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Upskilling and Reskilling in the Logistics Sector: Insights from Human Resources Managers' Perspectives

Lojistik Sektöründe Upskilling ve Reskilling: İnsan Kaynakları Yöneticilerinin Perspektifinden Bulgular

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ABSTRACT

This study examines how Industry 4.0-driven digital transformation reshapes workforce skills in the logistics sector and explores the organizational and policy mechanisms that support this transformation from the perspective of human resources (HR) managers. Using a qualitative design, semi-structured interviews were conducted with 12 HR managers from logistics companies in Türkiye, and the data were analyzed through thematic analysis. The findings indicate that skill development increasingly prioritizes digital and analytical competencies—particularly data analytics, digital reporting, AI-related applications, and enterprise systems (e.g., ERP/WMS/TMS) —while transversal capabilities such as communication, adaptability, and continuous learning remain equally critical in hybrid human–technology environments. In addition, routine task profiles are perceived to decline in importance as digital systems expand, intensifying the need for reskilling toward technology-enabled roles. HR managers emphasized that sustainable skill transformation depends on organizational mechanisms such as continuous learning culture, employee engagement practices, structured training design, and senior management support, alongside enabling policy and institutional collaboration that aligns training provision with evolving sector needs. The study contributes an HR-centered account of skill transformation in the logistics sector and offers implications for workforce development strategies in digitally transforming environments.

JEL Codes: F14, L91, O33, J24, L87.

Keywords: International trade, logistics performance, digital transformation, human capital

ÖZ

Bu çalışma, Endüstri 4.0 kapsamında gerçekleşen dijital dönüşümün lojistik sektöründe iş gücü becerilerini nasıl dönüştürdüğünü ve bu dönüşümü destekleyen örgütsel ve politika temelli mekanizmaları insan kaynakları yöneticileri perspektifinden incelemektedir. Araştırma nitel bir tasarım çerçevesinde yürütülmüş ; Türkiye'de faaliyet gösteren lojistik işletmelerinde görev yapan 12 insan kaynakları yöneticisi ile yarı yapılandırılmış görüşmeler gerçekleştirilmiş ve veriler tematik analiz yöntemiyle çözümlenmiştir. Bulgular, beceri dönüşümünün özellikle veri analitiği, dijital raporlama, yapay zekâ uygulamaları ve kurumsal bilgi sistemleri (ERP, WMS, TMS) gibi dijital ve analitik yetkinlikler yönünde yoğunlaştığını ; buna paralel olarak iletişim, uyum sağlama ve sürekli öğrenme gibi aktarılabilir becerilerin de önemini koruduğunu göstermektedir. Rutin ve manuel görevlerin göreli öneminin azalması, yeniden beceri kazandırma süreçlerini daha kritik hâle getirmektedir. İnsan kaynakları yöneticileri, sürdürülebilir bir beceri dönüşümünün ; öğrenme odaklı kurum kültürü, yapılandırılmış eğitim tasarımı, çalışan bağlılığı uygulamaları ve üst yönetim desteği gibi örgütsel mekanizmalar ile sektör–eğitim iş birliklerini güçlendiren politika çerçevelerine bağlı olduğunu vurgulamıştır. Çalışma, lojistik sektöründe dijital dönüşüm bağlamında beceri dönüşümünü insan kaynakları perspektifinden ele alarak literatüre örgütsel düzeyde katkı sunmaktadır.

JEL Kodları: F14, L91, O33, J24, L87.

Anahtar Kelimeler: Uluslararası ticaret, lojistik performans, dijital dönüşüm, beşeri sermaye

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Introduction

The logistics industry has undergone significant transformation over time. Not only has it evolved from the initial stage of transporting commodities from point A to B, but it has also developed into a highly sophisticated system, which relies on highly developed computer-based technology. The original form of logistics, which came into practice during the Industrial Revolution, included transportation and storage, while in the second half of the last century, it expanded into a holistic approach, which focuses on supply chain management, customer satisfaction, and other such aspects (Ntule et al., 2024). The factors of globalization and development in computer-based technologies later accelerated this industry toward automation and use of data-driven decision support systems. Such advancements, which are linked with the principles of Industry 4.0, further included AI, IoT, big data analytics, etc., in the normal working of the logistics industry (Kumar et al., 2020; Pacheco-Velázquez et al., 2024).

The widespread use of digital technologies has brought about advantages as well as challenges. Automation improves speed and accuracy, but a significant sector of the labor force is facing difficulties in adapting to the new skill set (Frady, 2021). Conventional employment is declining, while modern employment requires increased familiarity with technology as well as problem-solving skills. Companies that have been investing in improving such skills within their workforce are witnessing improved logistic performance, thus proving a relationship between digital literacy skills and competitive success (Ntule et al., 2024; Pacheco-Velázquez et al., 2024). This relationship has been proven from a conceptual point of view as well as from a research perspective. For example, a regression analysis on 234 logistics businesses revealed that greater digitization led to increased logistic performance (Ntule et al., 2024). Companies are thus emphasizing organized reskilling and upskilling programs (Kumar et al., 2020).

The digitization of work is also changing learning in the workplace. Workers are forced to keep abreast of changes in software, equipment, and data systems. It is not enough to be competent; communicative, problem-solving, and critical thinking skills are also necessary (Frady, 2021; Muhammad et al., 2023). This is supported by literature. Oswald et al. (2023) state that technological change promotes a permanent renewal of knowledge, skills, and competency needs, such that the development of novel digital competencies via the process of lifelong learning is an absolute requirement. This means that institutions of higher learning, such as universities, need to work in close collaboration with industry to ensure that the learning offered is relevant (Areesophonpichet et al., 2024; Pacheco-Velázquez et al., 2024). It is also important that the necessary support is forthcoming, especially in terms of costs, learning, and opportunities that are typically unavailable to small logistics enterprises (Hansen et al., 2023).

Prioritizing the skills required has been identified as a burning need. This helps in identifying skills for which training programs can be formulated by governments as well as businesses. The literature has identified domains such as expert-level issue troubleshooting in automated systems, interpretation, and digital management as critical skills that are essential for the modern workforce (Kumar et al., 2020; Oswald et al., 2023). Comprehensive training improves short-term efficiency, while with the passage of time, it instills a sense of malleability in the workforce (Dhiman & Solkhe, 2025). In order to achieve this goal, a uniform policy is required that focuses on industry, financial assistance for training, and an overall emphasis on learning throughout life (Dhiman & Solkhe, 2025; Idrus et al., 2024; Kumar et al., 2020). In fact, quantitative models specifically targeting the transportation and logistics industry in the United States depict that a large chunk of the workforce qualifies for knowledge worker employment overall in the industry, listing a close approximation that nearly 71% of the tasks can be automated, making it essential to possess greater skills in the logistics workforce (Kumar et al., 2020).

Against this background, the present study addresses the following research question: “Which skills are being developed, transformed, or displaced in the context of Industry 4.0 in the logistics sector, and which organizational and policy mechanisms support this transformation?” By answering this question, the study aims to provide organizational-level insights into workforce adaptation strategies in digitally transforming logistics environments. The remainder of the paper is structured as follows. The next section reviews the relevant literature, followed by the conceptual framework, methodology, findings and discussion, and concluding remarks.

Literature Review

Opportunities of Industry 4.0 in the Logistics Sector

The adoption of these technologies by industries also

opens doors to the logistics industry, particularly in the context of efficiency, competitiveness, and sustainability. The adoption of artificial intelligence, robots, and the Internet of Things helps in the management of the supply chain. This, in turn, helps in the reduction of operating costs while also increasing the quality of service and customer satisfaction (Badmus, 2023; Dong et al., 2021). Moreover, the adoption of technology also helps in the implementation of the principles of green logistics, which, in turn, contributes to sustainability, as it involves the observation of energy consumption and the reduction of greenhouse gas emissions, thus aligning with the principles of Environment, Social, and Governance (ESG) reporting (Chen, 2025; Kele & Makhetha, 2022). Organizations that have adopted the principles of green technology are more likely to contribute to the improvement of their reputation, thus gaining a competitive advantage in industries that place significant emphasis on sustainability (Ren et al., 2019; Rosi & Obrecht, 2025).

In addition to the economic efficiency of the industry, the advancements in the context of technology have also been recognized to have a positive effect on the health of workers in the work environment. This is largely due to the adoption of artificial intelligence, which reduces the repetitive nature of work, thus promoting the health of workers (Badmus, 2023; Rosi & Obrecht, 2025). Moreover, the adoption of intelligent logistics also contributes to the creation of a healthy work environment, which facilitates the collaboration of humans and machines. Furthermore, the shift towards the digital revolution also places sustainability at the same level as organizational strategy, thus enabling the achievement of sustainable development through the operations of the logistics industry (Leogrande, 2024). Thus, it can be stated that the advancements in the context of Industry 4.0 have redefined the role of the logistics industry in the context of economic development.

Skill Transformation in Logistics: Challenges, Training Approaches, and Policy Context

Despite the opportunities presented by Industry 4.0, the logistics industry faces major challenges in developing the skills necessary to support Industry 4.0 transformation. First and foremost, the high costs of adoption of Industry 4.0 technologies and the resultant need to invest in capital costs and human skill development have proved to be a major hindrance in the adoption of Industry 4.0 technologies by the logistics industry, particularly by small and medium-sized enterprises (SMEs) (Muchiri, 2022). Secondly, the successful implementation of Industry 4.0 technologies into the existing operational systems of organizations depends on the ownership of change by the organizations and the technical skills of the workforce, both of which act as major barriers in the Industry 4.0 transformation process (Joseph, 2024).

Another major challenge facing the logistics industry in implementing Industry 4.0 technologies is related to the skill levels of the workforce and the ability of the workforce to keep pace with the constantly evolving Industry 4.0 technologies. A major part of the workforce in the industry lacks the skill levels necessary to operate Industry 4.0 technologies effectively and efficiently, and this has led to increased levels of job dissatisfaction and employee turnover (Joseph, 2024). Furthermore, skill development programs in many organizations remain limited to technical skills and lack adequate focus on the development of cognitive and human skills necessary in hybrid systems of human and intelligent machines (Muchiri, 2022). For example, in order to overcome skill gaps in Industry 4.0 technologies and the resultant increased levels of job dissatisfaction and employee turnover, skill development programs must focus on the simultaneous development of technical and problem-solving skills, as well as adaptability and emotional intelligence. Government and institutional support in this regard becomes very important in developing skill levels in the workforce and in designing skill development programs that include both technical and human skills in Industry 4.0 technologies, as the exclusion of the less-skilled but technologically literate workforce might act as a major hindrance in the Industry 4.0 transformation process itself.

Parallel to these issues, the skill set of the logistics workforce is also undergoing a fundamental shift. Industry 4.0 has extended the skill set of the logistics workforce from basic computer skills to include skills related to artificial intelligence, robotics, Internet of Things, and data analytics, among others (Joseph, 2024). In addition to being good at their jobs, these more general cognitive skills help workers deal with uncertainty, make sense of complicated operational data, and make smart decisions in digital environments. At the same time, leadership, teamwork, and emotional intelligence have become more important in the workplace, especially as people work with smarter and more automated systems. Emerging technologies seem to need a wider range of skills, where technical and human skills work together instead of replacing human input (Badmus, 2023).

Because of these changing skill needs, logistics companies have slowly changed the way they train their employees. Digital and immersive training methods, in particular, have gone from being experimental tools to more structured parts of programs that help workers grow. Employees can now practice tasks in safe, controlled environments by using augmented and virtual reality apps to make warehouse layouts, routing procedures, and operational workflows look like they are in real life. Research has shown that Extended Reality (xR) technologies can be useful for training by providing detailed instructions for complicated tasks and making learning easier in virtual simulations and process-based settings (Fast-Berglund et al., 2018). Research also shows that training based on simulations improves systems thinking and decision-making in environments that are unpredictable and changeable. These are two skills that are very important for managing logistics in supply chains that are digitally connected (Pacheco-Velazquez et al., 2024).

But you can't judge how well these digital training programs work just by looking at how technology has changed. The long-term effects of these programs depend a lot on whether businesses make it easy for people to keep learning and getting better at their jobs. In fields where technology moves faster than traditional school schedules, developing a natural desire to learn for the rest of your life becomes necessary instead of just helpful.

The path of skill transformation is also influenced by institutional and policy frameworks that go beyond the level of the organization. Governments and schools are increasingly expected to offer training programs that keep up with new technologies, often through partnerships with businesses (Muchiri, 2022). Regulations regarding data security, workplace safety, and environmental, social, and governance (ESG) standards contribute to the establishment of a robust foundation for workforce development and technology adoption (Leogrande, 2024). A lot of research shows that companies that invest in skills in a long-term, strategic way usually do better than their competitors. This shows how important it is for the logistics industry to fully transform its skills for the future (Cramarenco et al., 2023).

Evaluating Upskilling and Reskilling Outcomes

The processes of upskilling and reskilling have also begun to feature more prominently within the literature, not only as a process for developing skills but also as an investment within human capital that has multidimensional outcomes that need to be evaluated. The initial work of Baldwin and Ford (1988) provided a framework for training effectiveness that is dynamic and links learning outcomes to their transfer to the work environment and their maintenance over time, thus establishing that training success is not purely based on short-term learning outcomes. Further work using a meta-analytic approach has also provided evidence that training success is linked to behavioral changes and improvements in job performance, which are moderated by various factors (Blume et al., 2010).

From an evaluative perspective, the benefits of upskilling and reskilling have also been categorized and evaluated across various levels, from individual outcomes such as improved employability, productivity, and career progression, through to organizational outcomes such as improved business performance, innovation, and adaptability (Aguinis & Kraiger, 2009). Such multidimensional outcomes also reflect some of the more popular training evaluation models, such as the Kirkpatrick model, which differentiates between reaction, learning, behavioral application, and organizational outcomes, and some of its extensions that include return on investment (ROI) measures for organizational outcomes (Kirkpatrick & Kirkpatrick, 2006; Phillips & Phillips, 2016).

As recent policy-oriented and empirical studies emphasize, it is critical to recognize that the effectiveness of upskilling and reskilling strategies in the context of the digital transformation process will depend on their ability to address skill gaps and increase workforce resilience. In this context, it has been proposed to use approaches to measure skill gaps to conceptualize reskilling needs and outcomes based on the systematic comparison of current competencies with changing occupational demands (Rikala, 2024). At the same time, it has been recognized globally that effective adult learning and reskilling strategies produce significant effects on employment outcomes, wage progressions, and perceived effectiveness of the workplace; hence, it emphasizes the importance of outcome-oriented evaluation models (OECD, 2019). In total, it seems that the integration of specific measurement criteria, performance indicators, and assessments of the impacts of upskilling and reskilling strategies considerably improves the theoretical and analytical depth of the literature on upskilling and reskilling strategies in the context of the digital transformation process. These perspectives on evaluating upskilling and reskilling strategies provide a theoretical

basis for understanding how upskilling and reskilling strategies are perceived and implemented by human resource managers in the context of the logistics sector.

As the literature indicates, previous studies on the subject of upskilling and reskilling strategies in the context of Industry 4.0 and the technological implications of Industry 4.0 on the logistics sector extensively emphasize the importance of upskilling and reskilling strategies in the context of the digital transformation process. However, it seems that the majority of the literature either focuses on the perspectives of the employees at the operational level or adopts quantitative perspectives to evaluate the macro-level implications of Industry 4.0 on the logistics sector. At the same time, it seems that there is limited discussion on how the human resource managers in the context of the logistics sector perceive and implement upskilling and reskilling strategies in the context of the digital transformation process. In addition, it seems that there is limited empirical evidence available on the subject in the context of emerging logistics markets globally. In this context, it seems that the current study will provide a qualitative perspective on the subject and will contribute to the literature on the subject with specific insights into the perspectives of the human resource managers in the context of the logistics sector.

Conceptual Framework

On the basis of the reviewed literature, it is proposed that the process of skill transformation in the logistics industry can be conceptualized as a multidimensional process, which is subject to influences from technology, organizational learning structures, and strategic human resource practices. In this context, it is proposed that Industry 4.0 technologies can be conceptualized as the major driving forces of skill transformation, while upskilling and reskilling can be conceptualized as mediating factors that facilitate the process of workforce transformation. Corporate strategies and learning cultures can be conceptualized as enabling factors that shape the effectiveness of skill transformation processes.

The Impact of Technological Transformation on the Logistics Workforce

Building on the theory established in the foregoing sections of the paper, in this study, Industry 4.0 Technologies is the key structural change that affects the way people work in the industry. For instance, taking the case of AI, IoT, robots, and big data, they are the underlying drivers of work.

Within this framework, the role of AI is as a decision support partner that fundamentally changes the work that people do, as well as their approach to that work. IoT provides the infrastructure that enables the monitoring of the supply chain. Robotics minimizes the need for human labor in supply chain operations, simultaneously boosting the need for people to be involved in the technical monitoring processes that underpin operations. Big data technology are considered as augmentation technologies that increase the need for people to be involved in statistical analysis and informed decision-making (Efthymiou & Ponis, 2021; Ghobakhloo, 2018).

Therefore, technological transformation is perceived as a structural catalyst that forces employees to transform from manual to analytical, strategic, and implementation-oriented roles. This, in turn, generates the required synergy between human and technological resources, where cognitive flexibility and adaptability become essential to workforce sustainability.

Redefining Skills: Upskilling and Reskilling

In keeping with the shift towards tech-driven changes, the current system views upskilling/reskilling in terms of the organizational adaptation to changing skillset demands. In other words, upskilling involves improving the existing skillset of the present workforce, while reskilling involves providing employees with the skillset needed to fill the jobs created due to advancements in technology.

Thus, following this understanding, technical know-how is not enough for an organization to be transformed. Rather, as important as technical skills are, organizational transformation also needs soft skills like flexibility, analysis, communication, and collaboration, especially in a hybrid environment of both human and technical capabilities (Poláková et al., 2023). Skill transformation, therefore, is a multi-dimensional concept.

Training programs, in this context, have been considered as a key lever for up-skilling and re-skilling pursuits. Digital-based training technologies including e-learning platforms, VR/AR-based training sessions, and MOOCs facilitate training efforts and align them with organizational objectives (Famoti et al., 2025; Rassameethes et al., 2021). Continuous assessment approaches also help match training with technology-related shifting demands (Dhiman & Solkhe, 2025).

If one considers it in this fashion, it becomes evident that skill transformation is not an activity to be undertaken by the HR department. Instead, it's a strategic initiative to improve competitiveness. Upskilling and re-skilling represent the connection between technology disruption and growth in real-life capabilities (Gamberini & Pluchino, 2024; Miranda et al., 2021).

Corporate Strategies and Learning Culture

This framework enhances comprehension of corporate strategy and learning culture as facilitating elements that affect the efficacy and longevity of upskilling and reskilling initiatives. In the context of the rapidly changing technologies of Industry 4.0, a learning-oriented corporate culture is seen as a necessary part of the company's structure, not just a nice-to-have.

From the theoretical perspective of this model, three essential elements of corporate strategy and culture are emphasized: (1) the institutionalization of a learning-oriented culture, (2) the strategic alignment of human resource methodologies, and (3) the integration of innovative learning models. In this context, a learning-oriented culture refers to a corporate environment that promotes knowledge-sharing, collaboration, and experiential learning methods, thereby enhancing collective adaptive capacity (Humairah et al., 2023).

Strategic human resource approaches are seen as ways to help align the growth of the company with the growth of its employees. These methods can make workforce transformation processes more effective by encouraging engagement, resilience, and strategic alignment (Cristiani & Silla, 2018; Shahzad et al., 2024). In this context, employee development is perceived as a comprehensive and cohesive process integrated into corporate strategy, rather than as a separate training initiative (Lewis, 2018).

Innovative learning models, such as online learning platforms, virtual and augmented reality-based training tools, and mentoring systems, are regarded as delivery mechanisms that implement a learning culture within organizations (Al-Qudah et al., 2020; Patil & Priya, 2024; Zhao et al., 2019). These mechanisms enhance flexibility, accessibility, and cost-effectiveness, thereby bolstering workforce adaptability in contexts where technological change threatens organizational stability (Zakarya et al., 2019).

Methodology

Purpose and Research Questions

This research seeks to, from the perspective of Human Resource leaders, consider the impact that this digital shift within Industry 4.0 is having on the skills that individuals within the logistics sector possess. The overall research question this study seeks to address is, "Which skills are being developed, transformed, or displaced in the context of Industry 4.0 in the logistics sector, and which organizational and policy mechanisms support this transformation?". Expanding upon this research idea, this research will also examine digitalization's role within these aspects, such as capabilities, education policies, strategic actions, and aspects that this industry expects, along with how this industry is adapting its HR practices to meet this shift towards Industry 4.0.

Material and Methods

Data for the study were collected through semi-structured, in-depth interviews conducted between 30 September and 5 October 2025. Ethical approval for the study was obtained from Mudanya University (Date: September 30, 2025, Approval No: 2025-5). Written informed consent was obtained from participants who participated in this study. This interview format allows for the pre-determined thematic framework to be maintained while also providing flexibility for additional, more in-depth questions when necessary (Galletta & Cross, 2013; Kvale & Brinkmann, 2008). Participants were selected using a combination of convenience and purposive sampling to represent different components of the logistics ecosystem. Convenience sampling offers the researcher a rapid and practical means of data collection. Furthermore, its low cost allows for easy conduct of research under limited resources and time constraints (Etikan et al., 2016). In addition, guidance from industry networks and professional associations was also utilized in selecting participants. Selection criteria were determined as follows:

- Active participation in digital transformation projects in logistics,
- Experience in functions such as HR/learning and development, operations/planning, warehousing/distribution, 3PL/4PL management, and digital transformation leadership,
- Representation of companies of various sizes and sub-sectors (road, sea, air, warehousing, e-commerce logistics).

There is no consensus in the literature on sample size in research. Yıldırım and Şimşek (2016) stated that in-depth interviews can be conducted with even a single participant, while Adams (2015) suggested that approximately ten interviews would be sufficient. Equally, Galvin (2015) asserts that a dozen interviews are adequate for the analysis, while Litfin (2017) explains that he interviewed fourteen participants. In consideration of the different norms of the two studies, a twelve-participant sample is therefore used in the analysis.

Analysis of the data was done using the thematic analysis technique developed by Braun and Clarke (2006, 2019). This involved a number of steps, including repeated reading of the data, making notes to increase familiarity, development of open-ended codes, which were subsequently consolidated on the basis of certain themes, and the themes were identified by comparing them with the complete dataset. The final stage of the process involved definition of the themes with precision, giving a thorough explanation of the findings, with quotations from the participants, in the form of a report.

Results

General Information about the Interviewed Companies

Table 1 shows the descriptive statistics of the participants.

Table 1.
Descriptive Statistics of the Participants

Variable		N	%
Gender	Male	6	50.00
	Female	6	50.00
Marital Status	Married	9	75.00
	Single	3	25.00
Age	18-25	1	8.33
	26-35	4	33.33
	36-45	5	41.67
	46-55	2	16.67
Education	Undergraduate	5	41.67
	Postgraduate	7	58.33
Occupation	Learning and Development Specialist	5	41.67
	Talent Acquisition and Management Officer	4	33.33
	HR Manager	3	25.00
Income (TRY)	50.000 TL - 80.000 TL	3	25.00
	80.001 - 100.000 TL	7	58.33
	100.001 TL and above	2	16.67
Total		**12**	**100.00**

Analysis of the data available in the table reveals a fairly even split in gender (6 men, 50%, and 6 women, 50%) representation. Marital status reflects a larger number of married respondents (75% married, 25% single). Ages are dominantly represented within the 26 to 45 age range, with the highest number (41.7%) within the 36–45 age group. Most respondents (58.3%) have a postgraduate degree, with the remaining having a bachelor's degree (41.7%), denoting a relatively high educational level of the respondents. Turning to occupation, most are learning and development specialists (41.7%), talent management officers (33.3%), with the lowest being human resource managers (25%). Incomes are mainly represented by respondents with 80,001 to 100,000 TL (58.3%), with the second highest represented by respondents with 50,000 to 80,000 TL (25%), with the remaining having 100,001 TL and above (16.7%). Taken together, the table reflects that human resource practitioners in the logistics industry come from a population with a middle age profile, high educational background, and from an upper-middle class category income-wise.

Upskilling: Concepts and Skills

The following questions were put to human resources managers within firms that operate within the logistics sector with the intention of giving insights on how employees develop skills within the context of digital technologies within their current employment:

(1) In relation to the HR function, what are the definitions of upskilling (improving existing skills) and reskilling (gaining new skills), and how are they used?

(2) In which technical fields is further training or development required to upgrade employee performance in their current job?

(3) Can you give examples of up-skilling programs that have been introduced within your current organization recently? How are such programs affecting your business processes?

(4) In the area of digital technologies, what are some themes (for example, data analysis, management of inventory, implementation of automated systems) that would be useful for training staff?

On the basis of the answers to these questions, a summary of the most prominent themes, skills, and training areas for upskilling a logistics business has been provided in the following Table 2:

Table 2.
Upskilling Themes, Critical Skills, and Related Training

Upskilling Theme	Critical Skills / Sub-Fields	Given Training / Examples	Participant Support (≈)
Deepening Current Role	Performance improvement, error reduction, efficiency	Reporting techniques, Key Performance Indicator (KPI) literacy, performance analysis	6–7 participants
Digital Adaptation	Data analytics, AI, automation, ERP/TMS/WMS/CRM	Business Intelligence (BI) tools such as Power BI and Excel, ERP systems such as SAP, automation software, and data processing applications.	7–8 participants
Strategic Development	Agility, commitment, teamwork, problem solving	Coaching and mentoring, agility training	3–4 participants
Customer & Communication	Real-time communication, customer relationship management	CRM usage, digital communication techniques	4–5 participants

Note: ERP (Enterprise Resource Planning), TMS (Transportation Management System), WMS (Warehouse Management System), CRM (Customer Relationship Management).

The findings from the participants' perspectives revealed that the prominent aspect of the upskilling activity is digital adaptation. Seven participants (A, C, D, E, F, G, J) identified the importance of data analytics, artificial intelligence, and ERP skills, thereby arguing that the skills specifically develop efficiency in terms of speed and accuracy in the workflow. Six participants (B, D, E, F, H, I) identified that reporting, measuring performance, and minimizing errors are crucial aspects within the depth of the current job. Then, a small list of three participants (C, G, K) identified agility, commitment, and teamwork within the scope of strategic development. The fourth set of four participants (B, H, I, L) identified that customer job skills, alongside commitment and communication skills, have been significant, citing CRM skills, alongside online communications, particularly within the context of the post-pandemic era. In summary, the findings from the two perspectives illustrated that the scope of upskilling is not limited to skills but also includes social and strategic aspects.

To assess how far the training and development programs introduced in the concerned logistics enterprises are in line with the process of digital transformation, the following question was administered to the human resource managers:

(5) In your opinion, are your existing training and development practices adequate to support the sector with respect to digital transformation? The responses to this particular question are used to summarize the findings in the following table, which takes into consideration the responses indicating whether the practices are adequate, with reservations, or room for improvement.

Table 3 shows the adequacy of existing training.

Table 3.
Adequacy of Existing Training

Evaluation	Description	Sharing Tendency
Positive	Current systems, process speed/quality gains	Low-Medium
Conditional	Continuous updates and applied content required	High
Incomplete	Scope limited due to time/infrastructure constraints	Medium

An analysis of the responses submitted in the table clearly clarifies that training and development practices

are a significant foundation for adaptation in digital transformation, but most respondents feel that a continuous update is required in these practices to keep abreast. Four respondents (A, B, C, H) emphasized that, though a solid foundation has been established, to keep pace with dynamic conditions in the technological environment, one has to go beyond the boundaries of conventional training practices, which would emphasize more dynamic programming and persistent updates in content. Three respondents (D, E, F) emphasized that training is an essential activity that needs to be adopted extensively in order to make the field staff capable of handling digital systems effectively, enhancing the capacity to take decisions based on data-driven analysis, and ensuring that management is proficient in digital strategic practices. Two respondents (G, K) argued that the coverage of training practices is not adequate, thereby implying that more comprehensive, efficiently planned, and organized programs are necessary, keeping in mind the constraints of time and/or organizational capacity. Two respondents (I, L) reported a positive orientation toward existing digital systems (for instance, SAP S/4 HANA) or projects for process digitization, which give a competitive edge to certain sectors. One respondent (J) suggested that training practices cannot be effectively implemented entirely because of a lack of infrastructural support. It is thereby obvious that training and development practices are a significant foundation for adaptation in the context of digital transformation; unfortunately, they are insufficient on their own.

Reskilling: Concept and Guidance

To identify the new job descriptions and skill requirements that emerged with the digital transformation process in the logistics sector, the following questions were posed to human resources managers:

(6) What business lines or tasks have you observed to have undergone transformation with Industry 4.0? What new skills did this transformation necessitate?

(7) What positions have employees been reassigned to within your company as part of reskilling practices, or what new business areas have they been adapted to?

(9) How do you connect employees' existing experience and traditional skills to new roles during reskilling processes?

Table 4 shows the transforming roles and skills with reskilling dimensions.

Table 4.
Transforming Roles and Skills with Reskilling Dimensions

Reskilling Dimension	Evolving Roles	New Skills Required
New Role Acquisition	Operations / Planning	Data analytics, route optimization, AI-assisted planning
	Warehouse / Inventory Management	Warehouse Management System, automation, Radio Frequency Identification (RFID)/barcode systems
Technical Retooling	Customer & Documentation	Customer Relationship Management, digital communication, process automation, data-based reporting
	Technical Support & IT	Systematic problem solving, integration, IoT, and digital infrastructure knowledge
Strategic Adaptation	Sales & Advanced Strategic Roles	Persuasion and sales skills, sustainability management, strategic planning, Industry 4.0 training

Findings from participant perspectives show that the reskilling process takes place on three major dimensions. In relation to learning a new role, the highest priority is identified in relation to operations and planning, with participants A, B, D, and I identifying that individuals have shifted from previous roles to other departments, learning a different set of skills involving data analytics, routes, and warehousing. In relation to the technical aspect of reskilling, individuals C, E, G, and H identified that skills in customer relationship management, CRM-based online communication, and technical support skills have now reached a critically important level of adoption. The knowledge of the supporting infrastructure, especially involving IoT, automation, and systems, has empowered individuals to carry out duties in different capacities more effectively. In relation to the strategic adaptation major theme, individuals J, K, and L identified a high priority in relation to sales, as well as highly strategic dimensions, which reinforced that the skills of persuasion,

sustainability, strategic planning, and Industry 4.0 adaptation are the most fundamental dimensions of reskilling.

In order to identify the most common challenges faced in reskilling practices, including how these affect employee onboarding, a question was posed to the human resources managers in the logistics industry as follows:

(8) What challenges did you find most difficult during your reskilling experience? Analysis of the responses gathered from the respondents identified three major categories of challenges. The categories are concerned with challenges of constraints on time and resources, resistance from the workforce and employee motivation, as well as role fit challenges. The findings are illustrated in the table below, which identifies the challenges that affect sustainability in reskilling practices.

Table 5 shows the difficulties in the reskilling process.

Table 5.
Difficulties in the Reskilling Process

Difficulty Category	Explanation
Time & Resources	Time constraints for training, lack of infrastructure
Resistance & Motivation	Resistance to change, customer insistence on old methods
Matching & Adaptation	Role mismatch, adaptation time

Analysis of the views of the participants shows that the difficulties experienced in the reskilling program are varied. The lack of time and training opportunities, inability to commit time to training because of full schedules, the nature of existing duties that make it difficult to concentrate on training, and the extra work that has to be invested in learning new systems are considered challenges by four participants (A, D, E, J). Three participants (B, F, G) see resistance from employees to change as a challenge. This includes reluctance to use new technologies, difficulties in changing set behavior, taking a longer than expected time to change, and a proclivity on the part of customers and even employees to use the old way. The lack of motivation and misguided advice contribute to two challenges identified by two participants (C, H). The inability of the employee to see the long-term value of learning a different skill, lack of motivation, and assignment to a job that doesn't fit is a component that reduced the efficiency of the process. The need to put people to the right job as a potential source of error that has to be considered is identified by one of the participants (I). The findings of the research point to a conclusion that insufficient time and training, resistance from the employee, lack of motivation, and inability to put the employee in the right job are the most significant factors acting as difficulties in reskilling.

The following questions were used to identify the supporting strategic roles that human resource departments, together with employers, play in the logistics industry in relation to the employee upskilling and reskilling process, namely:

(10) In what way should employers and the HR department move to support employee upskilling/reskilling?

(11) In your current company, which areas do you see with the most requirement for training in the future? The responses shed light on the facilitating role of human resource management during the transformation process in the digital age, as well as the level of support from employers pertaining to the development of skills. The themes, factors, and support mechanisms identified within the context are described in the table given below.

Table 5 shows the *hr/employer support roles.*

Table 6.
HR/Employer Support Roles

Support Area	Recommended Practice
Planning & Mapping	Needs analysis, skill mapping, personalization
Motivation & Coaching	Coaching, mentoring, transparent communication
Content & Budget	Target-appropriate content, time, and financial support
Senior Management Support	Active participation and ownership

An assessment of the responses provided in the table shows that multidimensional approaches, such as training plan design, motivation, transparent communication, and senior management's direct participation, are also highly linked with more efficient support for upskilling/reskilling initiatives on the part of employers and human resource

departments. Four respondents (A, B, C, I) strongly emphasized the importance of needs analysis and developing personalized training plans, thereby underlining that thorough training analysis, skill inventory, and the design of adaptable training plans with a focus on employees' personalized goals, interests, and learning styles are essential. In this regard, respondents from this category encouraged employers to be proactive for changes and remain actively engaged in research and development initiatives. Three respondents (D, E, F) strongly emphasized that employers need to address the importance of adequate motivation, transparent HR practices, and mechanisms for feedback, thereby recommending that resistance from employees needs to be minimized by adequate motivations, transparency in overall HR practices, and that coaching, mentoring, and continuous feedback approaches are highly integral components in this regard. Two respondents (G, H) specifically emphasized developing skills in technologies, therefore recommending the need to develop highly competent training teams capable of effectively supporting use of digital technologies, AI, and organizing seminars that leverage the best knowledge from top leaders within the industry. Two respondents (J, K) specifically underscored the importance of departmental experiences via programs, emphasizing that such practices facilitate individuals' adaptation of skills within a business environment. The findings, therefore, clearly indicate that employers, together with HR departments, need to provide more comprehensive training on employable skills within a multidimensional approach that focuses on employee motivations, transparency in overall human resources, development of skills in technologies, and senior management's direct participation within overall development and transformation initiatives.

The results made available in Tables 3-6 clearly show that the concept of digital transformation, within the context of the logistics industry, is more than merely involving techno-related aspects; it also has organizational and people-related aspects (Table 3). The views expressed by the participants clearly state that the current training and development practices are providing a strong base for adaptation but need to be updated from time to time (Table 3). The difficulties that arose within the process of reskilling, such as lack of time, lack of resources, resistance, misalignment, etc. (Table 5), clearly state that a strong base for adaptation is not reliable to remain in a constant state, especially when it comes to the techno-related changes taking part within the organizational environment (Table 5). On the contrary, the findings clearly state that the role of HR support within the industry is largely limited to areas such as planning, motivations, quality, and senior management (Table 6).

Discussion

The findings from this research clearly state that the effect of digitalization on the logistics industry is changing the skills of the workforce significantly, which requires a comprehensive methodology that considers the technological, as well as the human, aspects together. The importance of Industry 4.0 technologies, such as Artificial Intelligence, Internet of Things, Big Data analytics and automation technologies has been clearly identified by many authors (Efthymiou & Ponis, 2021; Ghobakhloo, 2018), which improves efficiency but requires a complete makeover in job descriptions (see Ghobakhloo, 2018). The findings from this research also validate that there is a significant need for new skills, specifically in the context of developing skills in data analysis, reporting, Artificial Intelligence, and use of platforms, which is supported by existing literature (Kumar et al., 2020; Pacheco-Velázquez et al., 2024).

The findings also confirm that the notions of upskilling and reskilling have different but complementary focuses. Participants identified that upskilling is developing and enhancing the existing skill sets of the workforce, while reskilling is providing different skills to the workforce in order to assist with a transition to a significantly different job. This result is consistent with the findings of Poláková et al. (2023), who identify that training sessions need to include not only hard skills but also cognitive, social skills, such as teamwork, problem-solving, and communication skills. In addition, as stated in other research literature, such as Frady (2021), other skills such as soft skills, a learning mindset, are recognized as being highly important, alongside hard skills, in adapting to a changing digital environment. The findings from the current research confirm that a complementary development of hard skills, as well as soft skills, practices are necessary within the logistical industry when undertaking upskilling, as well as reskilling, programs.

The research also explains in detail the importance of the development of skills that result from the training programs initiated by the logistics companies to adapt to Industry 4.0. It has been identified that most of the respondents agreed that the development of skills related to systems such as ERP, WMS, TMS, RFID, CRM, RPA, and EDI has increased efficiency, speed, and quality, thereby

enhancing overall efficiency. This has been supported by the findings of research papers such as Dhiman & Solkhe (2025), Cramarenco et al. (2023), which emphasize the importance of developing skills for increased strategic benefits. The importance of developing skills in AI, automation, and big data, which has been identified, supports the findings that developing skills in digital areas is a significant component in developing competitive advantage because of reduced error rates, faster decision-making, and increased customer satisfaction.

Despite this, the research has also identified some challenges that the logistics businesses are undergoing within the transformation path. The workers showed evidence of having time constraints, lowered employee motivation, and resistance to change. The challenges fit within the literature's classification of cultural and organizational challenges within the process of digitization transformation (Joseph, 2024; Muchiri, 2022). The results confirm the quantitative findings surveyed by other researches. For example, Muchiri (2022) initiated a survey involving 115 participants, discovering that 70.4% of organizations are undergoing, or are expecting, drastic skills shortages, with 93.9% reporting that certain individuals in the businesses need development skills via training, reskilling, or upskilling. It is worth noting that digital literacy skills came top with a rate of 24.6% skills shortage. This compares with how the HR managers reported within the research, concerning similar skills shortages and challenges in transforming. In fact, employee resistance to, as well as reduced worker engagement with, emerging technologies are considered as critical factors within a transformation process to succeed.

Another significant observation revealed from the findings is with regard to the importance of institutional support, leadership engagement, and skills transformation. The respondents clearly articulated that the support and engagement of senior management are vital to the achievement of the desired impact of upskilling/reskilling initiatives. This is supported by literature, which asserts that human resource practices need to be strategically linked with corporate strategy, with transformation projects needing to be a high priority for senior management (Cristiani & Silla, 2018; Hansen et al., 2023). Additionally, the importance of personalized learning approaches for transforming skills in employees is identified from the findings, which is supported by recent literature on adult learning. For instance, as cited by the World Economic Forum (2020), a literature stating that a single industry cannot undertake reskilling; there is a need for collaboration with policymakers, as well as learning institutions. The findings identified the importance of a multi-stakeholder, multi-industry, and multi-institution approach (private sector, education sector, and government sector), which is essential for developing the skills of the logistics sector to prepare for the digital age. In conclusion, the overall importance of this research is to confirm that the process of digitalization in the logistics industry is a multi-faceted phenomenon that moves on from a mere technological upgrade, touching upon organizational culture, human resource development, and employee adaptation. Although the overall results are consistent with the existing literature, they depict sector-level implications that, in order to succeed with a competitive edge, a greater emphasis on human resources, as well as the induction of employees themselves into the overall makeover, is required. This means that people-oriented digitalization is a pre-condition for success (Areesophonpichet et al., 2024; Barney, 1991). The following section discusses the conclusions that arise from this research, set within the context of existing literature.

Conclusion

It is evident from this research that the technological shift in the logistics industry has a significant impact on the skills of the workforce. The research clearly indicates that a paradigm shift is necessary not only in technologies but also in skills. Upskilling and reskilling have now become a need for ensuring competitive advantage in a modern-day logistics business setup. It has been revealed from this research that merely providing skills to the workforce is not enough, but other human skills, such as flexibility, problem-solving, communication skills, teamwork, and a learning culture, are also to be encouraged. The technologies used in Industry 4.0, such as artificial intelligence, Internet of Things, automation, big data, etc., are providing efficiency, speed, and optimisation to the entire logistics activity, but to make a full use of the technological shift, a complete plan for skill development of the workforce is necessary, which should work alongside the technologies. The findings directly address the research question by identifying key skill transformations and the organizational and policy mechanisms supporting them.

The research also explains the challenges faced by employees when adapting to changes brought by new technologies. Time limitation, inability to coordinate training programs with business, and lack of motivation provide adequate reasons that indicate that digital

transformation is a transformation involving not only technological changes but also changes within the socio-organization structure. Therefore, it is concluded that in the logistics industry, investment in technology should be supported by a similar investment in human capital. In fact, the implementation of digital transformation projects alongside people-focused change management is necessary for employee engagement, organizational agility, and long-run competitiveness (Cristiani & Silla, 2018; Hansen et al., 2023).

The overall findings from this research clearly indicate that industry leaders, as well as policymakers, should avoid limiting the scope of digitalization to merely integrating new technologies; rather, they need to follow a comprehensive approach towards the development of human capital. The research has recognized certain limitations. For instance, the scope of the research is limited to a sample of 12 people, making it difficult to generalize the findings on the entire sector of logistics. Additionally, although the findings have been descriptive, accounting for a deeper analysis, the findings are limited to a lack of quantification. The scope of research is limited by the constraints of time, making it difficult to assess the long-term impact of the technological shift. Lastly, the research has been limited to people from different branches within the sector of logistics, but different means of transportation within that sector are not included.

Policy Recommendations

The research provides a number of implications with respect to public policy and strategic formulation at the organizational level. In the first instance, there is a need to enhance the current continuing education system. It is essential that public institutions, together with sector associations, support, fund, and address the cost implications, especially experienced by small to medium-sized enterprises. On a complementary note, organizational-level education policies should not only focus on enhancing technical skills but also develop soft skills, such as critical thinking, communication skills, teamwork, and emotional intelligence.

The application of modern educational technologies appears to be a highly significant consideration from a policy perspective. Online learning platforms, MOOCs, augmented/virtual reality based applications, as well as e-mentoring platforms, need to be adopted more extensively in the arena of logistics with a view to providing scalability as well as flexibility to the learning process of the workforce. Additionally, the alignment of strategic human resource policies with training programs is also bound to make a significant impact on minimizing resistance to the adoption of digital transformation in the sector.

Etik Komite Onayı: Bu çalışma için etik komite onayı Mudanya Üniversitesi'nden (Tarih: 30.09.2025, Sayı:2025-5) alınmıştır.
Katılımcı Onamı: Yazılı katılımcı onamı bu çalışmaya katılan cevaplayıcılardan alınmıştır.
Hakem Değerlendirmesi: Dış bağımsız.
Çıkar Çatışması: Yazar, çıkar çatışması olmadığını beyan etmiştir.
Finansal Destek: Yazar, bu çalışma için finansal destek almadığını beyan etmiştir.
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Genişletilmiş Özet

Endüstri 4.0 ile birlikte yaşanan dijital dönüşüm süreci, lojistik sektöründe yalnızca teknolojik altyapının yenilenmesini değil, aynı zamanda iş gücü yapısının, yetkinlik profilinin ve organizasyonel süreçlerin yeniden tanımlanmasını da beraberinde getirmiştir. Bu çalışma, söz konusu dönüşümün insan sermayesi üzerindeki etkisini analiz etmekte ve özellikle upskilling (beceri yükseltme) ile reskilling (yeniden beceri kazandırma) uygulamalarının sektörel rekabet gücü üzerindeki stratejik önemine odaklanmaktadır. Lojistik sektörü, teknolojik yeniliklerin en hızlı biçimde entegre edildiği alanlardan biri olmasına rağmen, çalışanların bu değişime uyum sağlama kapasitesi çoğu zaman işletmelerin dijital dönüşüm hızını belirleyen temel faktörlerden biri hâline gelmiştir. Dolayısıyla bu araştırmanın temel amacı, lojistik sektöründe dijitalleşmenin gerektirdiği yeni becerilerin neler olduğunu, bu becerilerin geliştirilmesine yönelik insan kaynakları uygulamalarını ve süreçte karşılaşılan zorlukları derinlemesine incelemektir.

Araştırma kapsamında nitel yöntem tercih edilmiş ve veri toplama aracı olarak yarı yapılandırılmış derinlemesine görüşme tekniği kullanılmıştır. Türkiye'nin farklı illerinde faaliyet gösteren lojistik firmalarında görev yapan toplam 12 katılımcı ile gerçekleştirilen görüşmeler, Braun ve Clarke (2006, 2019) tarafından geliştirilen tematik analiz yöntemiyle değerlendirilmiştir. Katılımcılar; Eğitim ve Gelişim Uzmanı (5 kişi, %41,67), Yetenek Kazanımı ve Yönetimi Uzmanı (4 kişi, %33,33) ve İnsan Kaynakları Müdürü (3 kişi, %25,00) pozisyonlarında görev yapan profesyonellerden oluşmaktadır. Bu dağılım, insan kaynakları süreçlerinin farklı fonksiyonlarını temsil ederek veri çeşitliliğini artırmaktadır. Söz konusu çeşitlilik, hem mikro düzeyde çalışan becerilerinin dönüşümünü hem de makro düzeyde örgütsel stratejilerin bu dönüşüm üzerindeki etkilerini çok boyutlu olarak analiz etmeye olanak sağlamıştır. Özellikle eğitim ve gelişim, yetenek yönetimi ve stratejik insan kaynakları perspektiflerinin birlikte değerlendirilmesi, lojistik sektöründe dijital dönüşümün yalnızca teknik bir süreç olmadığını, aynı zamanda insan kaynağı, kurumsal yapı ve organizasyonel adaptasyon süreçlerini de kapsayan bütüncül bir dönüşüm olduğunu ortaya koymaktadır. Tematik analiz sonucunda elde edilen bulgular, lojistik sektöründe dijitalleşmenin teknik altyapı yatırımlarının ötesinde, çalışan yetkinliklerinin yeniden yapılandırılmasını ve örgütsel öğrenme kapasitesinin güçlendirilmesini gerektiren çok katmanlı bir dönüşüm süreci olduğunu açıkça göstermektedir.

Araştırma bulguları, dijital teknolojilerin iş süreçlerine entegrasyonu ile birlikte lojistik çalışanlarının iş tanımlarının, rol dağılımlarının ve beceri profillerinin önemli ölçüde değiştiğini göstermektedir. Özellikle veri analitiği, raporlama, yapay zekâ uygulamaları, otomasyon sistemleri ve ERP/TMS/WMS tabanlı yazılımlar gibi teknik becerilerin önemi artarken, bu becerilerin sürdürülebilir biçimde kullanılabilmesi için bilişsel esneklik, iletişim, problem çözme, takım çalışması ve sürekli öğrenme alışkanlığı gibi sosyal yetkinliklerin de geliştirilmesi gerektiği belirlenmiştir. Bulgular, literatürdeki benzer çalışmalarla da uyumlu şekilde, lojistik performansının yalnızca dijital altyapıya değil, aynı zamanda dijital becerilere sahip insan sermayesinin etkinliğine bağlı olduğunu göstermektedir. Katılımcılar, upskilling uygulamalarını mevcut görevlerdeki becerileri derinleştirme ve verimliliği artırma süreci olarak tanımlarken; reskilling uygulamalarını ise çalışanların tamamen yeni pozisyonlara veya teknolojilere uyum sağlayabilmesi için yeni beceriler kazandırma süreci olarak ifade etmiştir. Bu yönüyle iki kavram, birbirini dışlamaktan ziyade birbirini tamamlayan stratejik araçlar olarak görülmektedir.

Çalışma, dijital dönüşümün yalnızca teknik bir süreç olmadığını, aynı zamanda örgütsel kültür, motivasyon ve liderlik gibi insani faktörlerle şekillenen çok katmanlı bir dönüşüm olduğunu vurgulamaktadır. Katılımcıların büyük bölümü, zaman kısıtları, bütçe yetersizlikleri, çalışan motivasyonunun düşüklüğü ve eğitim programlarının operasyonel süreçlerle uyumlaştırılmasındaki güçlüklerin beceri dönüşüm sürecinde önemli engeller oluşturduğunu belirtmiştir. Özellikle KOBİ ölçeğindeki firmalarda bu engeller daha belirgindir; çünkü sınırlı finansal kaynaklar, dijital eğitim teknolojilerine yatırım yapılmasını güçleştirmektedir. Ayrıca, üst yönetim desteğinin yetersiz olduğu durumlarda dijitalleşme projelerinin uzun vadede sürdürülemediği de gözlemlenmiştir. Bu sonuç, dijital dönüşümün yalnızca teknoloji yatırımıyla değil, aynı zamanda stratejik insan kaynakları yönetimiyle desteklenmesi gerektiğini açıkça göstermektedir.

Araştırma, insan kaynakları birimlerinin dijital dönüşüm sürecinde oynadığı kilit rolü de ortaya koymaktadır. Etkili bir beceri dönüşümünün gerçekleşebilmesi için üst yönetimin sürece aktif biçimde katılması, açık iletişimin sağlanması, eğitim içeriklerinin kurumsal hedeflerle uyumlu hâle getirilmesi ve çalışanlara geri bildirim mekanizmaları sunulması gerekmektedir. Bu doğrultuda geliştirilen temalar, planlama, motivasyon, içerik kalitesi, liderlik katılımı ve öğrenme kültürünün kurumsallaştırılması unsurlarının başarıya giden yolu belirlediğini göstermektedir. Araştırmanın bulguları, dijital adaptasyonun başarısının yalnızca teknolojik altyapıya değil; aynı zamanda çalışan yetkinliklerine, öğrenme kültürünün kurumsallaşmasına ve güçlü liderlik desteğine bağlı olduğunu ortaya koymaktadır.

Bu çalışma, politika yapıcılar ve sektör temsilcileri açısından da önemli çıkarımlar sunmaktadır. Öncelikle, sürekli eğitim ekosistemlerinin güçlendirilmesi gerekmektedir. Kamu kurumları, meslek örgütleri ve sektörel birlikler, özellikle KOBİ'lerin finansal yükünü hafifletmek amacıyla upskilling ve reskilling programlarına mali destek sağlamalıdır. Üniversiteler ve lojistik işletmeleri arasında kurulacak iş birlikleri, sektörün ihtiyaçlarına göre şekillenen müfredatların geliştirilmesine katkı sağlayacaktır. Bununla birlikte, eğitim politikalarının yalnızca teknik becerilere değil, aynı zamanda eleştirel düşünme, iletişim, takım çalışması ve duygusal zekâ gibi sosyal yetkinliklere de odaklanması, dijital dönüşümün insani boyutunu güçlendirecektir. Ayrıca, yenilikçi eğitim teknolojilerinin (örneğin e-öğrenme platformları, artırılmış/sanal gerçeklik uygulamaları, dijital mentorluk sistemleri) yaygınlaştırılması, öğrenmenin esnekliğini ve erişilebilirliğini artıracaktır.