Publisher homepage:www.universepg.com, ISSN: 2707-4668 (Online) & 2707-465X (Print)

https://doi.org/10.34104/ajssls.022.01480159

Asian Journal of Social Sciences and Legal Studies

Journal homepage: www.universepg.com/journal/ajssls

IR 4.0 Readiness of Apparel Industry in Bangladesh

Sadia Sharmin*

Department of Management, Faculty of Business Studies, University of Dhaka, Bangladesh.

*Correspondence: sadiasharmin24@gmail.com (Sadia Sharmin, Assistant Executive & Project Director, Skills for Employment Investment Program (SEIP), Finance Division, Ministry of Finance, Peoples Republic of Bangladesh).

ABSTRACT

Innovation and technological advancement are crucial for the apparel industry, particularly in manufacturing, made-to-order items, and customer requirements. This industry has become one of the most critical aspects of Bangladesh's industrialization process. However, businesses now strategically drive a series of changes, both from an organizational productivity perspective and a technologically supportive one. Industry 4.0 has significant potential to swap the business and manufacturing processes. Although perceptible advancement has been made in the practice of Industry 4.0 technologies and innovation in the manufacturing industries in industrialized countries, there is hesitation about the readiness of competitive businesses and manufacturing industries in developing countries like Bangladesh to adopt Industry 4.0. This study investigates the Bangladeshi apparel Industry's preparedness to implement Industry 4.0. A mixed-methods strategy has been implemented to evaluate the Bangladesh garment sector's readiness. The quantitative information was gathered through an online survey backed by a questionnaire instrument and quantitative methods of the Impulse Foundation of the Mechanical Engineering Industry Association (Verband Deutscher Maschinen- und Anlagenbau-VDMA). Furthermore, the qualitative data was taken through key informant interviews (KIIs). This exploratory research focused on how companies use technological tools and methodologies and how prepared to adopt the massive changes brought forward by IR 4.0. Based on this study's findings, apparel companies should use technologies such as ERP, Big Data, Cloud, M2M Communication to boost Bangladesh's global competitiveness. In addition, respondents believed that digital transformation could create a smart factory to optimize the manufacturing system, which has a very substantial impact on industry 4.0. Moreover, this exploratory study revealed that Bangladesh's garment companies face significant difficulties in IR 4.0 strategy design and equipment organization to meet IR 4.0 expectations. It is also revealed in this research that skills related to Industry 4.0 exist in hands in Bangladesh. Therefore, further research is needed to discover more features of Industry 4.0 adoption and skilled employee prerequisites.

Keywords: IR 4.0, Fourth industrial revolution, Apparel industry, RMG sector, Readiness, and VDMA.

INTRODUCTION:

Bangladesh's readymade garments (RMG) sector, a $38.52 billion industry (Export Promotion Bureau, July-May 2021-2022), and the country's top export earner have begun green manufacturing by constructing 135 eco-friendly green buildings, the highest number in the world. In response to the rapid technology advancements, the garment and fashion sector is on the verge of a massive transformation. Various transformations and technological progress are brushing the apparel industry, specifically in manufacturing, E-tailing, customer-oriented and individualized mass

production, and consumer demands (business-to-consumer retailing). In addition, businesses must now strategically pursue a series of changes, both from an organizational productivity perspective and a technologically supportive one. Consequently, it has now become pertinent for apparel factories to adopt new technologies related to IR 4.0 to sustain in an internationally competitive market. Recent research indicates that technology propels certain nations into the fourth industrial revolution. According to experts, the potential for the fourth industrial revolution may include maximizing wealth through the ongoing improvement of inclusive GDP growth and enhancing social development indicators such as education, health, and the environment.

This fourth industrial revolution intends to restructure industrial production through information and technology and capitalize on newly discovered technologies and concepts. Thus, the production system of Industry 4.0 is more adaptable and intelligent, enabling industries to generate more customized products more efficiently. Since the term "Industry 4.0" is often used to designate the developing progression in managing production and manufacturing as well as chain production, it takes substantial importance for developing industrial countries, which largely depend on production and export (Benayoune *et al*., 2021).

Most developing countries, for example, Bangladesh, India, Pakistan, Philippines, and Nigeria, rely on manufacturing products to be delivered to foreign countries. Consequently, if these nations can adapt to managing production and manufacturing as well as chain production, the present rate of unit output relative to unit input will increase significantly, and it will be a crucial criterion of Industry 4.0 for these nations to be considered for advancement.

Objectives of the Study

This research's main objective is to investigate the Bangladeshi RMG/apparel Industry's readiness to implement Industry 4.0. Specific objectives: To achieve the main objective, the following specific objectives are formulated –

a) To examine the level of apparel/RMG factories (big, medium, and small) in Bangladesh regarding IR 4.0 readiness.
b) To inspect and determine whether the size of the factories is the critical determinant for the IR 4.0 readiness.
c) To explore where apparel industries in Bangladesh need to prepare to adopt and implement IR.4.0.

Research Questions

1) What is the readiness level of Bangladesh's apparel/RMG factories (large, medium, & small) for IR 4.0?
   a. Readiness with regard to organization strategy
   b. Readiness with regard to organization infrastructure
   c. Readiness with regard to intelligent operations
   d. Readiness with regard to intelligent products
   e. Readiness with regard to data-driven services
   f. Employment/talent/skill match strategy preparedness
2) Is the size of the factory the most important factor in determining IR 4.0 readiness?
3) In what ways must Bangladesh's apparel Industries prepare to adopt and implement IR.4.0?

Basis of the Study

The world is transforming towards Industry 4.0, and Bangladesh needs to immediately adopt new technologies and build an operational structure for its business. Lately, IR 4.0, with its extensive industrial automation, is interrupting almost every industry, starting from Readymade Garments (RMG) and Textile to Furniture, from Agro-processing to Leather and Footwear, and even the Tourism and Hospitality sectors of Bangladesh. The nation’s RMG and Textile industries comprise a massive 14.07% share of GDP, are responsible for 85% of the aggregate export earnings, and employ around 4 million labors. Despite the threats of unemployment, the apparel industry/RMG is slowly adapting automation technologies to stay on par with efficiency, growth, and international competition (Farhana *et al.*, 2022). International competitiveness is perhaps fiercely faced by the apparel sector, and to maintain an edge over the competitors, BGMEA needs to formulate policies inclusive of the latest technologies and innovations. Industry 4.0 can play a significant role in this regard, as it is entirely operated with IoT, thereby presenting the opportunity to reduce lead time and increase customer responsiveness with opti-

mum cost (Alam and Dhamija, 2022). The study proposed three frameworks that will be effective, feasible, and significant for implementing Industry 4.0 in the apparel industry of Bangladesh. To overcome the traditional supply chain challenges, Bangladesh Government and BGMEA should work collaboratively in changing infrastructure and building a digital ecosystem for a better future. Industries should also adopt these new revolutionary frameworks as soon as possible to compete in the global market (Rahman and Maniam, 2022). As an emerging developing nation, Bangladesh is adopting innovative technologies in many sectors for socio-economic growth despite obstacles such as a lack of awareness, a lack of finance, the availability of cheap labour, and the need for digital infrastructure and skills. Nevertheless, public and commercial entities are presently undertaking steps to expand infrastructure and human, technical, and financial capacity, enhance education and training systems, and reap the full benefits of IR 4.0. Thus, the study examines the outcomes of assessing IR 4.0 preparation in Bangladesh's garment industry, the difficulties and possibilities of the Industry 4.0 revolution, and the recommended strategic solutions.

Literature Review

According to (Souza *et al.,* 2022) the four enablers of a Smart Factory are Smart operators, Smart goods, Smart machines, and Smart planners. Since Industry 4.0 is still a relatively novel idea, there are no scholarly publications related to Industry 4.0 in Bangladesh now. However, there are several publications and reports on the applicability of Industry 4.0 concepts in industrialized nations. A report by Deloitte identifies the benefits of Industry 4.0 for the Swiss manufacturing sector, which may be applied to any other country, including Bangladesh, despite our status as a developing nation. This study examines the extent to which Swiss manufacturing enterprises have already positioned themselves for this digital transition and the benefits of adhering to Industry 4.0. Some recommended benefits are increasing competitiveness, utilizing chances and decreasing risks, adapting people and IT resources, expanding the potential for unique business segments, and leveraging impetus from exponential technologies (Deloitte, 2015).

The adoption of Industry 4.0 needs

1) The horizontal integration of the value chain.
2) A networked production system and vertical integration.
3) The end-to-end digitalization of engineering design along the complete value chain.

They believe that new technologies such as IoT, wireless sensor networks, big data, cloud-based services, embedded systems, and mobile Internet meet these requirements (Jiang *et al.*, 2022). Hermann, Pentek, and Bucker and their co-authors, in their analysis of 50 studies, identified four basic tools needed to implement Industry 4.0 within the company (Bücker *et al.*, 2016).

These are CPS, IoT, the Internet of Services, and the Smart Factory. These are, in themselves, comprehendsive categories, and do not specify the technical tools needed to operate the CPS (e.g., sensors). Adopting modern technologies of the fourth industrial revolution (IR 4.0), such as automation, robotics, and artificial intelligence is crucial for Bangladesh's ready-made garments (RMG) industry. In a private environment, IR 4.0 will prompt comprehensive automation and digitalization operations and widespread use of electronics and information technology (Sommer, 2015). The internet, big data, cloud computing, artificial intelligence, autonomous vehicles, advanced robotics, new additive manufacturing technologies including 3D printing, hybrid manufacturing, machines, new materials, and synthetic and generic microbiology are the drivers of the fourth industrial revolution (Hofmann and Rüsch, 2017; Schwab and Davis, 2018). Big data is one of the leading technologies of Industry 4.0, allowing businesses to collect, process, and analyze data for decision-making purposes utilizing intelligent algorithms. One of the most indispensable features of IR 4.0 is the ability to monitor a large volume of data on open systems and enable a real-time connection with the production system. Cloud computing would be helpful for this purpose because it would enable access to data regardless of time or location, fostering flexibility in business operations (Anderl, 2015; Ghoreishi *et al.*, 2020). In the garment industry, roles and responsebilities include accepting customer orders, planning production, acquiring the necessary fabrics and materials, obtaining customer approval, and managing company resources. Industry 4.0 requires end-to-end digital integration, real-time production planning, and order

tracking (Shabur *et al.,* 2021). Additive manufacturing and 3D printing are two technologies that have been made to meet customers' many different and quickly changing needs (Gokalp *et al.*, 2016). However, the new industrial revolution will shorten the time it takes to launch new products even more, thanks to more flexible product lines, higher productivity, and a better way to use resources (Wijewardhana *et al.*, 2020). This will allow more companies to join the global value chains. To get the most out of Industry 4.0, public and private organizations need to help with policy and investment support, infrastructure development, education and training, and upgrading and upskilling. Without these things, IR 4.0 cannot be customized and used in the manufacturing and service industries (Ahmad *et al.*, 2020). Bangladesh has many problems putting Industry 4.0 into place as a developing country. For example, they do not have enough awareness, workers with the right skills, factory infrastructure, technology applications, and money. Bangladesh has been criticized for the skills of its workers, the way it uses technology in production and the way its factories are set up (Bhuiyan *et al.*, 2020).

Ideas of IR 4.0 Preparedness Evaluation of the Apparel Industry

This study investigates the various dimensions of a preparedness/readiness model that may be most applicable for measuring the preparedness of the Apparel/RMG sector in its pursuit of IR 4.0. Therefore, it discusses the perspectives of various academics regarding organizational readiness. Following the discussion is a brief explanation of the study's guiding framework and the variables and framework utilized for the study.

Measurement of IR 4.0 preparedness

Preparedness models of Industry 4.0 care for having two distinct dimensions; one tries to identify means of implementation, and the other locates the users for those respective models. Through a readiness model, an organization can find out whether it has the capacity or not to facilitate changes and can act upon the existing shortcomings (Hizam *et al.,* 2020; Şener *et al.,* 2018) identified some core characteristics of the fourth industrial revolution: Interoperability, Virtualization, Autonomous Management, Real-Time Management, Internet of Services, and Modular Structure. A readiness model pays regard to recent organisational innovations to attain sustainability and perform with comparative advantages in its current setup. The manufacturers must initially accept the advanced technology and then instill it in production, marketing, design, and to reap the benefits of Industry 4.0 (Susanto, 2008). For fear of job security, employees might feel bothered and cause problems during the transition phase to IR 4.0 since it will involve numerous automation changes in workflow. Sasanto, (2008) argues that there are six triggering factors behind an organisational readiness change: "observation towards changes, efforts, vision, shared faith, plans offered, and management support. "Many vital aspects fall under the umbrella of sustainability, including finance, environment, and social wellbeing; hence, (Almandeel *et al.*, 2021) emphasize building an enhanced body of knowledge that can find ways to blend the intervention of Industry 4.0 with naturally sustainable production processes and argues the need for quantitative studies on organisational readiness. On the other hand, (Alayón *et al.,* 2017) recommend "optimum utilisation of resources", coupled with a natural control over-discharge, to accomplish sustainability. According to them, the "reducing, reusing, recycling (3Rs)" approach can expand the lifecycle of products, and technological processes can be utilised positively for the environment. Organisations can study and understand diverse Industry 4.0 models to find benchmarks and take a leaf out of leaders' books who have effectively achieved digital transformation. In terms of planning, strategies, and execution, what works and what do not work is of sheer importance to an organisation that is willing to move forward with IR 4.0, as well as to policymakers for designing the most appropriate blueprint, and therein lays the significance of learning. Lack of attention to the readiness models will only create a digital divide among organisations. Those who hastily, ignorantly, and without any preparation try to capitalise on IR 4.0 will eventually crash out of the market (Canetta *et al.,* 2018). Most Industry 4.0 readiness models tend to prioritise technological aspects; for instance, a study titled 'Industry 4.0 readiness models: a systematic literature review of model dimensions' states that "70 (44%) out of a total of 158 unique dimensions on Industry 4.0 pertain to the assessment of technology alone," which indicate that organisations must be

technologically sound first before jumping into IR 4.0 (Hizam *et al.,* 2020). Industrial excellence is characterised by the level of sophistication in production processes, the extent of automation, the preparedness of the workforce, and the intensity of innovation; to add additional value, there are the likes of industry receptiveness, innovation network, and internet sophistication. In Europe, industries are segregated in four ways in terms of IR 4.0; they are known as "the frontrunners, the traditionalists, the hesitators, and the potentials (Götz *et al.*, 2020). Then there are measurement tools even to evaluate the readiness of cities; one such example is the Smart Collaboration Index, which encompasses "performance indicators versus enablement indicators" and the contribution of different stakeholders, such as the industry itself, the regulatory bodies of the economic environment, and academy (Nick and Pongrácz, 2016). Each group should be examined in terms of "prerequisites, management, smarter systems and outcomes".

METHODOLOGY:

Research Design

Choosing an appropriate research method mainly depends on the nature and context of the study, such as descriptive or action research (Nilsson *et al.*, 2018). Qualitative and quantitative approaches are used in this research, constituting a hybrid method. The quantitative method collects data in numerical form, while the qualitative method collects data in literary form. The following formula was used for determining the sample size n is

n = N*X / (X + N – 1)

Where,

$X = Z_{\alpha/2}^2 * p*(1-p) / MOE^2$, and

$Z_{\alpha/2}$ is the critical value of the Normal distribution at α/2 (e.g. for a confidence level of 95%, α is 0.05 and the critical value is 1.96), MOE is the margin of error, p is the sample proportion, and N is the population size (So, 1987)

Sampling Design

Population size

This is the total number of distinct factories in Bangladesh. The sample size doesn't change much for populations larger than 100,000.

Sample proportion

The sample proportion is the expected results to be. This can often be determined by using the results from a previous survey or running a small pilot study.

Sample size

Using the formula given above putting MOE 5%, confidence level 95% and population size 4000 and sample proportion 90%, the sample size is 134.

Target Population

Using the formula given above putting MOE 5%, confidence level 95% and populationsize 4000 and sample proportion 90%, the sample size is 134. The sample proportion is taken from previous studies where it was found that data get saturated in the case of more than 120 Bangladesh apparel industry factories.

Calculation,

$N = 4000$, $Z_{\alpha/2} = 1.96$, $p = 0.9$, $MOE = 0.05$

A total of 200 factories were reached randomly from the list through email using the sampling. Upon which 138 responses were received. However, during the data cleaning process, 3 responses could not be used for analysis due to a lack of adequate responses. In the end, the analysis was made using the responses from 135 factories.

Sampling Frame

A sampling frame is a list of all the items in the population. It's a complete list of everyone or everything that needs to study. In this case, the member list of BGMEA and BKMEA has been used as a sampling frame for the survey.

RESULTS AND DISCUSSION:

The study explores the various dimensions of a readiness model that could be best suited for measuring the preparedness of the apparel sector in its pursuit of IR 4.0. Therefore, it discusses the opinions of different scholars on organisational readiness. Followed by the discussion is a brief understanding of the guiding framework of the study, and the chosen variables and framework implemented for the study.

The present research investigated 134 sampled apparel industries in Bangladesh regarding IR4.0 readiness. In this regard, the research assessed IR 4.0 readiness of apparel industries in Bangladesh in various categories.

The result and discussion are described below categorically.

Dimensions explained in the VDMA model for Industry 4.0 assessment are -

Dimensions	Criteria
Strategy and organsiation	- Status of the Industry Strategy 4.0 implementation - Review of the strategy using indicators - Investment for Industry 4.0 - Use of technology and innovation
Smart factory	- Digital integration - Machines and infrastructure - Data utilization - IT infrastructure
Smart operations	- Use of cloud storage - Sharing of information - Security in the IT system - Automatic processes
Smart products	- Quality ensured by data analysing
Data-driven services	- Availability of various services using data - Data sharing among various departments
Employees	- Related skills in IT - Related skills in new technologies

Source: (Akdil, Ustundag and Cevikcan, 2018)

Industry 4.0 readiness assessment by various categories

Category 1: Organisational Strategy

According to **Table 1**, more than half of the sampled factories are at an intermediate level in terms of organizational strategy readiness that is required to adopt Industry 4.0. Only 1 factory is deemed as an expert in this category, and 43.7% of factories are experienced enough to incorporate IR 4.0.

Table 1: Industry 4.0 readiness assessment- Organizational Strategy.

Readiness level	Frequency	Percent
Beginner	4	2.96
Intermediate	71	52.59
Experienced	59	43.70
Expert	1	0.74
Total	135	100

Category 2: Organizational Infrastructure

Table 2 reveals that factories are lagging more behind in infrastructural readiness than strategical ones. Once again, more than half of the factories are at an intermediate level, but the number of experienced factories is lower than that found in the measurement of organizational strategy. In addition, no organization has become an infrastructural expert yet to adopt Industry 4.0.

Category 3: Smart Operation

From **Table 3**, it can be easily concluded that the majority of factories (81.48%) have a long way to go to execute smart operations of IR 4.0 as they are all at an intermediate level. Only a handful of factories (8.89%) are experienced in this category, and the rest stand at the beginner level.

Table 2: Readiness assessment of Industry 4.0- Organizational Infrastructure.

Readiness level	Frequency	Percent
Beginner	12	8.89
Intermediate	72	53.33
Experienced	51	37.78
Expert	0	0
Total	135	100

Table 3: Industry 4.0 readiness assessment - Smart Operation.

Readiness level	Frequency	Percent
Beginner	13	9.63
Intermediate	110	81.48
Experienced	12	8.89
Expert	0	0
Total	135	100

Category 4: Smart Products

According to **Table 4**, more than one-third (35.56%) of factories are at an experienced level of readiness to reap the benefits of IR 4.0's smart products. 12.59% of factories have an expert level of readiness, & a little over that figure, 14.07% of factories are at infant stage.

Table 4: Industry 4.0 readiness assessment - Smart Products.

Readiness level	Frequency	Percent
Beginner	19	14.07
Intermediate	51	37.78
Experienced	48	35.56
Expert	17	12.59
Total	135	100

Category 5: Data-driven services

Table 5 reveals that the preparedness for utilizing data-driven services is quite low among the sampled factories, with 76.3% of them at an intermediate level, and only 14.81% of factories are at an experienced level. No factory has become an expert yet to practice data-driven services.

Table 5: Industry 4.0 readiness assessment: Data-driven services.

Readiness level	Frequency	Percent
Beginner	12	8.89
Intermediate	103	76.30
Experienced	20	14.81
Expert	0	0
Total	135	100

Category 6: Employees

According to **Table 6**, more than half of the factories (55.56%) have a workforce with an experienced level of preparedness to embrace Industry 4.0. 20.74% of factories have expert-level employees to operate the highly complex systems and processes of the industrial revolution 4.0.

Table 6: Readiness assessment of Industry 4.0: Employees.

Readiness level	Frequency	Percent
Beginner	5	3.70
Intermediate	27	20.00
Experienced	75	55.56
Expert	28	20.74
Total	135	100

Industry 4.0 readiness assessment by factory size (using weights)

Small factories

Table 7 shows that majority of the small factories are at an intermediate level of readiness to adopt Industry 4.0. What is more striking is that none of the small factories has displayed experienced readiness, and in fact, nearly one-third of them are at a beginner level of preparedness for implementing IR 4.0.

Table 7: Industry 4.0 readiness assessment: Small factories.

Readiness level	Frequency	Percent
Beginner	8	27.59
Intermediate	21	72.41
Experienced	0	0
Total	29	100

Medium factories

Although it is generally presumed that medium factories will be more prepared to implement Industry 4.0, **Table 8** shows that it is not the case. Their stance on IR 4.0 is the same as that of small factories; nearly one-third of medium factories are at a beginner level, and the rest are at an intermediate level of readiness.

Table 8: Industry 4.0 readiness assessment: Medium factories.

Readiness level	Frequency	Percent
Beginner	19	27.94
Intermediate	49	72.06
Experienced	0	0
Total	68	100

Large factories

According to **Table 9**, more than half of large factories (57.89%) are at an intermediate level of readiness for the installation and practice of IR 4.0, and the remaining ones are merely at the beginner level.

Table 9: Industry 4.0 readiness assessment: Large factories.

Readiness level	Frequency	Percent
Beginner	16	42.11
Intermediate	22	57.89
Experienced	0	0
Total	38	100

Table 10: Potential areas for industry 4.0 adoption.

Areas	Very or great potential
Research and development	74.50%
Production/manufacturing	83.40%
Procurement/purchasing	79.10%
Warehousing/logistics	70.10%
Marketing	83.00%
Sales	57.10%
Services	60.20%
IT	83.60%

Potential areas for industry 4.0 adoption

According to the survey results, Production/ Manufacturing, Marketing, and IT are the main business segments within the company where there is great potential for industry 4.0. These segments will likely benefit from the digital trans-formation to IR 4.0. On the contrary, the other areas like Sales, Services, Warehousing/logistics, and Procurement/purchasing have also possibilities of reaping the fruits of the revolution.

Industry 4.0 readiness for sampled factories

Based on the overall weighted score, more than half of the 134 sampled factories are at an intermediate level of readiness for IR 4.0. This means that Bangladesh's apparel industry is still unprepared for the highly complex and sophisticated phenomenon of the fourth industrial revolution.

Overall weighted score is 52 which stands at Intermediate

The survey results from this study were put into the VDMA (the Mechanical Engineering Industry Association) model, which shows that RMG factories in Bangladesh are currently at the intermediate level of adapting to Industry 4.0, which means that most factories are currently making plans for how to use industry 4.0 technologies. The factories are investing in the newer automated technologies or investing very recently, like within two years. The current employees are relatively skilled in the new steps towards 4.0 upgradation. Data collected from the production level are at a minimal scale, and the use of the data is limited. The infrastructure available at the factories is unsuitable for future technologies. Most importantly, the score arrived from the model is 52, which is only a bit higher than the beginner level. It implies that a good number of factories are at a transition phase from beginner to intermediate in terms of industry 4.0 adaptation. There must be other parameters and challenges present within the sector that must be addressed before undertaking a transition to IR 4.0. This also calls for more research in this field and attention from the policymakers to establish a sustainable support system that enables the apparel sector to adopt automation and keep up with the growing international competitiveness. On the other hand, there must be other parameters and other challenges present within the sector that needs to be addressed before undertaking a transition to IR 4.0. This also calls for more research in this field and attention from the policymakers to establish a sustainable support system that enables the RMG sector to adopt automation & keep up with growing international competitiveness

Major Findings of the Study

- More than fifty-two per cent of the sampled factories (52.59%) are at an intermediate level of organizational strategy readiness required to adopt Industry 4.0. 43.7 per cent of factories have sufficient experience to implement IR 4.0.
- Infrastructure readiness lags further behind strategic readiness among factories. Again, more than fifty-three per cent of factories (53.33 per cent) are at an intermediate level. However, the number of experienced factories is lower than that found in the organizational strategy measurement (37%). Moreover, no organization has yet become an infrastructure expert by adopting IR 4.0.
- Most factories (81.48%) have a long way to go before executing IR 4.0's intelligent operations, as they are all at an intermediate level. Only a few factories (8.89%) have experience in this category, while the remainder is novices (8.89%)
- More than one-third (35.56%) of factories are prepared to reap the benefits of IR 4.0's intelligent products. 12.59% of factories are at an expert level of readiness, while slightly more than 14% are in the infant stage.
- 76.3 % per cent of the sampled factories are at an intermediate level of readiness for utilizing data-driven services, while only 14.81 per cent are at a professional level. No factory has yet achieved mastery of data-driven services.
- More than fifty-five per cent (55.56%) of factories have a workforce prepared to adopt Industry 4.0. To operate the highly complex systems and procedures of the fourth industrial revolution, 20.74 per cent of factories have employees with expert-level knowledge.
- More than half of large factories (57.89%) are at an intermediate level of readiness for the installation and implementation of IR 4.0, while the rest are at the beginner level. Most small factories are prepared to adopt Industry 4.0 at an intermediate

level. Surprisingly, none of the small factories has demonstrated an advanced level of readiness for IR 4.0 implementation, and nearly one-third of them are at the novice level. Table demonstrates that contrary to the common assumption that medium-sized factories will be better prepared to implement Industry 4.0, this is not the case. Their position on IR 4.0 is identical to that of small factories; nearly one-third of medium factories are at the beginner level, while the remainder is at the intermediate level.

- The result indicates that the overall weighted score for IR 4.0 readiness in the apparel industry is 52, which corresponds to the Intermediate level. According to the overall weighted score, slightly more than fifty per cent of factories are at an intermediate level of preparedness for IR 4.0, indicating that the Bangladeshi apparel industry is not yet adequately prepared to embrace the highly sophisticated and complex phenomenon of the fourth industrial revolution. However, production/ manufacturing, marketing, and IT of apparel industries/ RMG are the company's primary business segments and potential areas where IR 4.0 adoption is required most.

Recommendations

The implementation of 4IR requires considerable changes in Knowledge Skills and Attitudes (KSAs) in hiring, and training, both for Employers and employees, and adopting new technologies into their Industries. For successful adoption of IR 4.0 technology and implementation of it in the apparel industries, the following measures can be recommended:

Developing New Leadership Capabilities for 4IR

Have to develop positive and modern thinking leadership capabilities of people in the apparel sector considering technology and innovation. The industries have to come out of the old-traditional manufacturing process. They should adopt the right technology and build new innovative people strategies for future work.

Skill Disruption

The demand for skillful workers in IT technologies will rise for extensive use of software, robotics, and data analytics. There is no room for the traditional workforce or low-skilled people. The risk of losing old-aged people's jobs will also increase. Hence, industry owners should create training facilities for their existing workforce within the IR4.0 technology adoption purview.

Managing Integration of Technology in the Workplace

The latest technology could alter job responsibilities between humans and robots and algorithms, which can create consequences of job displacement. The human resource, may introduce concepts of reskilling, redeployment, and job reinvention.

Reskilling

Refers to the search for employees with "adjacent skills," It gives workers a lateral learning opportunity.

Redeployment

Is when employees are re-positioned within the company to avoid redundancy?

Reinvention

It's vital to remember that automation affects tasks rather than jobs. Therefore, it is necessary to rethink and restructured or redefined the job.

Enhancing the Employee Experience

The core of the employee experience is employee engagement. Without having the right set of skills and knowledge (KSAs), it is hard for employees to engage in work as they did before the fourth industrial revolution. As technology is altering how employees work in various ways, and as a result, it has an increasingly created positive or negative impact on employee experience. It has to ensure that all the employees continuously engage in work through technology.

Building an Agile & Personalized Learning Culture

The concept of agile learningis a method of training and development that emphasizes speed, collaboration, and flexibility of employee learning. By implementing agile and personalized learning culture, organizations can ensure that employees have enough time and facilities for training as needed.

Reforming TVET (Technical and Vocational Education Training)

In the Technical and Vocational Education Training institutes of Bangladesh the total courseware-Competency Standard (CS), Competency-based learning material (CBLM), and Assessment tool should be re-

designed based on the concept of automation and new technology related to the fourth industrial revolution.

Funding for Human resource development and new technology adoption

To have a skilled workforce for accelerated growth in Bangladesh National Human Resource Development Fund (NHRDF) has been established in 2017. It is time to activate NHRDF for helping the youth prepare themselves for market-responsive demand for work in the manufacturing sectors. At the same time, the government should give some financial support to the manufacturing industries especially the apparel Industries to adopt new technology in supply chain management and logistics, machine maintenance, technician development for implementing automation and industry four. More specifically in the department of accounts and financing, store, cutting, sewing and finishing, designing, real-time data collection, research and development financial support might be extended from the government side.

CONCLUSION:

The fourth industrial revolution, called Industry 4.0 or IR 4.0, is here to stay. Even though it is a relatively new movement, many countries have started to join it. Bangladesh is also considering joining the revolution, which I think is a good idea. In Bangladesh, the spotlight is on the apparel sector, also known as the RMG industry. This is because the apparel sector contributes considerably to the economy and IR 4.0 has much potential in the manufacturing sector. The thesis sheds light on the different parts of the revolution and how they affected the global apparel market. It also breaks down the theories and ideas behind IR 4.0 and how they can be used or realized in the garments sector. However, I think the thesis stands out because it is the first evaluation of how ready Bangladesh's RMG sector is to adopt IR 4.0. This assessment is essential because IR 4.0 is not just a move towards more automation. However, it is made up of very complicated technologies and ideas that cannot be used well until we answer the question "Are we ready for it?" Before joining the revolution, other countries similarly did things. Taking a page from their books and their readiness index, these thesis shows where the RMG factories of Bangladesh are now. That finding alone is essential for policymakers, the business world, and academics. After a thorough evaluation, however, the thesis finds that most RMG factories are at an intermediate level of readiness for IR 4.0. In every part of Industry 4.0, there is still much work to be done before our RMG industry can use it, let alone enjoy the facilities. In this way, the thesis gives suggestions and, more importantly, shows the strengths and weaknesses of our mighty apparel sector. We will have to adopt IR 4.0 eventually if we want to stay strong and do well internationally in the future. Given that, though, more readiness assessments need to be done to ensure that our slow progress goes in the right direction.

Limitations

The main limitation of the research was the lack of research or study conducted about implementing IR 4.0 in the apparel industries in Bangladesh. There are only a few write-ups related to IR 4.0 and the impact of IR 4.0 on cheap labour engagement in the Bangladeshi apparel industry, which made it difficult to review the literature. Therefore, literature of studies similar to our research conducted in other countries is mainly used in the literature review process. Besides, IR.4.0 is a new concept for Bangladesh, so many misconceptions are prevalent. The result of this research will reveal whether the apparel industry in Bangladesh is ready to adopt IR 4.0 technology, and by introducing Industry 4.0, the apparel industry in Bangladesh would be benefitted or not. Nevertheless, a lifecycle reengineering and new technology adoption across the entire value chain are required to properly implement Industry 4.0 in the local context, which is not exposed in this research. From this study, several important facts can be highlighted in terms of opportunities; for instance, both the IT and the apparel sectors consisted of a skilled and knowledgeable workforce which would be the most significant advantage of adopting the novel and innovative concepts in Industry 4.0. This study will convey that the apparel sector needs to rethink the fourth industrial revolution as a new business model rather than just limiting its vision to introducing information and communication technology. The study suggests additional research needs to be conducted on implementing Industry 4.0 in the apparel industry. The government should also take an important initiative by using industry 4.0 technology to assist the apparel sector. There should be a

collective mechanism between the government and the industry to be sustainable in adopting Industry 4.0.

Scope for Future Research

There are plenty of areas where more research could be conducted in the future with regard to IR 4.0 in the RMG sector of Bangladesh. A list of such areas of research is given below –

a) There is a need for productivity analysis of the RMG sector comparing the various level such as beginner, intermediate and experience levels of industry 4.0.
b) Finding appropriate policy measures to support small-level factories to adapt industry 4.0 will be an important research scope for the near future.
c) Factories will require improving the organisational strategy of the factories through research in order to accelerate their industry 4.0 goals.
d) It will be essential to identify the skill gaps of the future RMG workers with regard to experiencing industry 4.0.
e) A comprehensive exercise is required for identifying the needs and steps forcreating enabling environment for industry 4.0.
f) Comparative studies are required to assess a country's status in view of the competitive countries such as Vietnam, Sri Lanka, Cambodia, India etc.
g) There could be a well-developed comprehensive tool for assessing level of industry 4.0 for the factories. This will help the buyers to assess factories and their capacities.

ACKNOWLEDGMENT:

I am heavily indebted to my thesis advisor, Prof. Ali Akkas, Department of Management at the University of Dhaka for his continuous support, valuable guidance, and inspiration to accomplish my research under DBA (Doctor of Business Administration) program. I would like to thank the RMG expert Dr. Kazi Mahmudur Rahman, and Kishore Kumer Basak, and the industry experts Engr. Azim Mohammad, and Engr. Rupali Biswas for their whole-hearted support and co-operation in writing this article. Finally, I must express my profound gratefulness to my husband Sheikh Muhammad Muzibul Alam for his continuous support and encouragement.

CONFLICTS OF INTEREST:

The author(s) declaring that there are no potential conflicts of interest concerning the research, authorship, and/or publication of this article.

REFERENCES:

1) Ahmad, S. *et al.* (2020). 'Towards sustainable textile and apparel industry: Exploring the role of business intelligence systems in the era of industry 4.0', *Sustainability*, **12**(7), p. 2632. https://doi.org/10.3390/su12072632
2) Akdil, KY., Ustundag, A. & Cevikcan, E. (2018). 'Maturity and readiness model for industry 4.0 strategy', in Industry 4.0: Man-aging the digital transformation. *Springer*, pp. 61-94.
3) Alam, S. and Dhamija, P. (2022). 'Human resource development 4.0 (HRD 4.0) in the apparel industry of Bangladesh: a theoretical framework and future research directions', *International Journal of Manpower*. https://www.emerald.com/insight/0143-7720.htm
4) Alayón, C., Säfsten, K. and Johansson, G. (2017). 'Conceptual sustainable production principles in practice: do they reflect what companies do?', *Journal of Cleaner Production*, **141**, pp. 693–701.
5) Almandeel, S. *et al.* (2021). 'The Role of Leadership in Industrial Revolution (IR 4.0) Achievement & Creative Thinking Strategies'. https://doi.org/10.14257/ijdrbc.2021.12.1.02
6) Anderl, R. (2015). 'Industrie 4.0 – technological approaches, use cases, and implementation', *Automatisierungstechnik*, **63**(10), pp. 753-765.
7) Benayoune A, *et al*. (2021). Logistics 4.0 skills requirements: evidence from a developing country, *Can. J. Bus. Inf. Stud*., **4**(2), 24-36. https://doi.org/10.34104/cjbis.022.024036
8) Bhuiyan, A. B. *et al.* (2020). 'Industry 4.0: challenges, opportunities, and strategic solutions for Bangladesh', *International Journal of Business and Management Future*, **4**(2), pp. 41-56. https://orcid.org/0000-0003-1763-124X
9) Bücker, I. *et al.* (2016). 'Towards a methodology for Industrie 4.0 transformation', in International Conference on Business Information Systems. *Springer*, pp. 209-221.

10) Canetta, L., Barni, A. and Montini, E. (2018). 'Development of a digitalization maturity model for the manufacturing sector', in 2018 *ieee international conference on engineering, technology and innovation*. *IEEE*, pp. 1–7. https://orcid.org/10.1109/ICE.2018.8436292
11) Farhana, K. *et al.* (2022). 'Business Trend Analysis of RMG Industry in Context of Bangladesh-A Case Study', *International J of Industrial Management*, **14**(1), pp. 515–528.
12) Ghoreishi, M., Happonen, A. and Pynnönen, M. (2020). 'Exploring industry 4.0 technologies to enhance circularity in textile industry: role of internet of things', in *Twenty-first International Working Seminar on Prod. Economics*, p. 16.
13) Gokalp, M. O. *et al.* (2016). 'Big data for industry 4.0: A conceptual framework', in 2016 *International Conference on Computational Science and Computational Intelligence* (CSCI). *IEEE*, pp. 431-434.
14) Götz, M. *et al.* (2020). 'Effects of Industry 4.0 on FDI in the Visegrád countries', Final report. Vistula University, Supported by the International Visegrad Fund. https://industry40fdi.com/
15) Hizam-Hanafiah, M., Soomro, M. A. and Abdullah, N. L. (2020). 'Industry 4.0 readiness models: a systematic literature review of model dimensions', *Information*, **11**(7), p. 364.
16) Hofmann, E. and Rüsch, M. (2017). 'Industry 4.0 and the current status as well as future prospects on logistics', *Computers in industry*, **89**, pp. 23-34. https://doi.org/10.1016/j.compind.2017.04.002
17) Jiang, Z. *et al.* (2022). 'The evolution of production scheduling from Industry 3.0 through Industry 4.0', *International Journal of Production Research*, **60**(11), pp. 3534–3554.
18) Nick, G. and Pongrácz, F. (2016). 'How to measure industry 4.0 readiness of cities', Industry 4.0, **1**(2), pp. 136–140. https://stumejournals.com/journals/i4/2016/2/136
19) Nilsson, M. *et al.* (2018). 'Mapping interactions between the sustainable development goals: lessons learned and ways forward', *Sustainability science*, **13**(6), pp. 1489–1503.
20) Rahman, Z. U. and Maniam, V. A. (2022). 'The relationship between drivers of business ethics and business sustainability mediated by business ethics practices among the ready-made garments companies in Bangladesh.', *International J. of Early Childhood*, **14**(03), p. 2022.
21) Schwab, K. and Davis, N. (2018). Shaping the future of the fourth industrial revolution: A guide to building a better world, *Currency*. https://www.amazon.com/Shaping-Future-Fourth-Industrial-Revolution/dp/0241366372
22) Şener, U., Gökalp, E. and Eren, P. E. (2018). 'Towards a maturity model for industry 4.0: A systematic literature review and a model proposal', *Industry*, **4**, pp. 291-303.
23) Shabur, A., Hridoy, M. W. and Rahman, K. A. (2021). 'The investigation of challenges of implementing Industry 4.0 in Bangladesh', *Academia Letters*, **2**. https://www.researchgate.net/profile/Abdus_Shabur/publication/352076475
24) So, J. C. (1987). 'Some empirical evidence on the outliers and the non-normal distribution of financial ratios'.
25) Sommer, L. (2015). 'Industrial revolution-industry 4.0: Are German manufacturing SMEs the first victims of this revolution?', *J. of Ind Eng and Manag*, **8**(5), pp. 1512–1532.
26) Souza, R., Ferenhof, H. and Forcellini, F. (2022). 'Industry 4.0 and Industry 5.0 from the Lean perspective', *International Journal of Management, Knowledge and Learning*, **11**. https://doi.org/10.53615/2232-5697.11.145-155
27) Wijewardhana, G. E. H. *et al.* (2020). 'New product development process in apparel industry using Industry 4.0 technologies', *Int J. of Prod and Perf Manag,* 70(8), 2352-2373. https://doi.org/10.1108/ijppm-02-2020-0058

Citation: Sharmin S. (2022). IR 4.0 readiness of apparel industry in Bangladesh, *Asian J. Soc. Sci. Leg. Stud.*, **4**(4), 148-159. https://doi.org/10.34104/ajssls.022.01480159