

Competencies in 4.0 logistics: a case of Slovenia

Mateja ČUČEK¹, Anja CVIKL BLAŽAN¹ and Sonja MLAKER KAČ^{1*}

¹ University of Maribor/Faculty of logistics, Celje, Slovenia

*Corresponding Author

Abstract— This paper investigates the competencies demanded by employers in Slovenia's logistics sector, as identified through the analysis of job advertisements in field of logistics and supply chains in Slovenia. The study begins with a theoretical framework, outlining the concept of competencies, their relevance within the field of logistics, and their evolving role in the context of Industry 4.0, or the so-called "smart industry." The empirical component of the research focuses on identifying the competencies required of logistics and supply chain professionals in Slovenia. These competencies were systematically categorized into three groups—technical, managerial, and social—according to the model proposed by Grodek-Szostak et al. (2020). For each category, the five most frequently cited competencies were determined and ranked. The findings suggest that technical competencies, particularly those aligned with emerging and developing technologies and industry innovations, are extremely important in the Slovenian logistics and supply chain sector. The results stress the necessity for continuous professional development and lifelong learning, as most competencies are acquired through combination of formal education and work experiences. The analysis also highlights a discrepancy: many job advertisements do not explicitly require certain technical competencies that are essential for the successful implementation and advancement of smart industry principles.

Keywords— logistics, supply chain, competencies of the future

I. INTRODUCTION

Employees whose competencies align with their job requirements represent a significant competitive advantage for any organization. Success depends on having individuals with the right skills in the right roles. Relevant competencies enable employees to perform tasks effectively and contribute to organizational goals.

As the industry evolves rapidly, new types of competencies are continually emerging. This study explores various definitions of competencies. At its core, competence is a combination of knowledge, skills, abilities, and capabilities. These can be categorized into groups, though different authors may define them differently. Generally, competencies are divided into two main types: soft competencies and technical competencies. Soft competencies typically involve personal attributes and values, whereas technical competencies relate to expertise in technologies and work processes.

The evolution of industry can be observed through its different phases. Industry 1.0 began with the introduction of steam engines, revolutionizing transportation and production. This was period of focusing on optimizing transportation and the physical distribution of goods. It is also time when the industrial needs were generated by customer demands. This phase was followed by industry 2.0, which emphasized mass production and introduced automation in cargo handling—marking a major advancement in logistics. Companies began collaborating to coordinate and optimize physical flows both within and beyond organizational boundaries, leading to the emergence of supply chain management. Industry 3.0 was initiated by the invention of the first industrial robot. Logistics expanded rapidly and beyond physical flows. Logistics and supply chains were not only about transport, internal production lines and warehouse anymore, but started to include also administrative workflows, cash flows, service flows, decision-making processes and similar. The main purpose was to add value for the customer (Amr et al., 2019).

Industry 4.0 or so-called smart industry, is characterized by the integration of advanced technologies such as 3D printing, digitalization, smart robotics and nowadays also artificial intelligence. This phase involves a

Article History: Received August 2025; Accepted January 2026

©2026 The Authors. Published by University of Maribor, Faculty of Logistics, Slovenia.

This is an open access article under the Creative Commons Attribution 4.0 International license (CC BY 4.0; <https://creativecommons.org/licenses/by/4.0/>).

comprehensive digital transformation across entire organizations and supply chains the companies are involved in. (Fitsilis et al., 2018).

II. THEORETICAL BACKGROUND OF COMPETENCIES

Lifelong learning has become essential for employees seeking to remain competitive in today's dynamic labour market. Continuous learning allows individuals to adapt to constant changes in their professional environment (Bazaras et al., 2016). Companies on the other hand gain a strategic advantage through highly qualified employees whose competencies align closely with job requirements (Flöthmann et al., 2018). These competencies enable employees to perform successfully, even as job roles and workflows evolve rapidly in today's fast developing business environment. (Kotzab et al., 2017).

The foundation of organizational success lies in placing the right people, with the right competencies, on the right working positions. Strategically, managing human resources involves aligning employee competencies with job demands and the broader organizational context. This alignment not only enhances performance but also increases employee satisfaction and contributes to better organisational climate and overall organizational success (Flöthmann et al., 2018). This is why companies need to be aware of the importance of competencies and this is why it is important for our research to appropriately define them.

Although various definitions of competencies exist, they generally share some common elements. McClelland (1973) was among the first to define competencies, describing them as habits and personality traits that lead to goal achievement and effective performance. Weijers et al. (2007) define competencies as a combination of knowledge, skills and attitudes required for specific professions. Derwik & Hellström (2017) upgrade competencies as a mix of knowledge, skills, abilities, capabilities and resources.

According to Kotzab et al. (2017) competencies can be developed through experience, on-the-job learning and targeted training programs. Chryssolouris et al. (2013) describe competence as one's ability to successfully handle a task or situation. These authors (Chryssolouris et al., 2013) argue that skills and competencies form the foundation of the learning process. They (Chryssolouris et al., 2013) also define competence according to multiple components, such as cognitive factors (such as different types of knowledge), intellectual and motor skills (for example: dexterity), affective factors (such as motivation, values and attitudes), personality traits (for example: self-confidence) and social skills (for example: ability to communication, cooperation and collaboration skills).

So, competencies are typically understood as a combination of knowledge, skills and personal attributes. Knowledge on one hand represents the cognitive information individuals possess and can apply in work, personal, and social contexts. It is shaped by experience, truth, intuition, and values. Skills are on the other hand practical abilities that impact one's ability to perform tasks and solve problems effectively. Together, these elements form the basis of competencies—qualities and attributes necessary to perform a specific job (Gorenak, 2016). Though knowledge and skills are distinct aspects of human development, they are closely interconnected. Intellectual capabilities underpin the acquisition of knowledge, while the practical application of that knowledge fosters skill development. Together, these elements contribute to the formation of comprehensive competencies.

Kotzab et al. (2017) identify four core categories of competencies: professional, methodological, social and personal competencies. Professional competencies are domain-specific knowledge that is needed for a particular profession. Methodological competencies are the ability to work independently through information processing, problem-solving, decision-making, and solution development. Social competencies (often referred to as soft skills) include communication, knowledge of foreign languages, teamwork, interpersonal behaviour, and managing conflicts. Personal competencies are attributes related to self-management and personality development, such as self-reflection, motivation, and self-organization. Personal competencies also collectively support talent development, motivation and job performance, contributing to both personal and organizational long-term success.

III. COMPETENCIES IN LOGISTICS AND SUPPLY CHAIN MANAGEMENT

The primary objective of logistics and supply chain within an organization is to deliver the right products to the right place at the right time, while minimizing costs. Logistics encompasses a broad range of activities, including order fulfillment, inventory control, distribution, physical handling of goods, transit planning, warehousing, and IT system support. Over the past five decades, logistics has evolved significantly, characterized by increased integration, cost optimization, responsiveness, and strategic importance. While it has retained its core functions, it has expanded in conceptual, technological, and managerial complexity (Niine & Koppel, 2015).

Logistics and supply chain management are in times of huge business competition critical functions in every organization. Within the framework of Industry 4.0, logistics operates as part of a cyber-physical system. This shift has driven the emergence of developing logistics 4.0 or smart logistics, which leverages smart products and services to meet the growing demand for individualized offerings. Logistics 4.0 enhances system flexibility, improves customer connectivity, and plays a pivotal role in demand forecasting and market responsiveness (Amr et al., 2019).

As an interdisciplinary field, logistics integrates knowledge from business management, technological design, information systems, and various engineering disciplines. This complexity necessitates a rethinking of logistics education and the competencies required by modern logistics professionals (Niine & Koppel, 2015).

Globalization, digital transformation, and resource scarcity are among the major megatrends shaping the logistics industry. These forces have not only expanded the scope of logistics-related roles but have also heightened the demand for qualified professionals. Employees are now expected to adopt lifelong learning practices and continually develop new knowledge, skills, and professional relationships to remain competitive and adaptable in the labour market (Kotzab et al., 2017).

Key competencies in logistics include business process organization, information management, order processing, warehouse operations, and the management of transport logistics technologies. Furthermore, professionals are expected to develop and manage logistics operations and transport companies, plan and execute projects, drive service improvement initiatives, manage business documentation, lead innovations in transport and logistics systems (Bazaras et al., 2016).

Looking back to first analysis of competencies in logistics, we can find some interesting key areas competencies (Poist, 1984). At that time identified competencies in field of logistics were business skills, logistics skills and management skills. These areas are very general and presented background for all further research.

Weijers et al. (2007) identified ten core competencies in the logistics: verbal and written communication skills, organizational and planning capabilities, customer orientation, flexibility and adaptability, initiative and self-direction, ability of critical judgment, persuasiveness, environmental awareness, teamwork and collaboration.

Further research by Kotzab et al. (2017) highlights four core categories of logistics competencies: social competencies (interpersonal and communication skills), functional competencies (job-specific technical abilities and skills), cognitive competencies (analytical and problem-solving skills) and meta-competencies (adaptability, learning agility and innovation).

The industry 4.0 has significantly transformed the planning, production, operation, and maintenance of manufacturing systems (Grodek-Szostak et al., 2020) and this period is defined by automation, data exchange and the integration of digital technologies into all facets of manufacturing. Commonly referred to as smart manufacturing, smart industry, or the smart factory, Industry 4.0 marks a shift towards fully digitized enterprises, where physical assets are connected through digital networks and new digital ecosystems emerge (Fitsilis et al., 2018).

A core feature of Industry 4.0 is the digitization of the entire value chain and the seamless interconnection of people, machines, and data. Technologies such as artificial intelligence (AI) enable systems to independently respond to spontaneous environmental changes, thus enhancing operational adaptability

(Hecklau et al., 2016). Furthermore, Industry 4.0 supports product and service personalization, on-demand production reconfiguration, and efficient, flexible production networks, while fostering close integration between manufacturers and customers (Flores et al., 2019).

Industry 4.0 is driven by an array of advanced technologies, including big data and analytics, smart sensors and robotics, artificial intelligence (AI), cloud computing, 3D printing, cyber-physical systems, internet of things (IoT)

These technologies contribute to the holistic digital transformation of organizations, extending beyond product lines to encompass all business operations (Fitsilis et al., 2018). Robotics plays a particularly critical role, as machines now have the capability to communicate autonomously via wireless networks. Through AI, these systems can collect and process data, reducing the need for human intervention in repetitive and routine tasks (Jerman et al., 2020).

As a result, manufacturing organizations are required to become more flexible, adaptive, and efficient. This transformation calls for a major shift in organizational structures, workforce qualifications, and employee competencies (Jerman et al., 2020). The workforce of the future will be central to organizational success, with a growing need for individuals who can master new digital tools and problem-solving methods (Kannan & Garad, 2019).

According to Flores et al. (2019), Industry 4.0 will redefine the interaction between workers and their roles, fostering more creative, strategic, and coordinated activities. This evolution requires professionals to acquire a broader and more sophisticated range of competencies.

Grodek-Szostak et al. (2020) identify three essential categories of competencies needed in the Industry 4.0 business environment: technical competencies (such as computing expertise, data analysis, and system operation), managerial competencies (including problem-solving, decision-making, and conflict resolution) and social competencies (such as teamwork, leadership, and knowledge sharing).

Building on this, Hecklau et al. (2016) and Fitsilis et al. (2018) propose a more detailed four-dimensional framework of competencies required to meet workplace challenges in Industry 4.0. They stress the importance of technical competencies (advanced technical knowledge, understanding processes, programming and coding skills, IT security awareness), management competencies (creativity and innovation, entrepreneurial thinking, analytical and research skills, problem-solving and decision-making abilities, conflict management, efficiency and result orientation), social competencies (communication and networking skills, leadership skills, team collaboration, intercultural and language proficiency) and personal competencies (flexibility and adaptability, motivation for lifelong learning, stress resilience and emotional regulation ability, social responsibility and sustainability mindset).

As Industry 4.0 continues to evolve, the demand for a workforce equipped with a diverse and dynamic competency set will only intensify. Lifelong learning, digital fluency, and the ability to adapt to technological advances will be critical for both individual and organizational success in this new industrial era.

IV. METHODOLOGICAL FRAMEWORK

In the previous chapter, we reviewed various definitions of competencies provided by both Slovenian and international authors, with a particular focus on how competencies are categorized. Special attention was given to the competencies relevant to Industry 4.0. The central research question addressed was: *What are the key competencies required in Industry 4.0 within the logistics sector, and which competencies are currently expected of logistics professionals in Slovenia?*

To answer this question, we conducted an analysis of job advertisements to identify the competencies currently in demand in the Slovenian labour market. A total of 50 job advertisements was collected and analysed; all related to positions in logistics and Industry 4.0. These advertisements were gathered in January 2020 from leading online job search platforms in Slovenia and LinkedIn profiles.

The job advertisements were systematically categorized according to job positions connected to logistics and supply chains and relevant data such as required education and listed competencies. The findings were

analysed according to Grodek-Szostak et al. (2020) competency framework, which classifies competencies into technical, managerial and social categories.

V. RESULTS OF THE RESEARCH

All competencies identified through our research were categorized into three main groups: technical competencies, managerial competencies, and social competencies. The most advertised job positions (according to our search categories) were logistics manager, logistics expert, logistics specialist, purchase specialist and dispatcher.

Among the competencies listed in job postings, technical competencies were the most frequently required, followed by social competencies and lastly managerial competencies. The Table 1 presents the most frequently mentioned competencies within each of these three categories.

Table 1: Technical competencies, Managerial competencies, and Social competencies.

<i>Technical competencies</i>		<i>Managerial competencies</i>		<i>Social competencies</i>	
Computing knowledge	50	Problem-solving	12	Language skills	40
Driving competency	12	Department management	10	Communication skills	29
Organization of transport	10	Making decisions	10	Ability to work in a team	14
Organization of purchasing	9	Conflict solving	3	Leadership skills	10
Organization of warehouse	6	Achieving results and planned goals	6	Independence	8

The most frequently requested technical competencies in the analyzed job advertisements include computing skills, driving ability, transport organization, purchasing organization, and warehouse management. Computing skills are universally required across logistics roles, with computer proficiency being the most commonly listed technical competency. Employers expect candidates to be proficient in MS Office—particularly Excel—as well as specialized logistics software such as SAP, Timocom, MRP, and ERP systems.

Driving competency is another near-universal requirement, reflecting the mobile nature of logistics work. Most employers specify that candidates must hold a valid category B driving license and have access to their own transportation.

Equally important technical skills frequently mentioned are the organization of transport, purchasing, and warehouse operations. These three functions represent the core areas of logistics activity. Therefore, a strong understanding of processes within transportation, purchasing, and warehousing departments is essential for anyone employed in the logistics sector.

The five most frequently demanded managerial competencies in the job advertisements are: decision-making, conflict resolution, department management, problem-solving, and achieving results and planned objectives. Skilled managers are a critical asset to any organization. They are expected to lead teams and meetings, prepare reports, and maintain effective communication with employees.

Problem-solving and conflict resolution skills involve accurately identifying issues, evaluating possible solutions and their consequences, and implementing the best course of action. These competencies are

closely linked to sound decision-making abilities. Effective management also requires organizing teams efficiently and motivating employees to meet company goals. Without qualified and capable leaders at all levels, organizations cannot successfully achieve their planned results.

This category also includes competencies in planning and administration, as well as self-management, both essential for effective leadership.

The most commonly requested social competencies are communication skills, leadership abilities, language proficiency, teamwork, and independence. Communication skills encompass adaptability, persuasion, and active listening.

Proficiency in foreign languages is a consistent requirement, with English being essential across all advertisements. Additionally, knowledge of German, Hungarian, and Croatian is considered an advantage.

VI. DISCUSSION

In this study, all competencies extracted from job advertisements were categorized into three main groups—technical, managerial, and social—based on the competency model proposed by Grodek-Szostak et al. (2020), as outlined in the theoretical framework. As anticipated, technical competencies appeared most frequently in the analyzed job postings. Social competencies were mentioned less often, while managerial competencies were the least represented. This distribution reflects the nature of Industry 4.0, which is characterized by the integration of cyber-physical systems, the Internet of Things (IoT), the Internet of Services, cloud computing, smart devices, sensors, and robotics. These technological advancements demand specific competencies to ensure safe and efficient operations within smart factory environments. In particular, competencies related to working in digital environments, interacting with social machines, managing smart products, and operating in virtual production systems are essential. However, although these advanced technical skills are critical for Industry 4.0 and the logistics sector, they are currently not widely reflected in job advertisements in Slovenian companies, indicating that such competencies are not yet actively sought by employers.

VII. CONCLUSIONS

Industry 4.0 will be important in the future industry world and will facilitate heavy industry. We can talk about the logistics and supply chain sector at the global level as an industry that has a huge potential for further development in the near future. Therefore, professions in Industry 4.0 are very perspective.

The main purpose of the smart industry is to connect and network all parts to achieve maximum advantage for the whole community. Smart industry businesses need to be real-time, flexible, and mobile.

Competencies that are important in the logistics sector in Slovenia were in our research divided into three groups: technical, managerial and social competencies. In our research, we found out that most searched competencies in logistics sector are technical competencies. Competencies classified in this group are computing knowledge and statistical knowledge. In Slovenia in job advertisements most frequently required technical competencies are computing knowledge, driving competency, ability to organize and optimise transport, organization of purchasing and organization of the warehouse. Social competencies are reflected in the field of verbal and non-verbal communication, the ability to work in a group, conflict resolution, the ability to communicate in foreign languages, to work in different cultures, etc. In all jobs, advertisements also required social competencies. We focused on five main and most frequently required competencies which are communication skills, leadership skills, language skills, ability to work in a team, and independence. According to the research of Grodek-Szostak et al. (2020), they classified problem-solving, decision making, and, conflict solving into a group of managerial competencies. We found out that our job advertisements require the same competencies. Managerial competencies from advertisements are making decisions, conflict solving, department management, problem-solving, and achieving results and planned goals.

REFERENCES

- Amr, M., Ezzat, M. & Kassem, S. (2019). Logistics 4.0: Definition and Historical Background. *Novel Intelligent and Leading Emerging Sciences Conference (NILES)*, 46-49. IEEE.
- Bazaras, D., Čižiuniene, K., Palšaitis, R. & Kabashkin, I. (2016). Competence and capacity-building requirements in transport and logistics market. *Transport and Telecommunication*, 17 (1), 1-8.
- Chryssolouris, G., Mavrikios, D., & Mourtzis, D. (2013). *Manufacturing Systems: Skills & Competencies for the Future*. Procedia CIRP, 7, 17-24.
- Derwik, P. & Hellström, D., (2017). Competence in supply chain management: a systematic review. *Supply Chain Management: An International Journal*, 22 (2), 200-218.
- Fitsilis, P., Tsoutsas, P. & Gerogiannis, V. (2018). Industry 4.0: Required personnel competences. *International scientific journal "Industry 4.0"*, 3, 130-133.
- Flores, E., Xu, X., & Lu, Y. (2019). Human Capital 4.0: a workforce competence typology for Industry 4.0. *Journal of Manufacturing Technology Management*, 31 (4), 687-703.
- Flöthmann, C., Hoberg, K. & Wieland, A. (2018). Competency requirements of supply chain planners and analysts and personal preferences of hiring managers. *Supply Chain Management: An International Journal*, 23 (6), 480-499.
- Gorenak, I. (2016). *Upravljanje s človeškimi viri 2016/2017* (e-gradivo). Celje: Fakulteta za logistiko.
- Grodek-Szostak, Z., Ochoa Siguencia, L., Szelag-Sikora, A. & Marzano, G. (2020). The impact of Industry 4.0 on the Labor Market. *61st International Scientific Conference on Information Technology and Management Science of Riga Technical University (ITMS)*.
- Hecklau, F., Galeitzke, M., Flachs, S. & Kohl, H. (2016). Holistic approach for human resource management in Industry 4.0. *Procedia CIRP*, 54, 1-6.
- Jerman, A., Bertoneclj, A., Dominici, G., Pejić-Bach, M. & Trnavčević, A. (2020). Conceptual Key Competency Model for Smart Factories in Production Processes. *Journal of Management, Informatics and Human Resources*, 53, 68-78.
- Kannan, P.N. K. S. & Garad, A. (2019). Competencies of quality professionals in the era of industry 4.0: a case study of electronics manufacturer from Malaysia. *International Journal of Quality & Reliability Management*, 38 (3), 839-871.
- Kotzab, H., Teller, C., Bourlakis, M. & Wünsche, S. (2017). Key competences of logistics and SCM professionals-the lifelong learning perspective. *Supply Chain Management: An International Journal*, 23/1, 50-64.
- McClelland, D. C. (1973). Testing for competence rather than for "intelligence". *American Psychologist*, 28(1), 1-14.
- Niine, T., & Koppel, O. (2015). Developing Intelligent Logistics-Building a Competence Model for Logistics Systems Engineer. *IEEE Global Engineering Education Conference (EDUCON)*, 239-248.
- Poist, R. F. (1984). Managing logistics in an era of change. *Defense Transportation Journal*, 40, 22-30.
- Weijers, S., Glöckner, H., & Pieters, R. (2007). Competences as used by professionals in logistics: differences between shippers and logistic service providers. *International Symposium on Logistics and Industrial Informatics*, 69-74.

Manuscript received by 21 August 2025.

The authors alone are responsible for the content and writing of this article.

AUTHORS

A. Mateja Čuček, Faculty of logistics, University of Maribor (email: mateja.cucek@um.si)

ORCID ID: 0000-0002-6346-4123

B. Anja Cvikl Blažan, Faculty of logistics, University of Maribor (email: anja.cvikl@student.um.si)

C. Sonja Mlaker Kač, Faculty of logistics, University of Maribor (email: sonja.mlaker@um.si)

ORCID ID: 0000-0002-2806-460X

Kompetence v logistiki 4.0: primer Slovenije

Izvleček – Ta članek preučuje kompetence, ki jih zahtevajo delodajalci v slovenskem logističnem sektorju, kot so bile ugotovljene na podlagi analize oglasov za delovna mesta na področju logistike in oskrbovalnih verig v Sloveniji. Študija se začne s teoretičnim okvirom, ki opisuje pojem kompetenc, njihovo pomembnost na področju logistike in njihovo spreminjajočo se vlogo v kontekstu Industrije 4.0 ali tako imenovane »pametne industrije«. Empirični del raziskave se osredotoča na opredelitev kompetenc, ki jih zahtevajo strokovnjaki na področju logistike in oskrbovalnih verig v Sloveniji. Te kompetence so bile sistematično razvrščene v tri skupine – tehnične, vodstvene in socialne – v skladu z modelom, ki so ga predlagali Grodek-Szostak et al. (2020). Za vsako kategorijo je bilo določeno in razvrščeno pet najpogosteje navedenih kompetenc. Ugotovitve kažejo, da so tehnične kompetence, zlasti tiste, ki so usklajene z nastajajočimi in razvijajočimi se tehnologijami ter industrijskimi inovacijami, izredno pomembne v slovenskem sektorju logistike in oskrbovalne verige. Rezultati poudarjajo nujnost neprekinjenega strokovnega razvoja in vseživljenjskega učenja, saj se večina kompetenc pridobi s kombinacijo formalnega izobraževanja in delovnih izkušenj. Analiza prav tako izpostavlja neskladje: mnogi oglasi za delo ne zahtevajo izrecno določenih tehničnih kompetenc, ki so bistvene za uspešno izvajanje in napredek načel pametne industrije.

Ključne besede – logistika, dobavna veriga, kompetence, prihodnost