabir *et al.,* 2018). As the prevalent part of managers and supervisors in RMG are men, female workers often feel uncomfortable to share their health issues with them, especially if these issues concern specific women's needs as menstrual pains and changing of sanitary napkins as women have to go to the toilet more often when they have a period (Akhter *et al.*, 2019).

Before 2013 most of the factories didn't comply with safety requirements and facility inspections were insufficient. The tragedy in Rana Plaza, housing several RMG factories, that took lives of more than 1000 workers, preliminary women – the case showing poor engagement and performance of the working facilities inspections and lack of interest and control from the lead firms

and national government, that makes work at factories unsafe mostly for women (Asadullah/ Talukder, 2019). The expert from CPD says that if working conditions at the plants are bad then they are bad for everyone independent of gender. However, after Rana Plaza and increased pressure from the lead firms via CSR, manufacturing plants were improved a lot in terms of safety and working environment. The expert declares significant amelioration of working conditions in the last 5-6 years.

Gender-based violence

Women face constant sexual harassment and gender-based discrimination, are being physically and verbally abused at work. The industry employs widely informal workers, both formal and informal workers, mainly if occupied under fixed-term contracts, are exposed to sexual abuse at work as well as engaged in sex work. That raises risks of damaging physical health via transmitting diverse diseases and psychologically making women subordinated and vulnerable (Kabir *et al.*, 2018). Women rarely report rape and sexual harassment, because of diverse sociological and personal issues, such as being judged by society and losing chances to marry, etc. (Begum *et al.*, 2010). The daily travel to factories is also a challenge to women, who work till late at night because they "worry about attacks by mastans (74.4 per cent), by touts (75.6 per cent), harassment by police (6.7 per cent), harassment by boys in the street, etc." (Begum *et al*, 2010: 293). The CPD export says: „Security for female workers at plants is good but once outside the factory many women are being raped, robbed, catcalled and harassed on the way home. But it concerns all the women in Bangladesh not exclusively apparel workers". The rapid expansion of the sector led to an increased influx of workers from villages which resulted in the growth of slums. The commuting to these areas as well as living there poses a threat to health and safety of female workers. Yet, the lack of a decent wage prevents them from improving their living conditions (UNICEF, 2015). This example demonstrates the poor engagement of the government to tackle problems of female security as well as social and cultural norms discriminating women and making them vulnerable to gender-based violence.

Maternity issues

Especially vulnerable groups of workers in the industry are pregnant women and mothers with small children. Reports and experts state that pregnant women are often forced or asked to resign. Still, this issue is not researched well enough due to its sensitivity and limited access to violated workers due to diverse reasons. The local labour law gives 16 weeks of paid maternity leave – 8 prior to birth and 8 after it. However, the law is not implemented properly. There is a significant

lack of control mechanisms of its implementation. Less than 10% of garment workers have breastfeeding breaks. Although ILO maternity rights standards prescribe paid nursing breaks at work, Bangladesh has no legal basis for obliging manufacturers to follow this prescription (UNICEF, 2015). The NGO expert regrets that there is no space, proper sanitation and adequate equipment for feeding mothers at the factories. The Awaj foundation expert says that female workers who have children find themselves under psychological pressure as they don't have enough time for their kids and a big part of them have to send kids to live in the countryside with their grandparents.

The DBL expert states that the position of female workers in the industry is much better now, especially regarding mothers' rights due to the supporting programs and awareness-raising in society – locally and internationally. For example, UNICEF Bangladesh implemented an experimental program „Mothers at work" and many other factories adopted it later too, what the expert considers to be a great success. One of the requirements of the program was to give women the opportunity for extra breastfeeding. Now female workers have two additional paid breastfeeding breaks. This measure helps to relieve women of their mental pressure that they don't have enough opportunity to care about their children and is good for children who can spend more times with their mothers. Such measures go beyond CSR and standard company compliance, but are necessary to improve working climate and productivity, as feeding mothers are more motivated to bring better outputs when a company implement mother-friendly policies. Thus the company tries to invest in human capital and address social and environmental issues to make its business more profitable and attractive for foreign investments.

Wage

The wage in RMG in Bangladesh is insufficient, and the gap between the legal minimum wage in the apparel and an adequate living wage stays the largest in the world. The wage is not enough to allow decent living and nutrition (UNICEF, 2015). It is also not adjusted to inflation rates and other economic changes (Ahmed/ Peerlings, 2009). More than that, War on Want report (2011) and Begum *et al* (2010) argue that women are more often cheated with payment than men. Women face payment deductions for every single "mistake" like coming late, not meeting deadlines, conversations with co-workers, etc. They are often underpaid or face irregular payments (War on Want, 2011; Begum *et al.,* 2010). Women, interviewed in several researches, stated that their husbands had control over their money, meaning that even having a job has little positive impact on women's role in families (Khosla, 2009). Women are also working under

psychological pressure as they are threatened to lose their job if they don't meet deadlines or refuse to work night shifts, so the CPD expert. All these factors make working conditions unacceptable and directly contradict UDHR and ILO Decent work Agenda.

Promotions/ access to "good" jobs

Usually, women who find employment in RMG come from rural areas and low-income families, lacking opportunities, networks and access to education and better life chances, and they are ready to take any paid job. Thus more than 80% of female workers in the sector engaged in labour-intensive low-skilled labour. The 15% of managerial tasks are accomplished almost exclusively by men, making the industry highly sex-segregated. (War on Want, 2011). Women have almost no access to higher and better-paid positions in the sector. For example, knit products and textile production are better paid and mostly occupied by men, with only 14% of women working in the knit section (Bamber/ Staritz, 2016). Female workers are concentrated in the woven garment production which is labour-intensive and don't require specific skills, while the knit section is capital intensive and demands workers with medium or high skills (Ahmed/ Peerlings, 2009).

The gender-based employment bias makes it difficult for female workers to succeed in a career. „Good jobs" are mostly given to men via social networks as men have better connections in society, so NGO expert. The Awaj foundation expert says that women are often manipulated to take "bad" jobs or refuse from promotion in favour of male colleagues. The CPD expert states that discrimination against women is normality as well as gender bias by employment restricting access of female workers to "good" jobs, better-paid jobs. However, also social norms and lack of empowerment result in women's reluctance to accept jobs which require more responsibilities as women feel that they don't possess enough knowledge and experience to accomplish the tasks. She also reminded a conversation with a big apparel company owner who wanted to promote more women to manager positions, and he said that women refused to get such promotion because of the increased responsibility. It is another reason why the number of women in leading positions is very limited. The expert hopes that now as BGMAE (Bangladesh garment manufacturers and exporters association) has a female president for the next two years who is very committed to keep women in the industry and promote them to higher positions, the situation in the industry will improve.

The DBL expert provides the following information on female employment in the apparel sector: „Workforce composition in our company in the apparel section is approx. 50% male to 50% of

female workers. Women are occupied in all possible positions and not exclusively in low-cost labour-intensive stages of production". The bias by employment is still present, but it happens for a reason. For example, so the expert, the fabric dying plants hire men because it's a hard physical job that can be hazardous and dangerous for women, but when the technology comes, and this work won't be manual anymore, there will be more female workers employed in fabric dying plants too. That means that digitalization of the sector may help to alleviate the employment bias that is based on health and physical prescriptions. The under-representation of women in managerial positions is partially the result of lacking self-assurance and confidence to accept better jobs that also presuppose the increased level of responsibility. In 2013 the company started the project under the title „Female supervisor leadership program" aiming to expand the number of female supervisors. For today there are 60 female supervisors in the firm. One of the aims articulated in the DBL Group Sustainability report (2017) is to have 50% of female supervisors of sewing lines in RMG till 2020. Female supervisors proved to be 3% more efficient as their male counterparts, thus employing women in higher positions is profitable for business and becoming a priority for companies, so the expert. As there is a big part of female workers in the apparel industry, there is a necessity to have more female managers who can understand and adequately address specific sensitive gender issues. The DBL expert says that female promotion to leading positions is also a requirement from the lead firms and global buyers. The gender quotas and compliance with CSR, elimination of gender-based discrimination is necessary nowadays for a profitable business. If the buyers notice the lack of gender diversity in leadership, they are reluctant to have business with such a company.

According to the PDS Group manager, their company employs 75% of women who are localized in the lowest stages of production. Although the expert notices the steady improvement of working conditions for female workers, there are still many problems than need to be resolved – such as lack of promotion opportunities and restricted access to training, insufficient payment, employment bias and high gender-based segregation of labour, etc.

Therefore I can conclude that gender make up differs from company to company, but still, female workers are concentrated in the lowest labour – intensive positions with limited chances and willingness to get promoted. Big suppliers who are pressured from NGOs/IGOs and global buyers are more interested than SMEs to expand the number of female workers in management and improve working conditions for workers as well as address gender issues. The workforce composition also depends on the size of a company. The local cultural norms and the history of

long exclusion of women from work make it difficult today for female workers to develop their careers. Inadequate investments in education and psychological suppression of girls in families result in lack of self-assurance and subordinated position in society. The empowerment of women and awareness-raising about their rights and opportunities will help to change the situation in the apparel sector and also in the local society.

Governmental policies and implementation

The Constitution of Bangladesh guarantees equal rights to men and women and Bangladesh also ratified the UN Convention on the Elimination of All Forms of Discrimination Against Women (CEDAW), as well as ILO Convention 111 on Discrimination in Employment and Occupation (War on Want, 2011). However, in reality women's rights are being continuously violated. Nonetheless, women occupied in the industry do not stay calm and fight for their rights. In 1984 The National Garment Workers' Federation (NGWF) was founded, that aims at protection and enforcement of female workers rights. Due to protests encouraged by NGWF, the Bangladeshi women got a pay raise in the garment sector. There are several laws intended to protect and ameliorate the position of women in the apparel industry, such as the law prohibiting work lasting more than 8 hours and the law against sexual harassment. Still, according to many reports, they are not implemented properly or at all. The texts of laws are widely open to interpretation and in reality, rarely help women to protect their rights (Siddiqi, 2003).

The experts state that the local government doesn't pay too much attention to gender-specific problems, and there is not enough initiative from its side. Women lack access to social upgrading in the factories because of gender bias and lack of motivation. Thus lead firms, stakeholders and local government should provide garment workers with more education opportunities, safe working conditions, proper housing and secure commuting opportunities, facilities for childcare, formal contracts and decent payment. These initiatives have already been undertaken by diverse NGOs, aid agencies and government and need to be further fostered. Women should be educated about their legal rights and organizations where they can claim diverse forms of abuse. The norms of CEDAW must be complied with correctly, and the language of anti-sexual harassment law must be changed to less vague (Khosla, 2009). All these measures are necessary to raise awareness among female workers about their personal and professional value, to give them the ground for development and assurance that they have the same chances to succeed as their male colleagues. Combining social and economic upgrading is necessary to ameliorate productivity and work of the value chain (Willem te Velde, 2014).

Positive aspects

Although work in RMG factories is seen as abusive and exploitative, at the same time it gives women opportunities for empowerment and improving their social position, also gives them a certain degree on personal and professional development. Women working in the industry have children later than not working women, the reduction in fertility has been noticed, and that shows positive results in changing social structures and family patterns. Though changes are not happening fast, it must be noticed that since the development of RMG in Bangladesh, the position of women in society and family changed for the better. Strikes and revolts on factories make women and their challenges at work visible for trade unions (which are still dominated by men) and government, as well as the international community. "The ready-made garments industry is almost like a natural experiment that illustrates that change in the economic environment such as the growth of the ready-made garments industry and women's employment therein, can spur further changes in other aspects of women lives." (Khosla, 2009: 299-300).

Mustafa *et al* (2016) conducted a study on the changes of livelihood of RMG workers and found out that the work in the sector positively contributed to the lives of female workers: 1) they got an access to free medical service at factories that helps them to monitor their physical state, 2) due to increased salary they started saving money, 3) the living conditions ameliorated after receiving a job in RMG, 4) increased self-esteem and empowerment (Mustafa *et al.*, 2016). It proves that despite the challenges women face working in the industry, it also has positive sides.

The employment by RMG changed lives of millions of women for the better putting them on a social and economic map of the country. The restructuring of the industry due to its digitalization may become crucial for female workers in 2 different ways – either women will lose their positions in the industry and will have to search for other types of jobs matching their skills, or they will adapt, learn and upskill which will result in increased empowerment, better wages and power gaining. Thus it is necessary to research the subject of automation of the industry to find ways for the successful transition of female workers from the low-skilled labour force to medium and high skilled with sufficient technical literacy.

5.3. The digitalization of the apparel industry and its effects on female workers in Bangladesh

The digitalization/automation of the apparel industry in Bangladesh is a necessary step to develop the sector in terms of economic upgrading. Still, it will have dramatic effects on female workers,

who already face massive reductions and need to search for other employment opportunities. Due to gender-based segregation of labour, female workers are employed by the low-value-adding tiers of production and in times of automation of labour not only they become redundant, but also confront with additional employment bias, which presupposes that male workers better perform at technical jobs. The deep embedment of gender-based discrimination and inequality in the local society contributes to the exclusion of women from better employment and access to social upgrading. Although, the pressure from various IGOs/NGOs on lead firms and local company owners shows positive results as female workers become more attention as a vulnerable and disadvantaged group, but also as a leading engine of the industry has to be supported in the transition to the digital industry.

Digitalization of the RMG sector in Bangladesh

The apparel sector is marked with high levels of competitiveness. Countries and companies which don't develop long-term plans of sustainable growth of the industry will most likely be the losers in this race. For today Asian countries are the leaders in exports of garments mostly due to low-labour costs and high volumes of production, but with the wages raising and the African continent to be the next supplier of low-cost labour, the positions of the Asian region in the apparel sector are put in question. In order to guarantee the growth of the industry, it is necessary to predict its needs in the future. The pressure from NGOs/IGOs on lead firms and suppliers is growing, social awareness of customers relating to the products they buy is also increasing. Customers in the Global North are becoming more reluctant to buy clothes from the countries where human rights are not respected and violated continuously, and people working on plants are being exploited. The production has to become “green” as customers and investors are interested in environmentally friendly business and garments – the less hazardous emissions and the less industrial waste the plant makes, the more attracted the global buyers are. “Global pressure on manufacturers to be transparent about materials, chemicals and processes to support sustainability initiatives to reduce environmental damage and climate change” (BRIA, 2019:17).

The diversification of products achieved through product upgrading and increased productivity via process upgrading augments competitive advantages of a firm. Investments in the development of human capital via social upgrading on the firm and state level is also a must for a successful business. Employees have to be more skilled, better paid and have good working conditions. All of these points can be positively influenced by digitalization and automation of apparel manufacturing. Still, these measures have a negative aspect too – the labour force has to

shrink many times, and as the industry is highly gender-segregated employing mostly low-skilled women, female workers will be disadvantaged by the automation more than men.

In terms of advanced technologies adoption, Bangladesh is making its first, but solid steps and the manufacturers, as well as government, have serious prospects to automate the industry. The productivity has to be increased, and costs of production need to be cut – these factors raise demand on automation/digitalization of the industry (Akter, 2018). The process upgrading in Bangladesh was initially spurred by the end of the MFA era. Moreover, as firms started using high-speed machines and advanced technologies, the first reduction in the labour force (up to 10%) was traced in the year 2014 in comparison to 2004 (Willem te Velde, 2014). The study of Moazzem and Sehrin (2016) shows that the successful process upgrading leads to a reduction of machines as well (as more advanced high-speed technologies are implemented) and workforce but result in increased productivity and capital. Thus the productivity growth depends on automation but leads to job losses (Moazzem/ Sehrin, 2016).

In order to spur the economic development of the country, the Bangladeshi government is planning to establish 100 Economic Zones in the country by 2030 and underlines the necessity of transmission to advanced technologies, especially in the apparel sector (Mohammad *et al.*, 2018). The attendees of the Bangladesh Fashionology Summit (100%) see the digitalization as inevitable process and are willing to adopt technologies and (88%) believe that the local government should provide tax incentives to facilitate the automation (BRIA, 2019). Mostafiz Uddin, the Managing Director of Denim Expert Limited, the Founder and CEO of Bangladesh Denim Expo and Bangladesh Apparel Exchange (BAE), says:

> "As a nation, we can no longer rely on the appeal of lower labour costs to attract and develop business. We need to embrace technology from top to toe in the garment cycle—from fabric development and concept design to cutting and sewing technology, adoption of technology-aided washing and finishing machinery, to purchasing and delivery systems, all of which will improve our efficiency and competitiveness in terms of price as well as the overall quality of product, and result in a reduction in lead-times to customers." (Uddin, 2018).

Such events as GARMENTECH Bangladesh contribute to the automation of the industry, as it is one of the most prominent and large forums for introductions and discussions of the newest technologies in the sector. It brings manufacturers, buyers and technology producers closer and opens up the platform for the dialogue (Yunus/ Yamagata, 2012).

Another incentive for the automation is the technological development of the industry in the advanced economies. The interviews with garment factories' directors state that the heads of

Bangladeshi enterprises are worried to lose their buyers and export markets because of growing automation levels and new technologies inserted in the sector in the Global North. Therefore the company owners, who have financial capabilities to invest in the newest technology, prefer to automate some steps of production and reduce labour force. The constant demands from workers, trade unions and international organizations to raise wages and improve working conditions also make company directors turn to digitalization. Ameliorating working conditions, improving and controlling manufacturing facilities is also capital-intensive, and company owners explain that it's easier to buy machines and displace employees than invest large amounts of money to meet the demands of trade unions and diverse workers' rights organizations (*"Automation threatens jobs for garment workers in Bangladesh"*, 2017).

Each interviewed expert underlined the urgent need of Bangladesh to adopt modern technologies in order to stay competitive. The strategy of high volumes production due to low-labour costs doesn't work anymore and in the nearest future with the emerging African continent and raising wages in the local apparel sector, Bangladesh will most likely lose its positions on the market. With the increased costs of labour force, Bangladesh is becoming less attractive for the lead firms. Thus big local companies are adopting advanced technologies such as robotics and AI to increase productivity and reduce the number of workers. According to RMG study conducted by CPD, large enterprises (about 47%) and medium enterprises (25%) use advanced digital technologies in the factories; small companies are lagging in the process of automation for diverse reasons (*"CPD study stresses the need for balanced level of upgradation in RMG Sector",* 2018). "Bangladeshi apparel manufacturers have introduced cutting edge software technology to reduce waste of clothing, laser technology in denim washing and latest technology in washing to reduce environmental impact" (*"Technology to define future of Bangladesh apparel industry"*, 2019). Furthermore, many other digital innovations are being inserted in the production process. Mostafiz Uddin states that the transition to advanced technologies in apparel is necessary to produce high value-added products and develop the industry further on. He also notices that small and mid-sized firms lack access to technology advisory services, industrial service providers, R&D providers, skilled training providers, etc., that makes them less competitive in comparison to richer and bigger firms (Uddin, 2019).

The medium-sized apparel company merchandising manager[11] said that the implementation of digital technologies is a must for the industry today, but high costs of technologies prevent SMEs from making investments in it. „We realize that it has to be done so we can stay on the market.

11 Later is referred to as the X company expert

Everyone is talking about it nowadays. But for smaller companies as mine it's tough because it's too expansive", so the expert. Other problems make firms reluctant by adopting new technologies such as large capital investments in new and risky technologies, which may take longer to pay off, and also infrastructural constraints, utility supplies and unfriendly governmental policies (Khan, 2008). If these restrictions are not overcome timely, it's possible that in the future the business will be overtaken by several large enterprises, operating in the country (like the DBL Group), which had enough finances to invest in technological upgrading of their plants. Others will have to close as human labour cannot compete with machines in terms of productivity. If one automated company can produce as many volumes of garment products using less space, material, time and workforce as ten labour-intensive companies, it is evident that the lead firms will better make business with digitalized firms, due to its efficiency and innovative approach, CSR compliance and environment-friendly production. As many researchers nowadays predict the nearshoring and onshoring of the apparel production, it's also possible that in case of widespread automation in manufacturing plants in the Global South and improvements of local infrastructure, the global buyers will keep offshoring the garment production. The cheap local labour force will not disappear as well. For example, the wage rate of a high skilled machine operator in Bangladesh will still be many times lower than the remuneration of the same employee in the Global North, making the offshoring a reasonable choice even in times of automated production.

Nevertheless, the adoption of the advanced technologies is problematic not only for SMEs. The DBL expert states that the big companies also struggle to automate their production: "Digitalization is an important issue in the apparel industry, but due to the high costs of technologies the process of full automation will be rather slow, because of the necessity of large investments". The abundance of low-cost labour makes the technological transition less profitable for the short term, especially if talking about hard automation. Soft automation, in its turn, is already being largely implemented. For example, knitting process is fully automated by now and is operated by people via computer programs. The implemented technology made the process of knitting more sustainable, because before the operations were done manually and that resulted in much waste of material. Now the technologies are precise, and there is no need in markers usage. Thus it is more profitable for the business and shows the positive impacts of digitalization. The PDS Group expert said that their company also turned to automation certain time ago using cutting tables, CAD, 3D design, etc. Although the advanced technologies require

capital, they attract global buyers, help reduce waste, save materials, make the production more sustainable and improve quality of garments.

Impacts of the RMG sector digitalization on female workers

The digitalization of the industry will positively influence the outputs and profits in production which is good for business and local economy, but also change workforce composition and displace millions of low-skilled women that will have serious social implications. The CPD expert says that when the apparel industry started to develop rapidly at the end of the 1970s, it was an excellent opportunity for women (especially from rural areas) to find employment, earn money, become independent and improve social status, it paved the ground for female empowerment as 80 % of all the workers in RMG were women. According to the recent study of the CPD Center in Bangladesh current digitalization of the sector has already decreased this number to 60%. Moreover, there will be much further displacement in the nearest future as one robot replaces 5-10 people. Young women prefer to look for a job in other sectors to gain necessary working experience and not be scared of possible job loss in apparel due to automation - the foreseen reduction of female workforce – from 80% to 53% in the nearest future and 60% job loss till 2030, as was claimed (BRIA, 2019).

Dr. Nazrul Islam (n.d.) says that technological upgrading leads to jobs elimination for the workers with the lowest skills and therefore raises concerns about job insecurity among female workers, which results in worse performance and has a negative impact on working atmosphere by increasing anxiety and stress (Islam, n.d.). In the face of automation of the industry, female workers became scared to talk about the problems they face at work, as they don’t want to lose their job, so the Away foundation expert.

The Shimmy foundation expert states that with the constant amelioration of sewing machines using thread cutting helpers job is almost eliminated in the sector. Needless to say that almost all of the helpers are women. The Awaj foundation expert says that the soft automation in the knitting section already impacted people engaged in this stage of production. The big knitted garment factories which adopted advanced technologies reduced the labour force twice or three times as one machine replaces around 10 workers. Factories which employed 1000 workers, now need only 500. As the knitted garment production employs mostly men that proves that male employees are also exposed to adverse effects of automation.

The DBL expert offers another sight on the problem. He says that the slow speed of technological

change gives companies enough time to adopt. There is no direct loss of jobs but rather transferring people from one occupational field into another one within the company. Of course, not all people can be retrained and transferred, but current automation doesn't pose too much of a problem. "It's not a trap, its opportunity", so the expert. As big firms expand and need to build new plants adopting automation, digitalization will not be challenging for workforce anymore, because employees can be reskilled and relocated to a new plant. If more advanced technologies should come, the workers in a new plant will already have digital literacy for operating the machines, and thus reeducation will take less time and effort because the potential is already there. The promotion and transferring of workers who are already employed within the company is the priority for the large firms. Still, the reallocation and reeducation of all the workers engaged in the sector are barely possible, and it is necessary to become prepared for the negative outcomes of apparel automation in the country.

The automation of the RMG sector in Bangladesh raises demand on workers with technological skills, which are usually performed by men. That results in much higher wages for men and better working conditions, better social status, etc. The Shimmy foundation expert states that even the digital job titles are male such as cut-man or laser-man. If we turn back to materialist feminism and discourse analysis of Foucault, we may notice that such discourse practices exclude female workers from entering jobs producing restrictive material mechanisms for women to be employed in these occupations as they are presupposed to be male starting with its linguistic background. In Bangladesh as all over the world, women widely lack necessary skills and access to technical education and STEM professions all over the world and in Bangladesh too, and for women working on the local garment factories, the insertion of new machines will mean job loss. As the garment productions in Bangladesh is not diversified and specializes on simple products, the automation of the industry may lead to 90% of total job loss (McKinsey, 2018). Women are becoming redundant, and they have to go first because better jobs are given preferably to men as they are considered to have better technical skills. It is very challenging for women; many have to return to rural areas; others change occupation or find a job in another apparel company if possible.

Another problem of the industry is high levels of informal employment. The CPD expert states that informal employees make out around 80% of all labour force. The digitalization of the sector will increase informal employment in other industries and will have serious macroeconomic implications. It is also supposed to raise gender inequality. The automation may lead to a

renewed wave of women exclusion from paid occupations and education, and also lead to erosion of already obtained rights and freedoms as women may lack financial opportunities and bargaining power in society. It may also result in civil unrest, high migration rates, deterioration of human capital.

The experts state that the future of the sector and Bangladeshi economy strongly depends on the development of female workers' digital/tech-skills (*"CPD study stresses the need for balanced level of upgradation in RMG Sector"*, 2018). As the lack of skilled professionals, who would operate the machines impedes the automation of RMG in Bangladesh, investments in upskilling of female workers are reasonable. The importance of vocational-technical training both for women and men is being articulated more often by the experts. The BGMEA established National Institute of Fashion Technology (NIFT) to educate new coming labour force with technological skills and thus facilitate the automation of the apparel industry (Yunus/ Yamagata, 2012).

The researchers found out that the process upgrading goes along with social upgrading in terms of upskilling. Although many employees lose their jobs, others become an opportunity to develop their skills and improve their positions in the company (Moazzem/ Sehrin, 2016). It leads to personal and professional development, ameliorates working conditions and allows workers to be occupied with more creative tasks. The usage of automated technologies positively affects workers health due to reduced contact with chemicals and hazardous materials (Islam, n.d.). In this regard, it is important to give prioritized access to social upgrading and technological upskilling for female workers and support gender parity in the apparel plants in the country. It will encourage new coming generations of female apparel workers to join the industry and develop their professional potential and improve social status.

Key findings

Regarding the automation of the RMG sector, Bangladesh faces many challenges that impede the implementation of the advanced technologies: 1) high costs of machines, 2) lack of tech-skilled personnel, 3) abundance of low- cost labour, 3) bad infrastructure, 4) high energy costs, 5) lack of governmental support. However, despite these negative factors, the automation of the industry has already started having positive impacts on productivity, respecting the environment and improving the quality of products.

Impacts of ongoing digitalization on female labour in the sector has already been noticed: 1) the numbers of female workers decreased from 80-85 to 60-65%; further reduction are foreseen; 2) female workers will be affected in larger quantities than male ones, due to lack of education among women; 3) job competition at factories, gender-bias by employment and small numbers of women in leadership may influence hiring decisions favouring men over women by work distribution, as women have less access to skills upgrading because men are more preferable in performing a technical job. Although nowadays manufacturing companies realize that female employment is crucial for the successful business because lead firms are more eager to invest in firms which help and promote female workers. Women also prove to be more productive than men. Thus suppliers are also interested in keeping more women in the industry and offering female workers upskilling opportunities; 4) newly created working places are not going to be enough for all displaced employees. Companies which have many plants may redistribute workers, so that the displacement will be minimal. However, many women, especially those who come from rural areas, either have to return and be employed by the agriculture sector or find informal job as a domestic help. In order to prevent or milder the negative aspects of automation, it is necessary to develop measures and policies that can help displaced workers find employment and not sharpen income inequality among societies and within it.

5.4. Possible policies and recommendations for women impacted by digitalization of the apparel sector in Bangladesh

The increased speed of labour automation has lately attracted a lot of attention from various actors, who are investigating the impacts of the Industry 4.0 on human labour and try to find solutions to milder the adverse effects of economic upgrading of diverse industries. This section introduces measures suggested in the analyzed documents and by the interviewed experts and divided into three sub-sections: 1) gender- and sector-neutral policies, which represent general policies and possible solutions on state- and firm-level, including limitations of the latter, without focus on gender and sector, 2) gender-specific sector-neutral policies offer insight on suggestions on state and firm level independent on sector but targeted to protect and ameliorate position of female workers facing adverse effects of digitalization, 3) the last part of this section discusses gender-specific measures in the apparel industry in Bangladesh and its limitations.

It is necessary to complement that these measures are not universal solutions to tackle the challenges, which are caused by the Industry 4.0. The possibility of implementation of these policies varies dramatically across countries and regions depending on the development model of

a country and its financial capabilities as well as human capital.

Gender- and sector-neutral policies

The first strategy to milder the negative impact of automation is to ameliorate quality and levels of education. According to Schlogl and Sumner (2018) and the McKinsey Institution report (2017) firms can closer collaborate with workers to retrain them, help them acquire new skills to match to new types of jobs created or give people further educational possibilities (Schlogl/Sumner, 2018; McKinsey report, 2017). The main task of governments, as ILO Report (2016) states, consists in assuring access and investing in high-level education for citizens. Closer cooperation of governments with enterprises, workers and educators are necessary in order to timely respond to the problems caused by automation (ILO, 2016). However, the prospects of advanced education and retraining are overestimated. The rapid development of technologies and AI make it possible to replace workers in more complex stages of production and service, performing complex cognitive tasks too. There is also a high possibility that there will be fewer jobs created than unemployed people, and even education will not be sufficient for tackling this issue. In his study Degryse (2016) points out that there will be a very significant job-loss among low- and mid-skilled workers, that will not be possible to reengage these people in other occupations, therefore upskilling is not a universal remedy against technological unemployment (Degryse, 2016).

The reaction of state on changes caused by digitalization will differ from country to country depending on diverse factors such as economic development, HDI, type of government, culture, etc. The growth of national economies could be the option to curb the negative impacts of automation by fostering and creating new occupations, as well as adapting income and transition support for people who lost their jobs to automation (McKinsey, 2017). Nonetheless, the economic growth of a state depends on many factors and not always directly on government's decisions. Another way to protect citizens is an introduction of universal basic income (UBS), but it is more realistic in high-income countries than in LDCs and modernizing states. The states can also enter legal regulations on the usage of technologies at the workplace and enter taxes on products made by robots (Schlogl/Sumner, 2018). Although some experts and researchers consider that such measures can impede the development of a country and have adverse economic effects on the long run, but others argue that regulations are necessary and detrimental economic impacts have not been proved in those countries where restricting laws on technologies have been entered (De Stefano, 2019).

The World Bank notes that the following measures can change the situation on labour market on the long-term protecting people from losing their jobs to machines: 1) investing in human capital by providing complex education opportunities (especially early childhood education), 2) creating formal jobs and curbing informal sectors, 3) investment in infrastructure (access to Internet), 4) fair taxation and 5) ensuring social protection (World Bank, 2019). Proper implementation of these measures requires an increased state's spending that can pose a problem in the Global North, let alone the countries in the Global South. The de-liberalization and monopoly on business could give a state control over all decisions concerning workers and provide social services that can be sponsored via financial gains of state-owned corporations.

The McKinsey Institution report (2017) and the World Bank report (2019) point out that digitalization will not only result in unemployment, but there will be changing of occupations for people replaced by AI/robotics and creation of new jobs, as well as transition to different types of employment and development of the gig economy. At the same time, there is a high possibility that there will be fewer jobs in the world and newly created occupations will not be enough to employ all of the displaced workers. The internal promotions and upskilling within the firm are also problematic, because it is easier and cheaper to hire specialists who do not need any additional training and have experience and skills, and there are much fewer jobs requiring complex cognitive and empathetic skills. Therefore not every worker can change occupation within the firm or the same value chain even after upskilling. In this scenario, education and retraining will not be very helpful. Another problem is that the experts and researchers fail to predict what kind of new jobs will be created (McKinsey, 2017; World Bank, 2019). These factors make it difficult to develop any specific strategies for addressing the coming problem. However, researches in this field are crucial for analyzing the dynamics that automation is causing on the labour market to develop possible solutions for the impacted workforce (types of new jobs created and eliminated, new technologies appearing, etc.).

Gender-specific sector-neutral policies

The workforce composition in different value chains and among occupations is gender-segregated. Male employees usually get access to better-paid jobs and jobs with advanced skills, while women get stuck in low- or mid-skilled positions with fewer opportunities for promotions. The reasons and implications of this phenomenon have been discussed in previous sections of this paper. The times of the Industry 4.0 with the implementation of advanced technologies are changing the organization of the working process in the value chains and lead to possible mass

unemployment. Although women and men are supposed to be affected by technological job-displacement almost in the same quantities, female workers may face an augmentation in employment discrimination for the same reasons the gender-based segregation of labour occurred. The widespread automation of labour will increase the job competition and women may confront additional barriers in finding employment. Thus it is crucial to develop gender-specific policies and programs helping female workers successfully transit in the times of digitally transformed labour.

Diverse reports underline the importance of gender equality and female empowerment in digital age across countries and offer the following measures that specifically are targeted on women and are supposed to help female workers to profit from the Industry 4.0 and increase the chances to get employed: 1) investments in female education in STEM sectors to increase the number of technical specialists among women; 2) closing gender gaps in leading positions that will help eliminate gender-based employment bias and influence hiring decisions. It will also help to pay attention to gender-specific working issues, ameliorating working conditions and making the working environment female-friendly. It can be achieved through gender quotas and family-friendly company/state policies that will help women correlate job and family life without sacrificing one another, reducing psychological and physical pressure; 3) states have to ensure equal treatment and support to male and female workers displaced by automation. It means that governments have to provide equal access to training, upskilling and reskilling programs independent of gender, especially in countries, where men are favoured over women; 4) investment in acquiring of advanced digital skills by women and fostering of digital literacy among women; 5) fostering of female entrepreneurship by improving an access of women to credits and finances; 6) ensure job security and quality in gig – economy; 7) promotion of flexible job opportunities with the usage of advanced technologies that will help female workers combine work and family. For example, jobs that allow to have home office and work via Internet; 8) continuance of researches in the field of digitalization and gender issues to keep track of changes and challenges that affect female employment and life in the Industry 4.0; 9) providing e-infrastructure by ensuring access to Internet and information access in native language as well as promoting e-governance services (INF, 2018; G20, 2017).

According to OECD policy paper (2017), women in the countries of the Global South where the literacy and education gaps between men and women are wider than in the Global North can profit out of this measure most of all. E-governance can facilitate bureaucratic procedures for

self-employed or entrepreneur women, especially with restricted mobility due to cultural specifics/ security issues/place of living (far from the city); 10) adopting policies and taking measures against gender-based discrimination; 11) ensuring public security for women that will increase the participation of women on labour market, making the commuting to work safe; 12) promoting digital inclusion of women. In some countries traditional discriminative rules exclude women from entering the digital era by restricting their access to STEM professions, usage of Internet and advanced digital technologies; 13) awareness-raising by attracting attention to gender-specific problems and running gender-specific initiatives that will help eliminate stereotypes (INF, 2018; G20, 2017; OECD, 2017), the expert interviews. These are some gender-specific measures that should be undertaken in order to help women get more empowered and adapted to structural changes in the labour market in the Industry 4.0. Their implementation and combination might differ from country to country, but their necessity is evident.

Gender-specific policies for the apparel sector in Bangladesh

The apparel sector in Bangladesh is already facing a large workforce reduction among female workers (from 80% in previous years to 60% in 2019, so the CPD expert). However, automation of the garment industry is a complicated and lengthy process that gives states and firms enough time to develop decisions before the real threat occurs. The researchers and experts state that retraining, investments in the education of employees and internal promotions or transfers within the firm are seen as the solutions for people who are working in the apparel manufacturing and facing risks of being replaced by robots in the nearest future. Nevertheless, due to the high rates of informal employment in the sector, women are often excluded from social upgrading opportunities because firms are not motivated to invest in unregistered workers. Often leadership of a firm is not aware of the existence of informal workers or at least of real numbers of such employment. Thus the finances given to the reeducation are distributed among formal workers.

The government has to protect and offer new employment and education opportunities to women who are the main workers in the sector that is accountable for around 80% of all the exports in the country. Curbing fix-termed contracts and strengthening employment control to penalize the informal unemployment will help workers to be socially protected having solid contracts. It would make companies' owners more responsible and aspire them to develop the skills of employees and keep them in the company. In order to successfully solve the problems of female workers in the apparel industry, it needs to be recognized by all the participants – workers themselves, company owners and government.

Reskilling and upskilling are seen as essential measures nowadays implemented mostly on a company level and financed by apparel firms and NGOs. According to the experts, the government doesn't do too much to improve the situation of digital literacy among women in the country. It offers some general training – vocational training, computer proficiency programs. Retraining requires significant investments from the government. With the current education budget of Bangladesh – 2% of GDP – it is almost unrealistic to ameliorate the quality and access to proper education. By the mass displacement of workers due to digitalization, the government will be forced to search for finances to be able to offer reeducation for people who lost their jobs because of the robotics; these resources will be hard to find. Apparel firms and lead firms are more interested in retraining and reskilling female workers, but as financing is limited, not a big per cent of women have access to social upgrading programs, so CPD expert. Yet the digitalization of the sector in Bangladesh is still in its nascent phase and is moving rather slow, making it possible to invest in education of female workers step by step preparing them for bigger changes. As most of the women working in the apparel sector come from rural areas and lack education and skills, the government should provide targeted support to these women and citizens living in villages. Of course upskilling cannot be the universal solution as many workers will still be displaced if the industry is fully automated, but on this stage today it's a good opportunity for workers to get some digital knowledge that can be implemented in other industries too. Nowadays, diverse international organizations and NGOs are occupied with the problem of digital unemployment among female workers, and they offer training and programs that increase the digital literacy of workers. For example, Shimmy foundation, a women-owned company, which helps female apparel workers make a successful transition into Industry 4.0 and obtain necessary technical skills. The foundation uses Gaming principles in its Upskill program to teach female workers to use digital technologies. One of the positive aspects of such training is a higher possibility of finding a job in other sectors in case of displacement from the apparel industry (Shimmy, 2019).

The DBL Group leads diverse projects helping workers to adapt to digital age too. One of the most important programs is the children segregation program which supports education of workers' children because employees lack time to develop their skills, but their children will obtain necessary technical skills for the future, that will make them more adapted to the needs of the economy and industries, helping them find a good employment once they grow up. Thus investing in the digital education of future generations will help to reduce the negative impacts of digitalization in the long run. The BGMEA/Stoll pilots a training program for women to operate

the knitting machines, thus it is possible that knitting section will probably won't be dominated by men in the future shifting women to positions of knit machines operators (BRIA, 2019).

Another solution for displaced women can be starting their own business, but due to restricted access to finances and high levels of gender-based discrimination in society, that will be a real struggle for women who will choose to go this path, so the experts.

Changing social and cultural discriminative patterns and promoting female empowerment will help women to demand better life opportunities and realize their worth. "The biggest barrier to female progression is limits placed on them by their parents, followed by society, education and lastly the workplace" (BRIA, 2019:50). This research showed that female workers in the apparel sector are reluctant to be promoted to managerial positions as they don't want to deal with the increased responsibility. Although the higher numbers of female supervisors can change the discriminative attitude towards female workers and have a positive effect on the development of specific gender-focused programs helping women to adapt to digital technologies and keep their jobs in the company. The reasons for such an unwillingness to make a career can also be traced to childhood and adolescence and local traditions suppressing girls' incentives and potential for personal development.

The government must implement and control mechanisms that aspire girls and women to study and strive for better work instead of prescribing them an inferior position in society. Gender-specific policies, increased attention to women's problems via public service announcements, proper investigations of sexual harassment cases and gender-based violence with strengthened penalties could help women feel more protected on the state level, thus shifting the existing power composition between man and women. Although it is challenging to eliminate gender-based discrimination on a country level in a relatively short time, it is yet possible on a firm's level via codes of conduct and grievance boxes where women's voices can be heard. Pressure and investigations initiated by the global buyers and NGOs, trade unions and local organizations protecting human/female rights can also help women feel support and protection. All these measures are crucial to achieve a successful transition of female workers from manual labour-intensive to digital knowledge-intensive production and to ensure their further development and chances for employment.

The economic model of export-oriented development of Bangladesh based on low-value adding activities and low-cost labour can further impede social and economic upgrading of the apparel value chain. In order to change the existing situation, it is necessary to change the development

model and concentrate on local and regional markets and shift from production to social services, which can be very challenging for an LDC, because it is deeply embedded in the global economic structure of GVCs.

The position of female workers in Bangladesh requires more organizational capacities from women, who will struggle for their rights and attract more attention from IGOs/NGOs and local government and society. Such a bottom-up movement can change the gender power relations in the country, making female proletariat and their challenges visible to various actors. It has to be mentioned that Bangladeshi women are continually fighting for their rights and go on strikes demanding the improvement of working conditions and wages. However, to achieve significant positive results, it is necessary to increase pressure on the local apparel company owners and the government, trade unions and lead firms.

6. Conclusion

The focus of this master thesis laid on automation of the apparel industry and its effects on female workers employed in the sector globally and in Bangladesh in particular. The aim of this research was to estimate the impact of the digitalization on the global apparel sector and the labour force in it, the effects of digitalization on female workers in the apparel sector in Bangladesh and to discuss measures, which are suggested for female workers affected by the digitalization of the apparel industry globally and Bangladesh in particular.

In order to answer the research questions, I combined theoretical literature on materialist feminism with a focus on feminization and gender-based segregation of labour, digitalization and its impacts on female workers, theory on GVCs and gender-specific social upgrading. The intertwining of theoretical literature gave a solid ground on the phenomena of research and their origins.

I implemented such research methods as document analysis, trade data analysis, the GVC mapping and semi-structured expert interviews, where I obtained necessary and valuable information and data to understand the phenomena, their interactions and answer the posed questions.

Materialist feminism claims that female oppression and inferior position in comparison to men are rooted in social constructions (gender, race, ethnicity, class) that produce material relations of oppression. Material feminism underlines the necessity of the intersectional approach to the gender-specific analysis of social phenomena and regards women not as a homogenous group but

pays attention to their differences and realities women are embedded in such as countries of origins, cultural and traditional norms.etc. It also argues that the global division of labour created a hierarchy among women from the Global South and the Global North. It further explains poor working conditions of female employees in the Global South as a material result of oppressive relations in the GVCs.

The feminization of labour that started with the wave of neo-liberalization paved the way for women to participate in paid formal labour. It further contributed to and resulted in gender-based segregation of labour, because the job sectors that before were considered to be male were devalued and became dominated by female workers ascribing them specific "natural" skills. The roots of gender-based segregation of labour lie in gender discrimination and long-lasting history of women's exclusion from paid labour, education and political and economic decision-making. Still, acquired access to formal employment has a lot of positive impacts on women's lives, helping them to achieve gender equality, have economic value in society and improve bargaining power at home.

The global division of labour led to the creation of multiple global value chains with the high-value-added processes and the lead firms concentrated in the Global North and low-value-added labour-intensive jobs in the Globa South, thus producing hierarchical relations between countries in terms of their positions in the GVCs. Taking into account a severe competition between companies in the Global South, the economic upgrading (process, product, functional, etc.) within the chain is an important strategy to reduce productions costs, ameliorate the quality of goods and attract more global buyers. It regards human labour force only in terms of productivity blinding out social dimensions and workers' rights. However, recently, the social upgrading attracted the attention of scholars, NGOs and IGOs trying to improve measurable working standards (wage, working hours, etc.) and non-quantifiable (workers' rights, non-discrimination, etc.). Social upgrading with a gender-focus plays a significant role in refining the position of female employees in the workplace as women have gender-specific challenges at work that need to be addressed.

The digitalization of labour brings new challenges for female employees with it. The most susceptible to automation/digitalization are low-skilled, manual, labour-intensive types of jobs that require minimum skills. These occupations are prevalent in manufacturing, agriculture, food and service industries and these sectors employ women mainly on the lowest stages of production, making them easily replaceable by robotics and AI. Although according to the

reports, automation is supposed to result in almost equal labour force reduction among women and men globally, female workers will be more disadvantaged in times of increased job competition as they are under-represented in STEM sector, widely lack technical skills and are affected by the "male-breadwinner" model in traditional societies. The implications of digitalization on female workers have to be assessed dependent on country and industry. Otherwise, there is a possibility to obtain inadequate results on percentage of impacted female employees.

The analysis of gender-specific employment issues in digital times requires to distinguish between women and their realities – political, economic, cultural, ethnic, etc. and implement the intersectional approach. The position of women and their access to resources in the Global North and in the Global South differ a lot. There are also different percentage rates of female employment across countries. It is important to remember that the reliability of official statistics varies from country to country and doesn't include correct data on informal and home-based work. Due to the global division of labour that shapes value chains, countries specialize in particular sectors of production, which employ women in different quantities and can be digitalized in different rates too. It means that the effects of digitalization on female workforce must be researched on a sector-study basis and if possible, on a country case-study basis. Thus, I started with the apparel industry and its automation prospects and further adapted the results to Bangladesh.

The apparel sector is one of the largest industries in the world, which is continually expanding. It is a buyer-driven value chain, meaning that lead firms offshore their production to the countries with low-cost labour, while concentrating on high-value-adding processes as design and marketing. The industry is intensely gender-segregated with a higher concentration of women from the Global South in the lowest value-added stages of production. The global apparel value chain employs around 75% of female workers in manufacturing labour-intensive low-paid jobs. With the forthcoming digitalization, these jobs have a big potential of being automated in the nearest future – up to 80% in the simple and up to 40% in the complex garment production. There are many digital tools and robotics that have already been developed and implemented for automation of the chain – in both low and high-value-adding stages. Still, the apparel industry adopts advanced technologies rather slow than others. It happens due to the abundance of low-skilled labour in the Global South and high costs of machines, making the digitalization of the manufacturing not cost-efficient on the short term. Lack of skilled professionals who can operate

the programs and robotics also impedes the automation of the apparel sector in the Global South. Nonetheless, global buyers invest largely in the development of new technologies making possible nearshoring and onshoring of production, thus fostering the suppliers to adopt advanced technologies in order to stay competitive and save the market in the Global North.

The female workforce in the apparel industry will be most affected by the digitalization of the chain. First of all, because of the high percentage of female low-skilled employees, as male workers constitute only 20% of apparel workforce globally and work mostly as managers and supervisors. The prevalent part of apparel manufacturing plants finds themselves in the Global South. Thus women will be additionally challenged by search of new jobs, due to employment bias and social/cultural patterns favouring men. Women in the garment sector mostly come from rural areas, have only primary education and are impoverished, without a targeted help from companies and states they will have to return to villages or find a job as domestic helpers. This disadvantaged position of female workers can be explained by the tools of MatFem, stating that socially constructed patriarchal relations caused material consequences of female oppression and exclusion from power and decision-making processes and property rights. And as socially behavioural patterns are changing very slowly, gender-based discrimination is continuously reproduced. In the capitalistic society, it leads to the inferior position of female employees in the global division of labour, creating hierarchy between women of the Global North and the Global South and gender hierarchy between men and women.

The apparel sector in Bangladesh is the most important export industry in the country, making up to 80% of total exports each year. The rapid development of the sector started in the 1970s, and today Bangladesh became one of the 5 leading exporters of apparel in the world. However, the apparel industry is a very competitive market and to keep the leading position, Bangladesh has to tackle problems with a low-educated labour force that has negative impacts on productivity, lousy infrastructure, instability in the investment climate and social unrest of apparel employees resulting from non-compliance of the local firms with CSR. As the global apparel value chain, the local RMG is also highly gender-segregated, employing women in the lowest stages of production and men as supervisors. The local industry has many gender-specific issues regarding the working conditions of female employees and poor access to social upgrading. The ignorance and disregard of these problems may worsen the situation of women in society in times of digitalization. Thus it is crucial to address gender-specific issues in the industry.

The digitalization of the apparel industry in Bangladesh is still in its nascent phase, but all the experts and researchers underline the urgent necessity of adoption of new technologies in the chain to stay competitive. The model of production based on exploitative low-cost labour and high volumes output is not effective anymore. The sector must be diversified and rely on expanded service offers, a better quality of garments, better working conditions for workers and sustainability of business that can be achieved through implementing of advanced technologies. The companies that already automated some stages and segments of production (cutting, knitting) state the positive results in terms of increased productivity, quality and environment-friendly production. However, even at this infant stage, the automation reduced female employees dramatically. The experts noticed the reduction in female workforce, which dominated the industry reaching up to 80-85% a couple of years ago, to 60-65% in the year 2019 and further shrinking of these numbers is foreseen. As women lack technical skills and education, they become redundant and have to leave the industry, while male workers are getting promoted and can become a job as a technician or a machine operator. Upskilling and acquiring of tech-skills may help women to be transferred to better jobs within a company or to find employment elsewhere.

The biggest companies in Bangladesh that are supported and also pressured by lead firms, NGOs, IGOs develop programs for female workers promotion on managerial positions and also offer technical training to reallocate women within the company and help them to obtain necessary digital literacy. Workers who receive certificates and knowledge during such upskilling programs have better chances to get employed by other industries and apparel firms. Of course, automation creates fewer jobs than it eliminates. Thus it is hard to make certain prognoses for the future of the sector and its employment capabilities. Therefore the local government has to pay more attention to female citizens, especially those uneducated coming from rural areas. Although the higher level of education is not a guarantee for employment, it will increase the chances among women to find a job and compete with male workers. Combating gender-based discrimination and promoting female empowerment will have positive effects on the local economy and social development as well as the development of human capital. The government can also pose additional taxation on the apparel companies that use advanced technologies in their plants and use the revenues for reeducation of displaced workers, ameliorating the infrastructure and ensure social protection. The curbing of the informal sector and quantity of fixed-term contracts will help female workers in the garment sector become visible to the leadership of the firms and give them access to social upgrading and other social services. These are only some possible measures

that can cause milder negative effects of digitalization on female workers in the apparel industry in Bangladesh. However, the export-oriented model of development of the country may impede the implementation of these measures. To achieve significant results in amelioration of gender-specific working conditions and access to labour, Bangladesh has to change its development model, and it can be very challenging. Another possibility is the organizational capacity of female workers themselves as they have to struggle for their rights from bottom-up, which can lead to shifts in local power relations.

The rapid development of advanced technologies requires further researches on this issue as well as increased awareness-raising among IGOs, NGOs and lead firms, but the most crucial – local government. The gender-specific working problems in times of automation are relevant for both – the Global North and the Global South and need to be addressed before it has serious implications in gender relations within a society and between them.

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Appendix

Interview questions:

1. Could You please tell a little bit about your job – job- title, field of research, etc.?
2. How long have You been in this field?
3. What are You working on now (projects, researches, etc.)?

Group questions

Digitalization of the apparel industry in Bangladesh:

1. How can You estimate perspectives of digitalization of the apparel industry in Bangladesh? (if digitalization is cost effective for Bangladeshi apparel industry, if the infrastructure of the country is prosperous for digitalization, are there any governmental programs to support digitalization of the apparel industry, etc)

2) What are the main advanced technologies* applied nowadays in the apparel sector in Bangladesh (hard automation vs. soft automation)?

*under advanced technologies we understand any machines or programs which replace human labour fully or partially

Gender issues in the apparel industry in Bangladesh:

1. How can You describe working conditions and rights of female workers in the apparel industry in Bangladesh? (break during working day, air-conditioned working facilities, safe working facilities; rights to maternity leave, sick leave, vacation, etc.)

1. Are there some specific gender issues/problems You would like to reveal on? (for example - gender bias by employment such as "women are more suitable for sewing job, men have qualities for managerial tasks"; gender-based discrimination; access of female workers to better paid jobs; access of female workers to leading positions; sexual harassment issues, etc.)

Impacts of digitalization on female workers:

1. How could You describe the possible impact of digitalization of the apparel industry on female workers in Bangladesh?

2. What is your opinion regarding digitalization of the apparel industry in Bangladesh and its impact on female workers?

Solutions of the problem:

1. What could be the solutions for female workers who are susceptible to job loss due to digitalization of the apparel sector?
2. Are You aware of any governmental or apparel companies' programs/policies within the apparel value chain in Bangladesh aimed at protection/help of female workers affected by digitalization?
3. Maybe there is something else You would like to tell about regarding the topic of conversation?

List of interview partners:

1) a scientific worker on economic, social and technology history department at the Aachen University in Germany

2) a scientific researcher of the IAB (Institut für Arbeitsmarkt und Berufsforschung), Germany.

3) a medium-sized apparel company (X) merchandizing manager (the name of the company is not revealed as was demanded by the interview partner), Bangladesh

4) a high-profile manager of DBL Group (one of the ten leading apparel manufacturers in Bangladesh)

5) a high-profile representative of Awaj foundation Bangladesh

6) a high-profile representative of the Centre of Policy Dialogue Bangladesh

7) an NGO representative (the name of the company is not revealed as was demanded by the interview partner), Bangladesh

8) a merchandizing manager of the PDS Multinational Group, Bangladesh

9) Shimmy foundation director, the USA