Independent University **Bangladesh (IUB)**

IUB Academic Repository

Conference and Proceedings International Conference on Economics, Business and Technology Manag

2025-11

Upskilling for industry 4.0: bridging the HRM-Sustainability Gap in Bangladesh’s tech sector

Arko, Koushik Biswas

School of Business and Entrepreneurship, Independent University, Bangladesh (IUB)

https://icebtm.iub.edu.bd

Downloaded from IUB Academic Repository

Upskilling for Industry 4.0: Bridging the HRM-Sustainability Gap in Bangladesh's Tech Sector

Koushik Biswas Arko [1*], K.M. Tahsin Kabir [2], Md. Mortuza Ahmmed [3]
[1]Department of Computer Science, American International University-Bangladesh
[2]Department of Computer Science and Engineering, Asian University of Bangladesh
[3]Department of Mathematics, American International University-Bangladesh
[1.]*22-49234-3@student.aiub.edu* , [2.]tahsin@aub.ac.bd, [3.]mortuza@aiub.edu*

Paper ID: ICEBTM-25-1024

Abstract-**As Bangladesh is working to become a regional tech hub, the realities of Industry 4.0 growth are opening up an increasingly large digital skill gap. This study analyzes trends in digital upskilling in Bangladesh and sustainable HRM practices in the tech sector from 2010 to 2024. By 2023, 22% of the workforce had obtained Industry 4.0 skills education; additionally, Bangladesh had set up 50 NBR-accredited centers and 10 national programs on digital skills. There was also an increase in bars on sustainability with a rising percentage of companies who had sustainability-oriented HRM strategies (5% in 2010 to 20% in 2023). Despite progress, there remained challenges to digital skills for example, limited access to advanced training, limited access to continuous training and educational programs as well as gender-based inequalities. The authors recommend more inclusive training, improvements in public- private partnerships, and that sustainability be included in talent development strategies as Bangladesh continues to modernize the technology sector responsibly.**

Keywords - **Industry 4.0, Upskilling, Digital Skills, HRM, Sustainability, Youth Employment, Bangladesh Tech Sector**

I. INTRODUCTION

As Industry 4.0 continues to reshape global industries through automation, AI, IoT and big data, countries like Bangladesh, feel the pressure to adapt and transform. Strategic national programs like Digital Bangladesh and Vision 2041, have shown the government wants it to be a big player in the tech sector for economic resiliency and competitive advantage. Their urban tech hubs have quickly grown in areas such as fintech, e-commerce, and software services [1]–[3]. But along with these rapid changes, Bangladesh has revealed a major deficit in professionals that can perform in their digitally skilled workforce to meet the new challenges and opportunities presented in Industry 4.0 [4], [5].

Previous studies have examined elements of workforce development and sustainability in the context of human resource management (HM), paying attention to the technological need for digital skills, or the importance of sustainability in corpo- rate governance [6]–[8]. Global forums, including the World Economic Forum, as well as regional reports from the Asian Development Bank, and the UNDP have provided evidence of a digital skills gap, and its impacts on youth employment in South Asia [9, 11]. Understanding the intersection be- tween HRM, employee wellbeing, and green business practices points to a vital role for HRM in the implementation of positive employee and planet engagement via green HRM initiatives to help create sustainable value in the organization over time.

However, the literature has not offered an integrated per-spective that explores the convergence of digital skills up-skilling with sustainability-led HRM in the context of the rapidly evolving technology landscape in Bangladesh. The vast majority of prior work has treated these dimensions as non-intersecting challenges [12]–[14]. Few studies have presented longitudinal data to illustrate how the policy land- scape, institutional frameworks, and industry supports have evolved over time with respect to upskilling and sustain- ability together [15]–[18]. Thus, there is a research gap in how digitalization transformed and sustainability expectations are being leveraged or blended into HRM strategies in the relatively uncharted landscape of HRM in the tech industry in Bangladesh.

The research presented here fills that void by delivering a complete and thorough, data-driven examination of digital upskilling and sustainable HRM integration in Bangladesh from 2010 - 2024. This study utilizes secondary longitudinal data to assess patterns related to Industry 4.0 skills acquisition, the number of certified training centers, youth's participation in technology-based employment, and the level of sustainabil- ity integration into industry-meaningful HRM practices. The study not only scarcely captures the level of transformation that has occurred during the past ten years but also identifies challenges for an equitable, sustainable digital transformation process such as regional inequalities, disproportionate gender representation in digital jobs, and lack of alignment between HRM sustainable practices and green jobs. The presented paper places the findings discussed in this integrated our focus on digital transformation and sustainable workforce under the umbrella of the development of an inclusive, equitable, and future-oriented tech ecosystem which can

ISBN 978-984-35-5270-9 *https://icebtm.iub.edu.bd*

be supported in pursuing pathways toward responsive recommendations.

II. METHODOLOGY

From a quantitative longitudinal perspective, this study seeks to examine how the tech sector in Bangladesh is devel- oping in relation to digital upskilling and sustainable HRM. Using secondary data from 2010 to 2024, this study focuses on existing data so it can examine changes over time identify patterns, progress, and gaps in workforce development. A data-informed study is appropriate for monitoring macro-level factors—such as those from national policies, institutional factors, and industry trends—related to Industry 4.0 [19], [20].

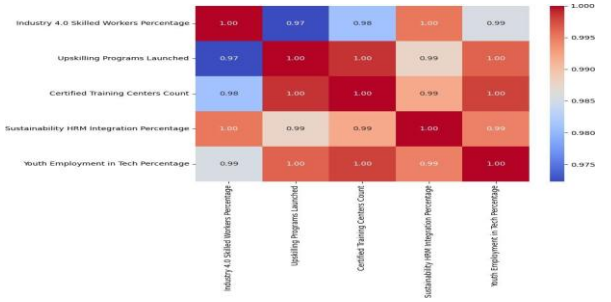
A. Data Collection

The research is based entirely on secondary data from na- tional and international sources of good standing. The sources include publications from the Bangladesh Ministry of ICT [21], the Bangladesh Bureau of Statistics (BBS) [22], and international organizations such as the Asian Development Bank (ADB), the World Bank, UNDP, and the International Labour Organization (ILO). Academic journal articles, policy briefs and official government reports were also reviewed to extract relevant statistics and program information.

The variables included:

- Percentage of tech employees possessing Industry 4.0 capabilities (e.g., AI, IoT, big data analytics).
- Count of new private and/or government upskilling ini- tiatives and offerings.
- Count of certified digital training facilities.
- Share of companies with sustainability integrated into HRM strategies.
- Percentage of youth working in the tech sector.
- Key policy developments aimed at digital workforce and sustainability objectives.

All data points speak to country-level statistics, although, for the vast majority, they were concentrated in urban and semi-urban centres because of more



extensive documentation, and consequently more robust data.

B. Data Analysis

The collected datasets were cleaned and analyzed in Mi- crosoft Excel and IBM SPSS Statistics (version 27.0.1). The following types of analyses were utilized:

- Trend Analysis, which followed the trends in key indica- tors over the 14 years of the study.
- Percentage Growth Calculations that allowed for an un- derstanding of the growth or decline in the number of people adopting new digital skills and sustainability practices.
- Comparative Analysis, which compared pre-policy and post-policy periods, especially since 2014, and when larger government initiatives began to emerge.
- Correlation Analysis, which analyzed examined relation- ships among other variables, such as upskilling efforts and youth employment, which uncovered some dynamic elements in the ecosystem.

Overall, this method of analysis allowed for a clear and manageable interpretation of a complex piece of working multi-year data; revealing not just what had changed, but some sense of why those changes might occur.

C. Limitations

Although it has merits, this analysis has some limitations:

- Data Gaps: Not all indicators were consistently reported over the entire time period, and in cases where some data was presented, they may be either under-reported or as a result of international estimates.
- Urban Bias: The analysis mainly reflects the formal tech sector which primarily is focused in urban areas. The rural and informal components of the tech workforce remain underrepresented.
- Correlation vs. Causation: The study has mapped sta- tistical relationship and associations. It does not claim to show direct causal relationship between policies and outcomes.

Nevertheless, the methodology provides a strong basis for monitoring trends over time, making useful suggestions in practical and employee-relations implications for future work- force and HRM development.

III. RESULTS

A. Growth in Industry 4.0 Skills

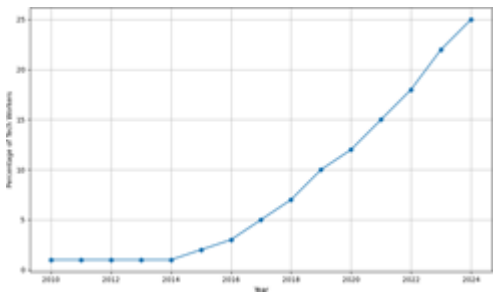


Fig. 1: Growth in Industry 4.0 Skills

Over the last decade the share of tech workers in Bangladesh with Industry 4.0 skills, such as AI, IoT, and big data, has increased significantly. As shown in the data, in 2010 less than 1% of workers had these skills. By 2014, less than 3% of workers had 4.0 skills. However, after 2014 we witnessed remarkable growth due to national-level upskilling programs. By 2024, this estimated percentage has grown to around 25%, the first major progress update emphasizing workforce readiness for the coming digital transformation.

B. Expansion of Upskilling Programs

ISBN 978-984-35-5270-9 https://icebtm.iub.edu.bd

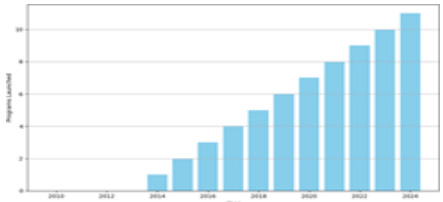


Fig. 2: Number of Upskilling Programs Launched

Before 2014, structured upskilling programs were still there, but they were minimal, spreading latency towards the up- skilling destination. After 2014, 11 distinguished programs from government boot-camps, university-industry linkages the government led online certification programs were re- alized. The stakes of rollout should be noted in creating more inclusive pathways for digital education rather than risk continuing the expensive process of systematic upskilling at a steep delta to the region's position in digital education.

C. Increase in Certified Training Centers

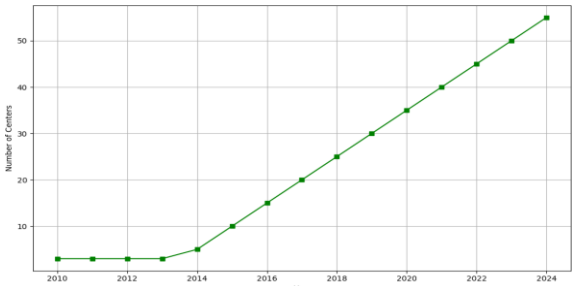


Fig. 3: Certified Digital Skill Training Centers

The overall number of certified digital training centres increased. Bangladesh, once only home to 3 certified digital training centres in 2010, now has certified 55 digital training centres (2024). Digital training centres established regional learning eco-systems with the advantage of physical locations dedicated to certify learning skill and digital skills for learners. They were able to establish decentralized access throughout urban and semi-urban settings eventually allowing for access to learning on volume.

D. Sustainability Integration in HRM

IV.DISCUSSION

The data seem to indisputably show that policy since 2014 has been a key driver of the fast-tracking of digital upskilling and the growth of training infrastructure in the technology sector of Bangladesh. The increases in certified training centres and upskilling training practices neatly correspond with increases in youth employment and Industry 4.0 skill development. While it is clear that the technical advancement is there, almost all of it has been achieved with social and economic disadvantage for the non-urban. As such, as a direct response to the stronger collaboration of public and private organizations, it makes sense to better develop, embed and implement strategies that support rural youth and disadvantaged groups like women. Therefore, there is an undeniable need for implementation at the social level. In terms of sustainability, HRM integration is slightly better differentiated from HRM, but is still considerably underdeveloped compared to PHD education digital initiatives. The weak correlation as a picture of identified digital upskilling may suggest that either of these areas are still viewed as stand- alone rather than a whole of organization process; too many SMEs still believe sustainability is optional. Improving the correlation of these two areas means developing, embedding and integrating internal green processes that respond to training in technology, along with clearly defined and

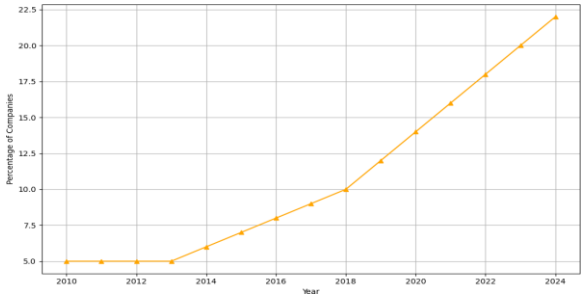


Fig. 4: Companies Integrating Sustainability into HRM

While skill development is progressing, the integration of sustainability into human resource management is developing at a slower rate. In 2010, less than 5% of companies had sustainability included in their HRM practices. This reached 22% in 2024. The main practices we noticed were green recruitment policies, employee engagement in their company's environmental initiatives and workforce programs relating to CSR as applied by companies.

E. Youth Employment Trends



Fig. 5: Youth Employment in Tech Sector

Youth employment in the tech sector also showed an im- provement. From a miniscule 1% in 2010 youth employment rose to 11% in 2024. There were a number of factors which helped support this growth. Better access to digital training; increases in the number of start ups; incentives for employing youth.

F. Correlation Among Indicators

Fig. 6: Correlation Between Digital Workforce IndicatorsStatistical analysis showed a number of statistically signif- icant relationships:

ISBN 978-984-35-5270-9 https://icebtm.iub.edu.bd

adequately resourced job creation. Only then do we have any chance of developing a future ready, healthy, resilient population that responds and supports innovation while being cognizant of our environment.

V.CONCLUSION

This study has explored how the tech sector in Bangladesh has evolved to meet the dual challenge of digital upskilling and integration of sustainability in HRM. From 2010-2024, the study shows that there has been a gradual increase in the adoption of Industry 4.0 skills, an increase in certified training centers, and a rise in the youth workforce in the tech sector, especially after the 2014 policy interventions. Furthermore, there has been gradual integration of sustainability applied to HRM although development in this area is still lagging behind digital development.

To build a more inclusive and tomorrow-ready workforce, digital transformation and sustainable HRM strategies must be more directly aligned. Improving these strategies would include, but is not limited to, improving access to continuing education and advanced training in remote and rural settings, greater gender inclusion, and delivering green job pathways included in digital education. By fostering public-private partnerships and further internalizing sustainability measures in talent development, the tech sector in Bangladesh can start creating a more competitive, enterprise, and socially and environmentally-responsible model.

REFERENCES

[1] P. Adler and R. Florida, "The rise of urban tech: how innovations for cities come from cities," Regional Studies, vol. 55, no. 10-11, pp. 1787–1800, 2021.

[2] S. Fatema and M. K. Raza, "Entrepreneurship in the age of technology: Astudy of start-up ecosystems and innovation hubs," J. Res. Innov. Technol. Manag, vol. 1, no. 2, pp. 1–5, 2023.

[3] S. Boyapati, "Bridging the urban-rural divide: A data-driven analysis of internet inclusive finance in the e-commerce era," Int. J. Eng, vol. 11, no. 1, 2021.

[4] R. Hossain, "Adopting industry 4.0: A strategic solution for transforming smart bangladesh: Prospective connections, opportunities, and challenges," Pakistan Journal of Life and Social Sciences, vol. 22, no. 1, pp. 3304–3323, 2024.

[5] M. T. Miah, S. Erdei-Gally, A. Dancs, and M. Fekete-Farkas, "A systematic review of industry 4.0 technology on workforce employability and skills: Driving success factors and challenges in south asia," Economies, vol. 12, no. 2, p. 35, 2024.

[6] M. Sharma, S. Luthra, S. Joshi, and A. Kumar, "Analysing the impact of sustainable human resource management practices and industry 4.0 technologies adoption on employability skills," International Journal of Manpower, vol. 43, no. 2, pp. 463–485, 2022.

[7] S. Mukhuty, A. Upadhyay, and H. Rothwell, "Strategic sustainable development of industry 4.0 through the lens of social responsibility: The role of human resource practices," Business Strategy and the Environment, vol. 31, no. 5, pp. 2068–2081, 2022.

[8] I. Zervas and E. Stiakakis, "Economic sustainable development through digital skills acquisition: The role of human resource leadership," Sustainability, vol. 16, no. 17, p. 7664, 2024.

[9] F. K. Sudan, "Technological disruptions, youth unemployment and vocational education challenges in south asia: a short report," Global Economics Science, pp. 80–97, 2021.

[10] L. Wignall, A. Roberts, J. Brown, and S. K. Ahmed, "Gender barriers to basic digital skills for employment in the asean region: A review of promising practices," 2024.

[11] K. Fietz and J. Lay, "Digital skills in the global south: Gaps, needs, and progress," 2023.

[12] Q.-M. Ton-That, P. G. Kry, and S. Andrews, "Generalized extended finite element method for deformable cutting via boolean operations," in Computer Graphics Forum, vol. 43, p. e15184, Wiley Online Library, 2024.

[13] R. Strauss and J. B. Oliva, "Posterior matching for arbitrary conditioning," Advances in Neural Information Processing Systems, vol. 35, pp. 18088–18099, 2022.

[14] S. R. Peddada, L. E. Zeidner, K. A. James, and J. T. Allison, "An introduction to 3d spi2 (spatial packaging of interconnected systems with physics interactions) design problems: A review of related work, existing gaps, challenges, and opportunities," in International Design Engineering Technical Conferences and Computers and Information in Engineering Conference, vol. 85390, p. V03BT03A034, American Society of Mechanical Engineers, 2021.

ISBN 978-984-35-5270-9 *https://icebtm.iub.edu.bd*