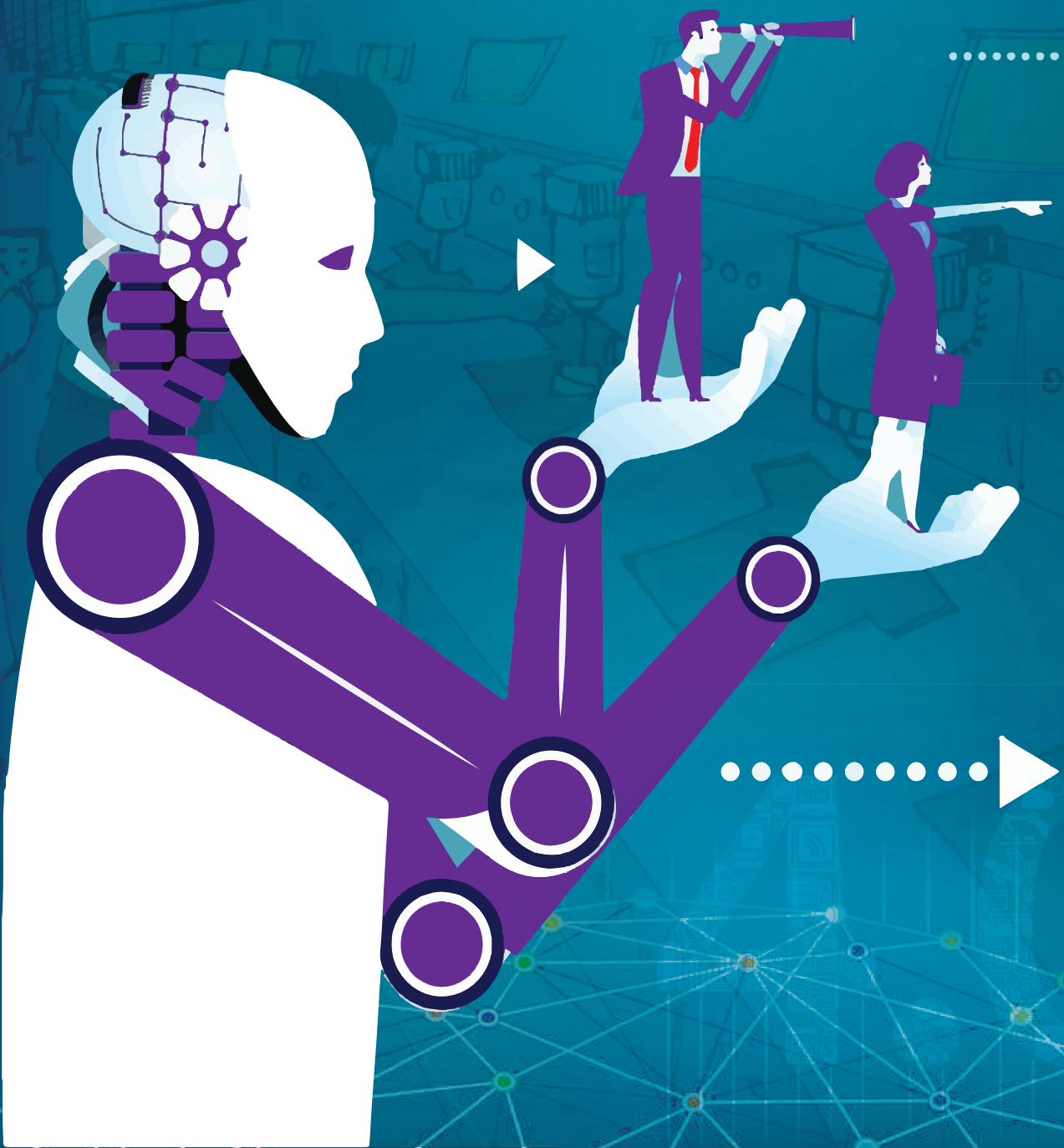
FUTURE SKILLS

FINDING EMERGING SKILLS TO TACKLE THE CHALLENGES OF AUTOMATION IN BANGLADESH



a2i
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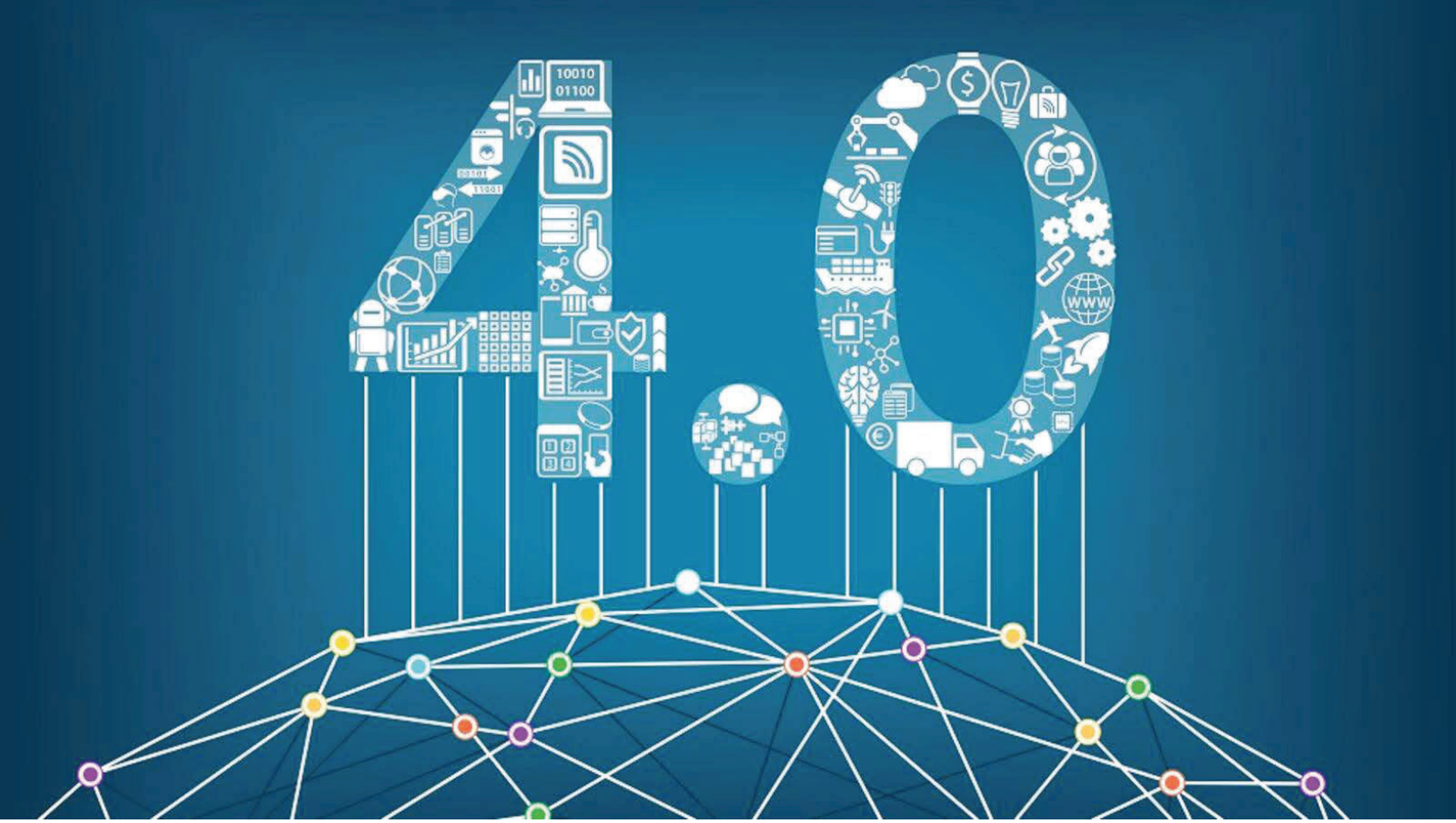

a2i - Aspire to Innovate

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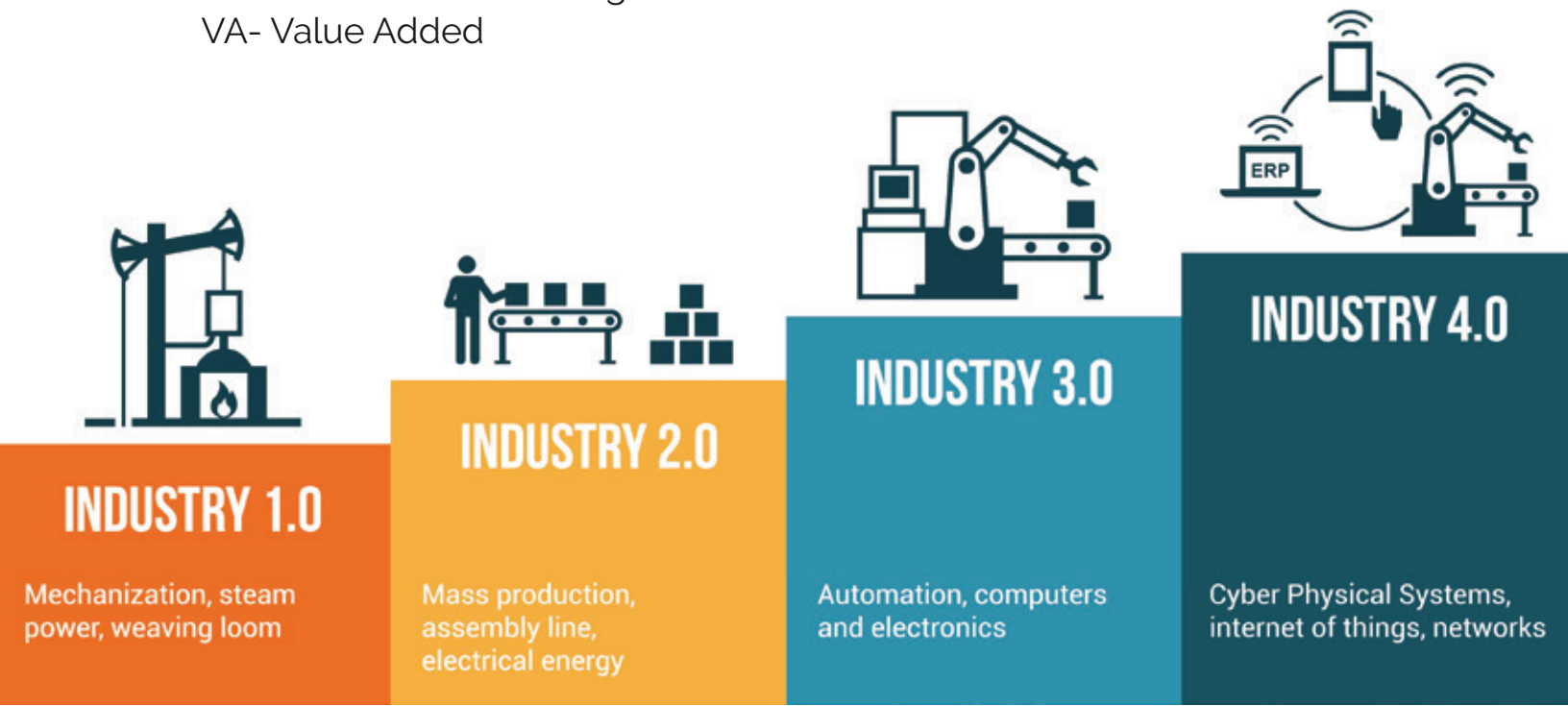
ACRONYMS

AI- Artificial Intelligence
AS- Administration Shell
CC- Cloud Computing
CR- Cloud Robotics
CPPS- Cyber Physical Production System
CW- Cyber World
DO- Data Ownership
DF- Digital Footprint
DSC- Digital Supply Chain
EG- Edge Gateway
FC- Fog Computing
OEE- Overall Equipment Effectiveness
OD- Open Data
PM- Predictive Maintenance
SCADA- Supervisor Control and Data Acquisition
SM- Smart Manufacturing
VA- Value Added



Executive Summary

Our world is ever changing through the use of technology and automation, with that statement, the question arises what will be the impact of automation in a developing society like Bangladesh? Robert F Kennedy gave a statement regarding the impact of automation "Automation provides us with wondrous increases of production and information, but does it tell us what to do with the men the machines displace? Modern industry gives us the capacity for unparalleled wealth - but where is our capacity to make that wealth meaningful to the poor of every nation?" The automation process will be going to impact different sectors of Bangladesh and with that impact, new skills-set will required to adopt the process. To face this challenges an initiative of the government of Bangladesh, a2i is doing extensive research to provide an understanding of the impact of automation in the enterprises and workers within five major sectors: Readymade Garment and Textile, Agro-food, Furniture, Tourism & Hospitality and Leather & Footwear. A comprehensive research methodology has been followed to develop this report. The research started with desk research by reviewing different international publications and policies of other counties with the guidance of a similar study developed by Carl Frey and Michael Osborne of the University of Oxford. After the desk research, the consultant develops a framework for a consultative workshop with the a2i team. After that, the framework for the workshop was conducted within the five sectors. From that workshop, the data was stored and then analyzed afterward an informative interview was held with the leading experts the sectors. After the research finding the information was shared and multiple consultative workshops were held within the five sectors and the feedback data was recorded. After that, the consultant and the a2i team verified the findings from the feedback through secondary research. The technology now day around the world are not only upgrading they are evolving into one entity through combination with one and other. Enterprises, governments, policy-makers, workers, and job seekers must adapt to these fast-encroaching technologies. This is an alarming situation in Bangladesh because technology will take over some jobs and also create new ones and the only way to cope up with the world is through adaptation. The adaptation comes with the skilled labor force, and skilled not only in one particular work but also in different dynamics technical and professional skills, including ICT skills. The key findings of the report point out that nearly two in five jobs face the risk of automation along with technological change in manufacturing and services, less educated women workers are more likely to be impacted, deeper sector based understanding and internal assessments will enable enterprises to benefit from automation, government and education and training providers have to be prepared for automation impacts. The sector-wise report will provide more clear information about the technological upgrade and the automation process within the five sectors of Bangladesh. With the finding of the research, a strong recommendation has also been provided for each particular sector.

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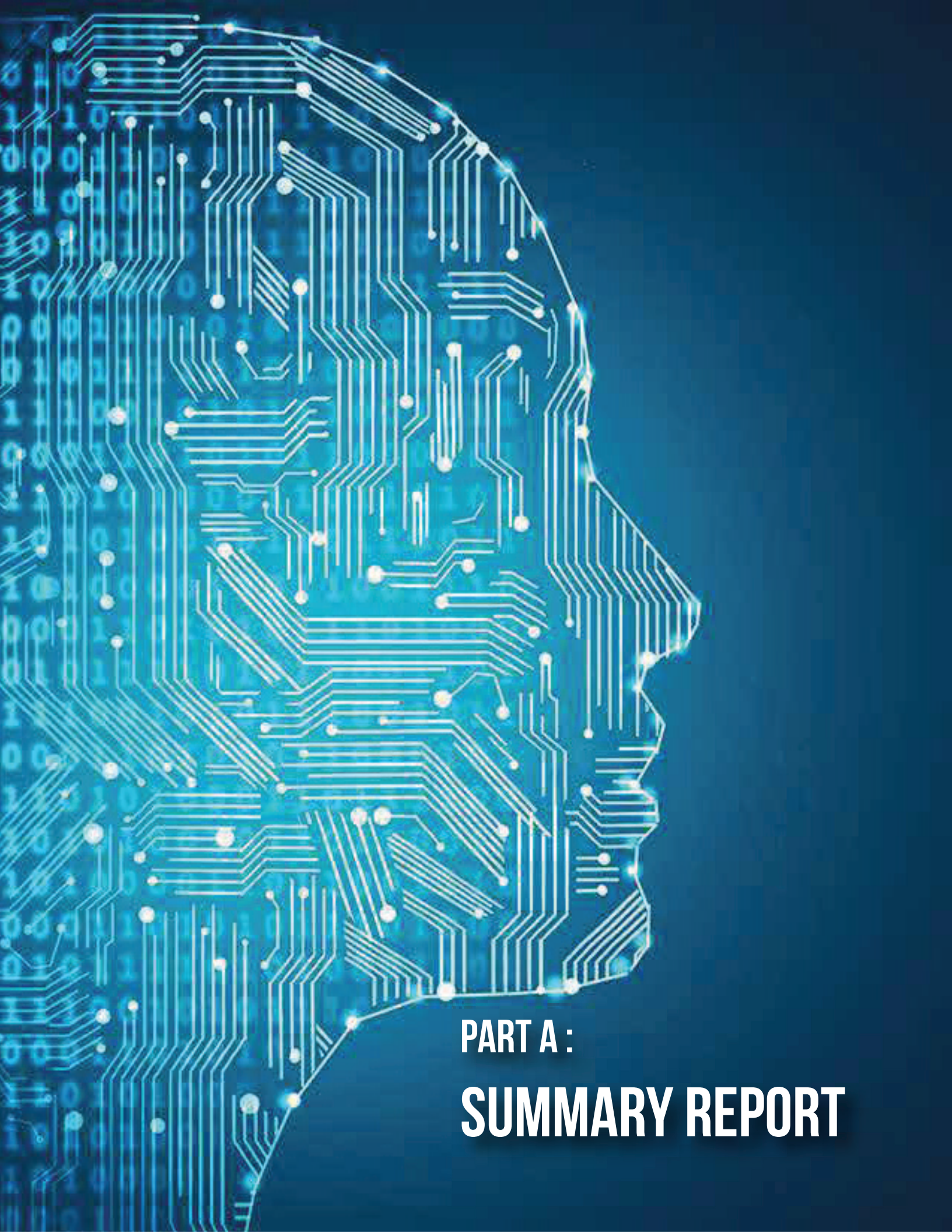


PART A :

SUMMARY REPORT

Background of Future Skills

The world is experiencing an unprecedented acceleration in technological advancement and implementation. Indeed, profound shifts are taking place – entire sectors are accommodating these innovations, rendering several human-performed occupations redundant. In the near future, these positions may be eliminated entirely. At the same time, other jobs are experiencing a rapid increase in demand, and some occupations are revising the skills sets they traditionally require. Discussions surrounding this topic are often polarized, with one side expressing excitement for the opportunity to improve product quality and living standards, and opponents voicing grave concern regarding the massive dislocation of jobs. However, a proper grasp of this topic requires a sector-specific understanding, as not all sectors are impacted equally by these advances in technology.

a2i - an initiative of the Government of Bangladesh, is extensively researching this subject to better prepare the human resource as well as the country to cope up with this changing demand. This report is a part of this continuous initiative that has been developed drawing from a stakeholder consultation process. The team assigned to facilitate this consultation workshop examined current technological trends of Bangladesh and how they impact enterprises and workers within five major sectors:

Alongside these in-depth consultations workshops, the team conducted few key informant interviews that provided insights on the threats and opportunities for the next generation of workers.

Methodology

The researcher followed a comprehensive research methodology to develop this report. The research started with an extensive desk research that included review different international publications, policies of other countries and other related materials available online.

The desk study took guidance from a similar study that applied a research methodology developed by Carl Frey and Michael Osborne of the University of Oxford. Once the desk research was completed, the consultant developed a framework of consultative workshop in consultation with a2i team. Based on the framework consultative workshops with key stakeholders from five sectors were conducted. The discussion from the workshops were encoded, transcript and analyzed to develop the first draft report. Based on the findings of the report the consultants conducted key informant interviews with leading experts on the subject to clarify some of the queries generated during the workshops.

The desk study took guidance from a similar study that applied a research methodology **developed by Carl Frey** and **Michael Osborne** of the **University of Oxford**

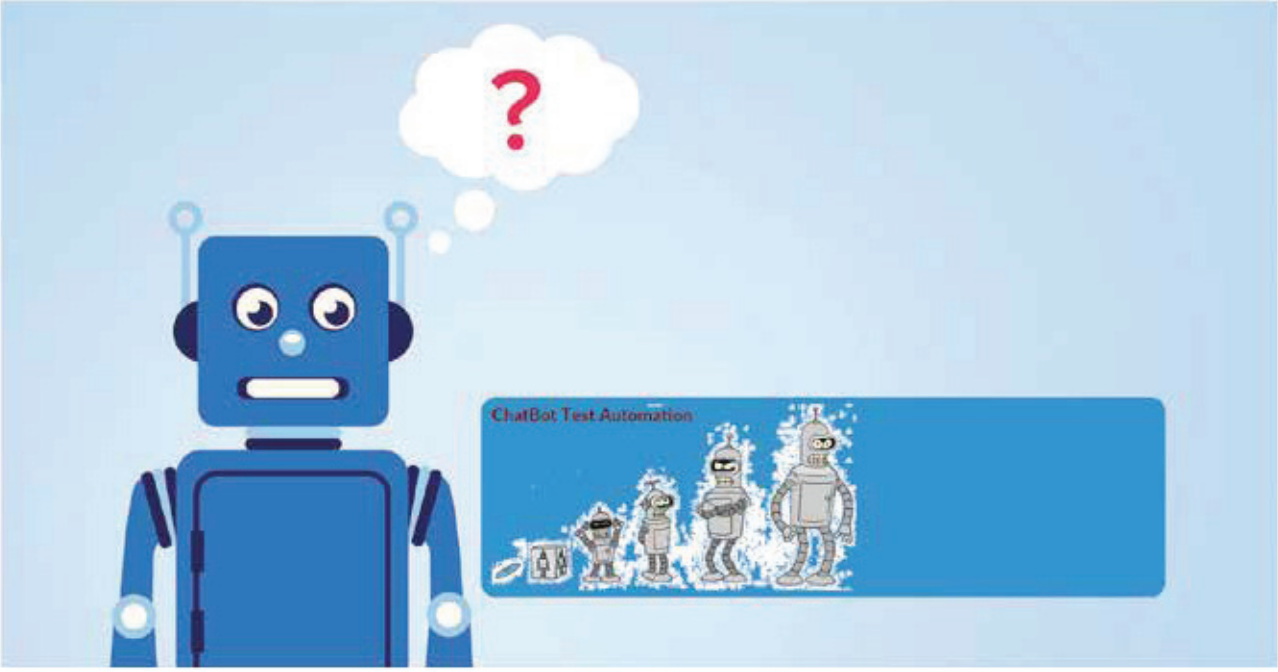
During the process the consultant, **with the help of a2i team identified the factories in Bangladesh that are already going through an automation process and visited those factories to see the changes first hand.** After the complete process, research findings were shared and consultations were conducted with representatives of the a2i. Ultimately, these efforts have culminated into this paper, providing an in-depth examination of different aspects of how technology will affect these sectors. For the consultation workshops, the facilitation team along with **a2i took a structured approach to get the maximum input from the industry experts** into the process. The participants were carefully selected from relevant stakeholders across the sectors. During the workshop, the participants were first made aware of the concepts of IR 4.0 through an audiovisual presentation. At the second stage of consultation workshop, key stakeholders were given space to share their experience regarding the changes that they are observing in their respective industry due to automation. At the final stage, the participants were divided into three groups to discuss three key points and share their feedback with the wider group.

3 QUESTIONS WERE:

The Feedback from the groups was recorded and documented. The team then verified the findings from the feedback through secondary research and clarifies certain feedback through several interviews with key stakeholders.

Limitations

This is a month-long exercise that primarily depended on the input for the industry experts. Though this study provided a significant guideline on future skills, it still requires further in-depth investigation to validate the finding. However, the best outcome of this consultative meeting is the identification of areas that would require further research. The other limitation emerged from the unavailability of data regarding this topic. This topic is new for Bangladesh as well as for the developing countries and the team found very limited data sources and available research to validate some of the findings. So the facilitation team had to depend significantly on the primary research, which is basically the input from the consultation workshops and key informant interviews.



> Due to the unavailability of data regarding the topic, the facilitation team had to depend significantly on the primary research, which is basically the input from the consultation workshops and key informant interviews

Provision for further research

Understanding the implications of disruptive technologies for developing and emerging economies has thus far proven challenging, as the current archive lacks consistent data and currently, there is simply a sheer absence of research conducted. It is therefore critical to study these economies in a rigorous manner, as they are more sensitive to the effects technology breakthroughs and susceptible to changes on wider and more profound scales than technologically advanced countries. Because developing and emerging economies like Bangladesh often engage in the singular, or less diverse, economic activities and also have a larger workforce in low-skilled employment with low educational attainment levels.

Preventative and proactive steps must be taken to avoid entire demographics from losing their jobs. These economies need to strategically transform in order to keep up with technology's advancement and implementation. Perhaps, these emerging and developing economies could even **"leapfrog"** over others and gain a new competitive edge and thus it will require further in-depth study of different thematic topics relevant to this issue.

GROWING SKILLS FOR YOUTH

Summary Findings

In 2015, The Economist revealed that **"a robotic sewing machine could throw garment workers in low cost countries out of a job",** citing advancements made by textile-equipment manufacturers in the United States. These manufacturers have succeeded in developing robots and materials-handling systems that can stitch pieces of fabric together, pick them up and move them to another machine. The quest for enhanced productivity, increased quality of goods, cost optimization and better working conditions are driving the development and implementation of new workplace technology.

The Industrial Revolution in the nineteenth century introduced the assembly line to manufacturers, creating mass employment for low-skilled workers and simplifying their tasks. In the twentieth century, the computer revolution hollowed middle-skilled manufacturing and clerical occupations, replacing repetitive production tasks with machines. Now, the twenty- first century's digital revolution has unleashed a new wave of advanced machines, further automating complex tasks and jeopardizing skilled workers in positions once considered difficult to automate. **Research increasingly shows that these disruptive technologies predictive analytics, artificial intelligence, additive printing, the internet of things, nanotechnology, automation, and robotics** are not only becoming better but are also being combined. Decreases in their costs and increases in their accessibility promise future prosperity and the creation of new jobs. Simultaneously, these technologies challenge existing configurations of the workplace, forcing dramatic changes at alarming speeds. Unless enterprises, governments, policy-makers, workers, and jobseekers proactively respond and adapt to these fast-encroaching technologies, opportunities may be lost and numerous industries may find themselves unprepared for the consequences. This is particularly true for developing and emerging economies. Ensuring that everyone has the right skills for an increasingly digital and globalized world is essential to promote inclusive labor markets and to spur innovation, productivity and growth.

Several types of skills are needed: technical and professional skills, including ICT specialist skills for workers who drive innovation and to support digital infrastructures and the functioning of the digital eco-system; ICT generic skills for workers and citizens alike to be able to use digital technologies; and ICT complementary "soft" skills, such as leadership, communication and teamwork skills, required for the expanding number of opportunities for ICT-enabled collaborative work.

In an increasingly digital world where the skills need of employers is continuously evolving, policymakers need to make sure that everyone can participate and learn new skills. Recent technological change has shifted skills demands predominantly towards high-level skills. Workers need to be prepared to change jobs over their working life while avoiding unemployment or ending up in a lower paying job. ICT foundation skills are becoming increasingly important in order to benefit from technological innovation in terms of better employment chances and higher wages.

A combination of policies is needed to allow workers to keep their skills up to date, help them move between jobs and ensure that employers have a skilled, highly productive and innovative workforce. This includes strengthening initial learning, improving incentives for further learning, and reinforcing active labor market programs for the unemployed. It will also be crucial to tackle skills mismatch and ensure that employers fully use the skills of their workers through management practices that motivate workers and flexible work organization which allows job content to be adapted or for workers to move to better-suited jobs. This would enhance productivity and has the potential for reducing inequality. Though the impact of automation will differ from sector to sector, there are few common trends across the five different sectors.

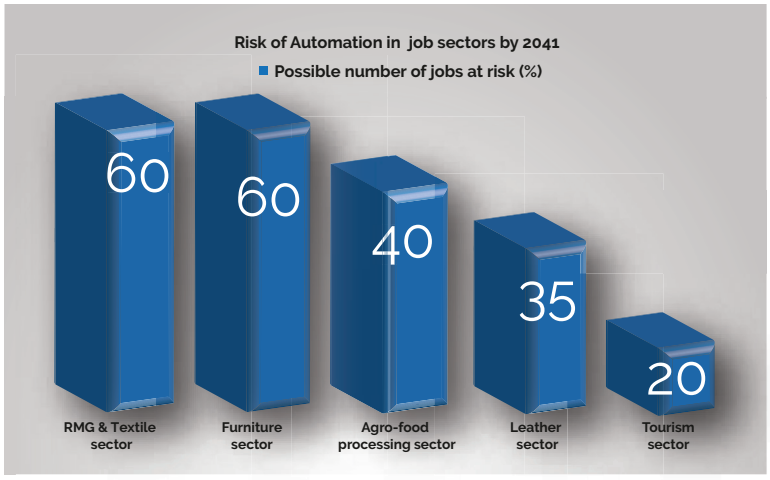
KEY FINDING : 1

Nearly two in five jobs face the risk of Automation

For the five sectors **(Readymade Garment and Textile, Agro-food, Furniture, Tourism & Hospitality and Leather & Footwear)** around **40 percent** of all employment has a high risk of automation in the next couple of decades. However, the risks of automation differ widely across the sectors. Among the five sectors, the share of jobs with a high probability of **automation is lowest in Tourism & Hospitality (20 percent) and highest in furniture and Readymade Garment** sector **(60 percent).** In the, **Leather & Footwear and Agro-food sectors,** the shares are **35 percent, and 40 percent,** respectively. The difference in the labor market structures of each sector produces these variations along with factors that include technology adaptationrate, current status, international competition, productivity etc. For example, in the Readymade Garment sector, where the share of low-skilled elementary occupations in total employment (around two in five) is the highest among the five sectors, the overall probability of automation is also the most pronounced. On the contrary, the tourism labor market exhibits the smallest share of low-skills employment which could reflect the relatively less diversified nature of the tourism sector and the labor market. Compared with wage employees, the automation risks for self-employed, workers are only marginally lower when looking at the five sectors. Although the overall figure is heavily shaped by the high automation risks in the furniture sector, by contrast, the risk of automation among own-account workers are significantly lower than for wage earners in the furniture sector.

These sector-specific trends hold true when controlling for differences in various social and demographic variables.

Among the **5** sectors, the share of jobs with a high probability of automation is lowest in **Tourism (20 percent)** and highest in **Furniture** and **RMG sector (60 percent)**. In the, Leather and **Agro-food** sectors, the shares are **35 percent, and 40 percent**, respectively.



KEY FINDING : 2

Technology will change the face of the future of manufacturing and services

The potential for technology substitution varies widely across different sectors. For the five sectors as a whole, key industries with a high capacity for automation include furniture, leather, and agro-processing industry. However, the risk of automation for a particular industry differs substantially for multiple numbers of reasons including the current structure of the value chain, the entrepreneurial mindset within the industry, global pressure and others. This is driven in part by the structure of the specific industry in Bangladesh and the skills level of jobs in that sector. Wage and salaried earners (relative to self- employed workers) are more likely to be employed in formal establishments with the financial and human resources to invest in technology and automation. Therefore, those workers in industries are likely to face the early impacts of workplace automation. Garment, textile and footwear production are major sectors that are more vulnerable to automation.

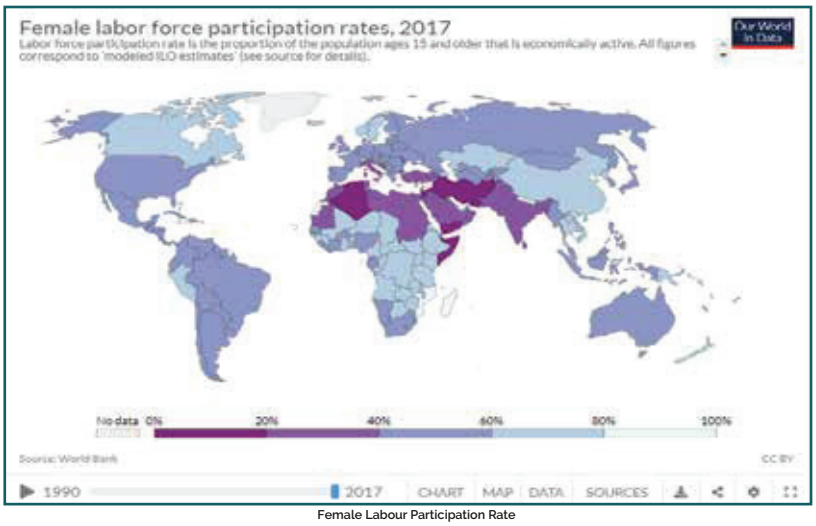
> "In Bangladesh, given that the bulk of salaried jobs in the sector (such as sewing machine operators) require completing extensive routine and manual tasks, the large part of garment wage workers are at high risk of Automation."

Garment, textile and footwear production, in particular, are strongly characterized by low-skills and labor-intensive production in Bangladesh. Given that the bulk of salaried jobs in the sector (such as sewing machine operators) require completing extensive routine and manual tasks, the large part of garment wage workers are at high risk of automation.

Food and beverage production (agro-processing) is another important manufacturing sector and faces the risk of automation. Among the Occupations, butchers and bakers fall into the high-risk category of automation but account for only around **15 percent** of all wage employment in the sector in Bangladesh. Compared with manufacturing, the services sector like hospitality and tourism faces considerably Lower automation risks. High automation risks underscore the potential vulnerability of hotel receptionists and cleaners, although the adoption of technology may allow for greater focus on social intelligence tasks associated with managing client relations and improving customer service, as opposed to outright labor displacement.

KEY FINDING : 3

Women workers with less education and workers in lower-wage occupations are more likely to be impacted



Female Labour Participation Rate

To extend insights beyond the main occupations and sectors at risk of automation, several socio demographic indicators are analyzed to further understand how workplace automation affects different segments of the workforce. In each of the five sectors, women are more likely than men to be employed in an occupation at high risk of automation. In these sectors, women also face greater odds of being in high-risk jobs than men.

Also in these sectors, **young workers aged 18–24** are slightly more susceptible to having an **occupation at high risk relative to adult workers,** although the age-based disparity is considerably lower than the gaps by sex. Education levels also produce significantly different odds of occupying a high-risk job. For workers with only a primary degree or less, the probability of being at high risk of automation is higher than for secondary school graduates.

When comparing primary school educated workers against those with postsecondary or tertiary schooling, the probability ratios increase substantially. These trends tend to support the notion that higher education and training helps develop the competencies needed for complicated tasks requiring advanced levels of perception and manipulation, creative intelligence, and social intelligence the tasks considered difficult to automate. It also substantiates warranted concerns regarding the low level and low quality of post-secondary education, tertiary education and training in Bangladesh, as well as the generally low education attainment levels among the work force.

KEY FINDING : 4

Deeper sector based understanding and internal assessments will enable enterprises to benefit from automation

Despite its accompanying challenges, technology can be a powerful catalyst for growth and productivity gains in the region. Because certain sectors–garments,leather, and furniture will increasingly engage in the use of technology and automation, the economic benefits could be reaped to a larger extent. As such, the changing landscape of technology-prone sectors challenges the status quo for enterprises in terms of the way they function and their employment needs. To remain competitive, Bangladesh enterprises need to position themselves as adopters of enabling technologies and consider a more rigorous assessment of their workforce development strategy.

6 QUESTIONS COULD BE CONSIDERED:

1. WHAT ARE MAJOR TECHNOLOGICAL TRENDS AND PROJECTIONS IN THE SECTOR?
2. WHAT IS THE SPEED OF THESE TECHNOLOGIES' APPLICATION?
3. WHAT ARE THE MAIN FACTORS THAT INFLUENCE THESE TECHNOLOGIES IMPLEMENTATION (WAGES, PRODUCTIVITY, QUALITY, AND GOVERNMENT INCENTIVES AMONG OTHERS)?
4. IF FACED WITH SKILLS SHORTAGE, CAN TECHNOLOGY PLAY A ROLE IN ADDRESSING THE SHORTAGE?
5. HOW WILL ENTERPRISE SKILLS NEEDS CHANGE WHEN THESE TECHNOLOGIES ARE ADOPTED?
6. WHAT NEW SKILLS WILL BE REQUIRED AND WHICH WILL BECOME LESS RELEVANT?

KEY FINDING : 5

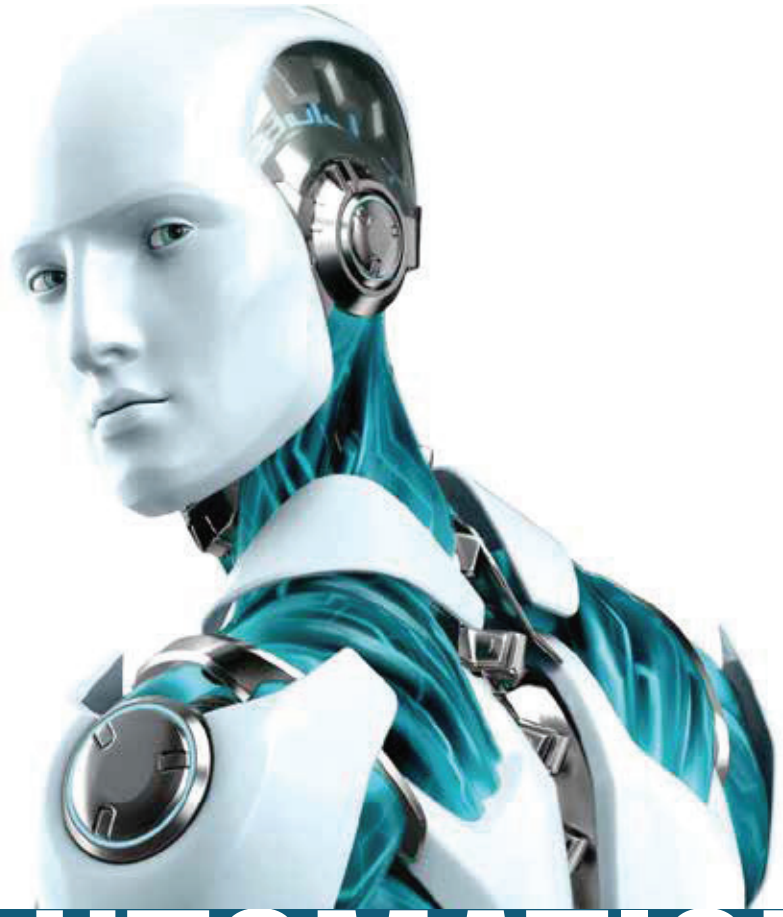
Government along with education and training providers need to actively anticipate for automation impacts

Because automation will most likely impact manufacturing sectors, Bangladesh governments and stakeholders must conduct deeper investigations and prudently plan ahead, especially for the labor intensive sectors. Governments may need to extensively revamp their economic structures to sustain development and prevent mass disruption. As such, policy-makers will need to carefully think about automation trajectories and take appropriate steps to diversify the country's economycally utilizing technology to drive productivity and growth. Bangladesh governments will need to work with enterprises, workers and educators to respond to automation impacts and conduct reviews guided by the following five questions:

5 QUESTIONS COULD BE CONSIDERED:

1. WHICH SKILLS LEVELS WILL BE MOST IMPACTED BY JOB LOSSES IN KEY SECTORS?
2. IS THERE ANY RE-SKILLING PROGRAM AVAILABLE FOR DISPLACED WORKERS?
3. WHICH CORE SKILLS (AND NEW SKILLS) WILL BE IN MOST DEMAND BY PREDOMINANT SECTORS?
4. ARE EDUCATION AND TRAINING PROVIDERS OFFERING FORWARD-LOOKING TRAINING ACCORDING TO THE CHANGING ENTERPRISE SKILLS NEEDS?
5. ARE THE GOVERNMENT AND EDUCATIONAL MINISTRIES PLACING MECHANISMS IN PLACE TO RAISE THE LEVEL AND QUALITY OF EDUCATION?

These questions should be deployed on a sector-by-sector basis to gain a complete purview of how Bangladesh can climb up the value-added ladder, strategically utilizing technology to drive productivity and growth.

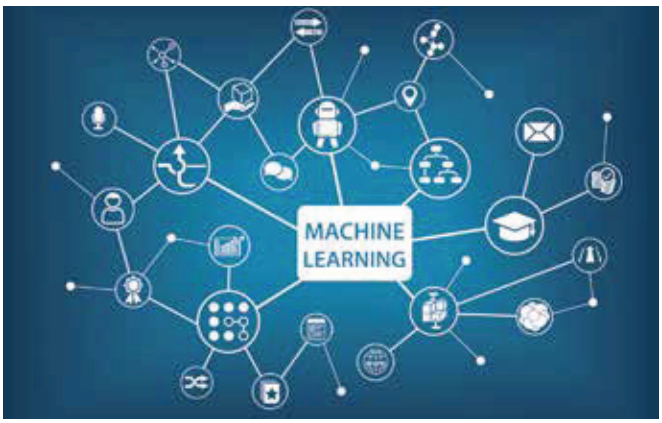


AUTOMATION AND FUTURE SKILLS

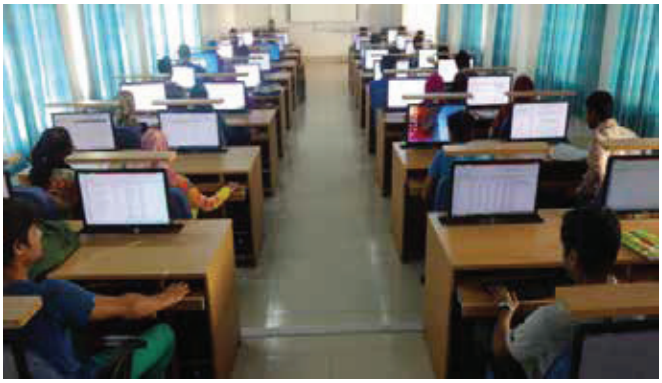
Summary Recommendations

Addressing the challenges arising in an increasingly digital world will require an overhaul of current employment and skills policies. The government must help ensure that an increasingly digital world yields better quality jobs and that both employers and workers have the means to take advantage of the new job opportunities that open up. There are **four key priorities for skills policies** to facilitate the take-up of these opportunities and promote inclusive growth:

1) Part of the task is to ensure that initial education equips all students with basic ICT skills as well as solid literacy, numeracy and problem solving skills to use ICT effectively. Many of these skills are acquired also outside education and training institutions for instance, in the workplace emphasizing the need to recognize skills acquired outside formal channels. For ICT specialist skills, basic programming is no longer enough. For instance, **advanced engineering and experience with machine learning** are increasingly important. In addition, ICT specialists also need domain- specific knowledge, given the potential applications of ICT in business, health, education and industry.



2) Education and training systems need to better assess and anticipate changing skills needs in order to adapt programs and pathways offered and guide students towards choices that lead to good outcomes. **Big data can be harnessed** to complement labor market information systems and monitor changing needs. By including all stakeholders in skills assessment exercises and in translating the findings into practice, governments can ensure that the information collected is useful and that policies respond to actual needs.

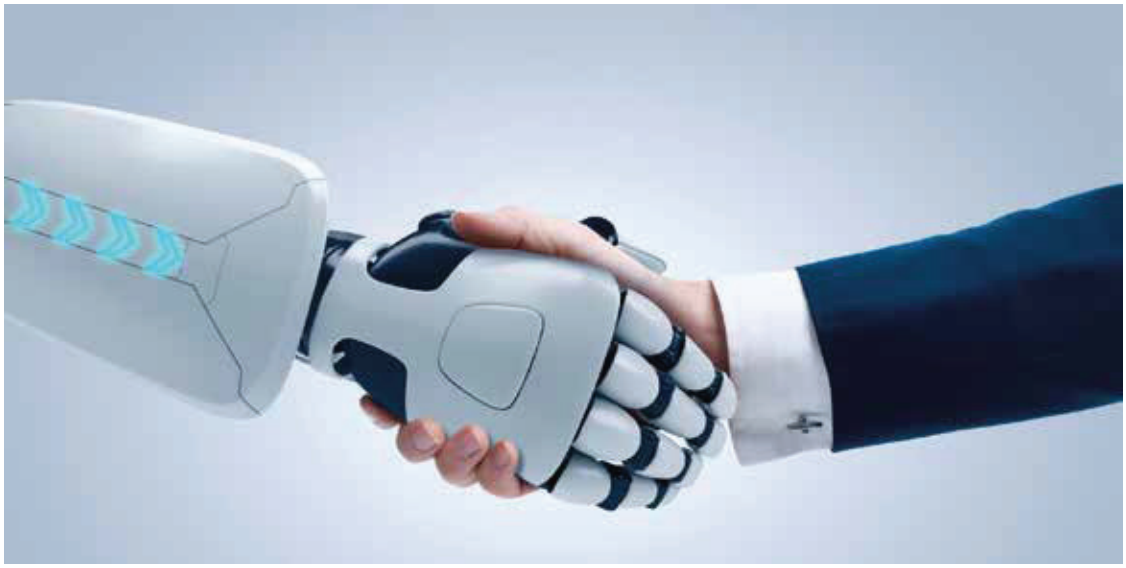


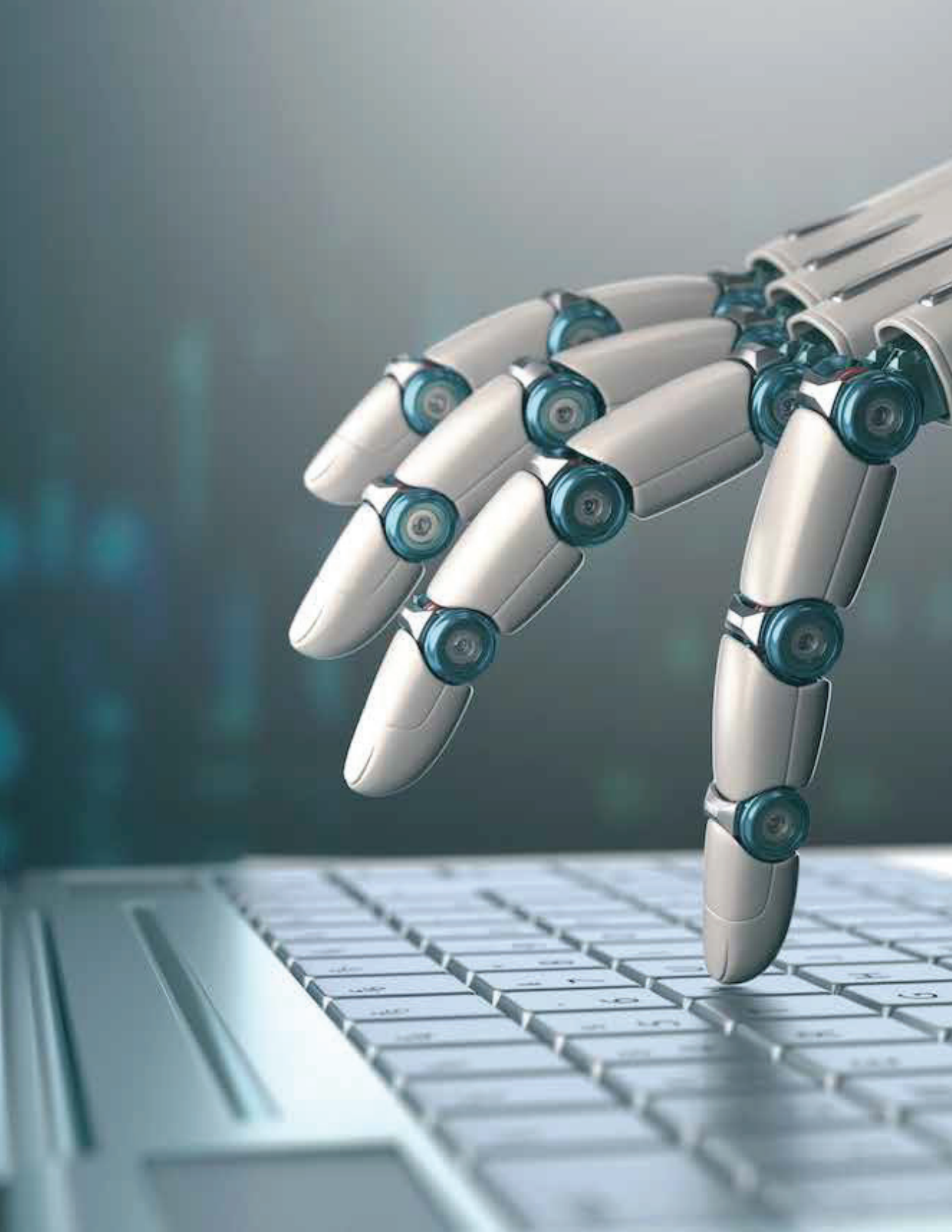
3) It is not just sufficient for workers to have the skills needed for the digital economy but employers must fully use these skills to reap their benefits in terms of higher productivity and greater competitiveness. The use of skills, including reading, numeracy and problem-solving in a technologically-rich environment, varies substantially across countries. A key factor driving this variation is the use of high-performance work practices such as teamwork, work autonomy, training, flexible work hours, etc. Thus it is important to promote better work organization and management practices within firms and across the economy, as well as fostering the skills needed to support these practices.

These are four key priorities for skills policies to facilitate the take-up of these opportunities and promote inclusive growth

4) As, skills demands change continuously, training for workers to keep up with new skills requirements is crucial. This requires offering better incentives for workers and firms to re-skills and up-skills. It also means using the possibilities of new technologies to adapt new job tasks to the skills sets of incumbent workers. At the same time, the diffusion of **"on-demand"** jobs on digital platforms puts increasing responsibility on individuals for managing their own skills development. Low and medium-skilled workers are the least likely to receive training, even though they may be facing the greatest risk of job loss.

A combination of policies is needed to allow workers to keep their skills up to date, help them move between jobs and ensure that employers have a skilled, highly productive and innovative workforce. This includes strengthening initial learning, improving incentives for further learning, and reinforcing active labor market programs for the unemployed. It will also be crucial to tackle skills mismatch and ensure that employers fully use the skills of their workers through management practices that motivate workers and flexible work organization which allows job content to be adapted or for workers to move to better-suited jobs. This would enhance productivity and has the potential for reducing inequality.





PART B :

SECTOR WISE REPORT

1.0 READYMADE GARMENT & TEXTILE SECTOR

Since its inception, especially during the last three decades, the RMG & Textile industry contributed significantly through the creation of physical infrastructure which is demonstrated by 4222 RMG units along with the development of human capital as around 4 million workforces are directly involved in this industry. It has also contributed tremendously through empowering women as almost 90 percent of its labor force is female which ranked the highest in South East Asia. In terms of core economic consideration, RMG & Textile holds almost 14.07 percent of the GDP of Bangladesh as well as the 81 percent of the total export earnings.

1.1 Impact of Automation in RMG & Textile sector

From harvesting cotton in the farms to make a thread, then weaving it into cloth in looms, followed by the stage of printing the textile manufacturing cycle has largely been automated in the past two hundred years. What remains in the hands of humans is when the fabric is sewed into the clothes that we wear. That might change as tech start-ups, encouraged by lightning technological changes, make robots that can imitate humans.**Software Automation, a company based in Atlanta, in the US,** has built an entire assembly line manned by robots that can pick a piece of garment, arrange it properly and then sew it. This technology is called **the Sewbot. Just picking up a piece of fabric is a massive step forward for robots.** Sewing and stitching have eluded machines because cloth is floppy and crumbly, difficult to handle even for humans who are not trained, tailors. Nimble finger movements can quickly adjust a piece of fabric under the needle of a sewing machine. It's a grueling job for a worker to continuously adjust the garment under the striking needle, making sure the seam stays straight and smooth. It's a skills that garment factory workers in Bangladesh acquire over many years of mentorship.

What has come to drive them out of the factories is a combination of powerful algorithms, fast computing speed and the ever-decreasing cost of technological products.
The Sewbot work-line robots rely on high-speed cameras, which see the individual threads in fabric, pinpointing the exact location where a needle strikes and adjusting the garment accordingly.

Organizations such as the OECD and the World Bank have warned that Automation can leave millions of people jobless

Software Automation sees this as a disruptive technology, which will have a lasting impact on how apparel, home textiles and garments are made. And it can do that without workers. Sewbot work-line can produce nearly twice as many finished t-shirts in an eight-hour shift as manual sewing can run 24 hours a day and it is **80%** more efficient. **Multiple studies by organizations such as the OECD and the World Bank have warned that automation can leave millions of people jobless,** not just in developing countries but also in advanced economies.

The growth in industrial robot sales is led by Asia. Between **2011** and **2016 robot sales increased by an average of 12 percent.**
The landscape of Bangladeshi RMG & Textile industry is already changing. At the **Mohammadi Fashion Sweaters Ltd.** Factory in Bangladesh's capital, a few dozen workers stand **watching as 173 German made machines knit black sweaters** for overseas buyers. Occasionally the workers step into program designs or clean the machines, but otherwise, there is little for humans to do. It's a big change from a few years ago when hundreds of employees could be found standing over manual knitting stations for up to 10 hours a day. Mohammadi's owners began phasing out such work in 2012, and by last year, the knitting process was fully automated. Garment, textile and footwear production are major subsectors that make manufacturing overall so vulnerable to automation.

Given that the bulk of salaried jobs in the sector (such as sewing machine operators) require completing extensive routine and manual tasks, the large shares of garment wage workers at high risk of automation is unsurprising. Within **ASEAN region workers in threat of losing jobs due to automation ranges from 64 per cent in Indonesia to 88 per cent in Cambodia.** The situation should not be very different in Bangladesh.

1.2 Possible occupations and number of jobs at risk

A study conducted by McKinsey shows that Bangladesh will remain the top garment sourcing destination for global retailers at least for the next five years, and buyers will continue increasing purchase from the country. Considering the Global and local economic and industry related factors, it is expected that the export volume of **RMG & Textile sector will reach to $50 Billion by 2021** and estimated that around 6 million workforces projected to be required to support achieving the target.

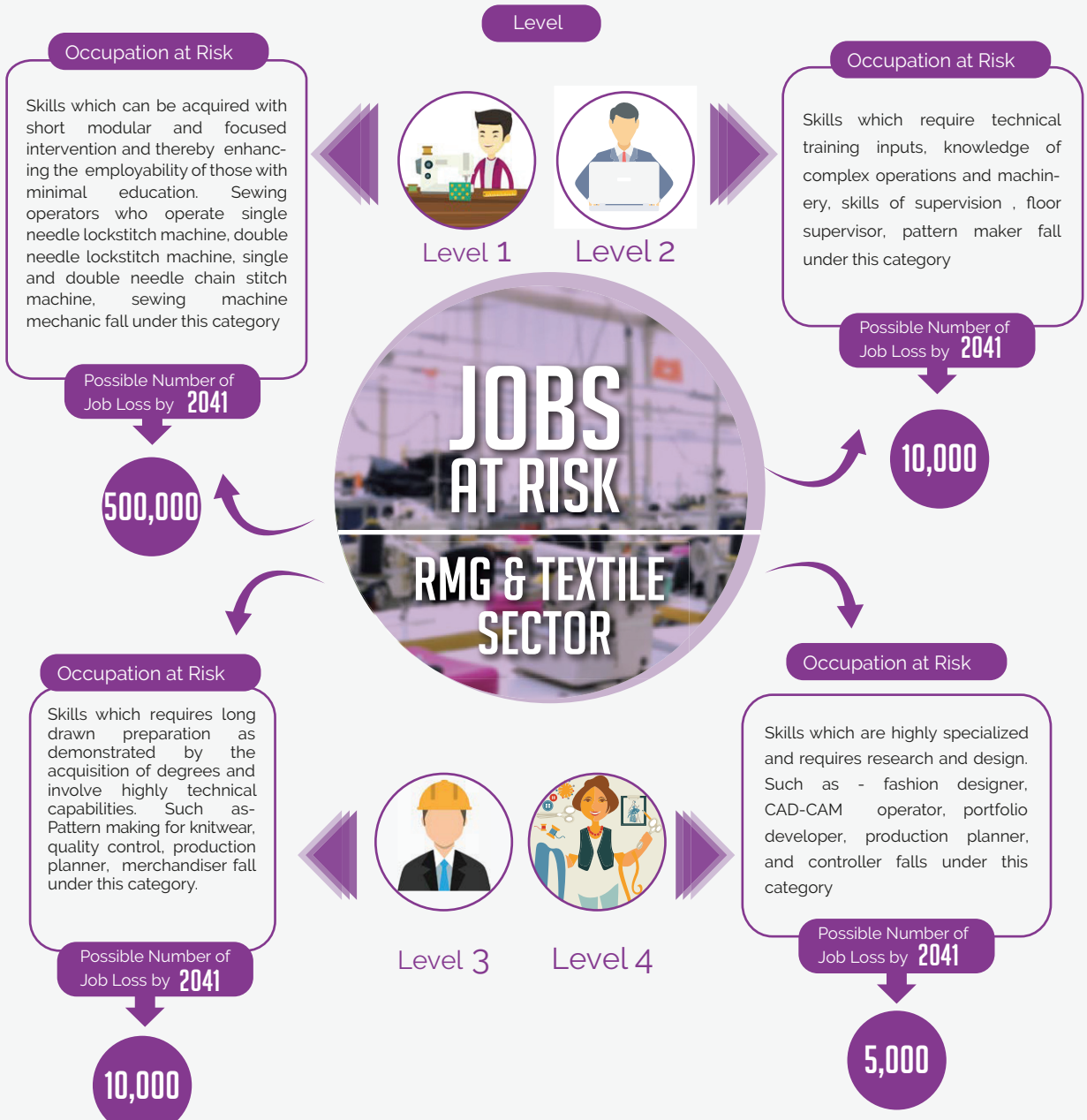
In addition to the current fashion wear, International Buyers are gradually putting emphasis on sourcing more range of fashionable and sophisticated high value and quality garments from Bangladesh. Buyers prefer to source from RMG manufacturers especially which are able to produce at an advanced level in terms of product design, product categories & differentiation, product quality, productivity, services and compliance. We have witnessed that a good number of companies are in a position to shift and transition into high-value production as per buyers' choice and this attitude tends to grow more. Therefore, a gap has been evident between buyers' requirements and suppliers' capabilities, strength which emerged as a challenge to RMG & Textile sector in Bangladesh.

As it is an era of fast fashion, it is normal that buyers want product within short lead-time but with low price. Already Bangladesh is lagging behind in lead-time management from its competitor countries. Recently, **Vietnam** and **Cambodia** have become **major competitors of Bangladesh** due to their shorter lead time. The lead time from Bangladesh is around 40 days, whereas it is only 20 days from the other two Asian nations.

Automating their production line to boost output and cope with strict lead time, which ultimately reduced the demand for human resources. **According to World Bank data, the number of new jobs added by the garment and textile has fallen to 60,000 a year, from over 300,000 annually between 2003 and 2010.** Government statistics show a crucial part of the supply chain, the production of basic textiles, is already seeing an outright decline in jobs. The following table shows the occupations that are at risk in the RMG & Textile sector and the possible number of job loss by 2041.

Major occupations that are in threat due to automation in the RMG & Textile sector are:

Major jobs that are going to get affected are:



Earlier, in **2016, a study of International Labor Organization predicted some Asian nations could lose more than 80% of their garment, textile and apparel manufacturing jobs as automation spreads.** Automation is the use of control systems such as computers to control the industrial machinery and processes replacing human operators.

1.3

Emerging new occupations

As buyers' preferences are frequently changing due to diverse preference, taste and demographic changes and automation are emerging with a faster than expected speed, Bangladesh would require more skilled and semi-skilled workers, technical professional and experts to obtain that market for balance and sustainable growth of RMG sector.

Major new occupations that will emerge in RMG & Textile sector are:

New Occupation	Description	Areas of Application
Computer-aided process planning professional	The use of computers in production planning of garment manufacturing	Production planning linkage between CAD and CAM
Computer-aided quality control professional	Application of computers to inspect the garment quality	Garment inspection, statistical process control
Computer-aided training professional	Testing the components by the use of computers	Intermediate testing of semi-finished materials or final inspection
Automated inspection	Presentation of the components and inspection are both done automatically	Fabric trims inspection.
Automated material handling devices	Used to automatically handle the fabric and other cut components	Fabric, pattern, semi-finished garment handling
Artificial neural network expert	A computational model based on the structure and functions of biological neural networks	Fabrics inspection, color solutions, garment inspection, supply chain, retail management
Pick and place robot operator	Robots are used to pick products from one location to another	Fabric handling for sewing
Numerical controller	Computers are used to perform a preprogrammed sequence	Sewing, buttonholing and button attaching
Automated fusing and pressing machine operator	Fusing and pressing equipment for automatic temperature control and automatic on-off	Fusing and pressing operation
Enterprise resource planning expert	Software that integrates several operations of a plant relating to technology, human resources, and other services	Fabric storage, spreading, cutting, sewing, pressing packaging, human resources, inspection, supply chain, and retailing

1.4 Recommendations

The industry is already seeing how these innovations are impacting the fashion industry and the companies are partnering with suppliers and initiatives. Some of the recommendations from the consultative workshops are as follows:

Opportunities and threats of Automation

RMG & Textile sector of Bangladesh has considerable automation opportunities and threats. Low-wage jobs and workers with low educational attainment face greater automation threats. Technological adoption and its associated workplace disruptions could also be greater in the garments sector than in other sectors, given that educational attainment is considerably low. Equally important to highlight is where job opportunities are likely to be less affected by technology in the RMG sector in Bangladesh. This consultative workshop calls for significant cognitive and social intelligence, require knowledge of human heuristics, and involve the development of novel ideas. Therefore, attention to cultivating these skills and preparing the workforce for new ways of working through corporate education and government initiatives are critical for a timely and effective response to automation trends.

Deeper sector based understanding and internal assessments will enable the RMG sector to benefit from automation. Despite its accompanying challenges, technology can be a powerful catalyst for growth and productivity gains in the RMG sector. As such, the changing landscape of technology-prone sectors challenges the status quo for enterprises in terms of the way they function and their employment needs. To remain competitive, RMG industries in Bangladesh need to position themselves as adopters of enabling technologies and consider a more rigorous assessment of their workforce development strategy. In doing so, the following six questions could be considered:

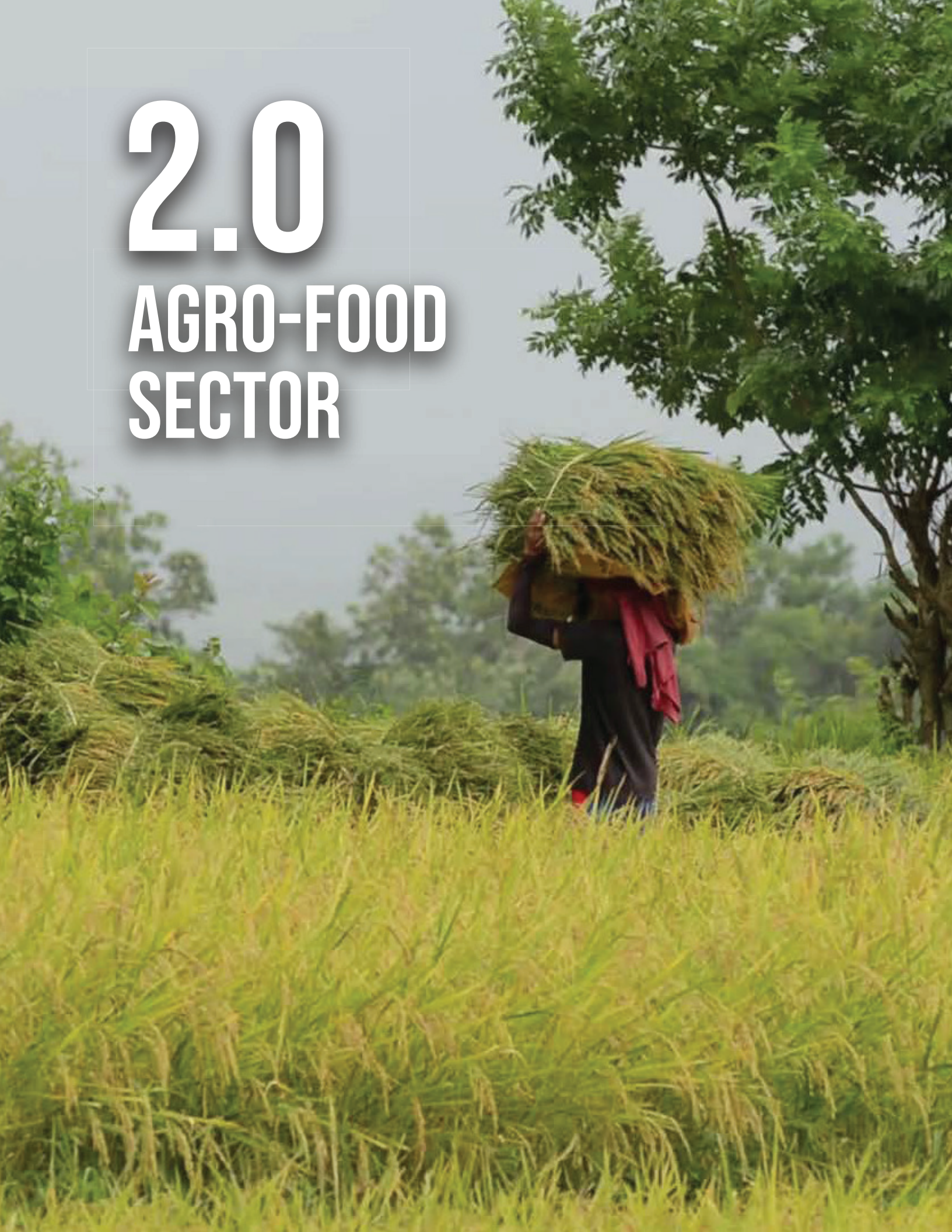
- What are major technological trends and projections in the sector?
- What is the speed of these technologies' application?
- What are the main factors that influence these technologies' implementation? (Wages, Productivity, quality, government incentives, and reshoring initiatives, among others)?
- If faced with skills shortage, can technology play a role in addressing the shortage?
- How will enterprise skills need change when these technologies are adopted?
- What new skills will be required and which will become less relevant?

Government, education and training providers need to actively anticipate automation impacts. Because automation will most likely impact manufacturing sectors, Bangladesh government and stakeholders must conduct deeper investigations and prudently plan ahead, especially countries that are heavily dependent on one or two labor -intensive subsectors. The government may need to extensively revamp their economic structures to sustain development and prevent mass disruption. As such, **policy-makers will need to carefully think about automation trajectories and take appropriate steps to diversify the country's RMG sector.**

1.5 Conclusion

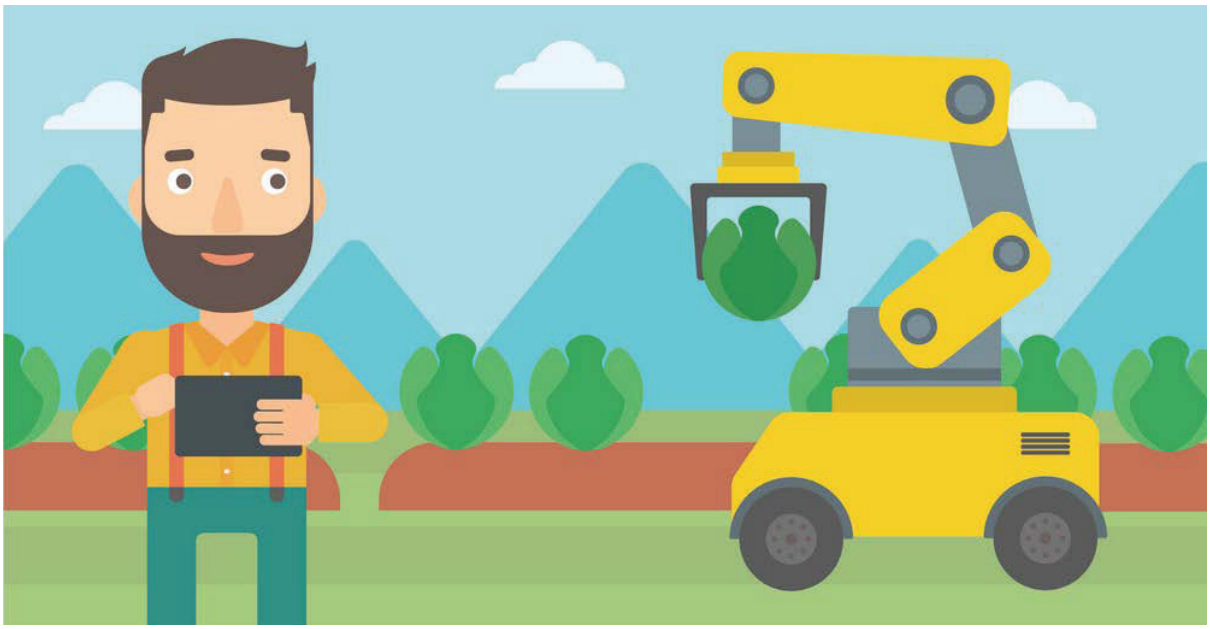
The changing scenario in the apparel industry has made it clear that automation is the key to success in long-term perspective. As technology is improving at faster rate and labor cost increases at the same rate, it is right to say that replacing labor with automated systems is a smart move to survive in long race of global competition. If the layout is planned properly, then automation will lead to saving of the space required. The space acquired by the conventional system can accommodate more manufacturing facility. The new manufacturing facilities will require much less space. Hence the unemployment created due to automation will be compensated by the new companies coming up. By automation, the industry will become knowledge- driven not labor driven. Obviously, it will add to the productivity of the firm. Before implementing the automation, some factors like the size of the organization, layout feasibility and manpower aspects should be considered. As ROI period is a long and the initial investment is high, it is good for small and medium firms to implement automation module-wise and not full at once.

A Glimpse of Consultaion on Future Skills in RMG & Textile Sector



2.0 AGRO-FOOD SECTOR

The agro-food sector in Bangladesh currently stands at USD 2.2 billion and grew on average 7.7% per annum between fiscal years 2014-15 and 2017-18. The beverage industry more than doubled during the same period to the US $29 million, showing an average growth rate exceeding 8 % per annum. According to **Bangladesh Agro Processor's Association (BAPA),** export of agro-processed products from Bangladesh **increased from USD 60 million in 2010-2011 to USD 224 million in 2014- 2015.** With the growing middle-class population of over 30 million, the food processing sector is expected to grow positively in the coming years. Despite, the positive growth trends, the contribution of the food manufacturing or food processing industry in Bangladesh has remained mostly static at around 2% of the GDP since 2004-2005. This indicates that the growth achieved in agro-food processing is not at par with the economic growth of Bangladesh and the sector is currently under-performing. There are several agro-processors such as **Pran, Akij, Square, Ahmed, ACI, BD Foods and Bombay Sweets in Bangladesh with Pran being the largest.**



According to **Bangladesh Agro Processors Association (BAPA), there are around 250 processors;** however, the list is not exhaustive as there are other processors who are not members of the association. These processors produce a range of items and sell their products both nationally and internationally. Export destinations are primarily countries with large Bengali Diaspora; penetration in new markets has been low. The processors are mostly engaged in the processing of food products for which there is a proven market; import trends and the significance of the local informal processing are used as indicators to test the market potential. This is observable in the growth in local manufacturing of real potato chips and growth in snack food items for which there has been a strong local informal processing market.

2.1 Impact of Automation in Agro-food Sector

The way our food is prepared, processed and packaged has become a highly automated process. In recent years, robotic and automation equipment has steadily found its way into most food processing and packaging facilities, and this trend is expected to continue over the next few years. **According to BCC Research,** the food processing and packaging market **will be valued at around $31.5 billion by 2020,** growing at a **4.2% compound annual growth rate (CAGR).** Separately, the food processing market and **the food packaging market will be worth $14.2 billion and $17.3 billion in 2020**, respectively. This steady growth marks an important shift in the way food processing and packaging plants operate, requiring new equipment and new investments as well as highly trained employees.

Robotic automation is already deployed in high volumes in the food processing and packaging industry, but the consultation workshop also revealed that half of companies in this industry plan to increase automation levels in the next **three to five years**. This increase in automation will be accompanied by the hiring of new employees with more technical skill and higher spending on capital equipment. Robotic automation capabilities have expanded in recent years. Industrial robots have become more flexible and more efficient with better programming and better sensors. This increase in robotic capabilities, along with the increase in overall automation levels, is allowing processing and packaging plants to introduce new products on the same assembly lines.

Automation in
Agro-food sector

Major occupations that are in threat due to automation in the Agro-Food sector are:

Major jobs that are going to get affected are:

Sector

Agriculture

Food Manufacturing

Food Packaging

Food Delivery

Cookery

Occupation

Robotic applications will replace jobs that include planting, identifying and sorting seedlings. There are also autonomous tractors, welding robots and harvesting robots that will replace the job of harvesting. Drones and autonomous ground vehicles are being used to monitor and analyze crops and replace the job of agro extension service providers.

Possible Number of Job Loss by **2041**

500,000

Occupation

Primary processing-Raw food products are cleaned, sorted, transported and blended. Robotic applications include a butchery, and fruit and vegetable sorting and will replace the job of butchers and sorters

Secondary processing — Ingredients are combined to form new food products by cooking, baking, chilling etc. Robotic applications include product sorting, defect removal and mixing. And will replace the job of mixers, sorters and quality controllers.

Possible Number of Job Loss by **2041**

100,000

Occupation

Primary packaging - Individual foods are packaged. For example, a pick-and-place robot puts sweets into plastic tubs and it will replace jobs of sorter and pick and place operator.

Secondary packaging - Individual packages are grouped together. For example, another pick and place robot stacks those plastic tubs into a larger box. This will significantly reduce workers involved in secondary packaging

Tertiary packaging - Secondary packages are grouped for shipping. For example, a palletizing robot puts many boxes onto a pallet. This will reduce the workers involved in large-scale export packaging professional.

Possible Number of Job Loss by **2041**

50,000

Occupation

Robotic food delivery has been getting a lot of press recently. However, in Bangladesh, this will not have a major impact.

Possible Number of Job Loss by **2041**

N/A

Occupation

Cookery automation does not necessarily mean cooking meals on demand. The APRIL robot, for example, seeks to bring restaurant quality to mass-produced food. Traditional mass production methods reduce the quality of food due in part to the large batch sizes. By using a KUKA robot to cook in smaller batches, the inventors claim that the quality of the food is better. So these technologies will eliminate workers involved in mass scale food production

Possible Number of Job Loss by **2041**

50,000

2.2

Emerging new occupations

Food manufacturing and processing factories are now using cost-effective automation solutions for higher production volume as compared to conventional processes. As the reliance on manual labor is considered a classical concept now, more preference is given to robotized handling/manufacturing installation. Common examples include; picking, placing, packaging and palletizing applications. The last two applications are most common. **Robots are being used from seeding, spraying water and harvesting to cutting, processing and packaging of food products.** Various robot systems are used in meat processing and automatic quality detection of the final product of bakery items. Also, in beverages industry, bottles are cleaned, counted, filled and arranged on a conveyer belt automatically via robotic machines. **Additionally, modern vision systems are utilized through multiple High Definition (HD) cameras for defect identification and inspection through robot learning.** A detailed review exploring the potential of computer vision to inspect and control the quality of vegetables and fruits is presented in.

Major Occupations that will be emerging in Agro-Food sector are:

Sector	Description of the Occupations
Agriculture	Big data analytics, drone operator, large sorting and planting machine operator, a mechanical engineer capable of servicing sorting and harvesting machine.
Food Processing	A major portion of the robotic applications in the food industry is carried out by the serial robots having a vertically articulated structure. The other class of robots which came later on in the food industry and is currently more common is conceptually based on parallel kinematics. The industry will need an expert in managing these robots and with an understanding of parallel kinematics. One of the first steps to develop an application for the robot is to derive its kinematic and dynamic models. It will also require the application developer.
	Food safety is an important issue and it is required that the food and beverage products must be untouched by humans during their processing in order to avoid transmission of germs and bacteria. For such stringent requirements, the hygienic design of robotic manipulators, vision systems and end-effectors or grippers is a necessity in the food industry. The grippers of the robots used for food handling application are washed down with industrial detergents and pressurized hot water. The industry will need such robot operators.
	The demand of productivity has been increased in the food preparation, handling and production as well as in the food serving industry. The prime focus of the PKM robots is in food preparation and handling. Fast operational pick and place speeds are possible due to highly agile robotic structures and the incorporated control schemes. The use of robots has surpassed the operator-based manual production rate. The industry will require PKM robot operators.

Sector	Description of the Occupations
Food Packaging	In this category, the robots and applications have been mostly standardized. The decisions are made based on the payload specifications and the range of speeds available. Palletizing of cookies, beverages, pasta, sweets and other items are now stacked using the robots. The packaging robot operators will be in increasing demand.
Worker's Safety	In a futuristic hybrid Human-Robot Interaction (HRI) environment, there is a stringent need to standardize risk hazards. The prevailing concept is to completely isolate the robot system from human worker access. The robot must be able to assess the hazard situations for which the smart sensor integration is a must to be employed and the industry will need experts with kills on automation sensors.

2.3 Recommendations

Major recommendations from the consultation workshops are as below:

Skills development

Skills development will be the key to success with the automation in the industry. Aside from selecting the right machine and software, exploring the ancillary options for the chosen machine is vital to maximizing ROI. While human workers can look at a series of ingredients and establish the best way to pick up items based on their shape, position and material, fully automating these actions haven't been possible until recently. Incorporating which they are picked up and assess the best position to place them in the primary packaging. Going beyond human capabilities, this type of software can also view and ascertain whether product labels are fixed correctly, include the right product information and help you meet industry regulationsin the blink of an eye. However this will still require **human skills and training service providers will need to develop courses to enhance the skills of workers.**

Partnership

The industry needs to conduct a need analysis in partnership with the government and international experts. When selecting the type of machine to introduce to food production facility,consideringthe actual needs of the industry and processes will result in a more cost effective and appropriate machine being installed. Many of the industry members are planning to introduce automation in the factory and some have already done that. Understanding the impact of such automation will be crucial factor for other industry stakeholders.

Automated data collection

The industry needs to move toward a data-driven business. **The benefits of using real-time data outweigh the cost of implementing the systems that generate it.** Automated data collection helps companies determine the root causes of performance issues, as well as enhance the efficiency of day-to-day processes. Automation isn't limited to big companies; food processors of any size can make good use of data collection. For smaller processors looking to become more data-driven, there are resources available at a reasonable cost.

Policy Framework

Government needs to get involved with food plant owners on a project basis for automation. The focus should to try to help them define a vision of the future - the sort of **"blue sky"** version of where they would like to be at some point in the future. The government and the private sector must understand the vision for where the automation system is intended to go in the agro-food sector. Then, make intelligent decisions about how to best spend capital on pilot project to support that vision. It's best to have a standard for hardware and software that is geared toward the fully integrated system that industry wants to own someday.

2.4 Conclusion

Research evidence suggests that huge opportunities exist within the food industry for automation to take place, especially within the primary packaging processes. As technology improves and the ability to manipulate complex and varying shapes becomes easier, further opportunities for higher levels of automation to take place will be presented. The needs of the food industry differ slightly from the industry norm, but they are not insurmountable. In the last five years or so there have been huge steps in automation and robot design that have taken most of these factors into consideration. There has been an emergence of a wide range of standalone robots, with fully hygienic pick and place capabilities that in theory appear to be able to handle a wide array of raw ingredients. With all the new technologies future of automation for the food industry looks very promising indeed.

A Glimpse of Consultaion on Future Skills in Agro-Food sector

3.0

FURNITURE SECTOR

Furniture sector is one of the high-growth potential small and medium-sized enterprises (SME) sectors of Bangladesh. In a project study conducted, it was reported that furniture sector has a growth rate of 19% per year and contributes 0.29% in the GDP of the country. Growth prospect of this sector is being stimulated by rising demand in the domestic market as well as gradual growth of export. Local demand has been growing due to gradual economic prosperity of the mass people while demand in international market is derived primarily from comparative cost advantage. Industry experts are of the opinion that the furniture sector has immense scope to grow; especially in the context of growth in international market. Bangladesh is yet to capture a sizable share in the world export of furniture as the country's export in the year 2017 was equivalent to 0.02% of world export. **The furniture market comprises of 71,034 firms and employs about 2 million people in Bangladesh**. However among these 71,034 firms, 81 falls under the small and medium enterprise category.

3.1 Impact of automation in Furniture Sector

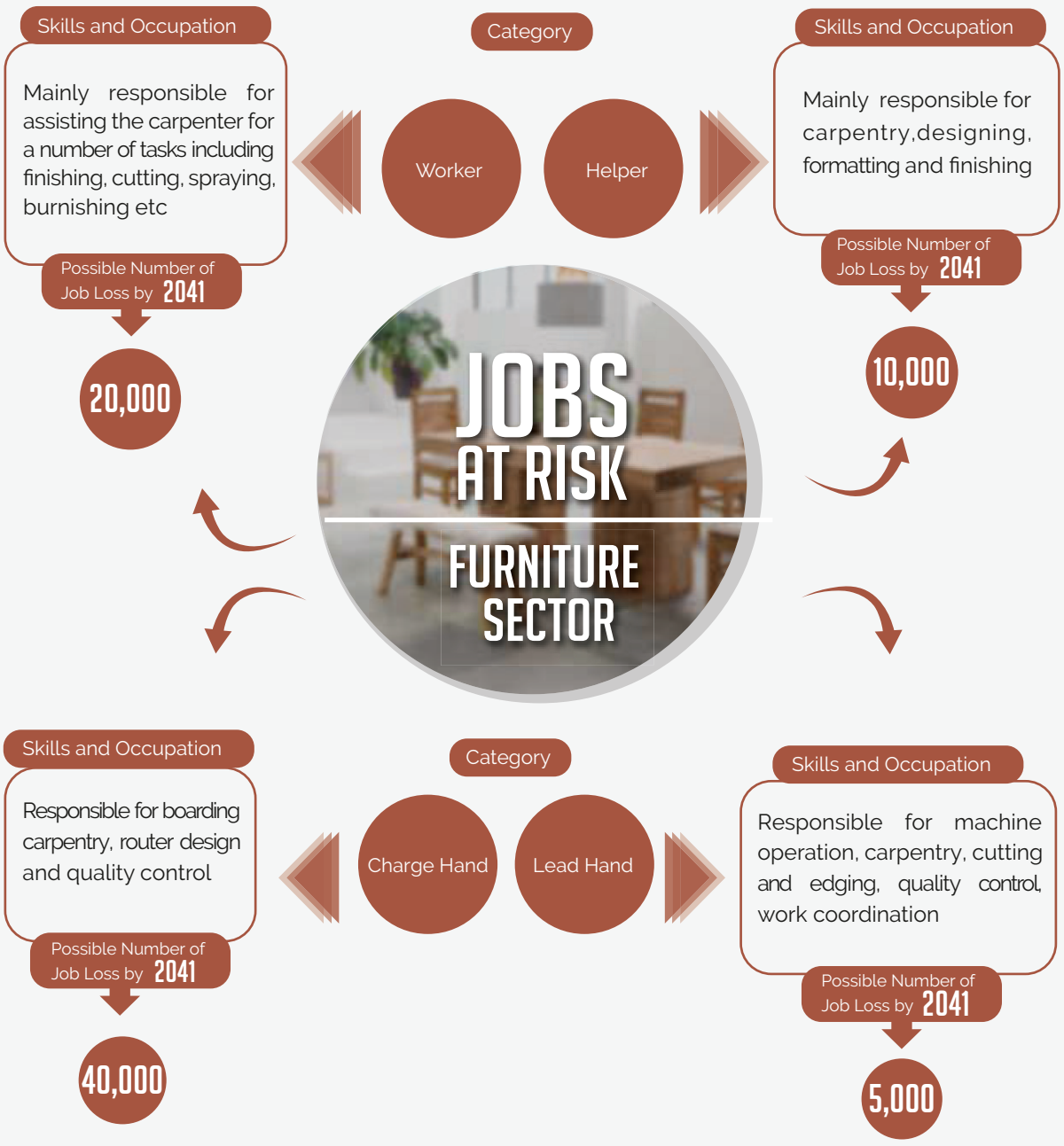
Customized goods were the norm in pre- industrialized societies. In the 20th century, manufacturers began to embrace the mass production model and the lure of cheap, readily available goods drew consumers away from the unique pieces that characterized earlier eras. Enter the 21st century, where a backlash against the uniformity of mass-produced products has re-ignited consumers' desire for distinctive, customized products. Though the furniture manufacturers will be the fastest to adapt (HATIL is opening a fully automated furniture manufacturing unit by early 2019) to the changing market scenario and ensure that they thrive in a dynamic, global marketplace but it will have consequences in the job market. **The furniture sector entrepreneurs believe that as we are on the cusp of a new industrial revolution, which will provide companies with the means to respond to the growing complexities of manufacturing and enable greater possibilities for product innovation and business model transformation, the sector will also lose a huge number of unskilled and or semi-skilled workers unless necessary steps are taken.**

Automation has consequences for the organization of work in the furniture sector, the type of jobs performed, skills required, and the tasks and working activities conducted. In general, automation (computerization, introduction of robots and AI) predominantly affects routinized work in stationary, predictable environments, typically found in the middle-skilled jobs in the furniture sector, particularly whenever tasks merely concern executing rules rather than require cognitive processing of information. However, automation and computerization by means of the introduction of robots, advanced software, and AI thus substitute for the routine and "rule-based" tasks in the furniture sector, yet complement the non-routine and cognitive tasks. The non-routine and cognitive tasks typically are executed by high skilled employees with high wages (i.e. lead hand in furniture sector), while the routine tasks generally are conducted by medium-skilled employees with medium wages (i.e. charge hand in furniture sector).

Consequently, jobs that are low-skilled, but are composed of non-routinized tasks in a dynamic and unpredictable environment cannot yet be robotized or computerized. Jobs which require refined perception and physical dexterity, creative intelligence/improvisation, or social intelligence, regardless of whether they are low-skilled, are less at risk of replacement). Although tasks including product development, designing using tacit knowledge or knowledge which is hard to codify cannot be automated, if there is a sufficiently large amount of data, cognitive, knowledge-based tasks can also be taken over by AI and are, as such, subject to progressive automation and substitution as well. Thus,technological substitution of jobs does not necessarily displace low-skilled work in the furniture sector, but rather routinized work. As routinized work is often executed by medium-skilled workers, **this substitution effectively "polarizes" or "hollows out' the labor force, with fiercer competition and thereby wages stagnation, particular for middle and lower skilled work.**

Major occupations that are in threat due to automation in Furniture sector are:

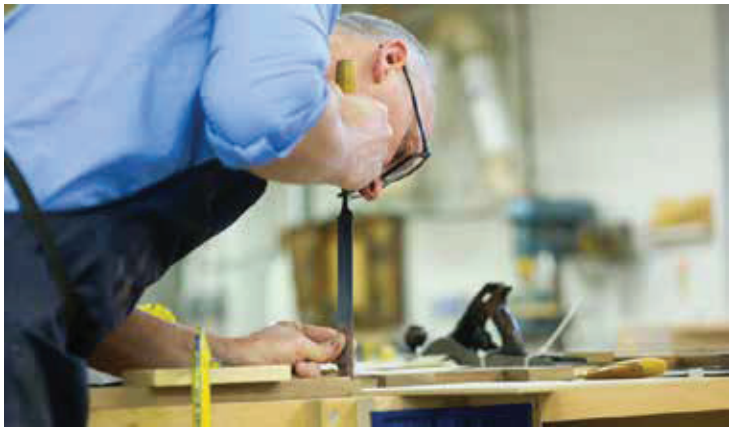
Major jobs that are going to get affected are:



3.2 Emerging new occupations

This new, digital industrial revolution holds the promise of increased flexibility in manufacturing, mass customization, increased speed, better quality and improved productivity. However, to capture these benefits, enterprises will need to invest in equipment, information and communication technologies (ICTs) and data analysis, as well as the integration of data,flow throughout the global value chain. There are clear differences in selected emerging job profiles in furniture sector, which normally relate to the differences that the furniture and woodworking manufacturing sectors have in terms of structure, size of companies, specific market focus (mass production or high-end production) and finally the typologies of products and materials.

With Industry 4.0, there is more and more room for large-scale product personalization manufacturing, with greater quality and no added costs or delays. Moreover, thanks to digitalization, IOT, connectivity, companies can easily switch back and forth among the four manufacturing models that require more agility, require more information in order to respond in real-time to a changing demand.



In the Industry 4.0 era, static, dynamic, easily reconfigurable production lines will replace today's static, one-way processes. This will be a boon for manufacturers producing personalized furniture, providing them with the means to efficiently and profitably manufacture smaller batch sizes even as small as batch-size 1 at a price and lead time comparable to mass- produced furnishings.

A networked, data-rich production system also offers the potential to understand in minute detail the entire production process and what changes are necessary to unlock production efficiencies and savings. The potential gains from advanced analytics range from cost savings due to predictive maintenance operations to smaller work-in-progress inventory through to a more flexible and better-informed business strategy. According to McKinsey Digital, a shift to a big data/advanced analytics approach to **furniture manufacturing can lead to a 25% increase in productivity and a 45% reduction in downtime.**

Major Occupations that will be emerging in Furniture sector are:

Occupation	Description of the Occupations
3D Printing and Additive Manufacturing for Furniture Manufacturing	This will mainly be used to develop new models of furniture.
Augmented Reality and Intelligent Tools that may be Used During the Design and Fabrication of the furniture	With the change in consumer behavior, buyers will look for customized furniture. This will help the furniture producers to produce higher-end furniture for selected customers.
Professional having expertise on sensors and wearable	This will be used to identify right raw materials, quality control and assembling of furniture.
Experts controlling robotics applied to furniture production at the different production stages	Robotics will be a major part of furniture production and will be used in different parts of furniture production.
Simulation, modeling, and virtualization in the design, virtual catalogs, 3D scanning	The technology will be used from marketing to production process planning of furniture sector.
Big data analytics	Furniture industry will be able to use big data analytics for marketing, consumer data processing and forecasting.

3.3 Recommendations

Major recommendations from the consultation workshops are as below:

Develop a roadmap

As discussed, job displacement due to automation is not a new phenomenon, albeit its vicissitudes of degree and variety may be particularly unfavorable to future workers. Boasting a tremendous growth the furniture sector is critical to Bangladesh's economy and social fabric. Policymakers should take proactive measures to promote the furniture sector's competitiveness as it finds its footing in the twenty-first century, while also considering the welfare of those whose livelihoods are supported by their employment within it. The government should work with the private sector and other stakeholders to develop a roadmap that is concerned with securing the sector's role in the future of global manufacturing.

Upgrading skills

The second set of recommendations pertain to upgrading skills of some furniture sector workers to both meet the rising demand for skilled labor in the industry and provide job security to workers through systematically introducing to automation. This is especially germane to younger populations and the existing skill development and educational institutions, about which **the participant in the workshop has stated "with low quality, low status and low labor market relevance, the system is still-prepared to address the needs of the country's burgeoning youth population"**. The suggestion is to develop a partnership with private sector partner like HATIL which is starting a fully automated factory by next year to understand the skills requirement and prepare the training centers accordingly. Due to abundence of informal workplaces in the furniture industry the transforms of the technology would be much more easier and accesible to others so that up skilling process gets easier.

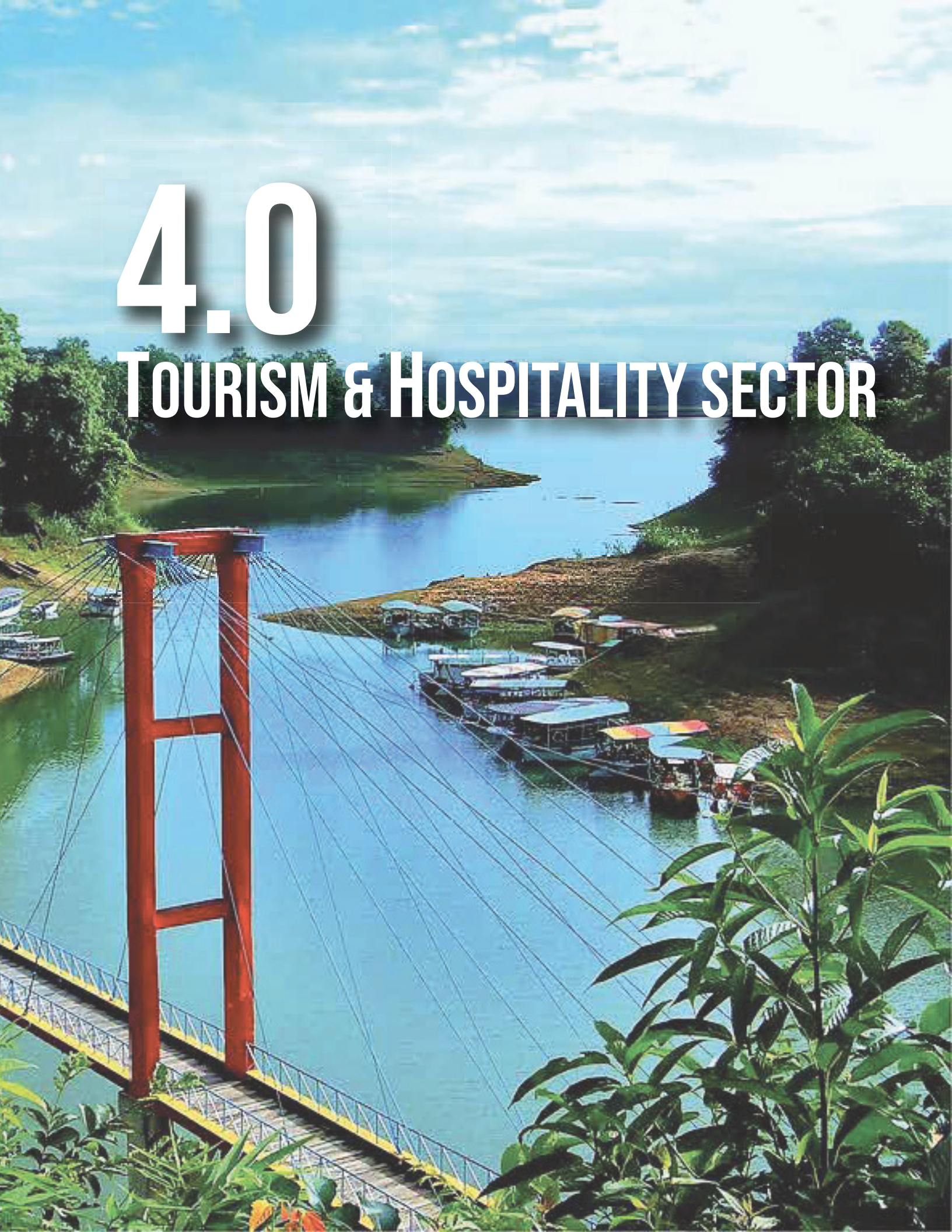
Policy suggestions

The last arena of policy suggestions exists in the domain of social welfare and is the most controversial. As stated earlier, it is unrealistic to expect that all of the labor within the furniture manufacturing sector at present can be adequately retrained as the labor market changes and that the net total of jobs proportional to the population will remain the same. It is thus evident, in order to maintain the welfare of those displaced and unable to find similar work, that there must exist policies which embrace the needs of those left behind, should such a population manifest.

A Glimpse of Consultaion on Future Skills in Furniture sector

3.4 Conclusion

The Bangladesh government expressly considers its furniture sector to be both a source of future employment for its citizens and an integral driver of the nation's economy. Although these objectives appear to run parallel to one another at first glance, moving into the twenty-first century, further scrutiny begins to reveal future deviation in their respective trajectories. The same advances that can keep the manufacturing sector competitive and producing wealth for the Bangladesh economy threaten to displace low and semi-skilled laborers. Although the future of the relationship between automation and labor is shrouded in bitter disagreements, Delphic prophesies, naïve optimism, and tired cynicism, the trend toward the integration of automation technology into manufacturing production lines and process chains of furniture sector is undeniable. It may not be possible to precisely predict the employment figures in decades to come, but it is as obvious that the government and the industry should start planning now. Only by being realistic about the future of labor in the furniture manufacturing sector can the nation deliver effective policies to simultaneously promote employment and the vitality of the sector.



4.0
TOURISM & HOSPITALITY SECTOR

In Bangladesh, the direct **contribution** of T&H sector to GDP was **BDT421.4bn (USD5.3bn), 2.2%** of total GDP in **2016** and is forecast to rise by **6.2% in 2017**, and to rise by **6.1%pa**, from **2017-2027,** to **BDT 806.6 bn (USD10.2bn), 2.1%** of total GDP in **2027.** The total contribution of T&H sector to GDP was **BDT840.2bn (USD10.6bn), 4.3%** of GDP in **2016,** and is forecast to rise by **7.2% in 2017,** and to rise by **7.1% pa to BDT1,783.0bn (USD22.6bn), 4.7%** of GDP in **2027.**

In **2016** T&H sector directly supported **1,057,000 jobs (1.8% of total employment).** This is expected to rise by 1.8% in 2017 and rise by **0.6% pa to 1,138,000 jobs (1.6% of total employment) in 2027.** In **2016,** the total contribution of T&H sector to employment, including jobs indirectly supported by the industry was **3.8% of total employment (2,187,000 jobs).** This is expected to rise by **2.7%** in to **2,247,000** jobs and rise by **1.8% pa to 2,695,000 jobs in 2027 (3.8% of total).**

4.1 Impact of automation in Tourism & Hospitality sector

Contemporary information society has made Tourism a highly information intensive industry as automation has a potential impact on the tourism business. The role of automation in the tourism industry cannot be underestimated and it is a crucial driving force in the current information-driven society. It has provided new tools and enabled new distribution channels, thus creating a new business environment. ICT tools and automation have facilitated business transaction in the industry of product services and providing information to consumers across the globe. On the other hand, consumers are also using online to obtain information and plan their trip and travel. Information is the key element in the tourism industry. Automation pervades almost all aspects of tourism and related industry. For instance, we depend upon it right from the scratch while identifying and developing tourism site and destinations itself. The use of Geospatial Information Technologies in recent years across the globe for varied purposes is popularly known and Tourism industry has not been an exception in availing its advantages. It can be used by tourist professionals to define the boundaries of the proposed tourist site as well as its surrounding areas and the communities living in it. It can also get information on roads linking to the sites and availability of other utilities like water, power, market etc. Such technologies are also useful for site management and monitoring. The role of ICT tools in the industry for marketing, operation, and Marketing techniques can be more innovative through automation.

6 MAJOR CHANGES THAT ARE EXPECTED IN THE T&H SECTOR ARE:


AUGMENTED & VIRTUAL REALITY (AR AND VR)


VOICE TECHNOLOGY


ARTIFICIAL INTELLIGENCE (AI)


INTERNET OF THINGS (IOT)


WI-FI CONNECTIVITY

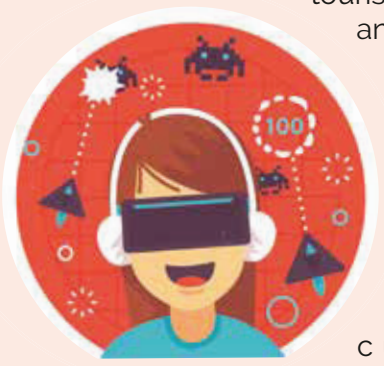

WEARABLE DEVICE

Automation

in Tourism and Hospitality sector

Augmented & Virtual Reality (AR and VR)

The past few years have seen an increase in AR or VR popularity among travel and tourism companies, and the trend is set to continue. These technologies are being used either for content marketing or to enhance the customers' experiences.



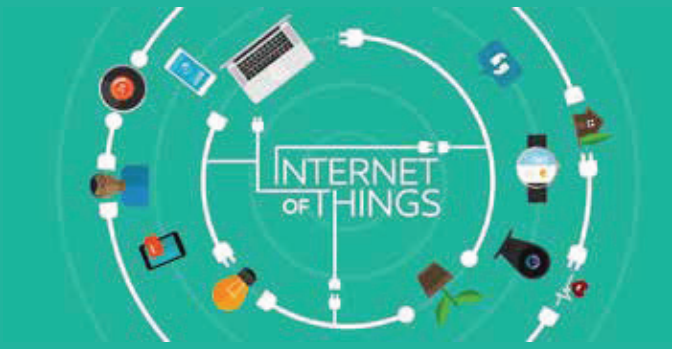
For example, airlines have started using VR technology to show travelers the cabins in advance, in order to increase ticket or ancillary services sales.

Artificial Intelligence (AI)

AI is behind many evolving technologies and innovations in the travel and tourism sector.

The ways in which it helps the industry can be classified into three major categories: Machine Learning, Chat Bots or Travel Bots, and Robots. Thanks to AI, operations which usually require human intervention and a lot of time to learn new skills, can be automated, thus speeding up processes, while improving quality and performance, and decreasing costs.

Internet of Things (IoT)

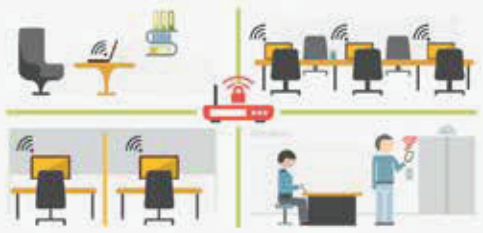


IOT has a lot of potentials to shape the future of the travel and tourism industry, and companies have started to realize that. An example of an industry player using IOT to reduce anxiety and stress levels associated with lost bags is Lufthansa. Passengers can track their baggage via a link found on their mobile boarding pass in the Lufthansa app.

Voice Technology

Voice technology is another digital novelty that is beginning to disrupt the travel and tourism sector, as more and more customers switch from typed in search to voice interactions. More and more hotels have started experimenting with voice-activated devices. Among them are W Austin of Marriott International, Kimpton Alexis Hotel, and Westin Buffalo.

Wi-Fi Connectivity



When travelling, people want to always be connected, either to get destination ideas, options regarding places to visit or eat, find directions to points of interest, or share their experience with friends via social media or other connectivity platforms. As a result, investing in network services helps companies offer a more seamless and highly personalized experience to customers, boosts operational efficiency, real-time decision making, strengthens the physical (via CCTV) and the cyber security, along with data privacy.

Wearable Device

Despite a sluggish start, travel and tourism companies are gradually using this technology to offer customers a more personalized and united experience. For instance, the Walt Disney Company deployed a wearable, customizable, RFID-equipped Magic Band, which connects to the theme park infrastructure, to reduce waiting times and track guests' locations and activities.

4.2 Possible occupations and number of jobs at risk

The major occupations that are expected to be at risk due to automation can be divided into four parts. These are front office management, housekeeping, sales and marketing and revenue management. At the accessibility level, the automation is going to have a serious impact on the front office management jobs.

Major jobs that are going to get affected are:

4.3

Emerging
new occupations

As the Fourth Industrial Revolution expands, digital is increasingly becoming a basic requirement to be competitive across the T&H sector. Countries not integrating technology and enhancing their connectivity will be left behind. The new occupations that are expected to emerge in this sector are related to social and emotional skills, technological skills and higher cognitive skills. Occupations like **demichef, chef de party, and pastry chef specialized front-of-house waiting and other staff, digital marketer, tourism product developer using augmented reality** will require more workers.

Major new occupations that will emerge in T&H sector are:

Front Office Management

Chef Concierge with knowledge management and data analytics ability, Voice Activated Device Managers,Chat Bots, Travel Bots operators

House Keeping

Wi-Fi connectivity managers, networkers, internet security designers for the tourism industry, IOT managers for the laundry room and housekeeping operations, mechanics and electronic operators

EMERGING NEW OCCUPATIONS

Sales and Marketing

Digital Marketing Executive, Digital Marketing Manager, Big Data Analyst, Content Developer, Digital Brand Manager

Revenue Management

Revenue Analyst

4.4 Food and Beverage Production

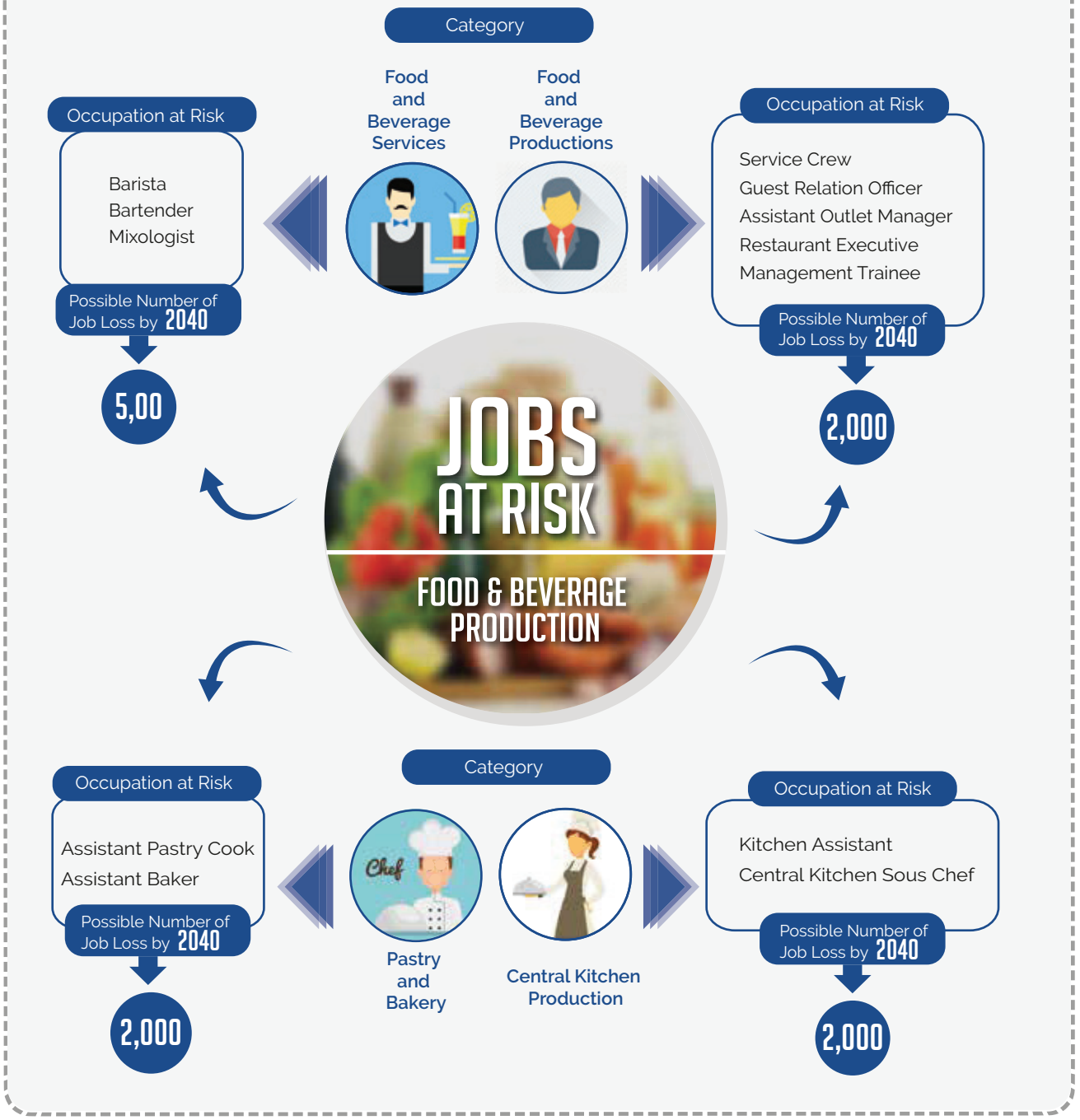
For the purpose of this report, food and beverage production for the tourism and hospitality industry has been reviewed in a different way. During the consultation process, the subcategory was discussed and analyzed separately. Industrial Robot is slowly expected to bring in a massive shift in the food and beverage production. Industrial robots for entertainment purposes in tourism have been present for a long time, mainly due to their efficiency and reliability. However, it is also slowly stepping into the food and beverage production. More recently, Royal Caribbean Cruises introduced robotic bartenders on their newest vessels (Quantum Class). Those robots can **mix 2 drinks per minute (or 1000 drinks per day)** and offer a menu of 21 cocktails aside their ability to handle custom orders. Moley Robotics has constructed a robotic kitchen and is currently developing an end-consumer version of its product). The robotic chef can cook over 100different meals and provide unlimited access to chefs and recipes. Its estimated price is **$92.00**.

Robotics and Automation in the Food Industry

Major occupations that will be Affected by Automation in Food and Beverage production of T&H Sector:

Due to automation, there will be a major shift in the occupations like beverage service, pastry and baking, central kitchen production and quality assurance. The occupations that are likely to be untouched by the automation for now, are culinary arts and research and development.

Major jobs that are going to get affected are:



Because the **21st-century food industry requires 21st-century skills**, employees who don't retire in the next 10 years will need new training to expand their expertise. Entry-level workers will need to be convinced there's a bright future in food production. Technology is drastically changing the way all manufacturing happens. To remain competitive in tomorrow's food processing industry, here are **7 areas** where skills matter most:

New Occupation	Description of the Occupations
 Mechanics Expert	Advanced mechanical operations are quickly replacing traditional manufacturing across industries. Employees who can see the big picture will be crucial to strong plant operations of the future. Jobs in the new millennium require knowledge of facilities design, lean manufacturing practices, work measurements, and process controls.
 Electronics Expert	Some labor shortages may be filled by automation technology, moving available service and labor technicians into new areas of expertise. With machines taking over more of the production line, humans must know how those machines work and are able to operate and service them safely and efficiently.
 Computation Expert	The Industrial Internet of Things (IoT) now allows manufacturers to collect data on everything. At a basic level, workers need to be able to operate the sensory systems as they communicate along the supply chain. The food industry also needs programmers who can write applications that will manipulate data, assist operations, and interface with consumers online.
 Communication Expert	Food and beverage industry will need professionals who understand the mechanics of communication–with consumers, with employees, and with supply-chain partners. These crucial professionals need technical skills to use 21st-century communication tools. They also need strong relational awareness to bridge personal, cultural, and industrial gaps as manufacturing processes become more diverse and global in their scope.
 Safety Expert	Consumers will require food manufacturers to devise new ways of testing and keeping food safe, handling recalls efficiently, and preventing large-scale adulteration. Professionals who can execute on these new requirements will have up-to-date skills in biotechnology, supply-chain communication, and safety training.
 Environment Expert	As population growth and production demand put increased pressure on the environment, food manufacturers need to consider how to make food processing sustainable. Food companies are forming green partnerships and developing new packaging, and exploring cross-industrial options. The food and beverage industry will require more environment experts in the coming days.

4.5 Recommendations

Adaptability will be a hallmark of the transition to a new era for the tourism industry. The term adaptability is used to express a company's ability to adjust its organization and workforce for the transition toward a more automated future. It was found during the consultation workshop that more companies are planning to increase agility in their organizations than see adaptability of workers as a constraint. This shows rigid internal structures and lack of flexibility today that will stand in the way of transformation and innovation. Not surprisingly companies that plan to increase their agility in general also see the need for a more adaptable workforce. Companies can do much to shape the workforce of the future, but other **stakeholders** also have an active role to play: **educational institutions, industry associations, labor agencies, and policy-makers, as well as non-profit organizations including foundations.** Sometimes, partnerships across the ecosystem can be most effective. There are some collaboration programs in a few countries which might provide ideas or inspiration for others. Following are some of the ideas that were discussed during the workshop, while acknowledging that we only skim the possible actions.

Education institutes

Education institutes need to contribute in T&H sector by developing courses on skills most relevant in the future. For now, many companies tend to think in isolation about their retraining programs. During the workshops it was discovered, most firms saw themselves as being responsible for developing and delivering these programs. At the same time, a range of higher education institutions, and other experts have called for universities, colleges, and other educators to play a more active role in filling the needs of the labor market. Technology can provide some ways of bridging the gap between educators and companies. Virtual and remote programs are cheaper than classic in-person courses. **Ad hoc methods such as open online courses, boot camps, and code schools** have attracted rising public interest and can sharply reduce the time needed to acquire some skills that previously required classic, degree-oriented programs. Part-time education programs or non-degree certificate courses also allow for broader access than classic full-time programs, especially for the education of adults. However, while online courses increase access to learning opportunities in general, research suggests that people who are already highly educated are overrepresented among today's participants in such courses. To further strengthen the retraining of those underserved today, improved coordination between companies and educational institutions would be beneficial.

Industry associations and TVET institutes

Industry associations and TVET institutes can improve matching of jobs and skills, including through retraining and talent pipelines. Industry associations and TVET providers, working together as partners, have traditionally played central roles in training efforts in several sectors. Both sets of stakeholders have **potentially significant roles to play in addressing shortages of certain skills and retraining in the automation era in the tourism and hospitality sector.** At a time when competition for talent is heightening, industry associations can enable employers to collaborate on building more talent faster within a particular sector. The aim is to help access to the skills they need while providing more affordable career pathways for learners and workers. **Their approach is to create a high-quality quality assurance system with increased employer leadership and investment to provide an alternative to accreditation style business models in the tourism and hospitality sector.**

Consultaion on growing skills in the Tourism and Hospitality Sector

Government agencies and policymakers

Government agencies and policymakers can strengthen support for workers in transition and improve mobility, including with a shift to portable benefits. Appropriate action on retraining and workforce benefits will differ among sectors including tourism and hospitality industry depending on skills requirement differences around individual responsibility and the role of the government. In the changing skills environment, policymakers will need to clarify the roles of individuals, companies, and government agencies.

Nonprofit organizations

Nonprofit organizations can work with **companies and government agencies to help workers acquire new skills in the tourism and hospitality sector.** Non-profit organizations have a flexibility to develop innovative approaches to issues relating to skills, and some have been testing novel approaches. NGOs can work with the TVET institutions and private sector to develop innovative models, help develop the infrastructure.

Pilot project

Initiatives should be taken to develop a pilot project with early adaptors of automation. Some of the companies (i.e. Khan's Kitchen) have already started automating the process and initiatives should be taken to further research the impact of such automation as well as develop a pilot project expanding the scope of such automation. **Initiative should take to work with universities to develop specific courses on digital marketing and data analytics** for the Tourism and Hospitality sector. Steps should be taken to analyze the current scenario of the TVET institutions, identify some of the potential early adaptors and develop an extensive financial and implementation plan to start pilot courses looking at the future automation of the Tourism and Hospitality sector.

Analyze the current scenario of the **TVET institutions**, identify potential early adaptors to develop an extensive financial and implementation plan to start pilot courses on future skills required in **T&H Sector**

A Glimpse of Consultaion on Future Skills in Tourism and Hospitality Sector

4.6 Conclusion

The dynamics of Information exchange among the Tourism & Hospitality sector players has drastically changed in recent years. The industry is now more complicated as there have been considerable changes in the distribution and sales. Distribution cooperation is expanding. While transport companies now provide opportunity to book accommodation, destination management organizations is developing an internet portal to distribute information. It is essential for the tourism professional to understand the Tourism Value Net. They also need to know the main players in the industry. The statistical database should be developed and research should be undertaken. Educational institutions should have access to such knowledge. The educational institutes should promote technology based digital courses. It should be supported with technical training as well as field-based training and practical experience in the industry. Educational institute specialized on Tourism education; IT educational institutions and tourism industry players like travel agencies, tour operators, hotels, technology providers etc. should have a network and have constant interaction in order to develop a skills base for the successful tourism industry and a successful navigation. The industry is generating excessive information and indeed information is the strategic and important resources for the industry. ICT tools are providing new means for analyzing the information for the industry. Emphasis should be upon converting this valuable information to the knowledge system. There should be a gradual transition from a data system to profound knowledge system for the benefit of future generations.

5.0 LEATHER & FOOTWARE SECTOR

Bangladesh leather industry is well established and ranked second in terms of export earnings. Because of its high-value addition and huge growth and employment opportunities, the leather sector has already been declared a thrust sector of the country. Additionally, recent research is being carried out to produce footwear in combination with leather and other locally sourced natural fibers. Bangladesh accounts for 3% share in the global leather & products market. Almost **95%** of its annual output is being exported. The export of leather and leather products increased manifold over the past decades. **The compound annual export earnings crossed billion dollar mark in the year of 2013-2014.** The composition of leather and leather goods from Bangladesh underwent a structural change. Whereas in 2008, 62% of all export earnings from the sector came from finished leather, by 2014, this proportion came down to 39%. **The growth of the footwear industry has increased from 20% of total sectorial export earnings in 2003 to 43% in 2015.** Products such as fabric-based footwear are also now being produced in Bangladesh for global retailers. Because of sustained growth performance and its increasing competitiveness in producing quality products at least **51 foreign companies have shown interest in establishing footwear units in Bangladesh.**

5.1 Impact of Automation in Leather & Footware sector

We have had three **"industrial revolutions",** the last being in the second half of the 20th century when computers began to be used. The first was the original Industrial Revolution of the 1700s created by the steam engine and mechanical textile looms. The start of the 20th century saw the second when the concept of interchangeable parts evolved into mass production, aided by the use of electricity.

Now it is different. The computers and robots that helped create the third revolution have not disappeared but they are capable of being used in quite different ways and are being added to by a host of new technologies whose costs have fallen dramatically in the last ten years. Part of this is the fables 'Internet of Things' when inanimate objects communicate with each other and take autonomous decisions.

This is what we hear of as disruption. **Microsoft has published a report, which used Harvard Business Review services to survey nearly 800 diverse businesses, that indicates that nearly all expect huge changes in their business by 2020. Quite a few talks about their existing model becoming obsolete.**

We know that in a tannery we still need to remove the hair and tan the hide, but how it is done is clearly starting to change. Anyone who looks at a modern lime yard and compares it 40 years ago can see a huge difference. The different approach between an automobile leather tannery and a footwear leather tannery making shorter runs and a wide variety of products has become far more obvious in recent years and looks likely to extend. How we buy and maintain our machines is changing, and the information they can collect and tell us too.

Beyond that, think about the need to reduce stock holdings throughout tanneries to move goods through faster; and essential requirement for speed in an always-ona society where things are bought when they are seen and delay is not acceptable. Robust data and communications will be needed to avoid catastrophe as step by step our old safety nets are removed.

Major occupations that are in threat due to automation in Leather & Footwear sector are:

Major jobs that are going to get affected are:

Skills and Occupation

Leather Goods

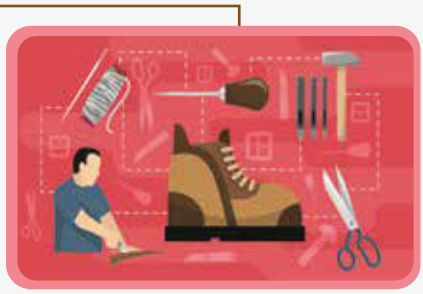
Possible Number of Job Loss by 2041

10,000	Leather cutting by hand
10,000	Leather sewing by hand
5,000	Synthetic material cutting by machine
5,000	Skive leather pieces
2,000	Split leather pieces
5,000	Embossing and stamping operation

Leather Footwear

Possible Number of Job Loss by 2041

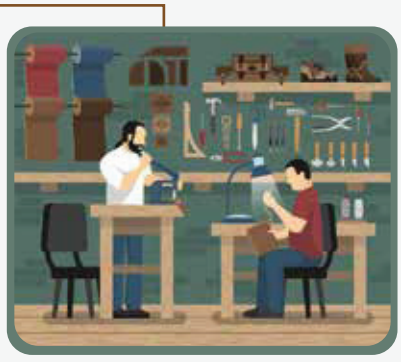
10,000	Leather cutting by hand
5,000	Show hand lasting
5,000	Embossing and stamping operation
5,000	Footwear finishing
5,000	Shoe upper sewing
20,000	Leather cutting by hand



Tannery

Possible Number of Job Loss by 2041

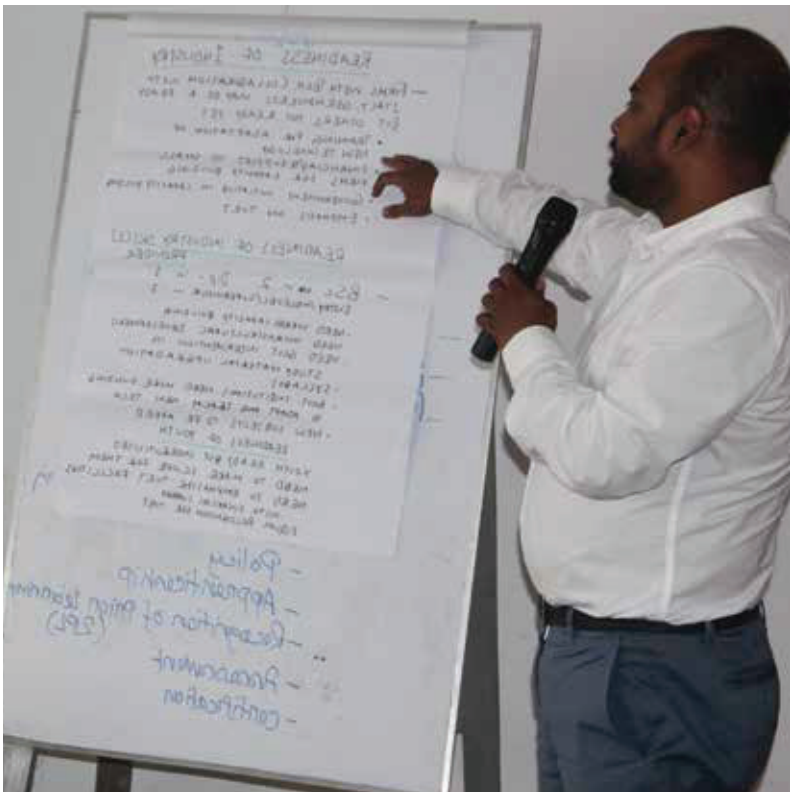
5,000	Leather trimming
5,000	Performing drying operation
2,000	Preparing chemicals as per requirement



5.2

Emerging new occupations

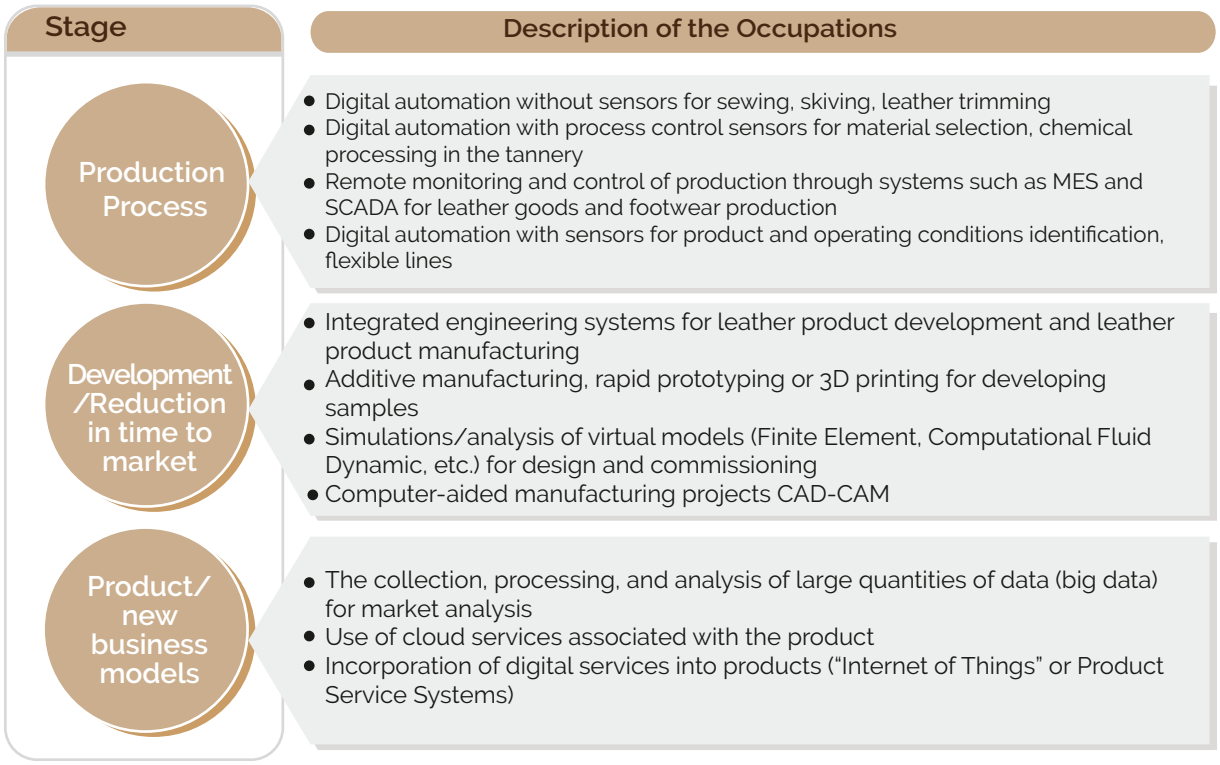
In relation to digital technologies applied to processes, Bangladeshi leather companies are still far from adopting more flexible and dynamic lines. Of all companies, it is expected that little more than half of the companies will adopt digital automation with sensors for process control. Regardless of company size, this will be the most used digital technology in the industry, although among large companies the adaptation of this technology will be higher. Digital automation with sensors to identify products and operating conditions, which allows for flexible and autonomous lines, will be used by the Bangladeshi leather Industry. Adopting more flexible production lines allows to implement the concept of mass customization, which reduces the minimum scale for efficient production and allows companies to serve customers of different tastes and needs, that is, in addition to reducing production costs, it increases the market in which they operate.



Digital automation with sensors to identify products and operating conditions is seen as the next natural stage of digitization of the production process. It is noteworthy that it was cited as important for the competitiveness of industry during the stakeholder consultation meeting. The second most to be used digital technology in Bangladeshi leather industry can be classified as focused on product development, reducing the time to make products available to consumers: integrated engineering systems for product development and product manufacturing. Special mention should be made, however, of the rare use of the other technologies to reduce development costs and the set-up of manufacturing processes. Simulations and analysis with virtual models will also be used by leather companies, as well as additive manufacturing, rapid prototyping or 3D printing for designing and sample development.

Little use will be made of technologies focused on products: small number of advanced export-oriented companies will collect process and analyze large quantities of data (big data). Some of the companies will use cloud services associated with products and will incorporate digital services into products (internet of things or product service systems).

Major emerging new occupations in the leather sector will be as follows:



5.3 Recommendations

Major recommendations from the consultation workshops are as below:

Implementing digital technologies

The focus on processes becomes even clearer when evaluating the benefits that companies expect to achieve by implementing digital technologies. The two main expected benefits from the companies are reducing operating costs, as indicated by participating enterprises and increasing productivity. Optimizing automation processes ranked fourth among the benefits mentioned by the entrepreneurs. The item **"improving the quality of products or services"** was indicated by the companies as one of the main benefits expected from digitalization and ranked third. Many of the enterprises also mentioned **"developing more customized products or services"** (related to product) and **"improving decision-making processes"** (related to management) among other benefits. For large companies like Apex, improving the quality of products or services is also an added benefit. The three benefits most mentioned by large companies are focused on processes: reducing operating costs; increasing productivity; and optimizing automation processes. Though the companies have a clear idea regarding the benefits of automation, it is strongly recommended that further in-depth research should be conducted to understand the impact of automation in the leather sector.

Internal barriers

For most companies, implementation costs constitute the main internal barrier to the adoption of digital technologies. The items "lack of clarity in defining return on investment" and "corporate structure and culture" are also mentioned as major barriers to automation. When the analysis is restricted to the group of companies that use digital technologies, it can be seen that corporate structure and culture decline in importance as an internal barrier. Though automation is a natural process lot of the companies still have a lack of clarity in defining return on investment for automation. The high implementation cost is the main internal barrier, as indicated by participating leather, leather footwear and leather goods companies. The government in partnership with the private sector involvement in the leather industry should develop a strategic plan for automation which should include a plan for the pilot project and cost sharing.

External barriers

Among all external barriers, special mention should be made of lack of skilled workers, who can lead the automation process. Lack of technical standards and inadequate regulation were not seen as a major issue by the stakeholders. As a result, the participants in the workshop strongly recommended that the pilot new courses on automation in the leather industry should be designed, developed and rolled out in selected technical and vocational training service providing institutions by 2021.

Initiatives

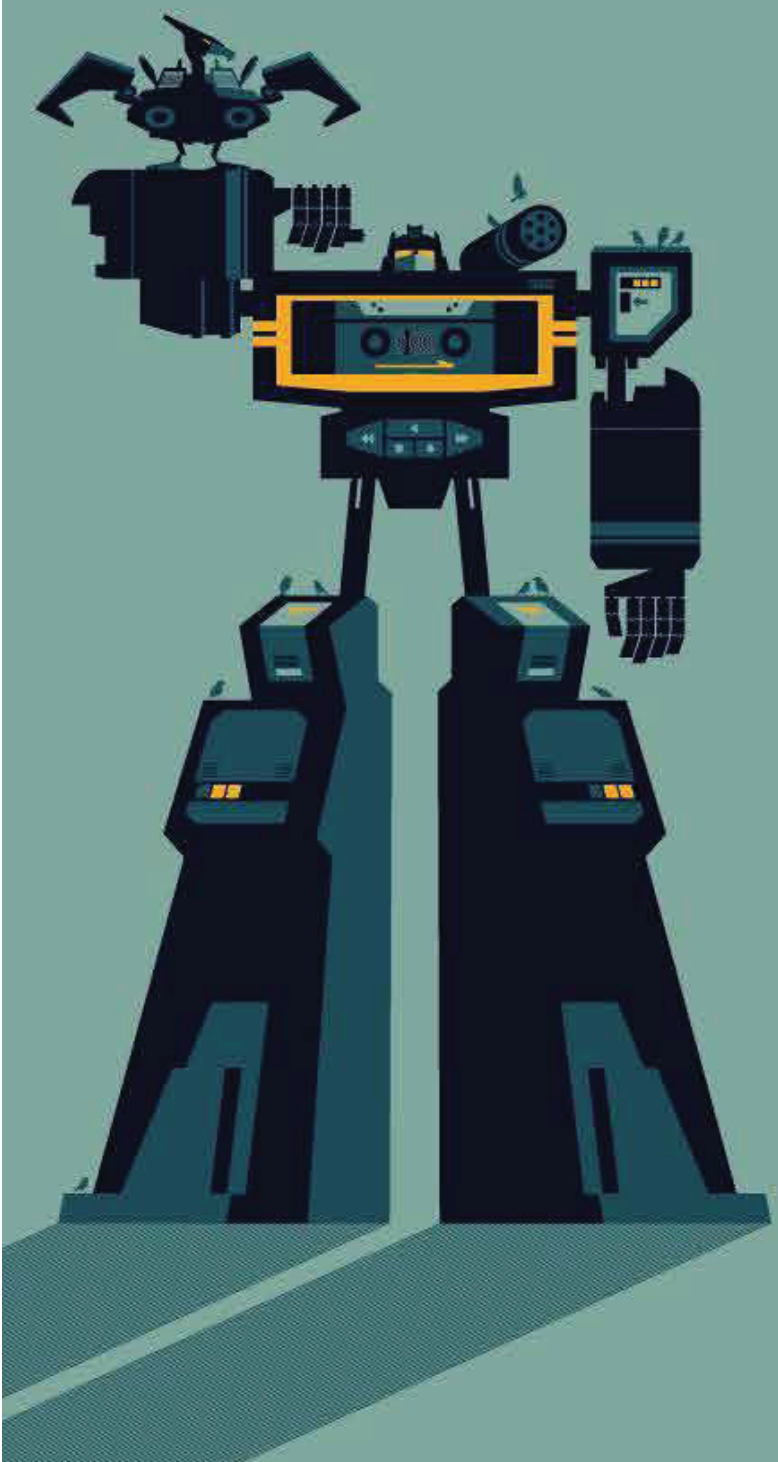
All the participating leather enterprises believe that the government should promote the development of digital infrastructure (broadband, sensors) to accelerate the adoption of digital technologies in Bangladesh. Education ranks second: for most of the companies, investing in new educational models and training programs should be one of the top three priorities. This option is followed by the need to establish specific credit lines for automation. Other issues related to the establishment of regulatory frameworks and technical standards and to data transfer and security were also listed among the most important measures. Government investment in new educational models and training programs is as important as the development of digital infrastructure for companies in low-technology and medium-low technology leather industries.

A Glimpse of Consultaion on Future Skills in Leather and Footwear sector

5.4 Conclusion

It is not the case that today's workers lack skills, but the skills they possess may not be the skills in demand in new workplaces. Qualifications are and this is commonly agreed – one of the most prominent challenges when it comes to Industry 4.0. The changes in the required skills are not just a challenge for workers, but they also have strong impacts on societies, especially in developed Bangladesh where skills gaps and skills misfit are already common problems in the labor market. Though leather sector will slow to adopt automation due to the nature of the raw material but initiatives must be taken from now on to ensure a smooth transition to industry 4.0 in the Leather & Footwear sector.

PART- C
CONCLUSION



Data, devices, algorithms, sensors and humans all form part of the future manufacturing landscape known as Industry 4.0. The rapid acceleration of technological innovation is giving rise to smart connected factories and promises to bring a wave of disruption with it. In fact, Industry 4.0 has the potential to create a tectonic shift in the global value chain as factories across the world become increasingly digitized and less labor intensive.

One such shift is the decision by many developed countries to invest in automation technologies as a cheaper option to taking their production plants offshore. With cost-saving, efficiency and sustainability being top drawing cards behind robotized factories, it is expected that more countries will choose smart conveyor belts over human-based factories in the not too distant future. Yet, the factory of the future doesn't spell doom for the countries like Bangladesh which depends on the outsourcing of its labor force by western companies. In fact, new opportunities are availing themselves that might give Bangladesh pole position in the age of the smart factory, if measures are taken from now on. Bangladesh has a unique advantage over developed countries in that it isn't weighed down by infrastructure and other legacy issues and faces comparatively little resistance when embracing disruptive technologies. Also, its relatively slow uptake of technology compared to the rest of the world has created a unique opportunity for the continent to "leapfrog" what is today considered outdated technologies and get ahead of the innovation curve. An example of leapfrogging is the massive adoption of mobile phones in lieu of desktop or laptop computers in Bangladesh. The continent has fully embraced connectivity in a way that's unique to its populace. Mobile infrastructure advancement has made it possible to connect millions of Bangladeshis across rural and urban areas.

The effects of previous industrial revolutions have been well documented. If we go back to the very first one, manufacturing moved from homes to the newly created factories. With the shift, some skills were carried over but most had to be adapted to new working conditions. The second and third revolutions saw a similar shift. With every industrial revolution there has been a requirement for a skill change. We are seeing the same trend with the industrial revolution occurring today - Industry 4.0.

However, this is perhaps the first time that Bangladesh and Bangladeshi companies have had to worry about how their manpower will keep up with the pace of change. Previous revolutions were seen as job and growth creators; with Industry 4.0 there is a concern that it may eradicate jobs and lead to unemployment.

Disruptive technologies like artificial intelligence are transforming global production systems. Factory processes and the management of global supply chains are all being impacted. This is creating a new wave of competition among countries because, if adopted correctly Industry 4.0 can unlock a 30-40% increase in productivity.

However, a crucial factor to unlocking this potential is labor, which needs to be up-skilled to handle these technologies. We also cannot run away from the fact that some jobs will be lost. The people doing these jobs need to be re-skilled to continue contributing. And this is where Bangladesh should focus.

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