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INDUSTRY 5.0 IN AZERBAIJAN'S LIGHT INDUSTRY: HUMAN CAPITAL DEVELOPMENT

Shalala Yusubova[1], Sevinj Babakishiyeva[2], Tamella Ahmedova[3]

[1]*Azerbaijan Technological University, Azerbaijan*
[2]*Azerbaijan Technological University, Azerbaijan*
[3]*Azerbaijan Technological University, Azerbaijan*

ABSTRACT

This article examines Azerbaijan's light manufacturing capacity to transition toward Industry 5.0, focusing on the link between human capital and higher education. Utilizing quantitative surveys from 42 enterprises in Baku, Ganja, and Mingachevir, and qualitative interviews with 24 academic leaders, the study analyzes the country's industrial-educational ecosystem.

The findings indicate that transitioning to human-centered, sustainable manufacturing depends heavily on human capital transformation rather than just hardware investments. Despite state-led regional modernization, a severe skills gap persists. Engineering and management graduates lack cross-disciplinary proficiency in automated workflows, CAD/CAM, cognitive problem-solving, and circular economy metrics due to rigid, outdated theoretical curricula.

Thematic analysis reveals that academia suffers from bureaucratic constraints, inflexible national standards, and a shortage of faculty trained in cyber-physical systems. Furthermore, university-industry collaboration remains superficial, limited to unmonitored internships due to low mutual trust and a lack of financial incentives like tax exemptions or R&D grants.

To bridge this gap, the study recommends strategic policy reforms: updating engineering education with smart-textile modules and live data analytics, legally expanding dual education, and adopting problem-based learning. Concurrently, industrial firms must prioritize long-term human capital development through structured internal training.

KEYWORDS*: Industry 5.0, Human Capital Development, Higher Education Reform, Light Industry, University-Industry Collaboration*

INTRODUCTION

The discourse among scholars about the development of manufacturing is gradually moving away from technology-centered Industry 4. 0 to the entire philosophical system of Industry 5. 0. In the area of present-day research, Industry 5. 0 is not seen as a mere chronological substitution of digitalization but as a remedial measure which reintegrates the human into the production environment as a central figure. Industrial change experts point out that the first industrial revolution, which concentrated on machine-to-machine communication, artificial intelligence and autonomous systems, often led to worker alienation and created various labor market imbalances. Thanks to its three mutually interdependent pillars: human-centric, environmental sustainability, and socio-economic resilience- Industry 5. 0 is capable of resolving those weaknesses. And, the change totally alters the way technology and human labor are connected, i. e. The workers are no longer regarded as mere system operators but rather as creative collaborators with whom intelligent machines, aka collaborative robots or cobots, are working.

The change affects educational institutions at various levels and gives rise to the academic idea of "Education 5. 0". The general changes in education suggest that the well-known teaching methods that heavily rely on routine technical training are no longer adequate under Industry 5. 0. Changing empirical studies show that, as manufacturing becomes more sophisticated and interconnected, the workforce of the future will combine not only digital skills but also non-routine cognitive components. Workers will need emotional intelligence, systemic thinking, and problem-solving, besides green management. And, current tertiary education research supports a turn to multidisciplinary curricula, design thinking ways, and lifelong learning that would prepare graduates to survive the new industrial world.

Within the specific domain of the light industry—encompassing textiles, garments, leather, and footwear manufacturing the human capital component has long been neglected in academic classifications of these industries as only labor-intensive, low-skilled ones. But, recently conducted worldwide surveys revealed that the survival of the light branch of the industry in high-cost or developing countries is strongly linked to upgrading the quality of human capital. Nowadays, the production of garments is heavily dependent on computer-aided design, smart fabrics, and real-time supply chain data analytics. Besides, the increasing focus on environmental sustainability means that industry workers need to be knowledgeable in circular economy principles, eco-design, and non-toxic production methods. As the studies, those countries that have managed to update their technical and vocational education systems in line with these high-value-added elements have had much better industrial innovation and regional economic growth results.

In fact, when looking at these issues for Azerbaijan, the available literature exposes a glaring research gap there. A large part of local economic research has concentrated on the broad macroeconomic issues of non-oil sector diversification and the setting up of

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regional industrial parks like those in Mingachevir and Sumgayit. Academics have also given thorough examinations of the fiscal and infrastructure inducements offered by the government to the business sector. Yet, there is still an acute lack of empirical investigations that systematically connect these industrial goals with the structural results of the country's higher education institutions. The micro-level links between the content of university programs, the exact skill shortages in textile engineering and the technological change capabilities of local companies hardly figure in current Azerbaijani scholarly literature. The present paper addresses this issue by investigating how the human capital bottleneck of Azerbaijan's light industry could be overcome through strategic higher education reforms aligned with Industry 5. 0.

METHODOLOGY

This study utilizes a mixed-methods research design to comprehensively analyze the transition to Industry 5.0 in Azerbaijan’s light industry and its direct implications for higher education and human capital development. By combining quantitative survey data with qualitative semi-structured interviews, the methodology ensures a pragmatic approach that captures both broad industrial trends and deep institutional insights. The primary objective of this empirical framework is to measure the current technological and operational readiness of local enterprises while identifying the precise qualitative gaps within the national higher education output.

The primary data collection was conducted across major economic regions in Azerbaijan where light industrial clusters are concentrated, specifically focusing on enterprises and academic institutions in Baku, Ganja, and Mingachevir. The quantitative phase involved the administration of a structured digital questionnaire distributed to executive managers, production directors, and senior engineers operating within textile, wearing apparel, and footwear manufacturing facilities. The survey instrument was designed to evaluate three core dimensions: the extent of modern digital technology integration, the internal willingness to adopt human-centric and sustainable manufacturing practices, and the perceived technical and soft-skill deficiencies observed in newly hired university graduates. A total of forty-two unique light industrial enterprises participated in the survey, providing a representative cross-section of the sector's operational landscape in Azerbaijan.

In parallel, the qualitative phase consisted of twenty-four semi-structured, in-depth interviews with academic stakeholders. The participant pool for these interviews included university deans, department chairs, and senior lecturers from leading national higher education institutions responsible for training engineering, industrial management, and textile technology students. These sessions focused on assessing the flexibility of existing curricula, identifying institutional barriers preventing deep university-industry collaboration, and evaluating the integration of Industry 5.0 concepts—such as collaborative robotics, data science, and circular economy principles—into current degree programs. All interviews were recorded and transcribed with the explicit consent of

To keep the methods as precise as possible, analysis of the data was conducted in separate specialized streams. First, the quantitative data collected from the industrial surveys was analyzed using descriptive statistics to find the frequency distributions, average scores, and variances, which led to mapping the main technical and skills deficiencies in the whole sector. Secondly, for the qualitative data obtained from the lecturer interviews, a thorough thematic analysis was implemented. This included the use of codes at different stages to single out the main patterns, institutional restrictions, and structural challenges in curriculum reform. Lastly, the quantitative and qualitative findings were combined through a triangulation exercise, whereby the empirical data collected from the factories were directly used to challenge and corroborate the pedagogical realities expressed by the universities.

FINDINGS AND DISCUSSION

The quantitative survey results of the forty-two light industrial enterprises in Baku, Ganja, and Mingachevir show a highly stratified pattern of technology adoption, and So, a multi-speed industrial ecosystem. On average, enterprises within the government-supported industrial zones such as Mingachevir Industrial Park (MIP) and Gilan Textile Park, have integrated automated hardware at a high level. These industrial parks have the latest German and Italian automated cutting systems, high-speed computerized weaving looms, and digital dyeing technologies, which are in very close alignment with basic Industry 4. 0 automation. Their utilization has led to the optimization of volume production and the minimization of raw material waste at the primary processing stage. (Hajiyeva et al., 2020).

Yet largely manufacturing enterprises (medium- and small-scale) of the textile, sewing, and apparel industries that are located in the Ganja-Dashkasan and Baku economic regions still depend on labor-intensive assembly lines and manual sewing machines for production. Herein lies a significant digital gap as it makes small subcontractors unable to integrate themselves in the supply chain and digitally connect with the larger manufacturing hubs. (Mammadova&Mammadov, 2025).

One of the main Industry 5. 0 capabilities that the surveyed companies (even the ones with huge capital) lack the most is collaborative robotics (cobots) that could help human operators in performing delicate tasks such as fabric alignment or custom stitching. Industry 5. 0 is all about the synergy of human creativity with technology, a combination the local factories do not have at present. Besides high-value-added apparel, cobots can also enhance the production of customized corporate textile goods.

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The company sector here misses out even on very basic applications of Industry 5.0, such as real-time data integration between human craftsmen and machines, for instance: an AR interface that guides a worker in the execution of a difficult technical pattern, or in the execution of a product customization. Predictive, AI-based waste-minimization systems that can make on-the-fly changes to dyeing and spinning requests based on operator reactions also do not exist. (Cavadov et al., 2024).

The key insight from the industrial survey is the huge qualitative mismatch in the workforce, mainly the stock of university graduates newly entering the light industrial sector. When industrial managers across Baku, Ganja, and Mingachevir were asked about recent fresh graduates, they pointed out serious, multi-faceted shortcomings in both advanced technical skills and essential cognitive soft skills. This structural gap suggests that even though universities manage to graduate a lot of students, the qualities of these individuals do not match the current operational needs of a changing manufacturing sector. (Hajiyeva et al., 2025a).

On technical skills, there is a major lack of individuals who are familiar with computer-aided design and manufacturing (CAD/CAM) operations specifically for modern textile patterning. Graduates normally have only a basic theoretical engineering background and are not capable of using the local digital design software for pattern-making, automated pattern grading, and marker making. In addition, the number of graduates having some knowledge of eco-design, circular economy indicators, or sustainable material science is almost zero. Local graduates are not at all aware of how to measure, track, or optimize ecological footprint data in production, whereas globally the textile sector is moving towards strict compliance with non-toxic dyeing and procurement of raw materials from traceable, zero-waste supply chains. (Hajiyeva et al., 2020).

With cognitive and behavioral skills, the gaps are just as significant. Graduates may know theoretical engineering concepts very well but they lack the systems thinking, quick problem-solving skills, and emotional intelligence needed to handle technology-based production lines. Dealing with sudden technical hiccups or fixing machinery in a modern light industrial workshop is very different from the more structured, top-down environment that graduates usually operate in, and, in fact, they struggle to take independent action. (Hajiyeva et al., 2024a).

Above all, the absence of cross-disciplinary education means that graduates are not proficient in exchanging ideas and working together with different groups (for example, the creative designers and production engineers). The significant skills gap (Skill Gap) that has brought about this situation in local companies leads them to spend much time and resources to support their employees' upskilling and reskilling.

The thematic analysis of 24 interviews with university deans, department chairs, and senior faculty members reveals the root causes of the factory floors' workforce deficiencies very clearly. The academic qualitative data show that the curriculum of industrial engineering, light industry technology, and fashion/textile design in Azerbaijan is still very rigid, siloed, and largely outdated. In fact, many traditional degree programs are still based on historical engineering models that emphasize mechanical processes and conventional metallurgy, leaving very little room for modern, interdisciplinary modules that integrate data science with manufacturing. The academic personnel openly acknowledged that vital Industry 5. 0 model-related topics are almost completely absent in the national curricula. For example, there are no undergraduate courses on smart-textile engineering, advanced data analytics for supply chain optimization, human-robot interface programming, and green lifecycle assessment (LCA). Even when such courses are available, they are mere electives, with minimal or no practical lab work components.

It was noted that from time to time students do attend lectures on the fundamental chemistry of synthetic fibers, but they leave the university without ever coming across or operating a digital dashboard that shows real-time carbon emissions or material waste during the weaving process. The university heads also lamented that the institutional and regulatory setups were so rigid and constraining that it was nearly impossible for them to strengthen their programs. More To be exact, the State Standards for Higher Education in Azerbaijan enforce a very heavy and rigid set of compulsory general subjects which limit the extent of specialized technical hours that the universities can provide. Also, the lengthy bureaucratic procedure that must be gone through to get a new curriculum or a radically new cross-disciplinary major approved is making these universities fall further and further behind the fast-changing global environment in technology. (Kerimova et al., 2024).

Alongside these institutional inflexibilities, an acute human resources problem in the universities themselves poses significant additional difficulties: large numbers of senior faculty members have no direct experience with cyber-physical systems and The final part of the research through the empirical analysis reveals that the institutional, financial, and structural barriers are so deep-rooted that they essentially immobilize any potential meaningful collaboration between universities and industries in Azerbaijan, resulting in an isolation of both academia and the manufacturing sector from each other. The use of different research methods to collect data from the industrial surveys and from the academic interviews shows that the present form of cooperation is only at the surface level and mostly confined to the short-term student internships that are not monitored. These compulsory student on-the-job training sessions last a very short time, usually only a few weeks at most, and students hardly get any practical experience because most of the time they are either kept silent and just watching or are detached completely from the actual engineering and design work being done on the production line.

Academic representatives and industrial executives agree that there are absolutely no collaborative training programs in which students would have been trained with the company's knowledge and their inputs. There are no established long-term programs -

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like the dual-education system or having semesters within industry - where a university and a textile company could work together and come up with a joint curriculum that will lead to producing the kind of workers that the market is demanding at this very time. Also, not a single knowledge-transfer partnership (KTP) has been initiated in the domestic light industry sector. While it is a fact that universities have research faculties, very few, if any, of the local factories have the habit of reaching out to university laboratories asking for help in solving the bottlenecks they are having in the production process, carrying out material testing, or creating together innovative and sustainable textile products. (Hajiyeva et al., 2024).

This physical distance is only part of the entire picture. Significant factors underneath include fundamental mistrust between different types of institutions and a lack of financial incentives promoting interaction. As educational entities, Azerbaijani universities concentrate mainly on pedagogy and the issuance of degrees to graduates. These universities also have their hands tied by bureaucratic teaching loads. Their research infrastructure, if present, is not targeted at commercializing and carrying out applied research. That means they depend largely on the state for financial support. The light industry in Azerbaijan works like a closed-circuit business that is geared toward the satisfaction of immediate operational needs of cost minimization and fulfillment of upcoming production plans. Due to the absence of any state tax incentives, grants, or legislative setups that would support joint R&D projects of private firms with public universities, the two are hesitant when it comes to investing time and resources in building a collaborative ecosystem. (Nushaba et al., 2024).

CONCLUSION AND IMPLICATIONS

A very large sample base empirical research work in hand results have thoroughly taken apart pieces and put them back together to fashion a complete picture of the condition or state of the plant for implementation of Industry 5. 0 in the light industry sector of Azerbaijan. The specific emphasis of the paper is human capital development and the outputs of tertiary education at the national level. A very detailed research scope was designed to understand the industrial-educational dynamics in the South Caucasus region by integrating time-tested quantitative methods with qualitative ones. Forty-two manufacturing companies scattered mainly along the industrial belts of Baku, Ganja, and Mingachevir were surveyed quantitatively, and simultaneously, the qualitative insights of twenty-four academic department leaders and deans were gathered. " The main, overriding finding determined by performing research on the subject matter is that merely relying on top-down capital investments in automated physical hardware or factory infrastructure to achieve the pervasive, sustainable competitive transition to an Industry 5. 0 concept is entirely erroneous. It is, on the contrary, a complete dependence on a radical, qualitative transformation of the domestic human capital ecosystem. State modernization drive in specialized industrial parks, for example, resulted in only a slight revival from a bricks and mortar point of view while the skills gap worsened. In particular, the light industrial sector that takes extensive reliance on the human element remains severely constrained to growth. Graduates in engineering and management are latest entrants to the workforce; Still, they have dependent, non-remappable outdated theoretical education. The cross-discipline depth, which is, automated manufacturing data workflows, computer-aided design, cognitive problem-solving autonomy, and environmental circular economy metrics is lacking. Currently, human-centric, flexible, and sustainable production environments demand these features. In the absence of prompt and well-coordinated institutional measures, the structural misalignment will not be redressed, and regional industrial clusters will be locked in low-margin, labor-intensive primary processing cycles. They will neither be able to raise their global innovation capacity nor come down on their long-term dependence on foreign technical expertise.

To effectively bridge this widening qualitative chasm and establish a resilient, knowledge-based industrial economy, a series of comprehensive, highly detailed strategic policy and managerial shifts must be institutionalized across all structural levels. For higher education institutions and national educational policymakers, the traditional academic standards must undergo a thorough legislative overhaul to dismantle isolated, single-discipline templates and replace them with agile, multidisciplinary degree structures. Universities must directly embed specialized, practical modules covering smart-textile engineering, cyber-physical system safety, sustainable product lifecycle assessment (LCA), and real-time manufacturing data analytics into the core curriculum of every industrial management and technical engineering stream. Furthermore, the Ministry of Science and Education, in tandem with macro-level economic planners, must formalize and scale up a legally binding dual-education framework.

This framework must allow students to systematically split their academic years between traditional university lecture halls and structured, credit-bearing technical roles within regional industrial parks, ensuring immediate, hands-on familiarity with modern computer-aided manufacturing interfaces and collaborative robotics before graduation. Simultaneously, universities must aggressively invest in the pedagogical retraining of their senior faculty, shifting institutional teaching paradigms away from passive, textbook-centered memorization toward active, problem-based, and project-driven learning methodologies that naturally cultivate students' cognitive soft skills, adaptive intelligence, and independent troubleshooting capabilities on the factory floor.

Industrial enterprise managers and corporate executives should lead the change in their operational strategy by moving away from a short-sighted, passive approach to talent acquisition and towards an aggressive, long-term human development model. Only then will the manufacturing sector actively design and fund continuous, internal upskilling (Upskilling) and reskilling (Reskilling) pathways of its existing, mid-career labor force, pay the most attention to human-machine digital literacy, predictive waste management, and flexible, customized small-batch production techniques.

In fact, it will be better for the large-scale light industrial firms not to work in isolation but rather, in a proactive manner, protect their supply chains through direct co-investment in the academic infrastructure; this will also entail sponsoring specialized design laboratories within local universities and equipping institutions with licensed, state-of-the-art textile modeling and grading software to make sure that graduating cohorts are fully production-ready upon entry. From a macroeconomic governance perspective, the state can be the institutional catalyst by offering aggressive legislative incentives, such as direct corporate tax exemptions, specialized R&D matching grants, and national innovation subsidies for light industrial enterprises that demonstrate through documentation verifiable, active partnerships, co-designed curricula, or knowledge-transfer partnerships (KTPs) with public higher education institutions, This way greatly reducing private financial risks related to long-term technological collaboration.

REFERENCES

1. *Cavadov N.A., Hajiyeva, N. A., Mammadova, A. V., Mammadov S.C. Artificial Intelligence in Azerbaijan Education-Opportunities and Perspectives. The 3rd International Conference on Creativity and Innovation in the Digital Economy. Petroleum-Gas University of Ploieşti Faculty of Economic Sciences. 2024. pp.28-33. https://www.researchgate.net/profile/BlertaLeka/publication/392123581_Enhancing_Business_Processes_with_Artificial_Intelligence_and_Self-Service_Business_Intelligence/links/68359353026fee1034fc434e/Enhancing Business-Processe*
2. *Hajiyeva, N. A., Huseynova, M. R., Mammadova, A. V., Ibrahimova, N. V., Shahverenova, E., & Rustamova, A. E. (2024a). Green economy potential in liberated territories and ways to use it efficiently. International Conference on Smart Environment and Green Technologies (ICSEGT 2024), Lecture Notes in Networks and Systems (Vol. 1, LNNS 1251, pp. 473–481). Springer. [https://doi.org/10.1007/978-3-031-81567-6_55] (https://doi.org/10.1007/978-3-031-81567-6_55)*
3. *Hajiyeva, N.A., Ismayılov V.A., Mammadova, A.V., Mammadov S.C. Analysis and Assessment of the Volume of Demand for Innovative Products in Light Industry. Innovative Economy and Management, Ganja, 2020. İssue 1, pp.13-23.*
4. *Hajiyeva N.A., Mammadova A.V. (2025a) Post-Conflict Period in the Karabakh Economic Region: Socio-Economic Transformation and Settlement Processes. Monograph. Ganja. p.124*
5. *Kerimova, M. H., Gurbanova, X. V., Mammadova, A. V., Karimova, I. C., Yusubova, Ş. A., Hasanzada, Z. F., & Pasha, A. T. (2024). Marketing strategy as a key factor in the market development of innovative products. Journal of Law and Sustainable Development, 12(7)*
6. *Hajiyeva, N. A., Huseynov, R. T., Huseynova, M. R., Mammadova, A. V., & Mammadov, S. J. (2023). Digitalization of education in Azerbaijan. Agora International Journal of Economic Sciences, 17(2), 130–136.*
7. *Hajieva, N. A., Yusifov, E. J., & Mammadova, A. V. (2024b). Bank services in Azerbaijan: Application of marketing in the sphere. Monograph.*
8. *Hajiyeva, N., Mammadova, A., & Mammadov, S. (2025b). Directions for improving virtual bank marketing in Azerbaijan. Rethinking growth, 17.*
9. *Nushaba, H., Minure, K., Xatira, G., Mehriban, H., Sevinj, B., & Ayshan, M. (2024, September). Green Economy in the Framework of Sustainable Development. International Conference on Science, Engineering Management and Information Technology (pp. 292-307). Cham: Springer Nature Switzerland.*
10. *Mammadov A.V., Mammadov S.C. (2025) The economic role of marketing strategy in light industry innovation. Agora international journal of economical sciences. Vol.19. No. https://univagora.ro/jour/index.php/aijes/article/view/7328*