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Automation and Digitization in the Myanmar Garment Sector

A review of the current situation and implications
for market strategies, investment and skills policies

The background features a complex arrangement of interlocking gears in various shades of blue and grey. Some gears are solid, while others are outlines. In the lower right, there are two horizontal arrows pointing right, one above the other, with a series of slanted bars between them. At the bottom, a dashed line runs across the width of the page.

Automation and Digitization in the Myanmar Garment Sector

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market strategies, investment and skills policies*

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Automation and Digitization in the Myanmar Garment Sector:
A review of the current situation and implications for market strategies,
investment and skills policies

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Foreword

In 2019, the International Labour Organization (ILO) marked its Centenary at a time of transformative change in the world of work, driven by technological innovations, demographic shifts, environmental and climate change and globalization all of which have profound impacts on the nature and future of work, and on the place and dignity of people in it.

Technological innovations, including those in the garment sector – a vital industry for the almost half a million Myanmar women and men it employs - increase the possibility of a shift between activities traditionally performed by humans and the ones that may now be performed by machines.

Technological innovations are not intrinsically good or bad. On the one hand, automation and digitalization technologies have the potential to play an important role in increasing labour productivity and over all competitiveness of the industry. On the other, these shifts could also pose serious challenges for the many garment factories and workers involved, mostly young women for whom the garment industry may offer a way toward economic independence and empowerment. In addition, technological transformation may be used to raise operational and administrative efficiencies and reduce various time lags that otherwise hinder the entire production process. The use of technological innovations may yet again reduce the environmental footprint of the industry and have a positive impact on the health and safety of workers.

The ILO constituents in Myanmar, and the Myanmar Garment Manufacturers Association (MGMA) in particular, are well aware of the twin potential and challenges associated with increased automation and technological changes. Among the industry stakeholders, there is a recognition of the imperative need to act with the goal to shape a fair, inclusive and sustainable future for the industry, to identify what type of skills and investment policies are needed for the industry to remain the engine of inclusive development it has been for the past decades. Paying attention at how the introduction of technological innovations impacts on Myanmar women and men differently and making provisions to ensure increased parity is a fundamental concern for the industry to remain the engine of development it is.

Learning from its first one hundred years of existence, the ILO confirms that the continuous and concerted action of governments and representatives of employers and workers, through social dialogue, is essential to the achievement of social justice, democracy and development. Evidence based research, which this report is a contribution to, is essential to feed into the policy dialogue the government, employers and workers organizations ought to have to ensure the sustainable future of the industry.

Donglin Li
ILO Liaison Officer
Yangon

Preface

The world of work, including the garment industry is changing rapidly as a result of globalization, digitalization and the introduction of other technological advances and climate change. Those are broad and interconnected phenomena, critical to understand for Myanmar, given that our industry is very much at the heart of the country's economic development. Even if the pace of the introduction of new technologies is uncertain, the trend is undeniable.

While the potential exists for certain tasks to be automated or digitalized, it is not likely that robots will take over the entire production. While certain tasks in an occupation might be automated, others might remain or evolve, rather than become obsolete.

The adoption of new technologies can be a powerful tool in the realization of the vision stated in our ten-years strategy, as we are working toward the transition from the current “cut, make and pack” model to the more demanding “freight on board” system which would ensure a brighter future for the industry.

What and how can the Myanmar Garment Manufacturers Association (MGMA) and our members prepare to reap the benefits of these shifts, and mitigate the possible challenges they might bring? How can we ensure that Myanmar is well positioned to gain from these innovations?

What appears increasingly essential is the need for the industry stakeholders to invest in skills development to embrace the future that lies ahead. We must take the lead role in designing skills development structures and programmes, with training delivery focusing chiefly in-factory. Technology and automation are essential for Myanmar to move up the path of increased wages. It is noteworthy that the following paper recommends to the government to invest and develop the adequate TVET legislation and to improve the current Employment and Skills Development Law. The proper incentives, programmes and policies must be developed to encourage training and technological adoption.

As a professional organization keen to respond to the needs of our members, MGMA, with our members' hope to proactively identify and address the challenges that lie in the path of increased automation and digitalization. We will encourage dialogue with the industry stakeholders and exchange views on how to reap the opportunities brought about automation and digitalization at both sector and factory level. Together, MGMA and its members and the industry stakeholders can ensure that these shifts lead to greater productivity, skill development and decent work for the women and men that power our vital industry.

We are very thankful for the support provided by the ILO Liaison Office in Myanmar as this new piece of research is timely and offer a solid ground for us to push the dialogue on automation and digitalization further.

Khine Khine Nwe
Secretary General
Myanmar Garment Manufacturers Association



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Executive Summary

The garment industry is changing rapidly, in large part because of the adoption of new automated and digital technologies. These technologies are being embraced across the supply chain, from the sourcing of raw materials to the engagement with end consumers. The factory floor, a bastion of labor intensive manufacturing, is no exception to these changes. McKinsey's annual report on the garment sector noted that "recent advances in technology span the whole gamut from sewing to gluing, knitting and finishing to warehousing and intralogistics" (McKinsey & Company 2019, p. 88).

Automation and digitization are creating fear that robots will replace workers, creating mass unemployment in developing countries that depend heavily on garment sector jobs. In the long run, technological advances are likely to replace many manual tasks in garment manufacturing. However, technological change will roll out gradually, and at first will automate simple, repetitive tasks. As technologies develop, increasingly complex processes may be automated. However, even automation proponents see limitations. The CEO of Softwear Automation, who makes the fully automated "Sewbot", has even publicly stated that automated sewing machines will "never make a bridal dress" (Peters 2017).

This study, based on a survey of factories and workers as well as qualitative interviews, finds that automation in the Myanmar garment sector is limited but growing. Almost all garment factories surveyed have invested in some type of automation for their factory, but this is often done for only a small part of the production process. In the last three years, nearly 70 per cent of surveyed factories adopted new technologies, such as digital plotter printers or computer aided design, in pre-production processes. Nearly half had introduced either automatic spreading or cutting. About 40 per cent of factories adopted some type of semi-automatic or automatic sewing machine.

The majority of workers already use technology at work that is either semi-automatic or automatic. More than half of the workers surveyed said that the machine they use most often is "semi-automatic" or "automatic." There were not clear trends evident in the survey data for this report about either the gender or education of workers who reported using more advanced equipment at work. However, only a small share of workers (about 4 per cent) have directly experienced a change in the digitization or automation of their work. These workers generally noted positive experiences with technological change. Most workers received training and higher pay, and all of the workers noted that automation made their jobs easier. More than half also noted that automation made their workplace safer. However, the number of workers and businesses providing these results is too small to draw statistically significant conclusions about the sector broadly.

While almost all businesses plan to continue investing in automation and digitization in the coming years, their future employment plans vary significantly. While most factories planned to keep future employment close to 2019 levels, two large factories noted that they planned to automate and reduce their workforce by approximately 80 per cent.

While automation will reduce job creation and make some jobs redundant, it will also create pathways to higher paying jobs and improved working conditions. The introduction of automated and digital technologies is not zero sum, with workers always losing out to machines. Instead, many workers will benefit as automation helps make them more productive at work. New technologies can also help improve occupational safety and health, for example by reducing repetitive motions or removing workers from close proximity with dangerous processes, such as manual cutting.

Other factors besides technology will shape the garment sector in Myanmar in the coming years. Geopolitical forces, such as trade disputes between China and the USA, and increasing wages and environmental restrictions in China, are pushing brands to increase sourcing elsewhere, including Myanmar (Mowbray 2018).¹ The garment sector is also experiencing significant growth, especially from Asian markets. These factors will provide significant tailwinds for Myanmar. However, there are still many risks. The recent UN Fact-Finding Mission, set up in response to the genocide in Rakhine State, recommended additional sanctions against the Myanmar military, which could negatively affect the garment sector. These effects, if they happen, will likely be indirect and connected to perceived reputational risk. Myanmar's garment sector must also contend with a comparatively inexperienced labor force, immature industrial relations, and weak training and skills development systems. A poor business environment, notably inconsistent electricity supply and slow ports, may also hinder investment in the increasingly time-sensitive garment sector.

Technological change will come gradually, but the scale and inevitability of change requires countries like Myanmar to begin preparing today. Future success in the garment industry will depend primarily on the skills of the workforce, which must build capacity to manage advanced machines while also enhancing the skills needed for manual production of complex, high value garments. Tomorrow's garment industry will also demand more highly skilled repair and maintenance workers. Training systems should be reformed, giving the primary role of designing and delivering training to employers and workers. Government should improve the legal framework and incentives to help encourage this training.

Skills development must be complemented by improvements in the business environment to help Myanmar become more competitive. Predictable, reliable, and affordable electricity is essential for automated garment production. Efficient ports and customs are also vital, as the industry puts increasing emphasis on time to market. Improved taxation, including addressing transfer pricing issues, are needed to fund the infrastructure and skills development necessary for the sector. These changes will require significant investment and policy reform in order to ensure that Myanmar remains competitive and continues to create quality employment in the garment sector.

¹ China has adopted environmental legislation in response to a number of environmental incidents that has resulted in the closure of many textile dyeing facilities. This has increased prices of dyed textiles significantly.

About the author

Dr. Jared Bissinger is a development economist and managing director of Bissinger Development Consulting. He has over a decade of experience working on private sector development and economic growth, with an emphasis on Myanmar. Dr. Bissinger has authored dozens of reports on topics including business environment reform, labor markets, economic governance, and technology and economic growth. He has consulted with a range of organizations including the World Bank, ILO, GIZ, The Asia Foundation, Overseas Development Institute, Deloitte, and many others. He worked for the ILO in Myanmar from 2015 to 2017, leading their technical assistance to employers in Myanmar. He completed his PhD in Economics in 2015.

The ILO in Myanmar

The International Labour Organization (ILO) is a specialized United Nations agency that aims to promote decent work. This includes opportunities for work that are productive and deliver a fair income; security in the workplace and social protection for families; better prospects for personal development and social integration; freedom for people to express their concerns, organize and participate in the decisions that affect their lives; and equality of opportunity and treatment for all women and men. With its unique tripartite composition, the ILO is well placed to assist governments, workers and employers' organizations to address challenges related to sustainable development through sound industrial relations at the enterprise, industry and national levels. The ILO has an ongoing engagement with its tripartite constituents in Myanmar on the basis of an agreed Decent Work Country Programme.

Disclaimer

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Introduction

The next decade will be critical for the adoption of automation. Executives are bullish about the future of automation... 82 percent of respondents believe that simple garments will be fully automated, leading to an 80 percent labour reduction by 2025. Seventy percent think that it is highly or somewhat likely that more complex garments, such as dresses and jackets, will be significantly automated (resulting in a 40-percent labour reduction).

-McKinsey & Company 2019, The State of Fashion.

The garment industry is changing rapidly, adopting and integrating new technologies across the value chain, from sourcing raw materials to engaging end consumers. The factory floor, a bastion of labor intensive manufacturing, is no exception to the changes which are affecting all parts of the garment supply chain. McKinsey's annual report on the garment sector noted that "recent advances in technology span the whole gamut from sewing to gluing, knitting and finishing to warehousing and intralogistics" (McKinsey & Company 2019, p. 88).

One of the most important areas of technological change is the increasing automation of factories where garments are made. Automation, or the use of a mechanical or electronic device that functions without continuous input from an operator, does not necessarily mean the full automation of all aspects of production. Fully-automated production lines are still in the very early stages of use, and can only produce a small number of products. However, a wide range of new machines that automate a part of the production process are being rapidly adopted by garment factories. This includes automatic sewing machines, hanger systems, and fabric spreaders and cutters.

The growth of automation is accompanied by the increasing digitization of garment factories. Digitization is the conversion of information into digital, machine-readable format. Digitization is increasingly common in garment factories, as they introduce technologies such as radio frequency identification (RFID) or Computer Aided Design (CAD) for pattern making. Digitization increases a worker's day to day interactions with computers, sensors and other information technologies. It increases the ability of management to monitor production and provides them with the data necessary to make real-time adjustments to improve efficiency and remove bottlenecks. It can dramatically improve the organization and analysis of information at the workplace.

Automation and digitization are part of bigger changes in the garment industry. Factories are facing increasing pressure to produce smaller orders (fewer pieces) and to do so with shorter turnaround times. An annual survey by Just-style.com on the state of sourcing noted that "speed was the top buzzword for apparel executives as they head into 2018" (Barrie 2018). Economic and political factors are also causing changes in sourcing. Over 80 per cent of buyers noted that they would reallocate some of their sourcing to another country in 2018 (Barrie 2018). To date, the biggest winners from these changes are not robots. They are other Asian countries besides China, which are experiencing significant increases in garment sector orders because of these trends.

The fear that underlies the automation and digitization of garment production is that it will put millions of mostly-female garment workers out of work. These fears are centered on two concurrent trends: (1) the overall reduction in jobs in the sector; and (2) stereotypes in some countries, including Myanmar, that women are not seen as capable machine operators (LaPlonge 2019, p. 12). The first trend would disadvantage women simply because they represent the majority of the garment sector workforce in Myanmar and many other countries. Garment sector jobs, while regularly criticized, are often not “low quality jobs” in the context of the developing countries that host them. Instead, they are an important source of employment in environments that often lack other opportunities (Robertson et al 2009). The second trend, the negative stereotypes about women, could disproportionately hurt women further, increasing gender gaps in the sector.

The current trends in technological adoption suggests that mass unemployment resulting from automation of garment production is unlikely in the near future. Instead, the production process will continue to be automated, with human workers increasingly utilizing more complex machines or taking on jobs requiring more advanced manual skills. The most well-known fully-automated production line, the “Sewbot”, is very limited in number and functionality, and not even for sale outside the United States (Peters 2017).

For Myanmar, changes in the garment sector, and especially automation, hold both opportunities and challenges. Automation could lead to greater productivity and higher wages for workers in Myanmar. However, it could also reduce the growth of formal employment in the garment sector, and potentially the developmental contribution of a sector that has played an important role in many other countries in Asia. Automation in the garment sector is not a simple, zero-sum game of human versus machine. Instead, it is a complex change that benefits some workers while reducing the labor intensity of the sector, thereby hurting other workers (or potential workers).

This report reviews the state of automation and digitization in the garment sector in Myanmar. It starts with a review of the methodology of the garment factory survey and qualitative interviews. It then provides an overview of the sector in Myanmar, before moving to a review of the state of automation and digitization based on the survey. The report reviews drivers and constraints to automation and digitization, as well as the future plans of factories to continue introducing these new technologies. It closes with a brief review of key findings and a number of recommendations about how Myanmar can maximize the benefits of technological change while minimizing the costs.

Methodology

Scope of study

In Myanmar, the garment sector is concentrated in particular parts of the value chain, notably the labor intensive manufacturing. The vast majority of manufacturing in Myanmar is cut-make-pack (CMP). Materials such as fabric, hangers and zippers are generally imported, both due to their scarcity within the country as well as a tax structure that results in higher taxes on locally produced inputs. Because these upstream suppliers are rare and manufacturers (especially CMP) common in Myanmar, we focus this study on technological change at manufacturing facilities in this part of the garment value chain.

Garment sector studies often include subsectors such as footwear and textiles, however this study excludes these areas because of differences in technology and business representation. Some publications refer to these sectors collectively as the garment, textile and footwear (GTF) sector. Myanmar does have a significant traditional textile sector, with labor force survey data suggesting that it provided (as of 2015) work for more than 200,000 workers (Huynh 2017). However this sector is largely disconnected from global markets, and structurally distinct from the globally-integrated garment sector. Textile producers that are integrated into global value chains often use different technologies than those used in garment production. Like garments, the export-oriented footwear sector in Myanmar has grown significantly in recent years, however the production process and technologies used to make footwear differ significantly from those used to make garments. Both textiles and footwear also have different business representation structures, which presents practical challenges for survey implementation. Given these considerations, as well as logistical and programming reasons, we focus this study on the garment sector.

Within the garment sector in Myanmar, we focus on the use of technology at the factory, though cite important technologies elsewhere that affect garment factories or workers. Improvements in technology are happening not just on the factory floor but

across the garment value chain. This includes new technology in areas such the operation of ports and efficiency of logistics, or mobile payments for workers' salary. Technological advancement in the broad ecosystem in which factories work is important but also large in scope. Because the potential technological drivers of job reductions are focused on the labor-intensive factory floor, we focus this study on technological change within the factory. However, at the factory, we will look beyond just production technologies, to also include new ways that management is using technology to run a factory. Often, new technologies introduced in the production process, such

Box 1. Profile of Participating Factories

Country of Origin	
Myanmar	4
Other	4
China	2
Japan	2
Korea	1
Year of Establishment in Myanmar	
Before 2010	2
2010-2014	4
2015-2019	7
Number of employees	
0-500	3
501-1000	3
1001-1500	5
More than 1500	1
<i>*one factory did not provide a figure for total employees</i>	
Total number of workers at surveyed factories:	
Female:	9,582
Male:	1,865
Total:	11,447

as automated hanger systems, provide new and real-time data to management. This data can be used in many important ways, for example to calculate productivity bonuses, and as such is a natural area for investigation.

This study draws on both qualitative and quantitative field research, as well as desk research.

The quantitative research was designed by the research team but administered by a subcontracted survey firm. The quantitative research consists of: (1) an employee survey, to be completed by approximately 20 workers in each factory; and (2) a factory survey, to be completed by the top manager, director of operations, or other member of management who is qualified to answer questions on automation. The quantitative surveys were completed from June to August 2019.

The initial survey design called for 40 factories and 800 workers to be surveyed using the automation tools.

However, the number of completed surveys was significantly lower. The number of completed factory surveys was thirteen (32.5 per cent of planned total) while the total number of completed worker surveys was 260 (32.5 per cent of planned total). Extensive efforts were made to encourage factory participation, including multiple email invitations and phone calls, as well as encouragement from numerous brands. While the subcontracted survey company initially planned to randomly select factories for participation, a high non-response ratio and the limited size of the sample frame led them to use networks and other means to recruit participants.

The low number of responses and use of non-random sampling significantly undermines our ability to draw significant conclusions from the data.

Thirteen factories do not provide enough data for meaningful conclusions about the industry. Surveys from 800 workers would have been enough to draw statistically significant conclusions, however other obstacles encountered in the data collection process undermine the quality and representativeness of that data. Because of concerns regarding interference with the factory’s production, the survey team asked for members of only one production line to complete the survey. Other departments, including cutting, finishing and warehousing, may not be represented in the worker survey data, potentially resulting in biases if automation in sewing is not progressing as quickly as in other departments. Given these shortcomings, the conclusions in this paper should not be viewed as statistically significant or representative of the Myanmar garment industry.

Table 1. Field Research Interviews

Type	Number
Industrial Zone Management Committee	2
Factories	3
Business Associations	2
Trade Unions	1
Brands	2
International Organizations and INGOs	5
Training Facility Visits	1

To complement the quantitative fieldwork, qualitative fieldwork was completed in April and May 2019.

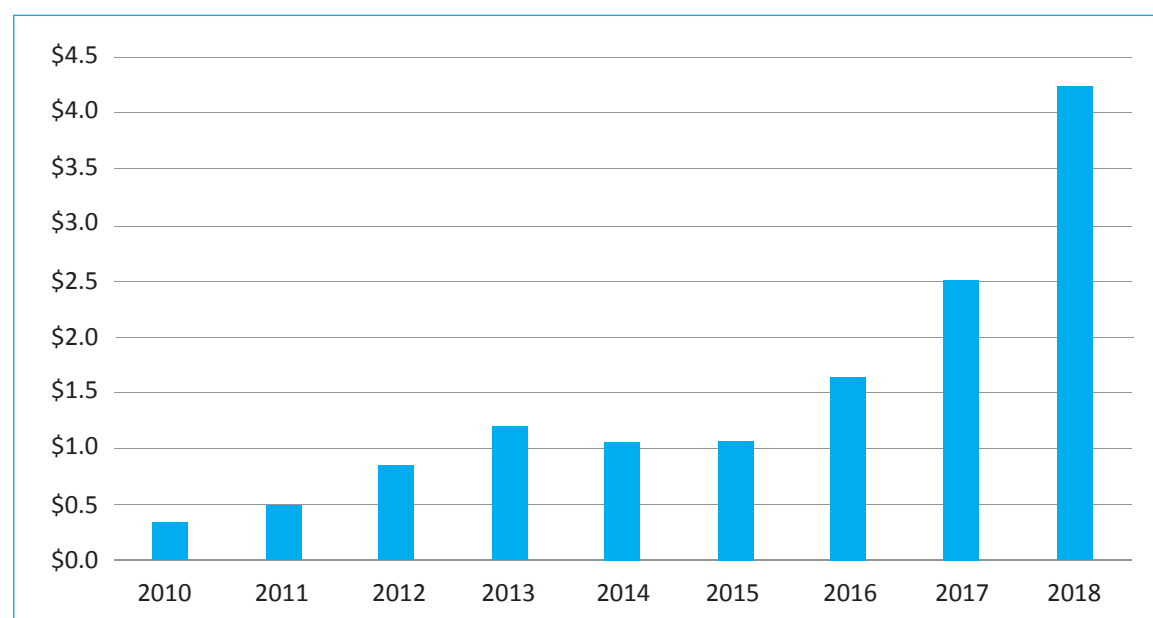
The list of interviewees was provided by the International Labour Organization (ILO) though a few additions were made by the lead researcher. Qualitative interviews were based on a semi-structured questionnaire, tailored for each group of respondents. Table 1 outlines the various types of field interviewees, as well as the

number of each type of interview conducted. Additional qualitative insights were gathered by the subcontracted survey team through key informant interviews with members of management who were most qualified to answer questions on factory automation and digitization.

The Garment Sector in Myanmar: An Overview

The garment sector in Myanmar has grown significantly in the last decade, and is now the country's most important manufactured export. Over the last decade, exports of garments have grown from approximately \$350 million per year in 2010 to \$4.23 billion in 2018. The growth has been dramatic especially in the last three years (2016 to 2018) with the value of gross exports increasing by more than 150 per cent. As more garment factories continue to apply for and receive approval to invest in Myanmar, it is likely that the sector will continue growing in the coming years, though the pace of growth may slow.

Figure 1. Myanmar Exports of Garments and Textiles from 2010 to 2019, in billions



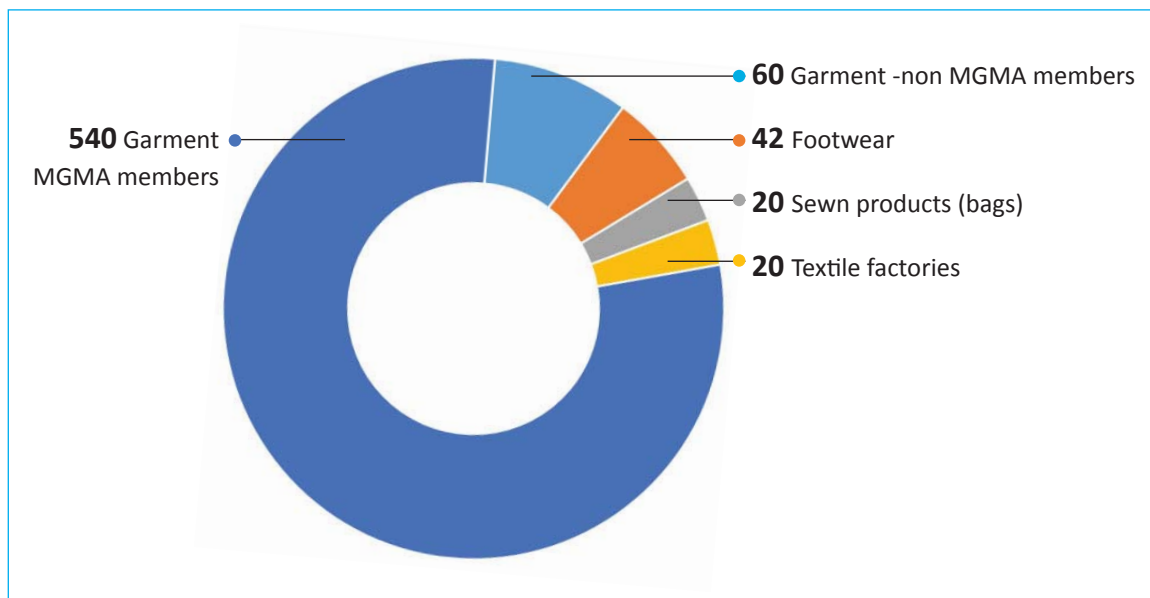
Note: data covers gross exports only, and therefore does not reflect value added. Covers HS 50-63, and therefore excludes footwear and certain types of bags. Source: United Nations 2019, Comtrade database, viewed 26 November 2019, <<https://comtrade.un.org/>>.

Garments has become Myanmar's most important manufacturing sector when measured by both employment and number of factories. As of 2018, the garment sector employed some 450,000 workers at factories affiliated with the Myanmar Garment Manufacturers Association (MGMA). This figure does not include employment at garment factories that are not affiliated with MGMA. It also does not include employment at footwear, bags, and other textile product factories. Garment factories are far more common than factories producing bags, textiles and other products. There are approximately 600 garment factories in Myanmar, 540 of which are affiliated with MGMA and another 60 which are not.² MGMA-affiliated factories comprise nearly 80 per cent of the country's

² MGMA affiliation is necessary for factories that import raw materials and export finished products, and would like to obtain import duty exemptions for the raw materials used in production. Factories that produce only for the domestic market would not be able to obtain this exemption, and therefore would not need to affiliate with MGMA (though they may choose to do so). We present these groups as separate, using "MGMA factories" as a close proxy for garment factories that export in international value chains.

total number of garment, textile, footwear and bag factories. The remaining factories produce footwear (42), bags (20), and other textiles (20).³

Figure 2. Number of Garment, Textile and Footwear Factories in Myanmar



Source: Eurocham Myanmar 2019

Garment manufacturing is concentrated in and around Yangon. According to the MGMA, about half of the country’s garment factories are in Yangon (Eurocham Myanmar 2019). The most significant concentration is in Hlaing Tharyar township, though there are also major clusters in Shwepyithar and Mingaladon townships. The Thilawa Special Economic Zone, located south of Yangon along the Yangon River, is also home to some garment factories. A number of secondary cities, including Bago and Patheingyi, also host clusters of garment factories, though they are significantly smaller than Yangon.

Myanmar’s garment sector has grown largely as a response to the country’s political and economic transition. In 2011, the country’s military junta ceded power to a military-led civilian government, which initiated a wide range of reforms that energized the country’s international engagement. Foreign investment in Myanmar surged, especially in previously moribund sectors such as manufacturing. In the first few years after the political transition, garments accounted for more approved investment projects than all other sectors combined.⁴

Myanmar’s garment sector has also benefitted from global and sectoral dynamics, as well as changes in other producing countries. Wage growth in other countries, notably China and Cambodia, has encouraged factories and brands to look for alternative sourcing locations, including Myanmar. At the same time, political and environmental risk is also shaping sourcing decisions. As one industry source noted, “there’s too much risk locating 100 per cent of your production in Bangladesh. (Natural and human) resources in Bangladesh are getting tougher and tougher, the environment is bad, and the country is poor. It’s a hot spot” (Interview 13, 2019). Because

³ Factories engaged in production of “bags” could include makers of backpacks, handbags, or other types of woven or sewn bags. It does not include bags made of materials such as plastic.

⁴ Measured by number of approved projects, not value of approved projects.

each of the major garment producing hubs in Asia has risks, brands seek to diversify by spreading production across many countries. This has helped Myanmar, as brands seek to include it as one of many locations from which they source. Other factors, such as the United States' increasing tariffs on Chinese imports, are also reshaping the sector, pushing Chinese factories to look for other locations from which to operate.

Despite strong growth, Myanmar's garment manufacturing sector faces a number of significant challenges. Infrastructure remains poor in comparison to other key export hubs such as China and Vietnam. Businesses have struggled to comply with Myanmar's labor law framework and international standards regarding labor rights. Political risk has created instability, including fears among the private sector that the European Union's Generalized System of Preferences (GSP, a preferential trade scheme that allows duty-free imports to the EU from select countries) will be removed (Interview 04, 2019). These factors create uncertainty for businesses and workers and may serve to moderate growth.

Garment manufacturing in Myanmar is inefficient compared to other countries in Asia, in part due to its youth. Most factories have been established in the last five years. A significant share of the workforce has limited experience in a manufacturing environment. Foreign managers tend to lack experience in the Myanmar context and in engaging with Myanmar workers. Local managers often lack experience in the garment sector, as well as working in a foreign-owned business. The lack of experience among workers and employers can result in weaker communication, underperformance, and lower productivity, as workers and managers learn the procedures, expectations and working styles of other parties. One industry expert noted an example of inefficiency in Myanmar: the high share of workers in the factory not engaged in operations, such as cleaners and guards. This can result in lower levels of total productivity per worker, as the additional cost of these non-production workers must be paid out of the total revenue of production. Splitting the same production revenue among a larger number of workers results in lower potential compensation per worker. As management and workers gain experience, factories should be able to improve efficiency by increasing the share of workers involved in production (Interview 12, 2019).

The State of Automation and Digitization in Myanmar

“We aim for 90 per cent of the work to be done by automated machines in the next 3 years.”

-Garment factory owner in Myanmar (Interview 6, 2019)

Myanmar’s garment sector is undergoing a major transition, with different groups of factories within the sector embracing automation and digitization to much different degrees. New, mostly foreign owned factories have entered the country by the hundreds. These factories are often owned by business people from China, Korea, and other Asian countries. These factories are more likely to have entered Myanmar with more sophisticated technology, or to consider adopting it. At the same time, there is a smaller group of factories that have been in Myanmar for a longer period of time. These factories are more likely to be smaller, locally owned, and less technologically advanced.

Many factories are new and have recently acquired machines for their operations. Because of this, it is unlikely that existing factories established in the last decade will invest in a wide range of new machines in the near future. However, factories that are looking to enter the market or expand to another location in Myanmar or abroad are thinking increasingly about automation (Interview 01, 2019). According to one industry source, “when businesses expand, they buy more advanced machines. When new factories are set up, they set up with new advanced machines” (Interview 04, 2019). Increasingly, newly established garment factories in Myanmar are utilizing automated and digital technologies from the very start of their business. A list of key automatic and digital technologies is contained in Annex 1.

The level of automation and digitization varies dramatically between different factories. On the one hand, there are a number of fairly sophisticated factories in Myanmar, which have numerous types of automation and have digitalized parts of the production process. These factories can have high levels of productivity. For example, one factory which has invested in automatic knitting machines is producing up to 700,000 sweaters a month (Interview 19, 2019). The level of automation at a factory depends in part on what the factory produces, as some technologies have progressed more quickly than others. Some garments, for example heavy knits, are often produced with more advanced technology. Other garments, such as shirts, trousers and jackets, can be produced with advanced technology, but there is greater variation in the level of technology at factories producing these garments (Interview 12, 2019).

Table 2. Technologies adopted by factories in the last three years

Type of technology	Number of factories
Computer aided design/Plotter printer	9
Automatic cutter	5
Automatic sewing machine	5
Automatic fabric spreader	4
Automatic fabric inspection machine	4
Automatic specialty sewing machine	4
Other	3
Digital inventory management (RFID, etc.)	2
Automatic hanger system/conveyor belt	1
Automatic ironing/pressing	1
Automatic knitting machine	1
Automatic screen printing	0

Note: n=13 factories. Not all factories will invest in the same types of automation. The types of machinery needed will vary based on the products that the factory produces. For example, a factory that does mostly knit products may invest in automated knitting machines, while most other factories that do CMP with fabrics would have no need of knitting machines.

A survey in Myanmar found that factories most regularly adopted new technologies in pre-production. The majority of factories surveyed had adopted CAD and/or plotter printers in their design rooms. Using CAD, patterns can be made on a computer, and optimized to reduce fabric waste. These designs can then be programmed into the automatic spreaders and cutters, creating a fully digital and integrated pre-production and cutting process. CAD and digitization of pre-production is an essential ingredient for a factory to move from CMP to Free On Board (FOB).⁵ According to industry sources, adoption of CAD is concentrated in foreign factories, which are often integrated with production facilities in other countries (Interview 05, 2019). Some factories were also doing digital sampling, which could significantly reduce the overall time needed to approve a garment for production (Interview 19, 2019).

The spreading and cutting of fabric is another area where a number of factories noted that they had invested in new technologies. Five factories noted that they had invested in automatic cutters while four had invested in automatic fabric spreaders. The results of the factory survey were echoed by numerous industry sources, who stated that they also viewed spreading and cutting as an area where automation was quickly being adopted (Interview 06, 2019). Computer controlled spreading and cutting is not new – some of these technologies have been around for three decades. Factories have been adopting these technologies for some time, with one industry executive noting that cutting and spreading is where he has seen the “most automation over the last twenty years” (Interview 12, 2019).

Many factories have also invested in some type of automatic sewing machines. There are many different types of automatic sewing machines. Standard sewing machines, such as single and double needle lockstitch machines with automatic trimming, have been adopted by five of the surveyed factories. There are also a wide range of specialty sewing machines that allow users to perform one or a limited number of sews automatically. Examples of this type of sewing machine

⁵ In CMP production, all raw materials such as fabric, zippers, etc. are provided by the buyer. The factory is only in charge of assembling the product. However, in FOB production, the factory is in charge of the entire production process. They source materials, assemble the product, and package it for shipping to the buyer.

include automatic buttonhole machine, automatic bar tack machine, automatic label attach machine, and many others. These automatic machines replace a specific manual sewing process, helping to improve efficiency and accuracy. Industry sources also note that factories in Myanmar are beginning to invest in automatic sewing machines for various sewing processes (Interview 06, 2019).

Two factories noted that they had invested in RFID, a digital technology to help better manage production and inventory. RFID systems allow management to track the movement of items or bundles through the factory in real time, with greater accuracy and in less time. The data captured through the RFID can also be used to calculate worker pay. At present the “ticket pay” system is the most popular system for tracking how many units a worker does in a day. In this system, “each process has a ticket and people cut out their ticket when they do a process and turn it in at the end of the day” (Interview 04, 2019). However, some factories have eliminated this system in favor of computerized RFID tracking. One brand noted that 30 per cent of their factories in Myanmar are using RFID and bundling system (Interview 12, 2019).

According to the survey and industry sources, new digital and automatic technologies are being introduced elsewhere in the factory, although on a more limited basis. One factory had introduced an automated hanger or conveyor belt system, which automatically moves a garment along the production line. An industry source noted that automated hanging or conveyors were the second most common area for automation in the Myanmar garment sector (Interview 01, 2019). New environmentally friendly digital technologies are being introduced in the finishing process. For example, some factories are investing in eco-friendly washing machines which not only use less water, but also keep track of water and chemical use, among other features (Interview 12, 2019). Other areas that were experiencing some level of automation or digitization include automatic gluing machines, automatic spider machines, automatic pocket machines, automatic quilters (down jackets), automatic fake down filling machines (down jackets), and automatic button attach machines (Interview 01, 2019; Interview 12, 2019; Interview 13, 2019).⁶ According to industry sources, some parts of the garment production process are less likely to experience significant automation and digitization. For example, while some factories are using forklifts (for warehousing), the need for significant technology in the warehouse is not great because almost all garment production in Myanmar is CMP, so no items are kept in stock (Interview 06, 2019; Interview 13, 2019).

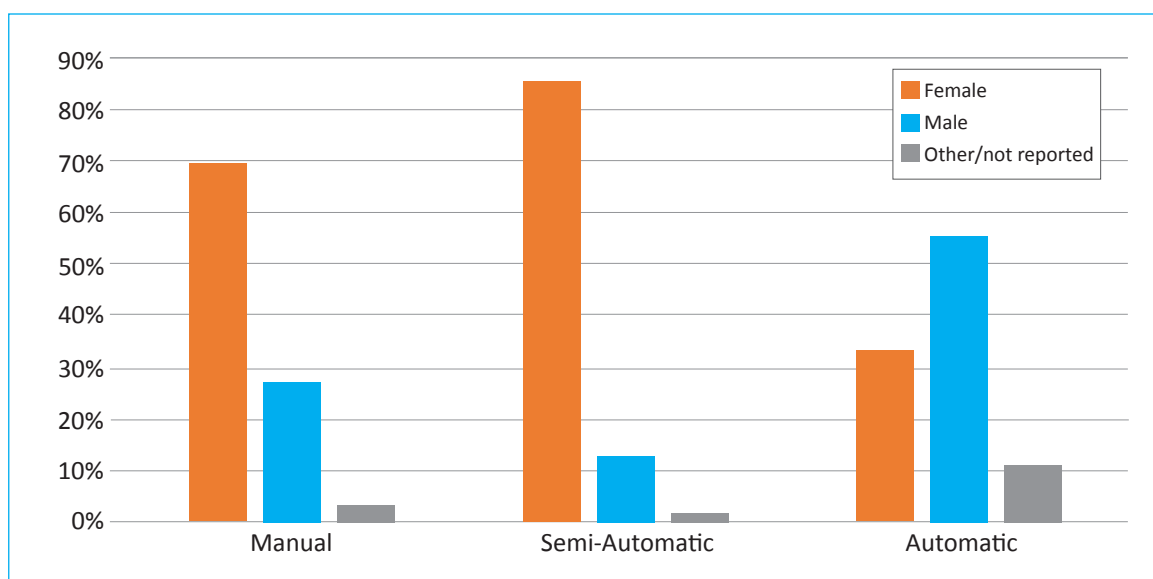
Acquiring automated or digital technologies is only the first step in using technology to improve factory performance. Machines have to be integrated into the production process, which can often present practical challenges. New machines often have a range of features, and businesses must learn all of them in order to take full advantage of their investments. Industry sources note that many factories in Myanmar are still in the process of integrating and fully utilizing new technologies. For example, some new machines are based on artificial intelligence (AI), and give real time data that allows businesses to perform preventative maintenance when an issue is identified. However, some factories in Myanmar are not using this feature, and therefore not fully utilizing the technology’s potential benefits (Interview 12, 2019). There is also technological change in office processes and procedures, and the integration of data between production and administration. Changes in other sectors, such as digital payments, are being widely adopted by factories, changing how workers are paid. In short, there is much more to the automation and digitization of a garment factory than just buying new machines.

⁶ Automatic spider machines are rotary printing machines that bear a resemblance to a spider.

Worker experiences with automation

The majority of garment workers in Myanmar already use a machine with some automatic features regularly. Of the 260 workers interviewed, just over half (131 of 260) reported that the machine they used most commonly was “semi-automatic”. Another 9 (3.4 per cent) reported that the machine they used most commonly was “automatic”. Only 92 workers (35 per cent) said that the machine they used most regularly was a manual machine.⁷

Figure 3. Level of Automation of Machine Used by Worker Most Frequently, by gender



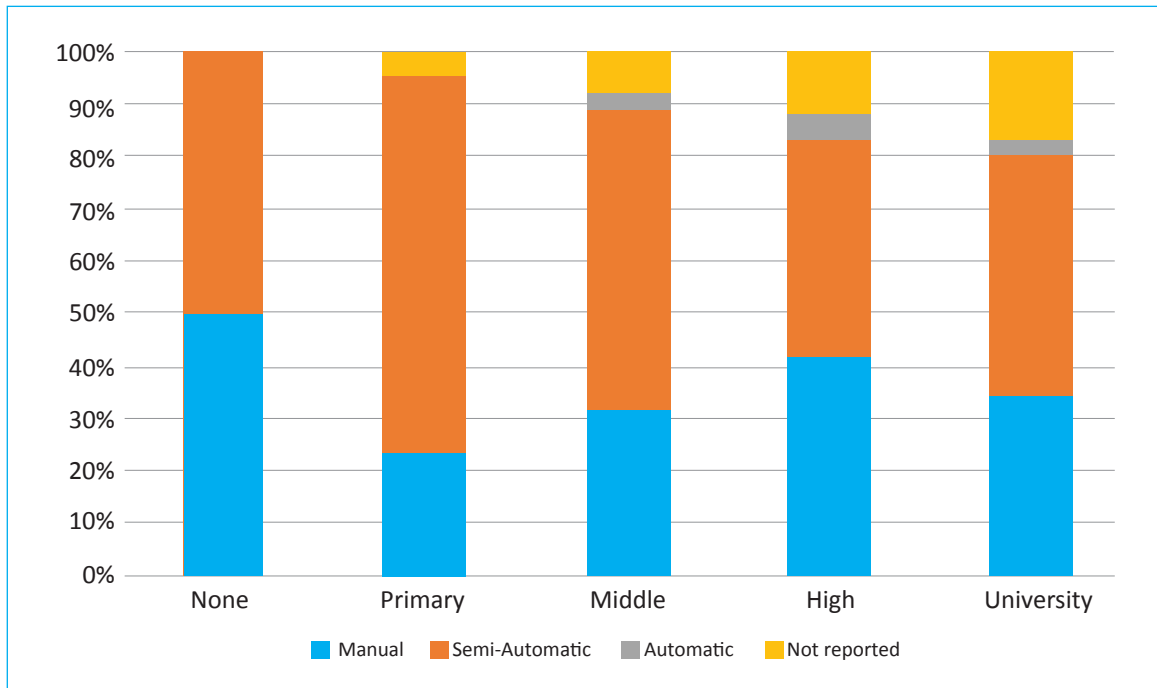
There was not a clear trend in the relationship between gender and level of automation, though male workers were significantly overrepresented in the very small group that regularly used automatic machines. In the survey, 78 per cent of respondents were women, 20 per cent were men, and 2 per cent reported “other” or did not provide a gender. Women were underrepresented among users of manual and automatic machines, where they comprised 70 per cent and 33 per cent of the total workers respectively. However, they were overrepresented among users of semi-automatic machines, where they comprised 86 per cent of all workers. The low number of women using automatic machines is concerning, but the small sample of workers using automatic machines prevents us from drawing more meaningful conclusions.

There is also not a strong relationship between education and the level of automation in the machines that workers use most commonly. Notably, workers with only a primary education were more likely to use semi-automatic machines than any other group, and reported the lowest rate of use for fully manual machines.⁸ The use of automatic machines was reported by workers with middle, high school and university education. These results suggest that automatic and semi-automatic machines often do not require greater levels of education for their day to day operation.

⁷ Percentages do not add up to 100 per cent, because some workers did not provide an answer about the level of automation on the machine that they most regularly use at work.

⁸ Only two workers reported no education. Because of this very small size, we do not include this category in our analysis in the paragraphs in this section.

Figure 4. Level of Automation of Machine Used by Worker Most Frequently, by education level



Only a small share of workers in Myanmar’s garment sector have directly experienced a change in the digitization or automation of their work. Of the 260 workers interviewed, only 11 had experienced some type of automation change that affected their day-to-day job. Of these workers, 6 were female and 5 were male. They cited the introduction of a range of technologies, including CAD, automatic cutters, automatic knitting machines and automatic specialty sewing machines.

Effects of automation

Automation has had both positive and negative effects on the garment sector and garment workers in Myanmar, including a negative effect on job creation. There is limited evidence that it has reduced the number of employees at a number of factories. One factory noted that they had decreased the total size of their workforce by 600 employees while increasing production, thanks to automation. However, other factories have used automation primarily to increase the volume of production (Interview 12, 2019). Both workers and employers generally cite positive experiences with automation, with workers noting that automation can often make their job easier and safer.

Factories adopt numerous strategies to change workforce size when they automate some part of their production. This is generally not done through mass layoffs, but instead through adjustments in recruitment targets, workforce reduction through attrition, and occasional layoffs. One industry expert noted that when factories are buying automation, “they adjust their recruitment in advance and plan for that so it minimizes disruptions” (Interview 14, 2019). Some factories try to adjust workforce size through attrition, not rehiring when workers leave, thereby reducing the total number of staff. However, factories that rely on attrition may not be keeping the right people (Interview 12, 2019). Given the numerous ways in which factories adapt workforce size, it is very

difficult to estimate the total effect of automation on job creation. Layoffs may be easily measured, but it is very difficult to estimate the number of jobs not created.⁹

Workers and trade unions are starting to become aware of automation but are “not fully aware” of the implications of new technologies (Interview 09, 2019). Because the pace of automation can often be gradual, and its introduction can be incremental, workers and trade unions generally do not view technology as an imminent threat. One international sector expert noted that while the trade unions were quite active in preparing for automation from 2015 to 2017, they are now “seeing that it is not happening so they are focusing elsewhere” (Interview 09, 2019). As one trade union representative noted, workers “think that automation won’t immediately affect them right now” (Interview 16, 2019). While automation may not be adopted by every factory in the next three years, the long term trajectory is clear. Union representatives even acknowledged that they are worried about the day when “technology will replace the workforce” (Interview 11, 2019). Given other pressing challenges such as union registration and the dispute resolution system, though, it is not surprising that workers and unions may have limited bandwidth to address long term trends such as automation.

There is limited evidence of constructive collaboration between workers and employers in the adoption of automation. The introduction of automation can be a challenge in any workplace, and especially so in Myanmar, where industrial relations are comparatively immature. Unions generally want employers to provide advance notice and consult them on significant changes in the workplace. As one trade union representative noted, “if there is automation coming to a factory, the owner should discuss with the workers and trade unions” (Interview 16, 2019). However, employers generally prefer to keep this information confidential, for fear of provoking a strike or some other type of disruption. One organization noted that some basic level unions believe that employers are “using the threat of automation as a trick” (Interview 09, 2019). Even if factory level social dialogue on specific investments is unlikely at most factories, other types of dialogue and information sharing with either a trade union or workplace coordination committee could help promote mutual understanding.

While there is a risk that automation could bifurcate the workforce, there is limited evidence that this has happened in Myanmar to date. There is a risk, one already being realized to a degree in some European and North American countries, that automation and digitization will split the workforce into a high skilled group and a low skilled group, hollowing out the middle class. The lack of bifurcation in Myanmar to date is probably due to the comparatively low levels of automation in the sector. However, as factories increasingly automate, the demand for workers with technical skills will increase while workers without skills may find it increasingly difficult to find or retain employment. While automation has not significantly bifurcated the workforce to date, one interviewee noted that there already exists some degree of bifurcation between foreign management, experts and technicians and local operators. “The workers only know how to operate it (the machines). For the time being, there are not any factories that trains local workers to be technicians on these more advanced machines” (Interview 11, 2019).

⁹ One possible approach to approximating “jobs not created” would be to combine employment records with export data to track changes in production per worker. Records of employment levels could be obtained from the MGMA. The Ministry of Labor, Immigration and Population collects monthly data on employment from factories that is quite detailed. These records are the most accurate but may not be easily accessible. These records could be cross-referenced with export records showing value and volume of exports, which should yield information about change over time in productivity per worker. However, this approach would not be able to account for other factors affecting change over time in productivity, and would not be able to say with certainty that is due to automation.

Box 2. How has Automation Affected Workers in Myanmar?

There is very limited evidence on the experiences of Myanmar workers with technology, however the limited insights from the worker survey suggest that their experiences to date are largely positive. Only eleven workers (4.2 per cent of the sample) had experienced a technological change at work, and of these only seven completed additional questions. However the responses are notably positive. Key findings include:

- No workers were made redundant as a direct result of the technological change; all continued their job in some way after the introduction of automation.
- Six of seven workers reported that they received training on the new machines, or on the aspects of their job that would change because of the new machines.
- All seven workers noted that their new roles required more skills.
- Six of seven workers noted that their pay increased because of the introduction of automation, with one worker noting that there was no change.
- All seven workers noted that automation made their job physically easier.
- Four of seven workers noted that the introduction of automation made their job safer, with three noting that it did not change their safety at work.

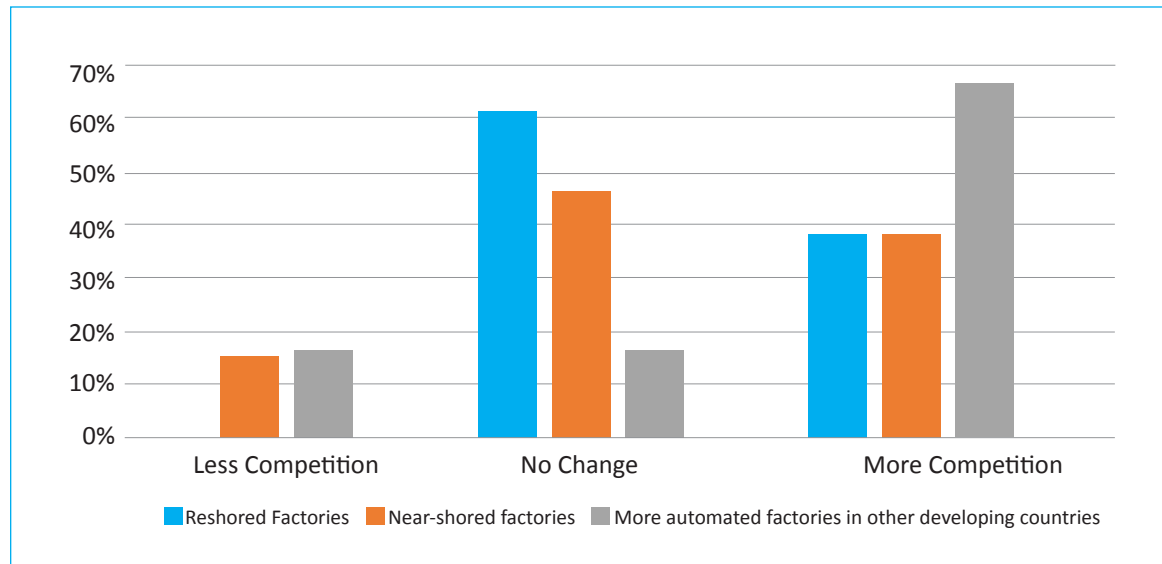
Wages for workers that use automatic machines can be, but are not always higher than wages for workers on manual machines. Worker wages depend heavily on skill and productivity levels, and how those are enhanced or degraded by automation. One factory that automated printing and cutting reduced the number of workers in that department, however the workers that remained were paid more, due to their higher level of skills and productivity (Interview 01, 2019). However, another factory that automated some machines said they did not pay a higher salary because the automation machine only requires the worker to do a simple movement, like pressing the machine down (Interview 14, 2019). Of the seven workers from the survey that had experienced a change to automation, six noted that their incomes had increased.

While there are potential gender-related risks for women because of factory automation, the survey was not able to capture evidence of their existence in Myanmar. There is concern that as garment factories automate, women will not have the same level of access to the higher skilled jobs that require technical and information technology (IT) skills. However, the survey yielded only 7 responses, which is not enough to make any conclusions about the gender implications of automation. According to a recent study by the ILO, gender stereotypes play a role in shaping the workplace experiences of both men and women. Notably it found that women are “denied opportunities to work in certain roles in the factories, especially...work with machinery” (LaPlonge 2019). One employer interviewed for this research provide a converse example. When the factory adopted an automated ironing system, they moved all of the male workers to other departments and replaced them with female workers because the male workers would press the machines too hard and damage garments (Interview 01, 2019). The assignment of jobs based on stereotypes perpetuates workplace discrimination, and suggests that additional training and education to combat stereotypes are needed to mitigate the impacts of technological change on women.

Factories in Myanmar think automation is contributing to structural change in the garment sector. Notably, the area where the greatest share of factories cited increased competition is with more automated factories in other developing countries. This suggests that at present, technological

change is not yet significant enough to drive a structural change in where garments are being produced. However, there is significant speculation that reshoring, or the return of production to destination countries, and near-shoring, or the return of production to countries near destination markets, may be increasingly important in the future.

Figure 5. Change in competition level in last three years



Nearshoring and reshoring will reshape the industry gradually, but in the next three years the implications of these facilities will be limited. A 2019 McKinsey survey of executives found that 60 percent of apparel procurement executives expect that over 20 percent of their sourcing volume will be from nearshore markets by 2025 (McKinsey & Company 2019, p. 84). While notable, this is a fairly small proportion of overall production. It also does not help estimate the speed at which nearshoring is taking place, as many nearshored hubs have long had some level of production. However, this indicates support for the overall trend of nearshoring and diversification away from low-wage Asian producers.

Reshoring remains expensive, and though it is beginning to become competitive in certain cases, it will not have a significant effect in the next three years. While costs vary between brands and factories, a 2018 McKinsey report estimated the relative costs of apparel production in a number of Asian, reshored and nearshored markets in North America and Europe. The report found that nearshoring production to Mexico was already cost competitive with production in China and Bangladesh, once all costs were included. This does not include any benefit that may come from reduced time to market. For Europe, nearshored production in Turkey was less expensive than China, but still not cost competitive with Bangladesh. Notably, there was a significant difference in the cost of reshored production between the United States and Germany. While reshored production in the USA was only 17 per cent more expensive than China, in Germany the costs were 144 per cent higher (McKinsey & Company 2019, p. 10).¹⁰ This is notable because it shows that the economics of reshoring are not homogenous amongst all major destination markets. The report also concluded that despite technological progress, “not even the rapid adoption of automation is likely to prompt the largescale return of apparel manufacturing to American shores” (McKinsey & Company 2018, p. 33).

¹⁰ The driver of higher costs in Germany compared to the United States was not detailed in the report, but likely due to proximity to raw materials (the US is a major producer of cotton while Germany is not), difference in wages (the minimum wage in the US is \$7.25 an hour, while in Germany it is €9.19 an hour, or approximately \$10.18 in US dollars), and differences in electricity costs.

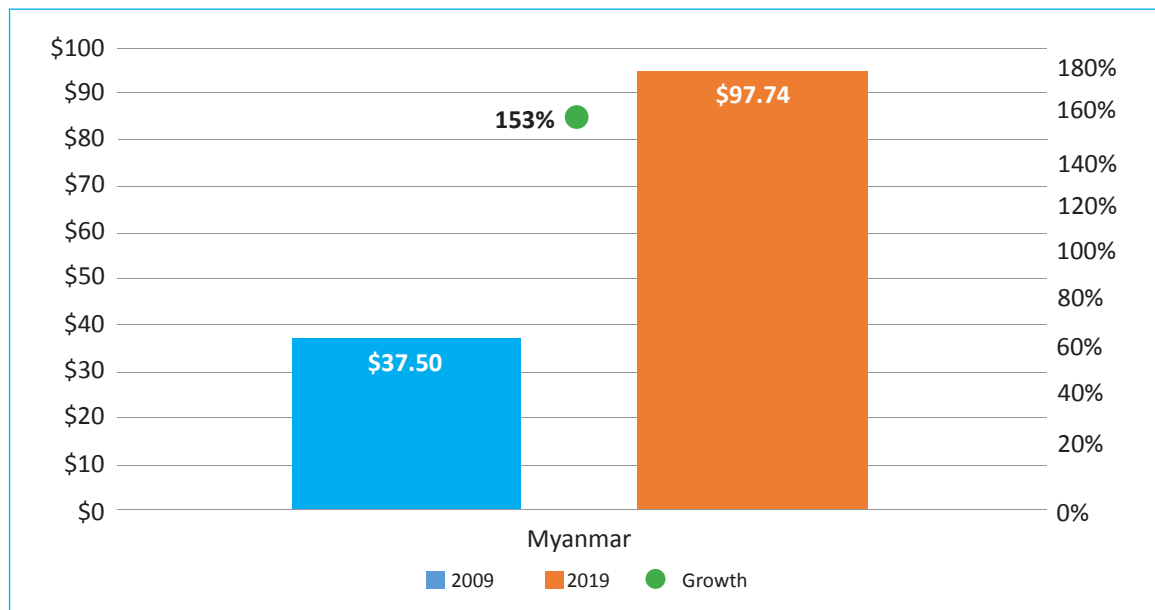
The Drivers of Automation and Digitization in Myanmar

Relative costs of capital and labor

One of the most important drivers of automation has been the relative changes in the costs of capital and labor. In the last twenty years, labor costs have increased significantly while costs to automate many parts of garment factories have decreased significantly. This has caused a dramatic shift in the relative costs of these two vital inputs to production.

Wages have increased significantly in Myanmar in the last ten years as they have elsewhere in Asia. While reliable wage data from labor force surveys is absent before 2015, growth in Myanmar’s minimum wages provides evidence of labor cost growth. In 2009, Myanmar’s minimum wage was approximately US \$38 per month. In 2019, the minimum wage was approximately \$95 per month (the wage was last adjusted in 2017 to 144,000 kyat per month, or 4,800 kyat per day for 30 days a month). In local currency terms, growth in the minimum wage has been even more significant, though these gains have been offset by inflation and currency depreciation. Other countries in the region have also experienced growth in both average and minimum wages. In China, the world’s largest garment exporter, average wages have risen from 32,736 yuan per year in 2009 to 82,461 yuan per year in 2018 (Trading Economics 2019). From 2009 to 2019, minimum wages in Bangladesh have risen by 298 per cent, from approximately \$24 to \$95, while in Cambodia they have risen from \$50 to \$182, an increase of 264 per cent.

Figure 6. Minimum Wages in Myanmar in 2009 and 2019, \$US equivalent



Wages in Myanmar will continue to rise, though they remain low in comparison to other countries in Asia. Despite recent increases, Myanmar’s current minimum wage level is tied with Bangladesh for the lowest minimum wage in the region. Given Myanmar’s continued inflation, which is projected to reach 8.4 per cent in the 2018-2019 fiscal year, it is likely that the country’s

minimum wage will continue to grow (Nan Lwin 2019). Ongoing wage campaigns by trade unions and labor activists, as well as political factors such as the 2020 election, may also affect minimum wage growth. Employers similarly expect continued growth, with one factory owner noting that they “expect every two years that the minimum wage will increase” (Interview 01, 2019; Interview 06, 2019). These expectations will play an important role in shaping the investment decisions that factories make.

The costs of key technologies that help automate and digitize garment production has decreased significantly over the same time period. A semi-automatic sewing machine with auto-trimming costs approximately \$300 now, in comparison to twenty years ago when it would have cost \$1000 (Interview 04, 2019). A factory that recently invested in an automatic hanger system noted that the price had dropped nearly 75 per cent since they first started considering the product. Another factory which invested in an automatic fabric spreader noted that it costs one third of what it would have ten years ago. According to factories interviewed for this research, prices of automated machines for garment production are in the following ranges:

- Automatic fabric spreader - \$8,000 and \$16,800
- Automatic fabric cutter - \$80,000 to \$120,000
- Automatic hanger system/conveyor belt - \$40,000 to 60,000
- Automatic sewing machine - \$500 to \$6882
- Automatic specialty sewing machine - \$500 to \$5800
- Automatic ironing/pressing machine - \$4000
- Automatic knitting machine - \$27,000¹¹

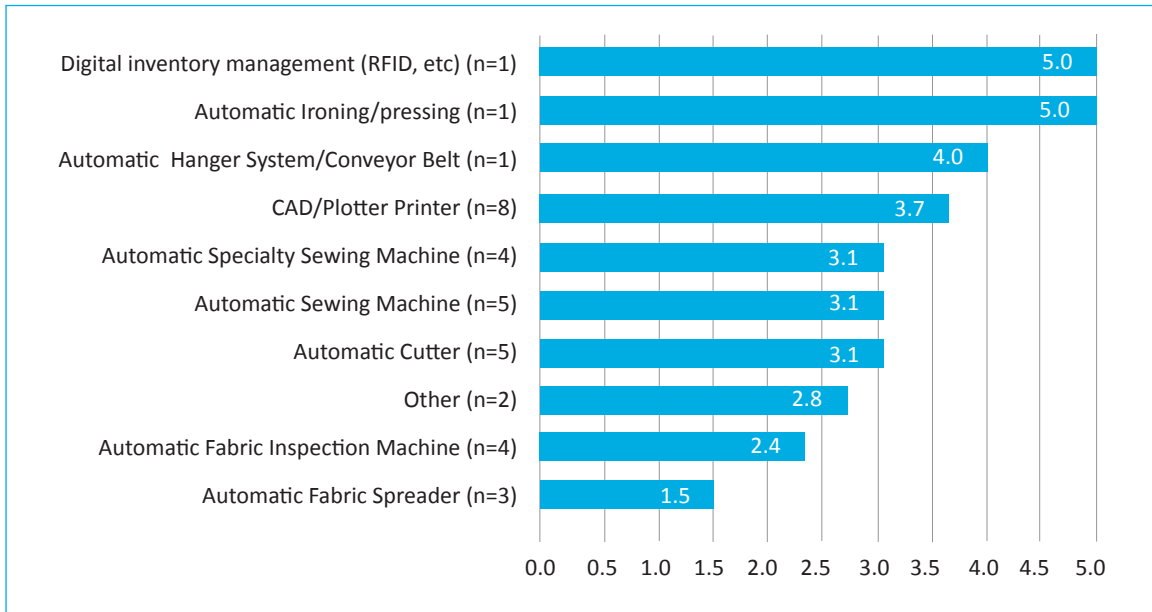
Despite cost reductions, automated lines at garment factories remain more expensive than manual lines. One industry source noted that they could be three times as expensive as a manual line. With these prices, automating even a single line can cost \$100,000, and often more. Automating a medium sized factory would almost certainly cost a million dollars. These cost barriers are significant, and are part of the cost-benefit analysis that many employers make before deciding to invest. While this calculation is different for each factory, one industry source noted that for many factories in Myanmar, “the benefits are still more tilted towards manual production because labor costs are still low” (Interview 01, 2019).

Quickly falling prices for automatic and semi-automatic machines have given garment factories new investment options, many of which require only a few years for the investment to pay off. Almost all of the automatic machines in which businesses were investing had a payoff period (the amount of time it takes to recover the cost of an investment) of five years or less. Some machines had payoff periods that were even shorter than this. For example, the three factories that invested in automatic spreading machines noted that the average payoff period for these investments was only 1.5 years. The one type of investment that had a significantly longer payoff period was automatic knitting machines (not included in table above, because these machines are used by factories producing knitted goods).¹² The one factory that had invested in these machines noted a payoff period of twenty years. The investment with the best return depends heavily on the individual factory, and there is significant variation between them.

¹¹ Variation in prices may be due to factories purchasing machines with different levels of quality, from different countries of origin, or with different degrees of automation.

¹² It is not clear why this payoff period varied so significantly from all of the other payoff periods noted by other factories for different technologies. As this is based on information from only one factory, it should be taken with a significant degree of caution. The data on automatic knitting machines is not included in the table because only one respondent factory produced knitted goods, while all other factories were CMP factories. This could give the incorrect impression that automatic knitting machines were not being adopted by most factories, when in actuality most factories in Myanmar are not engaged in production of knitted goods.

Figure 7. Years for 100 per cent Return on Investment

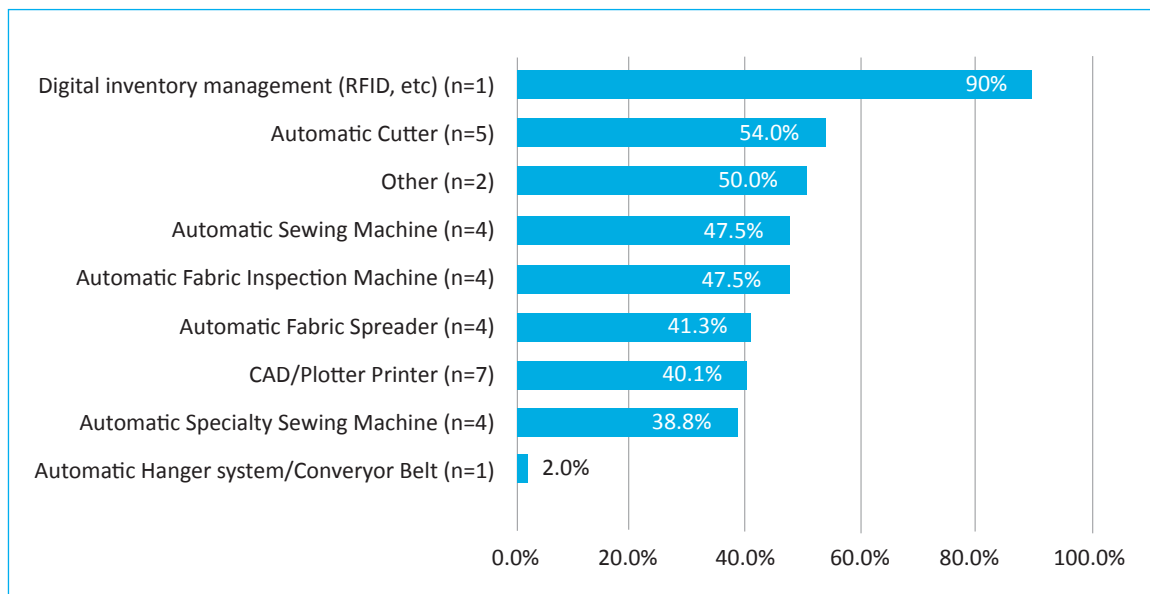


Businesses planning to make new investments in technology in the next three years noted that they expected quick payoff periods. All of the factories anticipated that they would earn back their investment in four years or less, with the exception of automatic knitting machines. The one knitting factory that anticipated investing in these machines in the next three years anticipated that they would earn back their investment in ten years.

Productivity improvements

One of the most important benefits of automation and digitization is the resulting increased productivity, both at the level of the individual process as well as overall at the enterprise level. The improvements in process-level productivity were significant, with factories noting that they increased productivity of an individual process up to 90 per cent. Interviewees noted that, in many circumstances, automated machines helped complete processes more quickly. One factory noted that their button auto-feeder machine helped make that process 25 per cent faster (Interview 14, 2019). Another noted that the auto spreader reduced the amount of time needed for spreading by half. A third industry source noted that their pocket machine could complete the stitching in 20 seconds – far quicker than what even the best manual operator could do. Lastly, automated machines can run 24 hours a day, seven days a week, allowing factories to be productive at times that previously were not possible.

Figure 8. Percentage Increase in Productivity



The improvements in factory level productivity differ significantly between businesses, as it is influenced by business-specific factors. For example, businesses with very poor old systems would see much greater productivity gains than factories with somewhat sophisticated systems. While one factory in the survey noted that automatic hanger systems/conveyor belts increased productivity of the line by 2 per cent, another factory that adopted automatic hangers noted that they increased productivity of the line by 100 per cent. This factory was previously losing significant time because workers on the production line were constantly bundling and unbundling, and having to match sizes and numbering. These time consuming steps were no longer needed because of the automatic hanger system (Interview 13, 2019). However, one industry source noted that productivity measures in Myanmar are still somewhat unreliable. While some factories had standard allowed minute calculations for garments, they were sometimes inaccurate. Because of this, factories could struggle to determine exactly how much new machines are adding to productivity (Interview 05, 2019).

Reduced dependence on labor and labor costs

Automation can enable businesses to reduce their dependence on labor and labor costs. Automation often needs significantly fewer workers than does manual production. For example, automatic fabric spreaders require only two workers to load the fabric, reducing the total number of workers needed for the process from twelve to two (Interview 06, 2019). Sewing machines with automatic trimming allow factories to operate production lines with fewer trimmers. Previously, a factory may have had 20 thread trimmers per line. Now using the auto trimming sewing machine, they only need twelve (Interview 14, 2019). For pocket making machines, one machine can serve 3 lines, reducing the number of people required from five to one. According to one factory, automatic spreaders reduced labor costs associated with that process significantly – by 80 per cent (Interview 06, 2019). Some factories have also reported that machines enable them to reduce total working hours, and eliminate overtime (Interview 06, 2019).

The reduction in labor also reduces indirect costs of employment for businesses. For example, businesses spend less on other direct costs, such as canteen space, food, and transportation to and from the factory. Taxes and contributions, such as social security board contributions that factories are required to make, also fall (Interview 14, 2019). Lastly, it can reduce total costs of human resources administration at the enterprise (Interview 03, 2019).

Some managers believe that automation reduces exposure to risks associated with poor industrial relations. Industry sources noted that employers who have largely manual production processes think that they are more vulnerable to worker demands. For example, when a factory needs to meet a strict production schedule, the “union might use that as a bargaining chip. Factories understand that, and automation can help them reduce that exposure, including the risk of strikes (Interview 01, 2019; Interview 03, 2019). One factory owner summarized it succinctly, stating that “automation puts workers in a tough position. Now workers have a strong position. There is high level of migration (out of Myanmar), so it is difficult to find people who can do skilled operations like making a collar. However, if the factory has an automated machine, then you don’t need a skilled person. That will take pressure off factories to meet workers’ demands” (Interview 13, 2019).

Reduced overheads and wastage

Beyond simple productivity improvements, automation and digitization can reduce costs in other ways, such as reducing overheads. Technology helps to reduce the amount of square feet needed to produce a certain volume of garments. This is partially due to the ability of many machines to reduce the overall number of workers in a facility, helping to reduce congestion and space required in the work place. This is especially important in Myanmar, where factory rental costs can be expensive (Interview 14, 2019).

Automation can also lower costs by reducing waste and improving the efficiency of resource use. For example, one factory that introduced automatic spreaders noted that they reduced waste. Another factory noted that their investment in auto-markers for cutting reduced material utilization by 5 per cent. These reductions help to cut costs elsewhere in the factory, adding to the benefits and shortening the total payoff time for these investments.

Improved quality

Introducing automation at various steps of the production process can help improve quality and reduce defects. As the global garment industry continues to grow more competitive, factories are being forced to continually improve product quality in order to attract orders and stay competitive (Interview 01, 2019). For some factories, improving product quality was the primary reason that they invested in automation (Interview 06, 2019). This is certainly the case in Myanmar, where some factories experience very high defect rates – up to 40 per cent. Correcting this level of defects means that factories may spend more time repairing garments than producing them, a costly proposition (Interview 03, 2019). Technology also provides additional transparency that helps factories monitor and improve quality. As one factory noted, “Sometimes workers try to hide mistakes but machines do not do that. The auto cutter inspects to make sure it is cut correctly” (Interview 06, 2019). While investment decisions are ultimately decided by the factory, buyers and

brands sometimes encourage suppliers to invest in various types of automation, in part to increase the quality of garments received (Interview 01, 2019).

Improved management and data collection capacity

Automation and digitization can help factories gather more information on the production process, and use that information to make more informed decisions. Technologies such as RFID allow factories to track the flow of pieces through the production process. This provides real-time information on progress towards production targets, as well as information needed to identify and alleviate bottlenecks. One industry source noted that some technologies, such as RFID, do not have any impact on labor. They are designed to help management improve efficiency (Interview 12, 2019). However, tools that allow management to monitor production do create new avenues of accountability for workers, because their production is tracked more precisely.

The Impediments for Automation in Myanmar

Industry trends

Globally, there are many factors that will constrain the adoption of automation in the garment sector. The most fundamental constraint on automation is economic – it is expensive to automate such a large industry in a short period of time. Studies looking at the rate of job losses from automation have cited this, noting that while high rates of job losses are technically feasible, they are not necessarily economically feasible (Acemoglu and Restrepo 2017). Automation of an entire garment factory, even a medium sized facility that introduces only modest levels of automation, can cost over a million dollars, a significant sum for most factories.

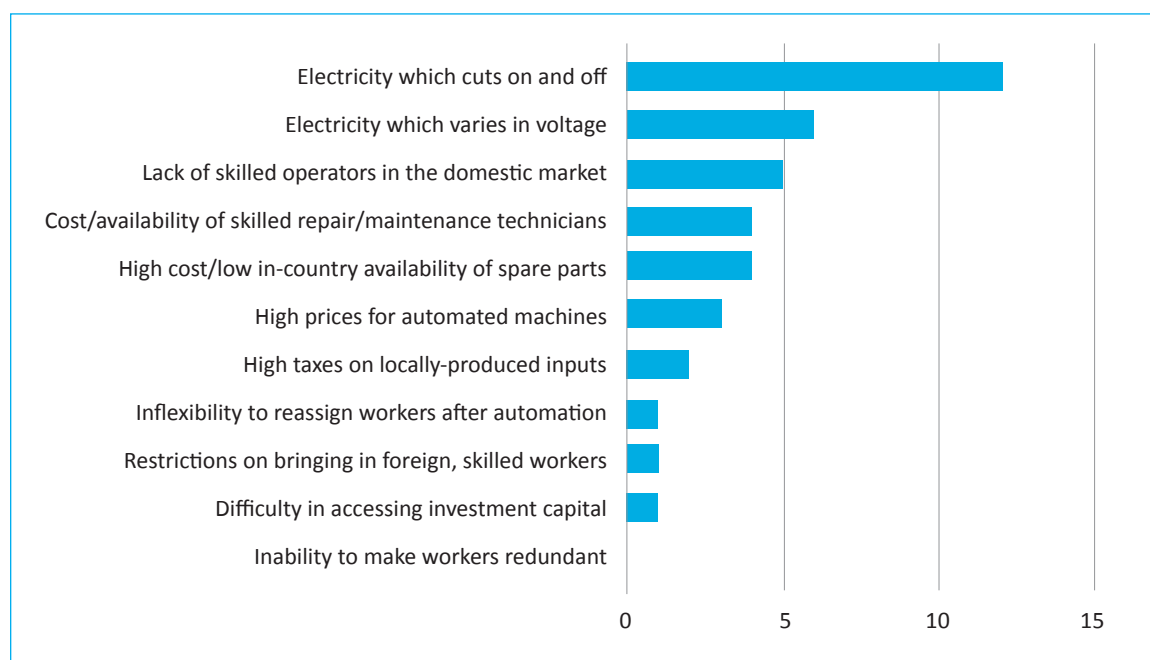
While large and consistent orders give factories the predictability needed to invest, the sector globally is moving towards smaller, short-term orders. Factories that receive a small number of large orders use the same production processes, including the same machines, for much larger production runs. This increases the number of times that a factory can use a machine, helping to bolster the return on investment. This also helps defray the costs associated with reprogramming machines for new production runs. For example, one factory noted that for their automatic pocket setter, they have to make a mold for each design. If the order size is too low, under about 5,000 pieces, it is more cost efficient to sew the pocket manually and forego the mold. It also takes approximately 2 hours to reconfigure the machine for a new order, so they must meet a minimum order size to justify the fixed time and financial costs associated with using the automated machine (Interview 14, 2019). Another factory manager echoed this, noting that “if a factory produces the same thing all year round, it’s easier to invest” (Interview 04, 2019). However, the garment sector is moving towards smaller order sizes, which will create disincentives to invest.

There are technical barriers to automation which, despite recent improvements in technology, will require human skills in some areas of production for decades to come. Many automated technologies have limited functionality, able to perform only one or a small range of tasks. Machines struggle to manipulate fabrics, with their soft and pliable texture, in the same way that they can work with rigid materials like steel. This limits the ability of machines to perform more complex operations. Because of this, skilled human workers will continue to play a vital role in the production of garments for the foreseeable future.

Views of factories in Myanmar

Global industry trends are complemented by a range of Myanmar-specific barriers to automation, including skills and infrastructure challenges. These factors will shape the future trajectory of automation in Myanmar, and heavily influence the future prospects of the garment sector in the country. According to the factories that participated in the survey, the two greatest challenges that they face are related to electricity. “Electricity that cuts on and off” was cited as a top challenge by all but one firm, while “electricity which varies in voltage” was the second most commonly cited challenge. Skills-related challenges were also cited regularly. Notably, labor related legal and other restrictions were relatively low on the list of challenges cited by businesses.

Figure 9. Most Important Challenges for Automation in Myanmar



Electricity

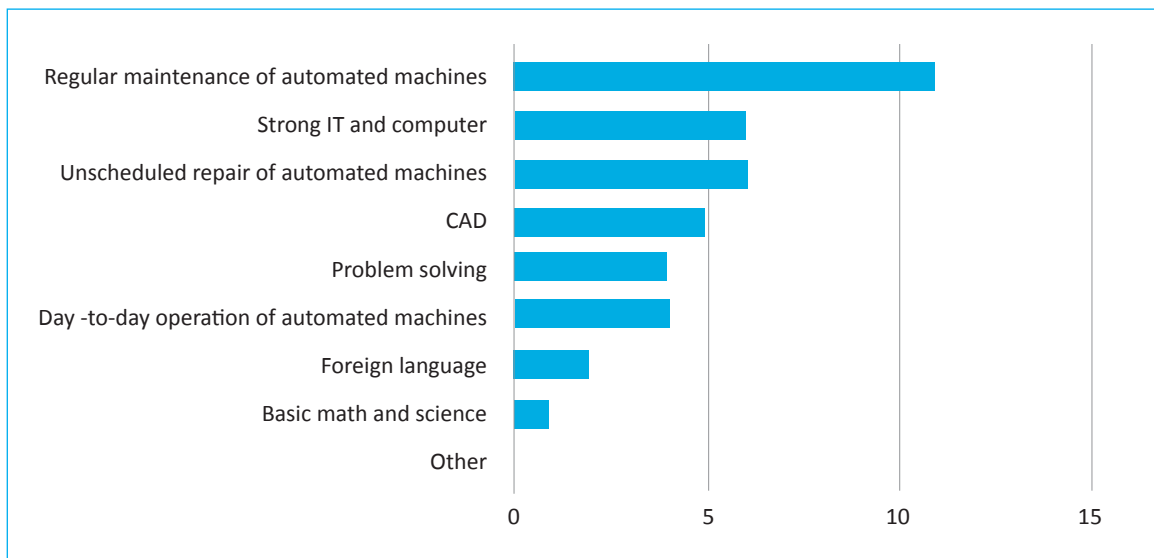
According to surveyed factories, the most important challenge they face is electricity – both an irregular supply and one that is inconsistent in voltage. Factory automation changes the needs of businesses, making them significantly more reliant on electricity which is required to run automated machines. Automatic machines are often quite vulnerable to changes in electricity, so poor supply can have a significantly greater effect on production (Interview 18, 2019). According to industry sources, Myanmar’s poor electricity is a leading reason why it can be difficult for Myanmar to attract foreign investment (Interview 12, 2019). One factory noted that in Myanmar, “electrical stability is not good. The voltage can go up and down. That can cause the machines to break down. Often this is because the microchips have been fried because of the electricity going on and off and voltage changing” (Interview 06, 2019). Businesses can try to respond by installing stabilizers, but these can be expensive and not always 100 per cent effective (Interview 13, 2019). The susceptibility of factories to electricity problems does vary based on the items being produced – one factory noted that blackouts do not cause defects in automated weaving as they might in other types of factories (Interview 04, 2019).

Skills deficits

Another commonly cited challenge that factories face when automating production is the lack of skilled workers. When asked about skills needed for the continued automation of garment factories, maintenance and repair skills were amongst the most often cited. Eleven of thirteen factories said that skills for the “regular maintenance of automated machines” was amongst the top three most important skills needed for continued automation. “Strong IT and computer skills” were cited as the second most important required skill, tied with “unscheduled repair of automated machines.” One industry expert noted that workers in Myanmar were “nowhere near being able to fix very sophisticated machinery” (Interview 03, 2019).

The skills shortages reflect shortcomings in both the general education system as well as the country’s technical and vocational education and training (TVET) system. One industry expert said that Myanmar’s TVET curriculum is “still in the 1980s” (Interview 19, 2019). Another noted the challenges of attracting high quality engineers to the sector, noting that these graduates tend to prefer work in other sectors and not the garment industry (Interview 14, 2019). There are also challenges in helping machine operators to fully utilize all the features of semi-automatic and automatic machines. For example, some factories that have invested in semi-automatic machines have workers that are shutting off some semi-automatic function, switching the machine to manual mode because they have not been properly trained and incentivized to use the machine. This significant reduces the benefits of investment in automated machines (Interview 05, 2019).

Figure 10. Top Three Needed Skills for Continued Automation of Garment Sector (n=13)



Other experts noted that the skills deficits go beyond solely technical and IT skills. For example, one industry expert stated: “What’s lacking here is basic problem solving skills and analytical skills. They just are not taught this in school. People are quick learners but when they first come to training the analytical skills just aren’t here” (Interview 05, 2019). Another issue cited by industry experts is the need for improved supervisory skills. As factories become increasingly automated, management must take on new responsibilities to make sure that machines are used right and that they are providing optimal levels of productivity (Interview 05, 2019). Another challenge noted by one factory was the lack of language skills. They noted that “most of the auto machines are Chinese, making it difficult for Myanmar workers to program and maintain them (Interview 13, 2019).

The shortage of skills is forcing factories in Myanmar to rely on human resources from outside the country. Myanmar can easily access new technologies, but the lack of skills forces factories to look elsewhere for skilled staff to manage them. One organization noted that they were trying to recruit a skilled Myanmar national as a CAD CAM trainer, which took a full year. This type of delay is hugely problematic for private sector, which must look elsewhere for skills. An industry source noted that many Chinese factories are bringing in skilled people from China (Interview 05, 2019).

Cost and availability of repair services

The limited availability and high cost of machine maintenance and repair, which is directly linked to skills deficits, is another factor that can constrain automation in Myanmar. According to industry sources, many of the machines come with a limited maintenance contract, and after that factories are liable to pay for repairs. This includes both the cost of labor and parts. Multiple factories noted that these can be expensive (Interview 06, 2019; Interview 14, 2019). There is also some variation between companies that produce automatic machines for the garment sector. One industry source noted that a few Chinese machine suppliers had mechanics that could service machines, but for some German and Italian suppliers, service was not available in Myanmar (Interview 13, 2019). Those vendors who do have repair services have “pretty significant pricing power” on repairs, according to one factory (Interview 06, 2019).

The biggest driver of the high cost and poor availability of repair services is the lack of skilled technicians in Myanmar. Many of the mechanics in Myanmar have limited knowledge, and are most familiar with older machines. This gives factories few choices regarding in-house or third party repairs, forcing them to use repair services offered by the vendors from whom machines were purchased” (Interview 06, 2019). The lack of skilled technicians can also contribute to delays in machine repair, extending downtime and increasing losses for the factory. Because of this, industry sources believe that foreign technicians will play an important role in the country for the foreseeable future (Interview 19, 2019).

Taxation

Myanmar’s policy framework favors direct importation of machines by factories, which unintentionally hinders the development of a stronger domestic market for machine vendors. As part of the approval process for foreign direct investment, the Myanmar Investment Commission can provide factories with a permit to import machinery duty free for a period of time while the business is being established. However, old factories, which are more likely to be local, cannot get the same tax holiday because their business is already established. They must either buy locally or directly import, but either channel requires payment of taxes, including “5 per cent commercial tax, 2 per cent customs duty and some under the table payments worth 1 per cent -2 per cent” (Interview 06, 2019). The tax holiday for new factories combined with the tax regime for old factories or suppliers not only distorts competition, but also decreases the local market for these machines (Interview 06, 2019). This is a key reason for the underdevelopment of the garment vendor market in Myanmar.

Myanmar’s policy framework also restricts the development of suppliers, whose presence could help bolster sector-wide stability and increase incentives to invest in automation. At present, most raw materials are imported. This is because of a policy framework that incentivizes businesses to bring in fabric (or other inputs) and then cut it and export it. These activities do not incur any tax obligations. However, if a factory buys fabric locally and then uses it to produce exported garments, it could incur a 24 per cent tax (Interview 12, 2019). This disincentivizes local sourcing, which significantly reduces the market for tier 2 suppliers whose presence could help create a more stable and competitive garment sector.

Lastly, Myanmar's weak enforcement of transfer pricing rules hinders revenue collection, and therefore the development of public goods and services needed to develop the sector. Transfer pricing refers to the way that prices are determined for transactions between different enterprises under common ownership. The purpose of transfer pricing rules is to ensure that the profits of a business are allocated based on the country where the economic activity is performed. This allows national governments to properly tax this economic activity. In Myanmar, many companies arrange orders and receive payments offshore, sending only enough money to Myanmar to cover factory expenses. Myanmar's government must increase scrutiny of these practices because they significantly diminish tax revenue. These public funds are needed to support investment in skills development and business environment improvements

Labor legislation and enforcement

Myanmar's labor legislation and enforcement can discourage automation and digitization when it does not contribute to a clear and consistent business environment. Labor laws should ensure that basic rights of workers are protected, that compensation is adequate and work is safe. However it must also help promote the country's competitiveness and productivity through providing clarity, consistency, and some flexibility for businesses. For example, Myanmar currently has restrictions on multiple shifts, allowing some factories to have them while others are restricted because they have not obtained government permission. For example, one factory that invested in printing machines recently petitioned the government to have split shifts for one department of about 50 workers, so that they can alleviate a bottleneck at their production process. However, the government did not approve the petition, despite agreement from the workers who would receive extra money for the second shift (Interview 01, 2019). This type of arbitrary decision-making is a significant barrier to investment and competitiveness, while also a disincentive to worker-employer dialogue. Another challenge to automation is the lack of flexibility to temporarily or permanently move workers to other roles in the factory, with conditions such as no erosion in pay and benefits and not in retaliation for a worker's actions. One industry source noted that businesses sometimes face workers who refuse to work in other departments when needed (Interview 12, 2019).

The Future of Automation and Digitization in the Myanmar Garment Sector

The prospects for Myanmar's garment sector

As factories continue to invest in automation, garment production in Myanmar will become less labor intensive and more dependent on capital. While this will lead to lower levels of job creation, productivity per worker will grow, as will average incomes. The overall growth in employment levels in the sector will depend on a number of countervailing factors.

Many businesses have plans to continue to invest in automation and digitization in the coming years. In a factory survey, 12 of 13 interviewed factories planned to make some investment in automation or digitization. Among these businesses, 6 factories noted that they planned to invest in some type of specialty sewing machine. Five factories planned to invest in either CAD/plotter printers or automatic cutters. Notably, none of the factories surveyed planned to invest in automatic hanger systems or conveyor belts. This is surprising given the important role that they play in both data collection and improving factory efficiency. However, these results should not be taken as representative of the Myanmar garment sector as a whole.

Table 3. Factory Plans for Investment in Automation, next three years

Type of technology	Number of factories
Automatic specialty sewing machine	6
CAD/Plotter printer	5
Automatic cutter	5
Automatic fabric spreader	4
Automatic sewing machine	3
Other	1
Digital inventory management (RFID, etc.)	1
Automatic ironing/pressing	1
Automatic knitting machine	1
Automatic screen printing	1
Automatic fabric inspection machine	0
Automatic hanger system/conveyor belt	0

Note: n=13 factories

Existing factories plan to reduce the number of workers on staff in the next three years. Of the thirteen factories that completed a survey, seven plan to have fewer employees in three years than they do today. Five plans to have more and one anticipates having the same number. The average change in number of employees amongst the 13 factories surveyed was a reduction of 10.3 per cent. However, the data suggests that the planned job reductions are concentrated at a small number of factories. Two large factories, with approximately 1500 workers, both plan to reduce their workforce by at least 80 per cent in the next three years. Many other factories plan only minor changes, either positive or negative, to the size of their workforce.

New factories will continue to come to Myanmar, creating additional jobs. The best leading indicator of growth in the number of garment manufacturers entering the market is through investment approvals by the Myanmar Investment Commission (MIC). However, in 2018 the power to approve investments under \$5 million was delegated to state and region investment committees. Because many garment factories fall under the \$5 million threshold, their applications would no longer go through MIC. This makes it difficult to track the total number of factories investing, because most of the state/region investment commissions do not publish data on endorsed investment by type. The limited data from the MIC shows that three new garment factory investments have been approved between January and August 2019. According to investment applications, these three investments plan to create a total of 2,062 jobs when open. This level is significantly lower than previous years, but is not directly comparable because of changes in the investment approval process.

Despite the challenges, Myanmar is comparatively well positioned compared to some other countries in the region. Countries such as China are more susceptible to job losses driven by automation in garment manufacturing. The reason for this is because Myanmar will continue to be a lower cost country over the near term, whereas automation is more likely in higher cost countries. Because of Myanmar's lower wages and skills levels, businesses with factories across many countries will likely introduce automation elsewhere before they do so in Myanmar. Lower labor costs will also enable factories in Myanmar to compete with more automated factories elsewhere, though with obvious negative implications for upward growth in wages. Myanmar will also benefit from wage growth and trade uncertainty elsewhere, which will continue to provide tailwinds for the Myanmar garment industry.



Conclusion

Technology is essential for Myanmar to move up value chains, increase wages and improve working conditions in the garment sector. While one of Myanmar's key strengths in the near term is its low costs, social partners aspire to move past being a "low cost" garment production hub. The reference to low cost is often synonymous with low quality and low wages, because labor costs make up a significant share of costs in the production process. However, in the long run Myanmar is aiming to move from low cost to good value to high end. This transformation is not possible without the introduction and effective utilization of automation, in combination with an increasingly skilled workforce. However, these changes will inevitably change the nature and distribution of jobs, leading to some redundancies during the transition.

Automation in the Myanmar garment sector is limited but growing. Almost all garment factories surveyed have invested in some type of automation for their factory, but this is often done for only a small part of the production process. A survey in Myanmar found that in the last three years, nearly 70 per cent of surveyed factories had adopted new technologies in pre-production, such as digital plotter printers or computer aided design. Nearly half had introduced either automatic spreading or cutting. About 40 per cent of factories had also adopted some type of semi-automatic or automatic sewing machines.

The majority of workers already use technology at work that is either semi-automatic or automatic. Of the 260 workers surveyed, 131 reported that machine they use most often is 'semi-automatic', while another 9 noted it was 'automatic'. Notably, there were not clear trends for either the gender or education of workers who reported using more advanced equipment at work. Despite these high numbers, only a small share of workers (about 4 per cent) have directly experienced a change in the digitization or automation of their work. These workers generally noted positive experiences with technological change. Most workers received training and higher pay, and all of the workers noted that automation made their jobs easier. More than half also noted that automation made their workplace safer.

While almost all businesses plan to continue investing in automation and digitization in the coming years, the effects of these investments on employment vary significantly. Almost all factories that completed the survey planned to make some new investment in automation or digitization in the next three years. While most factories planned to keep future employment levels close to 2019 levels, two large factories noted that they planned to automate and reduce their workforce by approximately 80 per cent.

Skills development is vital to both the long-term success of the Myanmar garment industry and the continued improvements in wages and working conditions for Myanmar's workers. Skills needs are changing in multiple ways. First, as basic sewing tasks are automated, the remaining manual sewing will be increasingly complex and require greater manual skills. Second, the sewing work that is automated will require oversight by managers and technicians with more advanced skills (especially IT skills). It will also create demand for more highly skilled repair and maintenance workers. Developing skills in these areas is key to making sure that workers continue to benefit from the automation and digitization of the garment sector. These skills areas should be a focus for Myanmar's garment industry over the long run.

Recommendations

Skills Development

Industry bodies and workers must take the lead role in designing skills development structures and programs, with delivery focused on in-factory training. Because workers and employers are aware of and implementing cutting edge technology, they are best placed to determine skills needs and implement trainings.

Partnerships between training schools and private sector must be developed in order for skills training programs to access new technologies. Automated machines are often too expensive to be purchased only for training. As such, partnerships could be developed with factories or machine suppliers to provide access to machines during periods when they are not in use. For example, a factory that has a single shift in its cutting room from 9 a.m. to 5 p.m. could become part of a partnership that would allow training for students from government technical schools to be conducted on its machines before or after the regular workday.

Skills certifications could be integrated into training, though they must accurately reflect job-relevant skills needed by employers. Skills certification could be beneficial for both employers and trade unions if they accurately reflect skills levels. Certifications are strongly supported by trade unions, who hope they can help workers achieve higher pay (Interview 11, 2019). Skills certificates could be integrated into training programs, however they must be accompanied by feedback mechanisms to ensure that certifications accurately assess skills that are relevant to work. This would require private sector involvement in the process, though only to a limited extent that guarantees the rigor of certifications. The certification process must remain transparent and based on objective skills.

The government should focus on improving the legal and policy environment to incentivize training, because its track record of training delivery is not strong. Key parts of the legal framework, such as the TVET law or the Employment and Skills Development Rules, should be reviewed and finalized (Interview 15, 2019). Among the areas for focus is the Employment and Skills Development Fund. This fund should be primarily used to support or incentivize in-factory or other training programs delivered by private (profit or non-profit) sector or other organizations. This approach is supported by the ILO's Multinational Enterprise Declaration, which notes that training programs should be "jointly administered by the parties (workers, employers and government) which support them" (International Labor Organization 2017).

The government should ensure that proper incentives for training and technological adoption are developed. Many factories provide limited training to workers for reasons include lack of worker capacity and lack of trust. Factories are afraid that they will lose workers after they train them, so they simply do not train them (Interview 05). To overcome this disincentive to training, incentive programs such as tax credits, grants, matching funds, tuition credits (or reductions), or limited duration wage reimbursements by government funds should be employed. Specific incentive programs could be designed to focus on companies that were experiencing technological change (Virginia Economic Development Partnership 2019). These types of programs could be funded out of the Employment and Skills Development Fund. Proper verification would be needed, and would require input from both organized workers and employers to ensure that training was implemented as required.

Incentive structures could also help encourage technological adoption at the workplace. Previous research has shown that workers can be reluctant to adopt technology if it means a short-term drop in pay, even if they will benefit in the long term (Atkins et al 2017). Employers could further study this issue and develop guidance for factories about how to ensure workers have the appropriate incentives to adopt technology.

International partnerships and other avenues of international exchange should be developed and supported. A number of factories in Myanmar are already sending workers overseas for internship programs. A number of Chinese factories have done this, sending Myanmar staff to China to spend 2-3 months so that they can develop skills. One program recently sent 20 people (Interview 19, 2019). These types of international programs are vital to increasing skills and exposure, and the government should look for tools to further support these types of exchanges, especially when some private businesses are already doing them without any outside support.

The development of technical skills must be complemented with workforce education initiatives that help develop other skills. Soft skills and problem solving skills have already been identified as key areas for improvement. Industry sources note that there are needs for additional education about rights and responsibilities at the workplace.

Business Environment

Reforms are needed to the business environment in areas such as electricity. Myanmar is currently engaged in a wide range of reforms and investments to improve electricity infrastructure, the details of which are far beyond the scope of this report. However, steps could be taken to alleviate the near-term challenges, such as improved transparency and providing advanced notice of power cuts, allowing them to properly program machines (Interview 12, 2019). Businesses could also be more proactive by exploring alternatives to the electric grid, such as installation of solar panels at factories.

Removing unnecessary red tape would reduce costs faced by businesses, increasing the space for increased investment, more responsive minimum wage increases, and a more sustainable sector. Specific attention should be paid to administrative directives, notifications, etc. that create minor obstacles for firms, but are easily changed. The cumulative impact of these regulations can be significant.

Myanmar should review its taxation system to eliminate policies that unnecessarily hinder development of garment sector value chains. Specifically, the tax on locally produced inputs discourages development of local input suppliers. This could be dealt with through the development of bonded warehouses, which are currently under consideration (Interview 12, 2019). The government could also consider reducing or removing tariffs on machinery, including specific HS codes relevant to garment production. It should also consider steps to address the inconsistent treatment between new factories that can import machinery duty-free (under MIC permits) and existing factories that are unable to do this.

The Myanmar government should urgently review its approach to regulation of transfer pricing, to ensure that factories are paying appropriate amounts of tax in Myanmar. This issue will increase in importance as factories become more automated, and need to send a smaller share of revenues to Myanmar to cover operating expenses. The government should also review whether brand

buying practices facilitate transfer mispricing. A review of these practices should be undertaken to give the government a clear understanding of the financial workings of garment value chains, and Myanmar's role in those value chains. This report should include recommendations for ways that brands can improve transparency of their buying.

Social Dialogue

Employer capacity should be developed to manage the transition to more automated factories. Specifically, employers could be assisted to improve social dialogue and consultation with workers before, during and after the introduction of automation. They may also benefit from specific assistance on labor law requirements regarding redundancy and internal transfer.

Factory level dialogue on automation should be encouraged and supported by government, social partners, international organizations and nongovernmental organizations. Social dialogue is a vital tool for addressing change at the workplace in many countries. In Germany, for example, workers prioritized working conditions over wages, winning increased flexibility while meeting employers lower personnel needs. In Myanmar, however, experience and trust between workers and employers is not at the same levels as in Germany, which can make dialogue about challenging issues harder. As a first step, employers and workers should consider enhanced information exchange at the factory level. This should include competitive pressures facing employers. It should also include information sharing about the safety and other benefits of automation. Employers should ideally strive to openly discuss factory automation plans with workers, who should ideally respond with a good faith effort to find a mutually-acceptable agreement about the changes at the factory.

For example, MGMA could share information with union leaders about the various types of automation and their return on investment. They could also share information on changing sector dynamics, such as decreases in order size, reductions in lead times, or increased quality demands. This type of information could help union leaders better understand the changing pressures that employers face. MGMA could also share information about the various benefits of automation, such as improved quality, predictability, and occupational safety and health. This may help demonstrate that automation is not simply about cutting labor costs (Interview 09, 2019). At the same time, unions can share worker experiences with automation, which MGMA can then use to help assist employers to manage the introduction of automation and digitization at the workplace.



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Annex 1: Links to Videos of Automated and Digital Technologies in the Garment Sector

- A. Computer Aided Design/plotter printers
(<https://www.youtube.com/watch?v=Yq0REVoJTtc>, <https://www.youtube.com/watch?v=GXVgVy9X0w8>, <https://www.youtube.com/watch?v=ZsV1cGp-8Wk>)
- B. Automatic Fabric Spreaders
(<https://www.youtube.com/watch?v=xUNzlgMlgtU>)
- C. Automatic Cutters
(<https://www.youtube.com/watch?v=Yht03YyNQWY>)
- D. Automatic Hanger System/Conveyor Belt
(https://www.youtube.com/watch?v=RuwV_gDWZlQ, <https://www.youtube.com/watch?v=oTgu6lFDaX8>)
- E. Automatic sewing machine
(<https://www.youtube.com/watch?v=LiSfHevTIEE>)
- F. “Sewbot”
(<https://www.youtube.com/watch?v=qXFUqCijkUs>)
- G. Automatic specialty sewing machine (such as):
 - o Automatic pocket setting machine:
<https://www.youtube.com/watch?v=Xh6s91kONMY>
 - o Automatic bartack machine:
<https://www.youtube.com/watch?v=3R6xzEMFK2k>
 - o Automatic button hole machine:
<https://www.youtube.com/watch?v=4C-E-bxOajo>
 - o Automatic button attach machine:
<https://www.youtube.com/watch?v=ZlY1YvZYr4E>
- H. Fabric Inspection Machine
(<https://www.youtube.com/watch?v=xfHL3K7pnO8>)
- I. Automatic ironing machine
(https://www.youtube.com/watch?v=sf-X_rleBds)
- J. Automatic knitting machine
(<https://www.youtube.com/watch?v=JxeCSQZ59rc>)
- K. Automatic screen printing machine
(<https://www.youtube.com/watch?v=G8ZVdOrwWoA>)

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- L. Digital inventory management (RFID) system
(<https://www.youtube.com/watch?v=G8ZVdOrwWoA>)
- M. 3D Printing
(<https://www.youtube.com/watch?v=U1c3ODk6ImM>)
- N. Smart Factory
(<https://www.youtube.com/watch?v=uKvN-Fx1bYM>)
- O. Reshored factory
(<https://youtu.be/0QwPwPqJ0ZM>)
- P. Body scanner
(<https://www.youtube.com/watch?v=jrVjJ9sX8v0>)
- Q. Wearables
(<https://www.youtube.com/watch?v=ZIQjtmr9CUA>)
- R. Clothes sorting for recycling
(<https://www.youtube.com/watch?v=Ye9Q-jzSEuQ>)
- S. Waterless dyeing
(<http://www.dyecoo.com/dyecoo-water-free-dyeing/>)

Annex 2. Employee Survey (Automation)

Introduction for the facilitator to read out loud

Please read this information carefully.

You have been invited to complete this survey because your employer has agreed to participate in research on absenteeism and turnover in your factory. Your participation is voluntary. If you no longer wish to complete this survey, please tell the facilitator.

You can record your answers in private. You do not need to discuss your answers or your participation in this survey with anybody else, including your colleagues and managers.

Your participation in this survey is also anonymous. You are not required to write your name on the answer sheet. The answers you give will be confidential and will only be used for the purpose of our research on respectful workplaces in Myanmar. We encourage you to answer all questions and to be as honest as possible.

The aim of this survey is to learn about how behaviours in your workplace affect you and your ability to work.

The survey should take 30 minutes to complete.

If you have any questions while you are completing this survey, please ask the facilitator for guidance.

Important instructions for completing the answer sheet

- Do not write your name on the answer sheet. This survey is confidential.
- Please record all your answers on the answer sheet using a black pencil (2B) which will be provided.
- Make sure you completely fill the circle and do not use ticks or crosses.
- Use an eraser to remove incorrect answers.
- Try to keep the answer sheet clean and do not make any marks outside of the provided areas.
- Do not fold or crease the answer sheet.
- Clearly mark your answers like in the example below.

<input checked="" type="checkbox"/>	Correct. The circle is completely filled in.
<input type="checkbox"/>	Incorrect. Do not use tick marks.
<input type="checkbox"/>	Incorrect. Do not use cross marks.

If you make a mistake or wish to change your answer, please call the facilitator for assistance.

Prefilled information

i	Date of survey completion	[Enter]
ii	Research code	[Enter]
iii	Facilitator code	[Enter]

Before you start the survey...

1.	Do you agree to participate in this survey?	Yes	a
		No	b
2.	Do you understand the instructions for completing this survey?	Yes	a
		No	b

If you have answered NO to any of these three questions, please tell the facilitator.

Section 1 – About you

3.	What is your gender identity?	Female	a
		Male	b
		Other	c
4.	What is your age group?	18 – 24	a
		25 – 34	b
		35 – 44	c
		45 – 54	d
		55+	e
5.	Where were you born?	Ayeyarwaddy	a
		Bago	b
		Chin	c
		Kachin	d
		Kayah	e
		Kayin	f
		Magway	g
		Mandalay	h
		Mon	i
		Nay Pyi Daw	j
		Rakhine	k
		Sagaing	l
		Shan	m
		Thaninthayi	n
Yangon	o		
	Outside Myanmar	p	
6.	Did you migrate here to work in the garment sector?	Yes	a
		No	b
7.	Do you identify as having a disability?	Yes	a
		No	b
8.	Do you have dependent children under the age of 5 who are living in the same house as you?	Yes	a
		No	b

9.	How many hours each day do you spend on domestic duties, including cooking, cleaning and caring for children or relatives?	Less than 1	a
		1 - 2	b
		2 -3	c
		3 - 4	d
		4 - 5	e
		More than 5	f
10.	What is your marital status?	Married	a
		Single	b
		Divorced	c
		Widowed	d
11.	What is the highest level of formal education you have completed?	None	a
		Primary	b
		Middle	c
		High	d
		University	e

Section 2 – About your current job

12.	Which of these describes your employment status?	Permanent	a
		Casual	b
		Fixed term	c
13.	Which of these describes your position?	Manager	a
		Supervisor	b
		Other	c
14.	How many years have you worked in this factory?	Less than 1	a
		More than 1 but less than 2	b
		More than 2 but less than 3	c
		More than 3 but less than 4	d
		More than 4 but less than 5	e
		More than 5 but less than 10	f
		More than 10	g

Section 3 – About automation and your job

15.	In which department do you work in the factory?	Cutting	a
		Sewing/knitting	b
		Finishing	c
		Other	d
16.	How would you describe the type of machine that you use most often?	Automatic	a
		Semi-Automatic	b
		Manual	c

17.	In the last three years, has the garment factory where you work introduced automation that has affected your work? <i>** Automation is when technologies are used to do a process or procedure with limited assistance from people.</i>	Yes	a
		No	b
		(=> Finish Survey)	
18.	If yes, what type of automation was introduced? (Multiple answers allowed)	Computer aided design (CAD)	a
		Automated fabric spreaders	b
		Automated cutters/laser cutters	c
		Automated hanging systems	d
		Automated or semi-automated sewing machines	e
		Automated specialty sewing machine (pocket setter, label attachment, button sewing, etc.)	f
		Automated fabric inspection machine	g
		Automated ironing machine	h
		Automated knitting machines	i
		Automatic screen printers	j
		Digital inventory management system (RFID)	k
		Another type of automation	l

19.	When the automation was introduced, what happened to your job?	My job continued although the automation changed it in some way (=> Question 20)	a
		My job was not needed any longer, so I moved to a different job in the factory (=> Question 28)	b
		My job was not needed any longer, so I left the factory (=> Question 31)	c
		None of the above (=> Finish Survey)	d

If automation changed your job:

20.	Did you receive training so that you could use the new machine?	Yes	a
		No	b
21.	Does your job now require a different skill level?	More skill	a
		Less skill	b
		Same skill	c
22.	Did the introduction of automation change your total income?	Increased	a
		Decreased	b
		No change	c
23.	Did the introduction of automation change the degree of physical difficulty of your job?	Physically easier	a
		Physically more difficult	b
		No change	c
24.	Did the introduction of automation change the level of safety at your workplace?	Safer	a
		More dangerous	b
		No change	c
25.	Did your managers explain the new technology to you and talk with you about how it would change your job?	Yes	a
		No	b
26.	Which challenges did you face when you started using the new machine? (Check all that apply)	I could not understand the language used in the new machine	a
		The training was not enough	b
		The training was provided in a language I couldn't understand	c

27.	Did you like your job more before the automation was introduced, or after it was introduced?	Before automation	a
		After automation	b
		It is the same	c

If automation resulted in you taking a different job at the factory:

28.	Which of the following best describes your new job?	Higher ranking job (promotion)	a
		Lower ranking job (demotion)	b
		No change	c
29.	Does your new job require a different skill level?	More skill	a
		Less skill	b
		No change	c
30.	Did your total income change when you moved to your new job?	Increased	a
		Decreased	b
		No change	c

If automation resulted in you leaving the factory:

31.	Where did you get a new job?	Garment sector	a
		Another sector	b
		No new job yet	c
32.	Does your new job require a different skill level?	More skill	a
		Less skill	b
		No change	c
33.	Did your total income change when you moved to your new job?	Increased	a
		Decreased	b
		No change	c

**** END OF SURVEY ****

Annex 3: Key Informant Interviews (Automation)

Introduction

Thank you for taking the time to talk to me today. As you know, we are conducting a study on the impacts of automation in your factory. We are trying to better understand the state of automation in Myanmar's garment sector, as well as business plans for new investments and the best ways to help both industry and workers benefit from automation.

I am interested to hear what's happening in your factory and your views on automation. Anything you say will be confidential. I am not recording your name.

Is it okay if I ask you some questions?

Confirm the person's agreement to participate.

Introductory Questions¹³

- How long have you been working here?
- Is this your first job in this kind of role?
- How do you like your work? Is it fun/challenging?

Interview Questions

- *Has this factory made any investments to increase automation of the production process in the last three years?*
 - o *If yes:*
 - *What was the reasons you are investing in these technologies?*
 - *What has been the effect of those investments?*
 - *How did you involve workers and their representatives in selecting and introducing these new technologies?*
 - o *If no:*
 - *Why have you decided not to invest in new technologies?*
- Do you plan to make any new investments to increase automation in the next three years?
 - o *If yes:*
 - *What are the reasons you are investing in these technologies?*
 - *How do you plan to involve workers and their representatives in the selection and introduction of these technologies?*
- *In your view, how competitive is Myanmar as a country from which to buy garments?*
 - o *What are the top priorities for reform that could help improve competitiveness?*

¹³ Introductory questions can be used to start the conversation. They are not part of the research. You do not need to record the interviewee's responses to these questions.

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- *Is this factory part of a larger company that has operations in multiple countries? If yes:*
 - o *What factors influence your decision on where to locate your new technologies?*
 - o *How would you compare Myanmar with other countries that you are considering as a potential location for your new technologies?*

- *As automation increases, what skills are becoming more important?*
 - o *What skills policies/approaches are needed to keep Myanmar's garment sector competitive?*

- *How is automation helping you collect new data on the production process?*

- *Have you noticed any changes in the garment business from the increased use of artificial intelligence, by buyers, brands, competitors, or suppliers?*

Annex 4. Factory Survey (Automation)

You have been invited to complete a survey about automation in garment factories in Myanmar. Your participation in this survey is anonymous. You are not required to write the name of your factory on the survey. The answers you give will be confidential and will only be used for the purpose of our research on automation of workplaces in Myanmar. We encourage you to answer all questions and to be as honest as possible.

The survey should take 20-40 minutes to complete, depending on the level of automation that has been introduced in your factory in the last few years.

This survey should be completed by a key manager such as a Director of Operations or General Manager. Some of the questions relate to specific technologies in department of the factory. If you are unsure of the exact answer, we encourage you to consult with the head of that department or other key manager to obtain the most accurate information.

You have received this factory survey in advance of the visit of our research team. We encourage you to complete as much of the survey as you can before our visit. When our team arrives at the factory, we will review the survey together, answer any questions you may have, and then submit the survey during the team's visit to your factory.

If you have any questions while you are completing this survey, please ask the survey team for guidance.

Section 1 - Information about the company

1.	Factory code	Number box (by enumerator)	
2.	In what year was this factory first established	Number box in Myanmar?	
3.	From which country is the majority ownership of this factory? <i>Select only one</i>	Myanmar	a
		China	b
		Korea	c
		Japan	d
		Other	e
4.	From which country is your top manager? <i>Select only one</i>	Myanmar	a
		China	b
		Korea	c
		Japan	d
		Other	e
5.	What is the education level of your top manager?	Number box	
6.	How many years of experience does your top manager have?	Number box	

Section 2 – Automation investments

7.	Which of the following types of automation has this factory introduced in the last three years? (check all that apply) For EACH answer that is selected, complete a copy of section 2.b. <i>If no answer is selected, skip to Section 3.</i>	Computer aided design (CAD)	a
		Automated fabric spreaders	b
		Automated cutters/laser cutters	c
		Automated hanging systems	d
		Automated or semi-automated sewing machines	e
		Automated specialty sewing machine (pocket setter, bar tack, label attachment, button sewing, etc.)	f
		Automated fabric inspection machine	g
		Automated ironing machine	h
		Automated knitting machines	i
		Automatic screen printers	j
		Digital inventory management system (RFID)	k
		Another type of automation	l

Section 2.b – Specifics of each automation investment (Complete one for EACH investment noted above)

8.	How many units did you purchase?	Number box
9.	What was the average cost of one unit? (US\$ only)	Number box
10.	How many years will it take you to recoup this investment?	Number box
11.	By what percentage has this investment increased productivity?	Percentage box (0-100 per cent only)
12.	How many workers do you need to operate these new machines?	Number box
13.	Because of the introduction of automation, how many workers were moved to another part of the factory?	Number box

14.	Because of the introduction of automation, how many workers were released from the factory?	Number box	
15.	Because of the introduction of automation, how many new workers were hired?	Number box	
16.	What was the primary reason you made this investment?	To increase speed	a
	<i>Select only one</i>	To reduce labor costs	b
		To reduce defect rates	c
		Because it improves occupational health and safety	d
		Because it offered the greatest productivity gains	e
		Because it increases overall factory efficiency	f
		None of the above	g

Section 2.c – Capital for New Investments

17.	Where do you primarily source capital for investment?	Own funds	a
		Myanmar Bank	b
		Foreign Bank	c
		Private fundraising	d
		Other	c
18.	From which country do you primarily source capital?	Text box – 1 line	

Section 3 – Future Investment Plans

19.	Which of the following types of automation does this factory plan to buy in the next three years? (check all that apply) <i>For EACH answer that is selected, complete a copy of section 3.b.</i> <i>If no answer is selected, skip to Section 3.c.</i>	Computer aided design (CAD)	a
		Automated fabric spreaders	b
		Automated cutters/laser cutters	c
		Automated hanging systems	d
		Automated or semi-automated sewing machines	e
		Automated specialty sewing machine (pocket setter, label attachment, button sewing, etc.)	f

		Automated fabric inspection machine	g
		Automated ironing machine	h
		Automated knitting machines	i
		Automatic screen printers	j
		Digital inventory management system (RFID)	k
		Another type of automation	l

Section 3.b – Specifics of future automation investments (*Complete one for EACH investment noted above*)

20.	How many units do you plan to purchase in the next three years?	Number box
21.	What was the average cost of one unit? (US\$ only)	Number box
22.	How many years do you think it will take to recoup this investment?	Number box
23.	How many jobs do you anticipate this investment will replace?	Number box

Section 4 – Investment environment

24.	In the last three years, how has competition changed between your factory and:	Re-shored factories? (factories that have relocated to destination markets)	More competition	Less competition	No change
		Near-shored factories? (factories located in markets very close to destination markets)	More competition	Less competition	No change
		More automated factories in other developing countries, such as Bangladesh or Cambodia?	More competition	Less competition	No change

25.	In your view, what skill set is most needed for the continued automation of the garment sector in Myanmar? <i>Select only one</i>	Computer assisted design (CAD) skills	
		Skills for regular maintenance of automated machines	
		Skills for unscheduled repair of automated machines	
		Strong IT and computer skills	
		Skills for day-to-day operation of automated machines	
		Strong skills in basic math and science	
		Strong problem solving skills	
26.	What are the three most important challenges your factory faces for the continued introduction of automation in the Myanmar garment industry? <i>Select three</i>	Electricity which cuts on and off	
		Electricity which varies in voltage	
		Difficulty in accessing investment capital	
		High prices for automated machines	
		High taxes on locally-produced inputs	
		Lack of skilled operators in the domestic market	
		Restrictions on bringing in foreign, skilled workers	
		High cost/low in-country availability of spare parts	
		High cost/low availability of skilled repair and maintenance technicians	
		Inflexibility to reassign workers after the introduction of automation	
		Inability to make workers redundant, despite following the appropriate legal process	
Another challenge not listed here			
27.	Do brands push your factory to automate the production process?	Yes No	
28.	Considering your investment plans above, how many workers do you anticipate employing at your factory in three years from now (May 2022)	Number box	

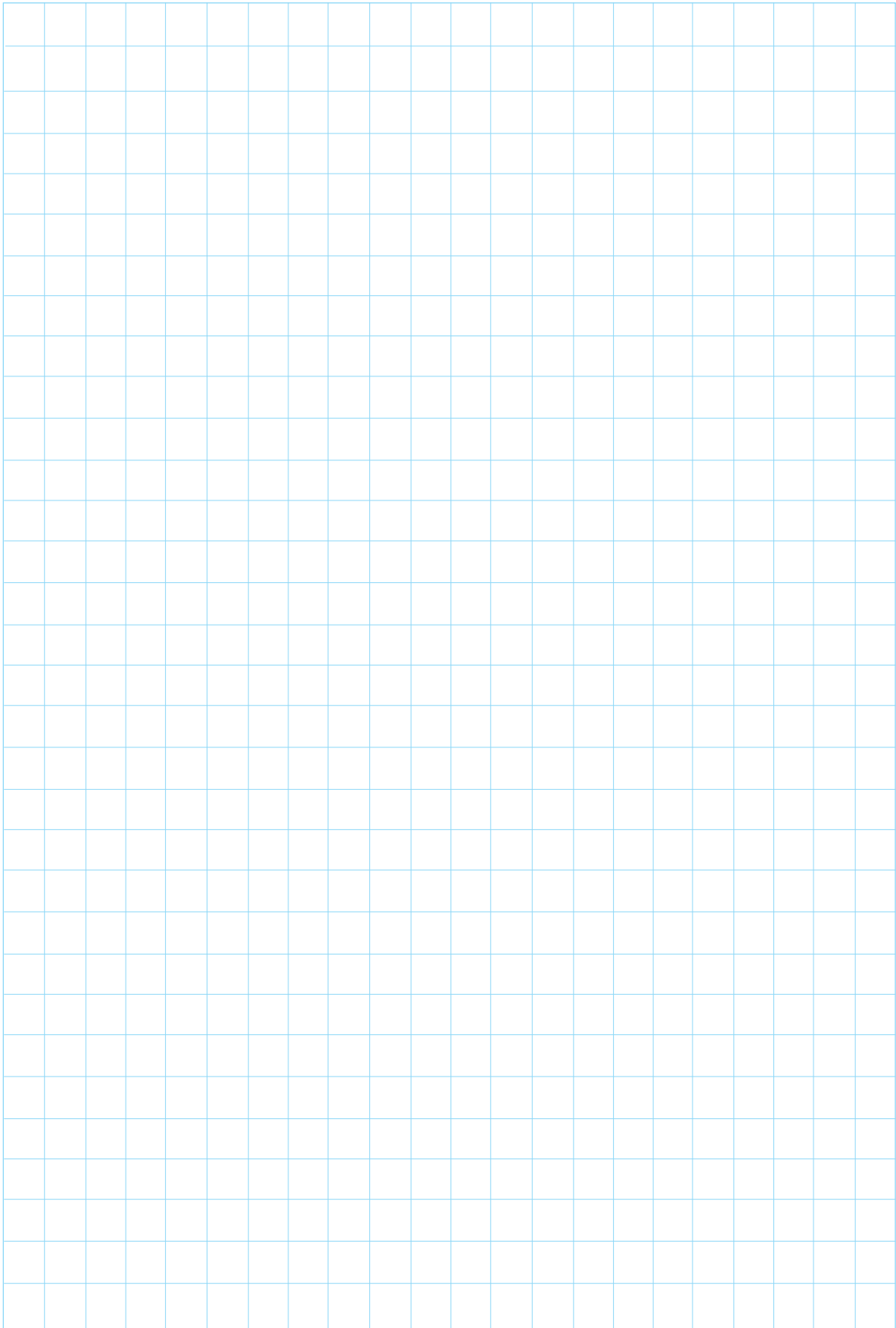


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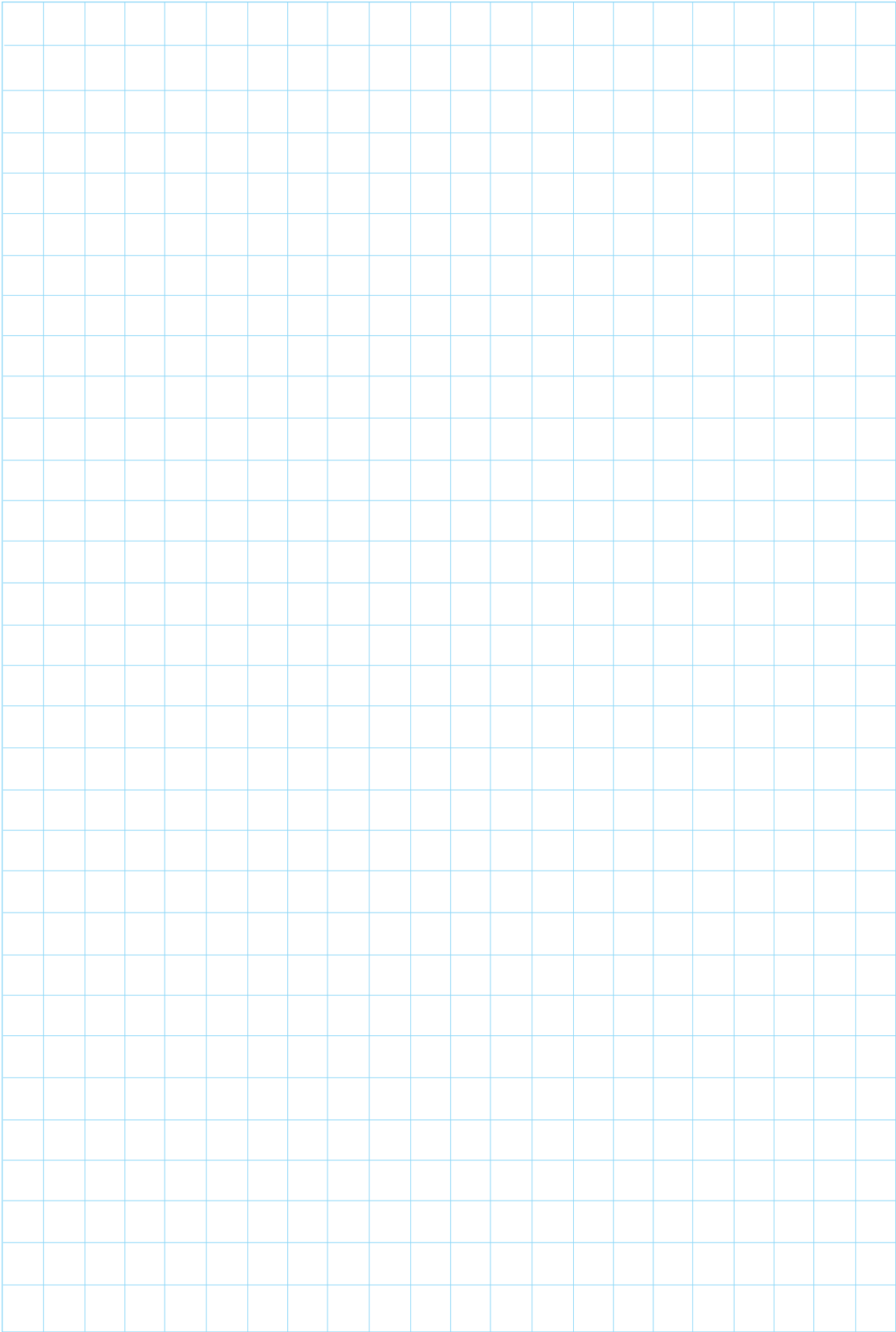
Notes

A large grid of 25 columns and 30 rows for taking notes, with a dashed line and arrows indicating the starting point for writing.

Notes



Notes





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