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Identifying the Future Skills Needs of the Job Profiles in the Supply Chain Logistics

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Abstract: The advent of Industry 4.0 is revolutionizing production and manufacturing, ushering in concepts like "mass customization," "personalization of products," and "agile manufacturing." Among the sectors profoundly impacted by this transformation is logistics, where the primary objective remains delivering the right product to the right place at the right time. As a result of the latest developments in the technology, there has been a shift from traditional 3D supply chains to dynamic 4D supply chains over the past decade—a paradigm shift that has given rise to Logistics 4.0, which creates a new era where digitization, automation and artificial intelligence enable companies to make smarter decisions at lower global costs. However, realizing the full potential of this digital revolution hinges on cultivating a highly qualified workforce. Therefore, it is vital to update the skills and knowledge of current labor force to meet the future needs of the supply chain logistics area.The aim of this article is to determine the current skills of the logistics workforce and to forecast the future skills needs of the logistics sector as a result of the changes brought about by the transition to Industry 4.0. Therefore, our findings during the research on the topic are collected and integrated in a database incorporating the skills demands of today and tomorrow. This database can be used to plan suitable training programs and policies for logistics companies, educational institutions and/or policy makers.

Keywords: *logistics; skills; digitization; jobs; Industry 4.0.*

1. Introduction

Logistics refers to the strategic management of procurement, movement, and storage of materials, parts, and finished inventory, along with related information flows [1]. The goal is to maximize current and future profitability by efficiently fulfilling orders in a cost-effective manner [1]. Therefore, this sector is responsible for the coordination of transport, the strategic vision of the supply chain, the management of production and distribution processes, as well as tasks related to corporate purchasing [2]. It includes not only pure logistics providers (Third party logistics providers (3PL) which manage all aspects of fulfillment, from warehousing to shipping and fourth-party logistics providers (4PL) which manage a 3PL on behalf of the customer and other aspects of the supply chain), but also internal logistics operations in the manufacturing companies.

Two of the main objectives of the sector are: (1) to place the right products (goods and services) in the right place, at the right time and in the optimum conditions, contributing as far as possible to the profitability of the company; and (2) to satisfy demand in the best conditions of service, cost and quality. Logistics manages the means necessary to achieve these objectives (surfaces, means of transport, IT…) and mobilizes the resources, both human and economic, appropriate to these objectives.

The digitization and computerization have had a major impact on the recent evolution of the logistics industry. The concept of Digital Logistics or Logistics 4.0 was born as a result of this evolution [3, 4]. Logistics 4.0 involves intensive technology use, leading to fully automated processes that minimize human involvement, enabling companies to meet new market demands by creating customer-oriented, individualized, and responsive supply chains [5, 6, 7].

Therefore, in today's rapidly evolving business landscape, many companies are undergoing digital transformation in their logistics to stay competitive. This shift involves minimizing analogy processes, such as paperwork and phone calls, and embracing digital solutions [4, 8]. Among the key players in this transformation are digital logistics operators, responsible for managing customer freight and delivery through online platforms. These platforms enable efficient communication flows and streamlined shipment processes [1, 5].

The development of sensors, QR codes, JIT (Just in Time) and traceability systems, route and fleet management, advance notice of delivery to individuals and the

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measurement of performance indicators are some of the new technologies that Digital Logistics has implemented over the years [8]. As companies embrace these technologies, it becomes essential for the workforce to stay informed and adapt. Training programs and ongoing education are crucial to equip employees with the necessary skills to navigate the digital logistics landscape effectively. By doing so, companies can thrive in an increasingly interconnected and data-driven world

In summary, logistics plays a crucial role both historically and in the future. Its significance is underscored by the symbiotic relationship between logistics development and technological advancements. As new technologies emerge, workforce preparation becomes essential to harness their potential effectively. This study centres on the adaptation of the workforce within the logistics sector during the emergence of the new digital era. The successful transition requires a comprehensive understanding of existing technologies and an exploration of additional innovations. Additionally, a profound grasp of the logistics industry itself, coupled with the acquisition of future-oriented skills, is essential for workers in this dynamic sector.

1.1. Description of the Problem

Logistics has become a key branch in ensuring the success of a company. For this reason, most of the new global companies are making a great effort to improve their supply chain. Thus, the sector needs to keep up to date, making a proper and firm transition that allows it adapting to the digitization of Industry 4.0 and its effect [1,5,9,]. This change must ensure that the sector's expectations are met, and its competitiveness is strengthened. Therefore, some of the key tasks of the sector are related to Logistics 4.0 and the creation of jobs. These groups of tasks could be summarized as follows:

- Implementation of IT tools and new technologies to manage the (Plan, source, make, deliver, return) processes required in the facilities (cloud data storage, IoT devices, automation, AI and digital twins).
- Enabling different storage solutions that adapt to the characteristics of each order and the volumes of stock with which each commercial establishment works.
- Inventory management and real-time updating and control: incorporating new technology in this area to make management as optimal as possible.
- Talent development: skills and soft skills training.
- Customer service: workers and operators who are part of the supply chain or distribution logistics process need to be better trained to achieve customer satisfaction.

In addition to the skills related to these duties, more elaborated skills are demanded by workers to achieve in the future. To accomplish this, a thorough understanding of the current needs related to the workforce of the sector is a must. It will enable us to compare these skills with the ones that future jobs and technologies will require from the logistics workforce. In other words, the sector must be prepared for the upcoming digitization and be able to find the gaps between the skills of current workers and future demands, in order to adapt to the new requirements of the industry. For this reason, a reliable and up-to-date skills database is highly demanded by the sector.

Within the framework of this research, we created the aforementioned sectorial database. For that, we used the European database of professions ESCO (European Skills, Competences and Occupations) [10] as a starting point. We combined the information coming from ESCO with sector-specific information mainly sector-related to competences, jobs, sustainability and digitization. This resulting new database is available with the necessary information to meet the current challenge in terms of future workforce skills.

Using this database, universities and educational institutions offering logistics-related training will be able to adapt and update their programs to prepare students and the current workforce better for the upcoming developments. In addition, the logistics business can also offer its own training programs to its workforce, based on the future skills obtained from this new database for better future performance. As well, the database will also be useful for the improvement of the selection of candidates for the job profiles related to logistics activities. Finally, policy-makers as well will find in the database support for their activities, as they will have a support in their prioritization of funding policies related to the sector.

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1.2. Objectives

The main objective of this work is to elaborate a solid, functional and up-to-date database based on the skills needed by any logistics worker to be competent (with their respective current and future skill requirements). This main objective is based on the professions of the sector extracted from the ESCO database and is accompanied by other sub-objectives:

- Deepen research in the plan-source-make-deliver-return logistics processes in order to identify (1) the state of digitization on its processes, and (2) the consequences and impact of the digitization on the sector. It is possible through reviewing the existing literature and looking for future trends in the logistics field.

- Select professional profiles related to this sector. It will be achieved by making use of ESCO's database, and considering all its sub-sectors and the value chain (keywords will be essential to find them).
- Identify the future competences required in the field, to answer the new challenges in the plan, source, make, deliver and return processes of logistics. For this aim, a detailed comparison will be made with the competences defined by desk-research and the ones registered in ESCO. The identified different skills will be labeled as the future competences.
- Analyze each job profile to identify in which ways it will be affected by digitization and the needed changes to adapt the profile to the future. The next step will be to incorporate their corresponding future competencies of each analyzed profile, based on skills, tasks and requirements.
- Integrate this information into the new database. The job profiles in the completed database will have current information and future skill requirements.

2. Methodology

As mentioned above, the aim of this article is to compile information on the competences that will be fundamental for the job profiles in the logistics sector. In this way, the professionals selected for the job profiles will be prepared for performing the tasks of the job smoothly. The methodology followed, successfully applied to other sectoral analyses [11-17] is based on the following three steps: (1) research, (1) database generation and (3) validation of results and detailed in the Fig.1.

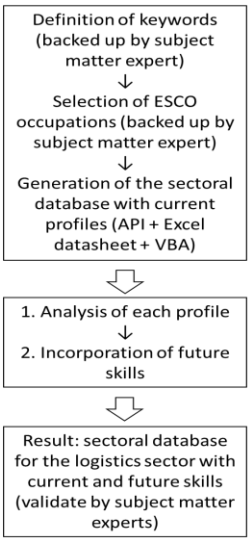

Figure 1. Methodology of the study.

Here it is worth noting that the validation of the definition of keywords and job profile was done by a local logistics expert, Dr. Ander Errasti, Technical Director of the Natra Group and author, among others of one of the reference books for the sector [18]. Additionally, the validation of the whole work was backed up by Dr. Errasti, but as well by the Basque Cluster of Logistics.

Thus, the first step should be gathering relevant information about the topics listed below:

- Logistics sector: basic information on the sector to understand the work process.
- Digitization: information on future technologies and trends to observe the development of the industry in general.
- Impact: research on the impact that digitization has or will have on the logistics sector, both in terms of the new integrated technologies and the evolution of its jobs.
- Future skills: the skills that will be in demand in the logistics sector for future jobs.

2.1. Background: Effects of digitization on the logistics sector and future trends, and identifying future skills requirements for the logistics sector

Logistics 4.0, driven by recent technological advancements, addresses critical aspects of supply chain management, data security, and interoperability with integrated devices. This paradigm shift introduces novel capabilities across various logistics domains, including warehousing, inventory management, transportation, and order fulfillment. It aims better source-to-delivery process management and precise control over material flows [4-6]. Logistics 4.0 aims to overcome existing challenges and elevate performance across several dimensions, including product customization, shipping times, customer experience, safety, security, costs, and the 7Rs (reliability, responsiveness, resilience, resourcefulness, robustness, recovery, and relationships) [2].

One of the most promising aspects of Logistics 4.0 lies in redefining customer interactions and supply chain operations. Leveraging blockchain technology enhances multi-attribute traceability, providing real-time visibility into cargo flows. This, in turn, optimizes infrastructure utilization and maximizes the potential of human and technological resources within companies [1-4]. As decision-making becomes more informed, overall process efficiency improves, leading to cost reductions and enhanced service quality [18]. As Logistics 4.0 continues to evolve, it opens doors to previously inaccessible areas, streamlines inventory management, and enables to operate 24 hours a day, 365 days a year [6]. Figure 2 represents fundamental technologies and concepts of Logistics 4.0. While some of these technologies are not cutting-edge individually, their collective application represents a transformative opportunity.

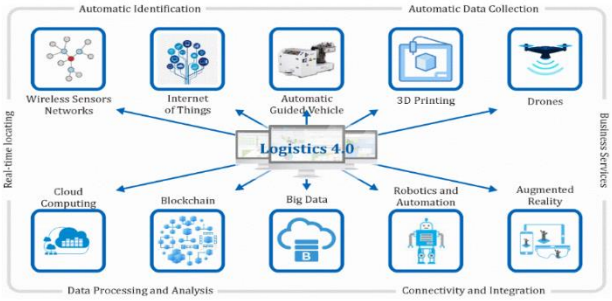

Figure 2. Fundamental concepts of Logistics 4.0 [19]

Finally, it is necessary to highlight that, these mentioned innovations are connected to other technologies (some of which are currently being applied and others that will have a great impact in the future). These technologies include Geographic information Systems (GIS) [20], nanotechnology and simulation [21], 5G [21], machine learning [22], driverless vehicles [23], and more.

After a considerable contextualization of the current industrial digitization in the logistics sector, the next step is to evaluate the needed skills and knowledge. It is possible by being aware of the obvious importance of knowing how to manage the skills adaptation in a constantly changing environment and with cutting-edge technological requirements. It is not only about knowing the specific skills and competences of one or several machines, or about production processes, business models etc., but also about considering transversal knowledge and skills for this development.

Thus, the aim is to complete a logistics-limited extraction of the existing database of ESCO with future needs of the logistics sector by considering, not only digital and technical skills but also transversal competences. In order to include these transversal competencies this research uses the taxonomy proposed by the SPIRE-SAIS project [24]:

- Methodological skills: the most significant methodological competences describe people who are intellectually strong, autonomous and able to consider the entire value chain in decision-making.
- Personal skills: in terms of individual and group responsibility, these personal competences underline the need for self-initiative and personal development.
- Social skills refer to skills used in a variety of ways to connect with others on a daily basis, including oral, non-verbal, written and visual communication.
- Green skills: the knowledge, skills, values and attitudes needed to live, develop and promote a sustainable and resource-efficient society.

2.3. Database Development

This section explains the process of creating a new database, based on the ESCO database. Once all the information about, logistics, digitization and future needs of the sector of interest are obtained, the process has been started by adding data to information provided by ESCO. As introduced ESCO is a dictionary that describes, identifies and classifies professional occupations, skills and qualifications relevant to the labour market, education and training. It is directly related to ISCO (*International Standard Classification of Occupations*) which is the classification of occupations groups managed by the International Labour Organization (ILO) [25].

In order to search for occupations in a convenient and efficient way, a local version of the online database is created, through a web API provided by ESCO, in order to facilitate and speed up the extraction of information. The content and visualization of the information is the same on both platforms, with approximately 3000 occupations with a list of essential and optional knowledge and skills. An example of a logistics engineer's information can be seen in Fig.3 [26].

Figure 3. Skills needed by the job profile 'logistics engineer' according to ESCO [27]

In order to defined identify and select the most relevant jobs that can be related to logistics sector in the ESCO database, a set of keywords are defined. This selection has been done working with and following the recommendations of a subject matter expert. These keywords are: *logistics*, *supply chain*, *warehouse*, *marketing*, *commercial*, *analyst*, *plan*, *transport* and *inventory*.

After obtaining more than 50 occupations through the keyword search, they are analyzed individually. After 22 job profiles which are most closely related to the world of logistics and education are selected: *intermodal logistics manager, logistics analyst, rail logistics coordinator, logistics and distribution manager, logistics engineer, supply chain assistant, supply chain manager, commercial director, marketing manager, inventory coordinator, data warehouse designer, warehouse worker, warehouse manager, business analyst, purchase planner, strategic planning manager, product quality controller, moving truck driver, international forwarding operations* ***coordinator, forwarding*** *manager and distribution manager, corporate trainer and vocational teacher*.

Finally, in order to determine future skills needs, - since the ESCO content does not incorporate them-, a literature review is conducted on the upcoming skill requirements of the profiles selected above, the research is done considering the digitization and diffusion of Industry 4.0 in the logistics sector and the studies done on this field of work [1-9, 27-29].

Based on the results of this research, each professional profile is analyzed to identify whether it would undergo a transformation due to digitization and technological advances in the sector. Also, we consider that the future requirements demanded by logistics must be guaranteed by these professional profiles. In addition, some new occupations that do not currently exist, may be developed in the future. The design and definition of these occupations goes beyond the scope of this research. Therefore, it is considered that the selected professional profiles will cover the future competence requirements.

Finally, once the future skills are integrated, the automated database involving the current and future skills needs is completed. Afterwards, it has been validated and verified by experts from the project funding the initiative and by an internationally recognized sectoral expert.

3. Results and Discussion

The work presented has:

- Identified 22 job profiles related to the logistics sector are selected through the ESCO database, filtering the occupations by keywords and classifying them by department, and then listing them in tables with their respective skills and current knowledge.

- A desk research is carried out on digitization, its impact on the logistics sector in particular and the corresponding future technologies and trends. The aim has been to find out which competences are needed to adapt to digital transformation of the logistics sector. In the end, 77 future competences are identified and they are divided into technical, transversal and environmental competence categories

- Each job profile is updated, depending on the type of work performed in that occupation, the work area, its main and secondary tasks, its current skills and knowledge and a possible future trend.

- The work has been validated from subject matter experts coming from both industry and the academia.

Following the work described in the previous section, the results obtained can be seen below in Table 1. Table 1 shows the selected job profiles mentioned in Chapter 2.3, that are categorized according to the area and department in which they belong to [9]. Subsequently, an exemplifying extract from the latest version of the updated database: one of the selected and analyzed professional job profile related to the logistics industry, the keywords used to identify it, and its essential, optional and future skills needs.

Table 1. Appearance properties of accepted manuscripts

GROUP	OCCUPATION
Direction	Supply chain manager
	Commercial director
	Strategic planning manager
	Marketing manager
Purchasing department	Purchase planner
	Business analyst
Planning and production department	Strategic planning manager
	Logistics engineer
Warehousing department	Inventory coordinator
	Data warehouse designer
	Warehouse worker
	Product quality controller
	Warehouse manager
Department of Transportation	Distribution manager
	Forwarding manager
	International forwarding operations coordinator
	Moving truck driver
	Rail logistics coordinator
	Intermodal logistics manager
Cross-cutting Occupations	Supply chain assistant
	Logistics analyst
	Logistics and distribution manager
Educational Occupations	Corporate trainer
	Vocational teacher

(a)

ESCO occupation (I)					
Intermodal logistics manager	Logistics analyst	Logistics and distribution manager	Logistics engineer	Rail logistics coordinator	Supply chain manager
Web link to ESCO					
http://data.europa.eu/esco/occupation/a2ff6cc3-15fa-4f02-a457-8fd5df7aa29e	http://data.europa.eu/esco/occupation/51cd3a7a-eae6-4dc6-9f24-179d7ec6d230	http://data.europa.eu/esco/occupation/823db06f-25e1-4658-b063-d6ef956b41f5	http://data.europa.eu/esco/occupation/c4071145-a774-4cf4-aefa-ae18a385cca4	http://data.europa.eu/esco/occupation/279c0ab1-212b-4e89-a41f-048f5de9dadf	http://data.europa.eu/esco/occupation/aacc3918-b5d3-484b-9480-5d29aa550d74
Alternative labels					
manager of intermodal transport logistics // transportation logistics manager // manager of intermodal transportation logistics // intermodal transport logistics manager // logistics and traffic manager // multi-modal logistics manager // multi-modal services manager // manager of multi-modal services // manager of intermodal logistics // multi-modal transport service manager	distribution consultant // logistics and supply chain analyst // logistics consultant // distribution and logistics consultant // distribution analyst // distribution and logistics analyst // logistics and distribution analyst // analyst of logistics // supply chain analyst // supply chain consultant	logistics and distribution director // logistics director // logistics coordinator // distribution & logistics manager // logistics & distribution manager // director of logistics and distribution // manager of logistics and distribution // distribution logistics manager // distribution coordinator // distribution and logistics manager // logistics supply chain coordinator // supply chain logistics manager // logistics manager // logistics operations manager	logistics engineering consultant // logistics technology engineer // logistics technology engineering expert // logistics engineering adviser // logistics technology engineering consultant // logistics technology engineering specialist // logistics engineering specialist // logistics technology engineering adviser // logistic engineer // logistics engineering expert	rail transportation coordinator // railway transportation specialist // rail transportation specialist // rail logistics analyst // railway logistics analyst	supply chain procurement manager // supply chain project manager // supply chain specialist // supply and distribution manager // global sourcing manager // supply chain managers // supply chain coordinator
Intermodal logistics managers manage and oversee commercial and operational aspects of intermodal logistics for an organisation.	Logistics analysts streamline product manufacturing, transportation, storage and distribution. They assess production and supply chain problems to determine economically efficient solutions. They assists company managers in decision-making processes and direct programs designed to provide subcontractors, managers and customers with logistic technology.	Logistics and distribution managers take decisions on logistic services, operations and provisions. They take internal and external variables into consideration for effective and successful organisational logistic services. They give appropriate support to all the activities of the supply chain from the beginning to the end. These professionals organise the storage and distribution of goods and ensure that the right products are delivered to the right location on time and at a good cost.	Logistics engineers design and implement systems aimed to optimise the time and efforts invested in transportation activities. They ensure that systems allow for micro-tracking and smooth communication across transport methods and stages.	Rail logistics coordinator manage shipments by rail including or excluding other transport modes. They coordinate the timely allocation of transport means and equipment and ensure a timely delivery. They design and maintain efficient supply chains for clients and shippers.	Supply chain managers plan, manage and coordinate all activities related to the sourcing and procurement of supplies needed to run manufacturing operations from the acquisition of raw materials to the distribution of finished products. The supplies can be raw materials or finished products, and it can be for internal or external use. Moreover, they plan and commission all the activities needed to be performed in manufacturing plants and adjust operations to changing levels of demand for a company's products.
ISCO Number					
1324	2141	1324	2149	4323	1324

(b)

Essential knowledge and skills/competences for each ESCO occupation (I)					
Intermodal logistics manager	Logistics analyst	Logistics and distribution manager	Logistics engineer	Rail logistics coordinator	Supply chain manager
Knowledge					
freight transport methods	green logistics	e-commerce systems	engineering principles	health and safety measures in transportation	corporate social responsibility
intermodal options	supply chain management	freight transport methods	engineering processes	markets for modes of transport	supplier management
intermodalism	theory of constraints	goods transported from warehouse facilities	logistics	multimodal transport logistics	supply chain management
supply chain management		regulations for international transportation	mathematics		supply chain principles
		safety regulations for warehouses	project management		
		supply chain management	supply chain management		
		types of packaging used in industrial shipments	technical drawings		
		warehouse operations			
Skill/ competence					
communicate with customers	analyse supply chain strategies	analyse supply chain strategies	define technical requirements	analyse transportation costs	analyse logistic changes
develop communication networks with shipping sites	analyse supply chain trends	analyse supply chain trends	execute analytical mathematical calculations	apply transportation management concepts	analyse supply chain strategies
exercise stewardship	analyse transport business networks	anticipate the overhaul of the fleet	interpret technical requirements	comply with railway safety standards	analyse supply chain trends
guarantee customer satisfaction	consider economic criteria in decision making	communicate with shipment forwarders	manage engineering project	enforce railway safety regulations	assess supplier risks
have access to shipping rates	detect bottlenecks	comply with checklists	manage logistics	ensure compliance with shipment regulations	estimate costs of required supplies
implement transport strategy	develop efficiency plans for logistics operations	conduct full-scale emergency plan exercises	perform scientific research	handle shipment documentation	follow company standards
maintain relationship with customers	enhance production workflow	consider economic criteria in decision making	use technical drawing software	handle shipment risks	liaise with managers
manage company transport strategy	liaise with logistics management teams	control reorder points		keep track of shipment payments	maintain relationship with customers
manage contracts	maintain freight rate databases	coordinate dock operations		negotiate logistics services	maintain relationship with suppliers
manage staff	maintain logistics databases	develop efficiency plans for logistics operations		operate railway communication systems	manage inventory
negotiate logistics services	manage logistics pricing systems	encourage teams for continuous improvement		prepare freight shipment reports	manage supplies
negotiate prices for transport of cargo	perform system analysis	ensure continuous preparedness for audits		prepare shipments in time	order supplies
plan transport operations	review distribution management procedures	give instructions to staff		resolve shipment issues	strive for company growth
provide customer follow-up	support development of annual budget	handle stressful situations		track shipments	
recruit employees	understand supply chain improvements in relation to profit gains	liaise with colleagues		track shipping sites	
track shipments	use methods of logistical data analysis	liaise with transportation companies		use different communication channels	
track shipping sites	use specific data analysis software	manage dispatch software systems		work in a logistics team	
	work in an economically efficient manner	manage staff			
		manage the fleet according to planned operations			
		perform cost accounting activities			
		provide operational efficiency training to employees			
		solve operational transport problems			
		understand supply chain improvements in relation to profit gains			
		work in a logistics team			

(C)

Optional knowledge and skills/competences for each ESCO occupation (I)					
Intermodal logistics manager	Logistics analyst	Logistics and distribution manager	Logistics engineer	Rail logistics coordinator	Supply chain manager
Knowledge					
	evolution of economic forecasts	transportation methods	green logistics	physical characteristics of railways	business strategy concepts
	online analytical processing		product package requirements	Statistics	conflict management
			transportation engineering		Economics
			warehouse operations		financial forecasting
					geographical routes
					human resource management
					labour legislation
					market pricing
					multimodal transport logistics
					pricing strategies
					project management
					quality standards
					risk management
					Statistics
					transportation software related to an ERP system
					warehouse operations
Skill/ competence					
exert a goal-oriented leadership role towards colleagues	assess risk factors	check dangerous goods transport unit	administer multi-modal logistics	build business relationships	accurately estimate work hours
handle conflicts	communicate analytical insights	cooperate with colleagues	analyse logistic changes	comprehend financial business terminology	advise on risk management
have computer literacy	execute analytical mathematical calculations	coordinate export transportation activities	analyse supply chain strategies	maintain financial records	analyse business objectives
perform ICT troubleshooting	have computer literacy	coordinate import transportation activities	analyse supply chain trends		analyse consumer buying trends
perform services in a flexible manner	perform data analysis	have computer literacy	carry out inventory planning		analyse economic trends
show confidence	perform ICT troubleshooting	improve rail service delivery	implement efficiency plans for logistics operations		analyse logistic needs
tolerate stress	plan self-organisation	liaise with port users	maintain logistics databases		analyse market financial trends
use Microsoft office	show confidence	oversee warehouse value-added activities	manage contracts		apply change management
	think analytically	show confidence	manage distribution channels		apply for government funding
	use different communication channels	use different communication channels	manage warehouse operations		assess financial viability
			manage warehouse organisation		assist in planning production scheduling
			process customer orders		attend trade fairs
			use methods of logistical data analysis		calculate purchasing levels of raw materials
					carry out statistical forecasts
					carry out tendering
					control financial resources
					control trade commercial documentation
					coordinate purchasing activities

(d)

Future knowledge and skills/competences for each ESCO occupation (I)					
Intermodal logistics manager	Logistics analyst	Logistics and distribution manager	Logistics engineer	Rail logistics coordinator	Supply chain manager
Skill/ competence					
Adaptability and adapt to change	Advanced data analysis and modelization	Adaptability and adapt to change	Adaptability and adapt to change	Carbon emission minimisation	Adaptability and adapt to change
Business change management skills	Analytical thinking	Advanced data analysis and modelization	Advanced data analysis and modelization	Collaborative/autonomous robotics	Advanced data analysis and modelization
Business intelligence (BI)	Big Data analytics skills	Analytical thinking	AI algorithms	Communication skills	AI algorithms
Communication skills	Business change management skills	Big Data analytics skills	Analytical thinking	Conflict management	Analytical thinking
Complex problem solving	Business intelligence (BI	Business change management skills	Artificial intelligence (AI)	Coordination skills	Artificial intelligence (AI)
Conflict management	Coding	Business intelligence (BI	Augmented reality (AR)	Customer relationship management	Big Data analytics skills
Consulting skills	Communication skills	Business networks skills	Big Data analytics skills	Dealing with human-robot interface (HRI)	Business change management skills
Creativity	Complex problem solving	Collaboration/ Cooperation	Cloud Computing	Decision making	Communication skills
Customer relationship management	Consulting skills	Communication skills	Coding	Design a sustainable operation	Consulting skills
Decision making	Cybersecurity	Complex problem solving	Collaboration/ Cooperation	Environmental consciousness	Coordination skills
Environmental consciousness	Dealing with communication systems (CS)	Conflict management	Collaborative/autonomous robotics	Flexibility	Creativity
Flexibility	Dealing with complexity	Consulting skills	Communication skills	Greening and maintenance of existing vehicles	Decision making
Negotiation skills	Dealing with information	Coordination skills	Complex problem solving	Mobile technologies	Design of greener transport systems
Product life cycle impact assessment	Decision making	Customer relationship management	Comprehensive IT skills	Negotiation skills	Digital security skills and knowledge
Resource reuse/recycling	Digital networks	Dealing with communication systems (CS)	Creativity	Overall process understanding	Environmental consciousness
Risk management	Digital security skills and knowledge	Dealing with complexity	Cybersecurity	Predictive and proactive maintenance	ERP systems
Traceability	Digital Twin (DT)	Dealing with information	Dealing with communication systems (CS)	Teamwork	Flexibility
Use of digital communication tools	Environmental consciousness	Decision making	Dealing with complexity	Technological knowledge	Overall process understanding
	Environmental impact assessment	Design a sustainable operation	Dealing with human-robot interface (HRI	Traceability	Product/process design skills
	Innovation capability	Design of greener transport systems	Decision making	Willingness to learn	Quantitative and statistical skills
	Machine Learning (ML)	Digital security skills and knowledge	Design a sustainable operation		Risk management
	Predictive and proactive maintenance	Environmental consciousness	Digital networks		Specific process knowledge
	Product life cycle impact assessment	Environmental impact assessment	Digital security skills and knowledge		Teamwork
	Programming knowledge	Innovation capability	Digital Twin (DT)		Technical jargon
	Quantitative and statistical skills	Product life cycle impact assessment	Environmental consciousness		Use of digital communication tools
	Risk management	Quantitative and statistical skills	Equipment and process monitoring and its implementation		
	Specific process knowledge	Risk management	ERP systems		
	Use of digital communication tools	Specific process knowledge	Flexibility		
		Strategic and leadership skills	Implement of new green technologies in businesses		
		Teamwork	Innovation capability		
		Technological knowledge	Internet of Things skills		
		Traceability	Machine Learning (ML)		
		Use of digital communication tools	Predictive and proactive maintenance		
			Product/process design skills		
			Programming knowledge		
			Quantitative and statistical skills		
			Resource reuse/recycling		
			Risk management		
			Self-initiative		
			Sensors technology		
			Specific process knowledge		
			Teamwork		
			Technical jargon		
			Technological knowledge		

Figure 4. The skills and competences needed by some of the professional profiles related to the logistics sector extracted from the generated database a) introduction of ESCO occupation; b) essential knowledge and competences; c) optional knowledge and skills; d) future knowledge and needs

4. Conclusion

A successful transition of logistics companies towards digitization begins with the correct understanding and internalizing of this evolution and realizing that the company's employees are also part of this change. The industry is evolving at the rapid pace of technological progress, and the skills of human resources must keep pace. This is why people must also learn new skills to adapt to new technologies and not always be replaced.

In this work, we have generated a skills database for the job profiles related to logistics, identifying the future skills needs of each profile through a detailed analysis. The selected profiles and future skills requirements for the logistics sector are reviewed and validated, demonstrating that the generated database is a relevant tool in the development of a skills strategy for the successful development of the logistics sector in the context of Industry 4.0.

The generated database holds immense potential for the sector, as it encompasses necessary specific competences for the sector. Our work's most significant contribution to the logistics lies in the meticulous analysis that identifies future competences for each profile. Education and training providers, companies, and universities gain access to data relevant to the specific profiles they engage with. This database serves as a reference and standard, facilitating the development of targeted training programs that deliver the industry-required competences. Moreover, by addressing skills gaps effectively, the database contributes to enhancing the sector's competitiveness.

Considering the potential limitations of this research and its future outlines, it is worth noting that the study primarily relies on the European ESCO database, which may limit its applicability to other regions. Different countries or regions might have varying skill requirements or job profiles in the logistics sector, so other sources such as the O*NET database (for example) should be studied in the future. As well, the skills needs might vary significantly between small-medium enterprises (SMEs) and large corporations, so further studies clarifying these potential differences should be carried out in future. Finally, we cannot forget that professions continuously change: Thus, further research will be oriented to the job profiles not created yet. Consequently, the outlines for the future of this research will be also focused on identifying the needs of the sector resulting into new professions..

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