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Identification and Analytical Comparison of Supply Chain Management Skills in Portugal

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Abstract—The use of digital technologies to optimize performance in logistics and supply chains is a phenomenon that aims to put the customer at the center of business thinking. The new scenarios arising from digital transformation force logistics to adapt to a more complex, ever-changing, and highly uncertain environment. So, the demand for well-qualified logistics professionals to perform in this context becomes essential for organizations. The objective of the article is to identify the key logistics and supply chain management competencies to perform in an environment impacted by digital transformation. We analyzed the content of textual data from: (1) job advertisements in the logistics area in Portugal, and (2) academic research articles on competencies in the logistics area. The results show an evolution in the skills required, with greater emphasis on technical skills related to information technology. Furthermore, interpersonal skills such as communication, teamwork, and flexibility are highly valued.

Keywords—Supply chain digitalization; Logistics competencies; Supply chain competencies; Soft skills; Hard Skills; SCM competencies framework.

I. Introduction

Supply Chain Management (SCM) is crucial for creating value for companies, reducing costs, and enhancing customer satisfaction through improved quality, on-time delivery, responsiveness, innovation, and service, [1]. Supply chain processes are crucial in business, particularly for global operations, [2]. Rapid economic, technological, financial, and social changes have continuously evolved supply chains. Notably, the emerging digital technologies associated with Industry 4.0 have led to advanced technologies such as blockchain, artificial intelligence (AI), cloud computing, and big data being used to simplify multifaceted tasks and accelerate supply chain integrations, [2], [3].

Despite years of process innovations and sophisticated technological solutions, achieving an agile and adaptable supply chain remains a challenging goal. Possibly, it is people who are causing constraints in supply chains. The issue is about talent rather than technology, especially as the market becomes increasingly complex, [4]. A study on digital talent revealed a significant shortage of digital skills in the workforce, [5]. The lack of digital talent can slow down or delay digital transformation. Digitalization requires a workforce with a digital skill set, capable of utilizing digital technologies and solutions, and possessing robust business intelligence, [6].

This study presents an unprecedented and specific analysis of the skills required in SCM within the Portuguese digital context, contributing to both academic theory and professional practice.

II. Problem Formulation

When examining the literature on the skills and competencies of logistics professionals operating in the context of digital transformation, we find that previous research lacks a discussion and empirical investigation of the skills required in logistics and supply chain management within the digital economy. In short, prior research does not provide logistics organizations with an industry-specific understanding and operationalization of the requirements for logistics personnel in a rapidly changing environment. From a practical perspective, this gap is relevant for both employers and employees. The research offers a comprehensive overview of the evolving nature of logistics positions and the skills required in the new digital landscape.

In this article, we focus explicitly on the logistics and supply chain management field in Portugal and its evolving scenario

due to digital transformation, particularly in characterizing the skills of the workforce. The aim is to identify the skill set SCM employers in Portugal are looking for in professionals in the field. The skills requirements of the labor market indicate the design of study programs and the adaptation of teaching methods. This approach opens up new avenues for improving higher education curricula.

Our approach employs content analysis, focusing on the text of 300 job advertisements in the supply chain and logistics sector in Portugal, to identify the skills required by the job market for logistics professionals. At the same time, it examines the research output in articles written by academics in reference journals focused on logistics and supply chain so that we can see whether there is a change in skills in the logistics area over time as a result of the digital transformation.

By addressing this research question, we contribute to theory and practice. This study presents a conceptual model that combines the existing competencies in Supply Chain Management (SCM). Additionally, we have identified the skills that employers expect from professionals in the field. New competencies, such as the adaptation competency, are becoming increasingly relevant as technology advances, customer requirements evolve, and supply chain integration becomes a standard practice in the industry. This study has the potential to guide companies in restructuring their organizations, creating new positions, and developing competencies whereas also helping academic institutions improve the training of logistics students more effectively.

A. Methodology

This article aims to identify the key logistics and supply chain management competencies required for action in an environment impacted by digital transformation. The research question is: What skill set do SCM employers in Portugal expect from professionals in the field?

To achieve our research objectives, we carried out two approaches: (1) a systematic literature review (SLR) was used to investigate academic articles on SCM competency frameworks, and (2) a content analysis of the text of job advertisements in the logistics area in Portugal (Fig. 6, Appendix).

The systematic review of the literature primarily contributes to the theoretical framework, providing a comprehensive overview of emerging skills in the international academic literature. On the other hand, the content analysis of job advertisements offers immediate practical insights into the skills currently required by the Portuguese market, allowing a direct comparison between theory and practice.

B. Systematic literature review

The articles selected for this study were searched in the *Web of Science* and *Scopus* databases. The keywords used in the search were *Skills, SCM,* and *Logistics*, in the categories *Management, Business, Transportation, Supply Chain Management* and *Logistics.* Peer-reviewed articles in English from 2000 to 2022 were selected for review. This is the period chosen because it is characterized as the beginning of the digital transformation since the rise of smart devices and social media platforms led to a drastic change in the world, altering the methods that customers used to communicate with companies and also changing the expectations that customers had regarding response times and multichannel availability, [7].

The selection of the final articles to be included in this study involved identifying the articles in the databases (217), screening by title (183), reviewing abstracts to select eligible articles (19), and reviewing the full text to finally choose the articles to be included (6), as they were articles that presented a *framework* on competencies in Supply Chain Management.

C. Collecting data from job advertisements

Regarding the advertisements, we employed the content analysis method to analyze the text of the job advertisements. Content analysis is the *"*research technique for making replicable and valid inferences from text (or other meaningful matter) to the contexts of their use" - in the text of the job advertisements, [8].

Job advertisements were collected online for analysis on the following websites: emprego.sapo.pt, net-empregos.com, michaelpage.pt and randstad.pt, during June and July 2022, with vacancies between December 2021 and July 2022.

Initially, we examined the job advertisements available during data collection, using the keyword search logistics ("*logística*") and the search region of Portugal, as these were the criteria we aimed to answer in our research. In the initial sample, we obtained 1,467 advertisements. After excluding ads that did not require a degree as the minimum level of training for the vacancy, we were left with 385 advertisements. We then excluded duplicate ads, resulting in 306 remaining ads. Next, we excluded ads for workplaces outside Portugal, leaving us with 300 ads. We consider this number of ads to be significant, as in 2021, the logistics sector in Portugal offered 2644 vacancies, including all levels of training, [9].

It is essential to acknowledge that the analysis of job advertisements has limitations in terms of its national representativeness and potential regional and economic biases, given that the data were collected exclusively in Portugal.

The next step was to identify the occupational category of each job advertisement, [10]. Categorical variables were introduced: (1) industry sector, (2) level of minimum experience, (3) job title and function, and (4) level of training required.

The data was then coded according to skills using NVivo 11.0, a software program for analyzing the content of qualitative data. This tool enabled the creation of 46 nodes, each corresponding to a skill. The coding of the advertisements was carried out by two independent researchers, achieving high inter-coder reliability, with a Cohen's Kappa value of 0.86.

However, we decided to develop a dictionary from the sample, [8]. To achieve this, we employed an empirical approach to create the dictionary by analyzing the text of all

the ads and separating them into hard skills (Table 7, Appendix) and soft skills (Table 8, Appendix). The data for each category was included in the frequency counts. Frequency analysis of keywords in texts has been widely used in many studies to identify the skills required by the sector from the text of job advertisements, [11], [12], [13], [14], [15].

A cluster analysis was employed to group the skills into homogeneous clusters, facilitating the identification of similarities among the skills. In this study, we used the complete linkage method, which maximizes the distances between clusters, providing a discriminating view of the grouping structure. Considering the binary nature of our data, we chose Jaccard's coefficient as a measure of similarity. This coefficient is particularly suitable for binary data, as it quantifies the overlap between clusters, indicating the proportion of common elements about the total number of distinct elements. Jaccard's coefficient is an appropriate measure for assessing the similarity of clusters in contexts where the presence or absence of specific characteristics is represented by observations, [16]. This analysis was carried out using SPSS software.

In the second phase, the chi-squared test of independence was used to assess whether there was an association between the various skills and the various categorical variables mentioned above. This test was carried out using the R software.

III. Problem Solution

A. Competencies and skills in SCM in the context of digital transformation

The integration of digital technologies often referred to as "digital transformation," is reshaping traditional supply chain paradigms, [17]. As companies strive to maintain competitiveness, business models are being updated and transformed to keep pace with rapid disruption, [18]. Organizations must rethink their strategies for skills development to meet the challenges of digital transformation, [19]. Understanding supply chain digitalization is still in its nascent stages, [20].

Recently, studies using computer simulations have highlighted the impact of digital transformation on SCM skills, [21], [22].

The demand for analytical and problem-solving skills is escalating as supply chain professionals are increasingly expected to leverage data-driven insights for decision-making, [23]. The ability to analyze large datasets, identify trends, and develop predictive models is becoming indispensable for optimizing inventory levels, forecasting demand, and mitigating risks, [24]. As supply chains become more complex and interconnected, the ability to build and maintain strong relationships with partners is essential for success, [25]. In the context of digital transformation, supply chain resilience refers to a supply chain's ability to withstand disruptions and adapt to changing circumstances, a crucial factor given the increasing complexity and volatility of the global business environment, [26].

B. Competencies based on the literature

Using our literature review, we compiled a catalog of 230 competencies identified in six relevant articles on logistics sector competencies (details are provided in Table 6 - Appendix).

Overall, there is a lack of consistency in the classification of the identified competencies, with some identical competencies being classified differently by different authors. To facilitate a more accurate comparison of the competencies, we employed the comparative model, which categorizes competencies into *soft skills* and *hard skills,* [27]. In this comparative table, we included the skills identified in the job advertisements (Table 4).

C. Content analysis of job advertisements

Categorical variables were created for each advertisement, according to [28], namely: (1) industry sector, (2) minimum experience level, and (3) professional qualification requirements.

The data obtained allows us to conclude that the predominant sector is the logistics sector, with 36%, followed by the industrial sector, with 21%, and the retail sector, with 9% (Fig. 1).

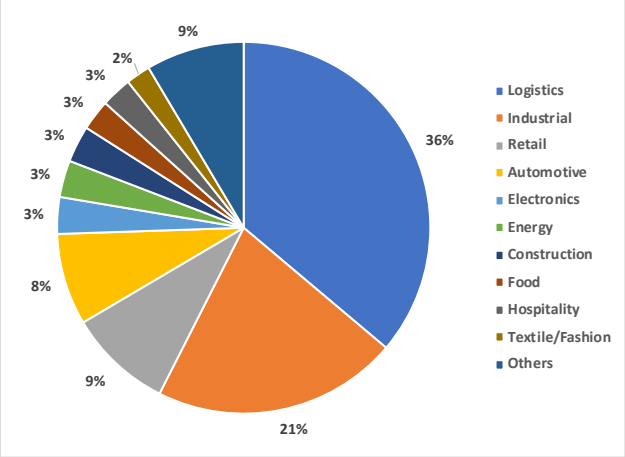

Fig. 1. Sectors in which companies operate

Regarding the length of experience, the most frequently demanded was between 3 and 5 years, as indicated in 111 ads. The time between 0 and 2 years was present in 45 ads, and this was reduced to 33 ads for more than 5 years of experience in the sector (Fig. 2).

Regarding the educational requirements specified in job advertisements, it was found that 285 advertisements required candidates with at least an undergraduate degree. In comparison, only 15 advertisements specified a postgraduate degree as a requirement (Fig. 3). There was considerable diversity in the areas of training required, with 24 different areas of training being cited. The most cited degrees were management (150), logistics (133) and engineering (109) (Fig. 7, Appendix).

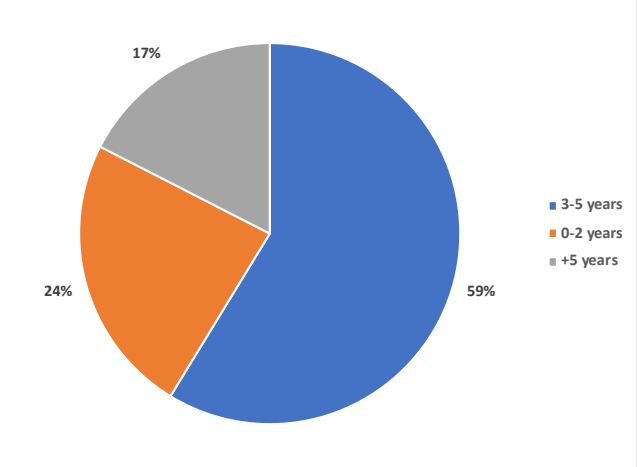

Fig. 2. Length of experience required

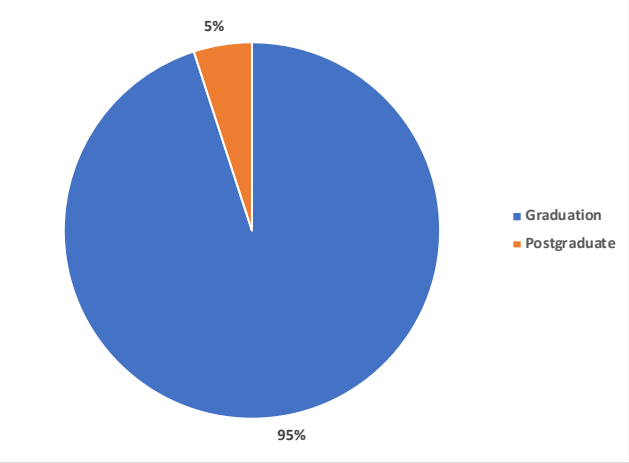

Fig. 3. Training requirements for candidates

Finally, the most frequently mentioned position in the ads was specialist (69%), and the least often was director (1%) (Fig. 4).

Drawing *treemap* graphs for the *hard* and *soft* skills enabled an analysis of proportions and comparison within the skill sets. The size of each rectangle reflects the frequency of the skills that appeared in the ads. By observing the relative sizes of the rectangles, we can understand the importance or impact of each skill.

Among the *hard skills*, 18 different competencies were identified. The skills most frequently identified in the advertisements were foreign languages (English, French, German, and Spanish) and the use of microcomputers, specifically *software* such as *MS Word, MS Excel, and Outlook,* among others (Fig. 8, Appendix).

Twenty different competencies were identified in soft skills. It is worth noting that there is a more even distribution of *soft* skills, with communication, organization, teamwork, and analytical skills being the most frequently identified (Fig. 9, Appendix).

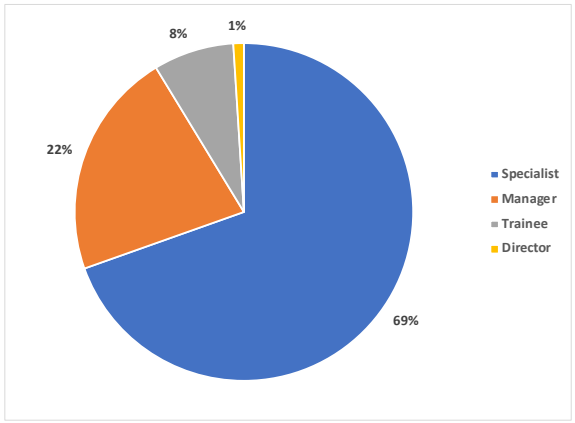

Fig. 4. Positions and functions mentioned in job advertisements

D. Skills analysis

The results in **Σφάλμα! Το αρχείο προέλευσης της αναφοράς δεν βρέθηκε.** (Appendix) are partially illustrated in two graphs (**Σφάλμα! Το αρχείο προέλευσης της αναφοράς δεν βρέθηκε.** and Fig. 11 in Appendix), which show a balance between *soft* and *hard skills*, with 36 competencies appearing in each category. However, only two skills appear in all the articles and advertisements: supply chain management (*a hard skill*) and teamwork (*a soft skill*).

Regarding *hard skills*, the advertisements only display 18 of the 36 competencies listed. The five *hard skills* that appeared the most in the ads were: foreign language, microcomputing (which means using *software* that is common in everyday business life. For example, *MS Word, MS Excel, and MS Access*, among others), knowledge of ERPs (*Enterprise Resource Planning*), logistics planning and warehousing. The most cited competencies in the articles are supply chain management, information systems management, transportation management, international logistics, and logistics planning.

This analysis highlighted a difference between the *hard skills* most cited in the advertisements and articles. Only the logistics planning skill appears among the five most cited in the advertisements and articles. Microcomputing skills are identified as relevant to the present and future of organizations, [34]. At the same time, ERP knowledge skills are listed as being essential for employability, [35]. Storage competence is ranked as the second most important for SCM professionals, [36]. Logistics planning, which is among the most frequently cited skills in both advertisements and articles, is identified as the most critical skill for SCM professionals, [37].

Foreign language was the *hard skill* most cited in the ads, but it only appeared in two articles. This difference may be because the articles were written in English-speaking countries, i.e., the language commonly used in international transactions. In contrast, the advertisements relate to Portugal, a Portuguese-speaking country, thus requiring competence in other languages to carry out activities with other countries.

Concerning *soft skills*, we found that 10 new competencies

are only listed in the ads (responsibility, resilience, proactivity, critical thinking, innovation, dynamism, curiosity, autonomy, adaptation, and customer focus). This can be attributed to the fact that SCM professionals are increasingly required *to possess soft skills,* [38], [39], [40]. The five *soft skills* that appeared most frequently in the articles were teamwork, analytical skills, communication, time management, and leadership. In contrast, the advertisements highlighted communication, organization, teamwork, analytical skills, proactivity, and problem-solving.

Emerging skills, such as proactivity and problem-solving, are directly related to the challenges faced by Portuguese companies, including the difficulty in filling certain positions that require these specific skills.

Table 5 (Appendix) directly compares the skills most frequently mentioned in job advertisements versus those in academic literature, highlighting significant discrepancies and convergences.

The difference between the *soft skills* most cited in the ads and the articles is smaller than in the *hard skills*. The three soft skills that are most frequently quoted in ads —communication, analytical ability, and teamwork — are also among those that appear most often in ads. This indicates that, despite the time difference between the comparative data, these skills remain relevant for SCM professionals. The results we obtained are similar to those presented by other authors. Communication is the skill most emphasized as the most critical *soft skill* for digital transformation, [41]. Meanwhile, analytical skills are the second most important soft skill for SCM professionals [38]. Teamwork is relevant for SCM professionals; however, a significant *gap exists* between what is desired and what is presented by professionals, [42].

Among the skills that are among the most cited in the advertisements but which are not among the most cited in the articles, we highlight organization, proactivity, and problem-solving. Organization is among the skills SCM professionals require in the digital transformation, as they are being forced to multitask in their daily lives, [38]. Proactivity competency is very relevant to the digitalization process, as professionals need to work more autonomously, [43]. Problem-solving competence is relevant because employees must be able to identify sources of errors and improve processes accordingly.

E. Cluster analysis

Hierarchical agglomeration is characterized by establishing a hierarchy or tree-like structure and interconnecting objects based on their associations, resulting in a graphic representation known as a dendrogram. In this representation, similar objects, as determined by the studied variables, are grouped. For agglomeration procedures, a specific method must be chosen. This study employed the Complete Linkage method for hierarchical clustering and the Jaccard coefficient as a measure of similarity.

To define the groups in the dendrogram, we set a cut-off point at a distance of 15. This approach enabled us to analyze relationships at various hierarchical levels, providing a comprehensive and contextualized understanding of the data. After examining the dendrogram, we identified 29 groups and highlighted 10 groups, as shown in Fig. 5, where each group contains competencies with similar characteristics.

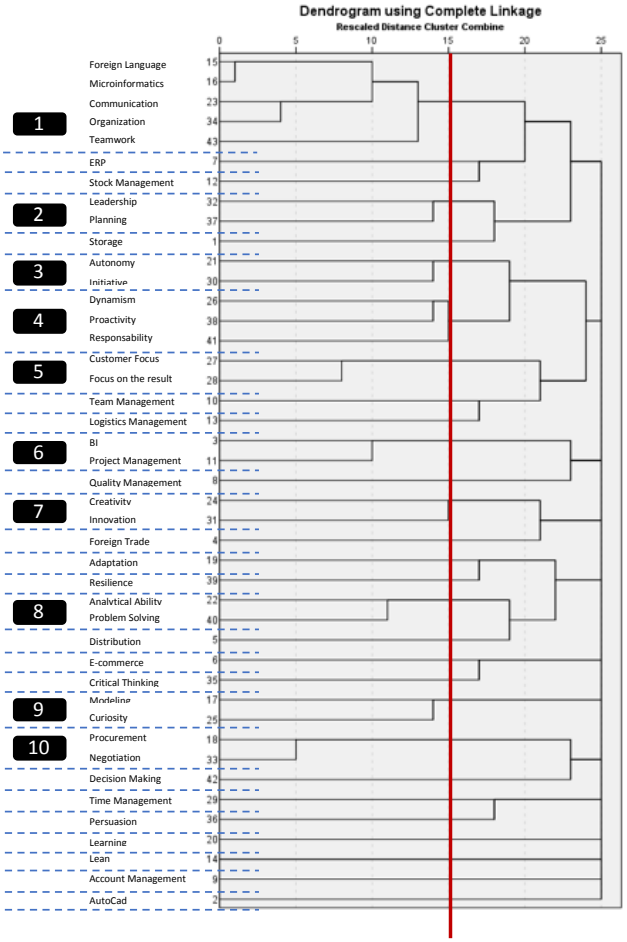

Fig. 5. Dendrogram grouping

Examining the grouped competencies reveals several trends. Group 1 is where the skills are grouped at a lower level. Foreign language and microcomputing are the *hard skills* that appear most in advertisements, while organization, communication, and teamwork are the *soft skills* most identified in the ads.

In Group 2, it is possible to identify that the competencies share similar characteristics. Leadership and planning are interdependent, as effective leaders translate visions into strategic actions, utilizing planning as a crucial tool for achieving goals and motivating teams. In Group 3, the competencies of autonomy and initiative are related, representing the ability to act independently and proactively to carry out tasks and make decisions, showing a self-confident and entrepreneurial professional.

In Group 4, the competencies share similar characteristics. Dynamism, proactivity, and responsibility are essential professional skills in a dynamic environment. In Group 5, customer focus and focus on results are fundamental competencies for business success. In Group 6, we observe

that business intelligence (BI) and project management skills are crucial for enhancing or improving an organization's performance. In Group 7, innovation and creativity have similar characteristics.

In Group 8, we can identify similarities between the competencies: analytical skills and problem-solving are interrelated, the former essential for breaking down complex information and the latter for applying analysis to find practical and effective solutions. In Group 9, a relationship between modeling skills and curiosity is evident. The negotiation skill in Group 10 is important for carrying out the *procurement* activity.

F. Chi-squared tests

Following this work, we conducted a data analysis, performing chi-squared tests of independence on the variables representing the skills found in the 300 advertisements collected. R software was used to carry out these tests.

We formulated three research hypotheses and applied chi-square tests to evaluate them.

Hypothesis 1: Is there an association between skills and sectors of activity?

Hypothesis 2: Is there an association between skills and length of experience?

Hypothesis 3: Is there an association between skills and job title?

Table 1. Chi-Square Test Skills and Sector

Skills	31
Categories	Logistics
	Industrial
	Other Sectors
Pearson Chi-Square	
Value	161.26
df	90
pvalue	0.005939

The result of the chi-squared test for the cross-referencing of competencies (31 soft and hard skills) with the sector of activity (with three categories: logistics, industrial, and other sectors) (qobs = 161.26; p-value = 0.005939 < 0.05) allows us to conclude that, at a significance level of 5%, hypothesis H_0 of independence between competencies and sectors is rejected. The assumptions for applying the test were validated, as only 16% of the cells resulted in expected frequencies of less than 5 and no expected frequencies of zero. We can conclude that there is an association between competencies and sectors (Table 1).

The skills most frequently mentioned by all sectors (including Logistics and Industrial) were foreign language, microcomputing, communication, teamwork, and organization. However, of all the skills mentioned, foreign language, microcomputing, communication, logistics management, focus on results, customer focus, negotiation, distribution, initiative, and foreign trade are most valued in the logistics sector. At the same time, teamwork, planning, proactivity, leadership, dynamism, autonomy, warehousing, stock management, resilience, adaptation, project management, and lean are most valued in the industrial sector. In other sectors, the most valued characteristics include organization, ERP, analytical skills, responsibility, team management, procurement, stock management, and time management. Furthermore, lean competence was not highly valued in the logistics sector. Although the initiative is more significant in the logistics sector, it is equally important in the industrial sector. As for team management, it is more prevalent in sectors other than logistics. In turn, planning stands out as a competence with greater expression in the industrial sector than in the other sectors. Finally, the focus on results in the industrial sector is relatively minor compared to the other sectors.

Table 2. Chi-Square test between competence and length of experience

Skills	31
Categories	0-2 years
	3-5 years
	+5 years
Pearson Chi-Square	
Value	75.593
df	90
pvalue	0.8614

The result of the chi-square test for the cross-referencing of skills (31 soft and hard skills) with length of experience (with three categories: between 0 and 2 years, between 3 and 5 years and more than 5 years) (qobs = 75.593; p-value = 0.8614 > 0.05) leads to the conclusion that, at a significance level of 5%, the hypothesis of independence between skills and length of experience is not rejected, so there is no evidence of an association between skills and length of experience (Table 2).

Table 3. Chi-Square test between skills and job title

Skills	31
Categories	Director and Managers
	Specialists and Trainees
Pearson Chi-Square	
Value	61.005
df	60
pvalue	0.4396

Finally, the result of the chi-squared test for the crossing of competencies (31 soft and hard skills) with job title (with two categories: director and managers; specialists and trainees) (qobs = 61.005; p-value = 0.4396 > 0.05) allows us to conclude that, at a significance level of 5%, the hypothesis of independence between competencies and job title is not rejected. Given this result, it can be concluded that competencies and job titles are not associated (Table 3).

G. SCM competencies framework

Existing research on competency structures in the logistics area is fragmented, with no clear standard on how logistics competencies can be grouped. SC researchers lack standardized names for the competencies identified over time,

which makes it challenging to compare competencies across studies.

This study aims to identify the skills demanded by the logistics market in the context of digital transformation. However, it is impossible to determine precisely the level of digitalization currently achieved by advertising companies, as no specific survey has been carried out with these organizations. The key competencies required during the digital transformation process within an organization vary depending on the stage of the process, [44]. In the early stages, technical skills are in higher demand, often at the expense of personal and social skills. In the final stages, however, the demand is reversed, as these skills are more important than technical skills.

Analyzing the results of our sample, which revealed equality between the *soft skills* and *hard skills* desired by advertisers, we can conclude that organizations are undergoing a process of digitization due to the increasing demand for *soft skills*. However, we cannot define their digitization level, and companies may be at different stages of this process.

We propose a model that categorizes professional skills into two main categories: *soft skills* and *hard skills*, subdividing the latter into *Supply Chain Management, General Knowledge,* and *Technology and Systems*. By graphically representing this classification, we demonstrate that the demand for different types of skills varies throughout the digital transformation process. Organizations in the early stages, for example, tend to prioritize knowledge in *Supply Chain Management* and *General Knowledge*, while those that are more advanced look for professionals with a strong command of *Technology & Systems* and a robust set of *soft skills*. Fig. 12 (Appendix) illustrates this relationship between the level of digitalization and the ideal skills profile.

The model presented reveals that the skill set needed to work in the logistics sector constantly evolves. In addition to traditional technical skills, such as stock management and logistics management, logistics professionals must also develop skills in *business intelligence* and critical thinking. This transformation requires continuous investment in education and professional development.

Future research could empirically validate the proposed framework through interviews or surveys with experts in the SCM sector in Portugal.

IV. Conclusion

The study analyzed job advertisements combined with a systematic literature review. It enabled the development of a comprehensive set of *hard* and *soft skills* required by logistics professionals in the context of digital transformation.

The results indicate an evolution in the skills required, with a greater emphasis on technical skills related to information technology, including the use of specific software and the ability to process large amounts of information. At the same time, interpersonal skills such as communication, teamwork, and flexibility are highly valued.

The comparative analysis of the data from the job advertisements and the literature revealed some differences and consistencies. Whereas the literature emphasizes the importance of management skills and in-depth technical knowledge, the job advertisements also emphasize the need for more practical skills related to day-to-day logistics operations. This difference can be explained by the more pragmatic nature of the advertisements, looking for candidates with immediate qualifications to fill the vacancies.

Digital transformation is driving significant changes in the logistics industry's profile. Companies are increasingly looking for employees with diverse skills, including technical and interpersonal skills. This study contributes to understanding the labor market's demands. It can form the basis for national policies and training programs to prepare workers for the future challenges of logistics. Therefore, logistics education should provide a diverse *range of know-how* and skills necessary for the job market. Structuring university curricula could increase the employability of graduates.

This study presents an unprecedented and detailed analysis of the skills required in SCM within the Portuguese digital context, making a significant contribution to both academic theory and professional practice.

From a practical perspective, the results reinforce that as digital transformation advances, soft skills are becoming the most relevant. On the technical side, whereas professionals must be proficient in basic technical logistics skills, business skills focused on customer centricity, and analytical skills, they also need to be up to date on technologies that support digital transformation. Additionally, our study can serve as a guide for identifying new talent and training SCM professionals.

Ultimately, the findings of this study can inform higher education institutions in updating their curricula by creating new content or specializations in response to the demands of companies in the logistics sector. Therefore, a suggestion for future work is to analyze educational and professional training programs related to logistics at the European level in terms of their skills requirements. Such programs would prepare the logistics professionals of the future to meet future challenges in the field of SCM.

Several limitations and unanswered questions warrant further discussion. Firstly, this study was limited to Portugal. Recommendations for further research include other countries. Secondly, the skills and competencies identified in the area of logistics suggest that studying others, such as accounting, finance, and health, using this approach could be interesting for future academic work.

Declaration of Generative AI and AI-assisted Technologies in the Writing Process

The authors wrote, reviewed and edited the content as needed and verifies that none utilised artificial intelligence (AI) tools were used. The authors take full responsibility for the content of the publication.

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Contribution of individual authors to the creation of a scientific article (ghostwriting policy)

Bruno Siano Rêgo for collecting and analyzing data and building the framework.
Diogo Lourenço was responsible for the methodology of the article.
Fernando Moreira was responsible for reviewing the article.
Carla Santos Pereira was responsible for the Statistics.

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APPENDIX

Table 4. List of competencies in Supply Chain Management

Skills Category	Skills	[29]	[30]	[31]	[32]	[33]	[28]	Job Ads (2022)
Hard	Financial management	-	-	✓	✓	-	-	-
SCM	Logistics planning	✓	-	-	-	✓	✓	✓
Skills	Human resources management	✓	-	-	✓	-	-	✓
	Statistical data analysis	✓	-	-	✓	-	✓	-
	Information systems management	✓	-	✓	✓	✓	✓	-
	Modeling operating systems	-	-	-	-	-	✓	✓
	Market regulation	-	-	-	✓	-	-	-
	Marketing	-	-	-	✓	-	✓	-
	International market regulation	-	-	-	✓	-	-	-
	Contract management	-	-	-	✓	-	-	✓
	Transport management	-	-	✓	✓	✓	✓	✓
	Inventory control	-	-	-	✓	✓	✓	✓
	Planning the location of logistics facilities	-	-	-	✓	-	-	-
	Product demand planning	-	-	-	✓	-	-	-
	Supply chain management	✓	✓	✓	✓	✓	✓	✓
	Storage	-	-	-	✓	✓	-	✓
	International logistics	-	-	✓	✓	✓	✓	✓
	Reverse logistics	-	-	-	✓	✓	✓	-
	Packaging	-	-	-	✓	-	-	-
	Controlling	-	-	-	✓	-	-	-
	Quantitative methods	✓	-	-	✓	-	-	-
	Business management	-	-	-	✓	-	-	-
	Strategic management	-	-	✓	✓	-	-	-
	Commercial management	✓	-	-	✓	-	-	-
	Industrial management	-	-	-	✓	✓	-	-
	E-commerce	-	-	-	✓	-	-	✓
	Foreign language	✓	-	-	✓	-	-	✓
	ERP knowledge	✓	-	-	-	✓	-	✓
	Project management	✓	-	✓	-	-	✓	✓
	Microcomputing	✓	-	-	-	-	✓	✓
	Third-party management	-	-	-	-	✓	✓	-
	Quality management	-	-	-	-	✓	-	✓
	Just in time	-	-	✓	-	✓	-	-
	Auto-Cad	-	-	-	-	-	-	✓
	Business Intelligence	-	-	-	-	-	-	✓
	Lean	-	-	-	-	-	-	✓
Soft	Customer relationship management	-	-	-	✓	✓	✓	-
SCM	Business ethics	✓	-	-	✓	-	-	-
Skills	Customer focus	-	-	-	-	-	-	✓
	Communication	-	✓	-	✓	✓	✓	✓
	Negotiation	✓	-	-	✓	-	-	✓
	Time management	✓	✓	-	✓	✓	-	✓
	Organization	✓	-	-	✓	-	-	✓
	Change management	✓	-	✓	✓	-	-	-
	Leadership	✓	✓	✓	-	-	✓	✓
	Teamwork	✓	✓	✓	✓	✓	✓	✓
	Planning	✓	-	-	✓	-	-	✓
	Motivation	✓	-	-	✓	✓	-	-
	Decision-making	✓	✓	-	✓	-	-	✓
	Confidence	✓	✓	-	✓	-	-	-
	Analytical Capacity	✓	✓	✓	✓	-	✓	✓
	Working under pressure	✓	✓	-	-	✓	-	-
	Objectivity	-	✓	-	-	-	-	-
	Creativity	✓	✓	-	-	-	-	✓
	Macro view	✓	-	-	-	-	-	-
	Troubleshooting	✓	✓	-	-	-	-	✓
	Conflict management	✓	-	-	-	-	-	-
	Flexibility	✓	-	-	-	-	-	-
	Multicultural awareness	✓	-	-	-	-	-	-
	Initiative	-	-	-	-	✓	-	✓
	Learning	-	-	-	-	✓	-	✓
	Adaptation	-	-	-	-	-	-	✓
	Autonomy	-	-	-	-	-	-	✓
	Curiosity	-	-	-	-	-	-	✓
	Dynamism	-	-	-	-	-	-	✓
	Focus on Results	-	-	-	-	✓	✓	✓
	Innovation	-	-	-	-	-	-	✓
	Critical Thinking	-	-	-	-	-	-	✓
	Persuasion	✓	-	-	-	-	-	✓
	Proactivity	-	-	-	-	-	-	✓
	Resilience	-	-	-	-	-	-	✓
	Responsibility	-	-	-	-	-	-	✓

Table 5. Comparative table of skills most frequently mentioned in articles and job advertisements

Hard Skills						Soft Skills					
Articles			Job Ads			Articles			Job Ads		
P.	Skills	%	P.	Skills	%	P.	Skills	%	P.	Skills	%
1	Supply chain management	100%	1	Foreign language	72%	1	Team work	100%	1	Communication	52%
2	Information systems management	83%	2	Microinformatics	64%	2	Analytical ability	83%	2	Organization	48%
3	Transport management	67%	3	Knowledge in ERP	31%	3	Communication	67%	3	Team work	45%
4	International logistics	67%	4	Logistics planning	22%	4	Time management	67%	4	Analytical ability	28%
5	Logistics planning	50%	5	Storage	13%	5	Leadership	67%	5	Planning	26%
6	Statistical data analysis	50%	6	Supply chain management	13%	6	Customer relationship management	50%	6	Proactivity	24%
7	Inventory control	50%	7	Human resource Management	13%	7	Change management	50%	7	Problem solving	21%
8	Reverse logistic	50%	8	Inventory control	12%	8	Motivation	50%	8	Focus on the result	19%
9	Project management	50%	9	Transport management	11%	9	Decision making	50%	9	Responsibility	19%
10	Financial management	33%	10	International logistics	8%	10	Trust	50%	10	Leadership	19%
11	Human resource Management	33%	11	Project management	6%	11	work under pressure	50%	11	Dynamism	18%
12	Marketing	33%	12	Lean	5%	12	Business ethics	33%	12	Customer Focus	16%
13	Storage	33%	13	Quality management	5%	13	Negotiation	33%	13	Autonomy	14%
14	Quantitative methods	33%	14	Contract management	4%	14	Organization	33%	14	Negotiation	11%
15	Strategic management	33%	15	Business Intelligence	3%	15	Planning	33%	15	Initiative	10%
16	Commercial management	33%	16	Auto-Cad	1%	16	Creativity	33%	16	Resilience	10%
17	Industrial management	33%	17	Operating systems modeling	1%	17	Problem solving	33%	17	Time management	10%
18	Foreign language	33%	18	E-commerce	1%	18	Focus on the result	33%	18	Adaptation	7%
19	Knowledge in ERP	33%	19	Information systems management	0%	19	Objectivity	17%	19	Creativity	5%
20	Microinformatics	33%	20	Statistical data analysis	0%	20	Macro view	17%	20	Learning	4%
21	Third party management	33%	21	Reverse logistic	0%	21	Conflict management	17%	21	Persuasion	4%
22	Just in time	33%	22	Financial management	0%	22	Flexibility	17%	22	Decision making	3%
23	Operating systems modeling	17%	23	Marketing	0%	23	Multicultural Awareness	17%	23	Innovation	3%
24	Market regulation	17%	24	Quantitative methods	0%	24	Initiative	17%	24	Critical Thinking	2%
25	International market regulation	17%	25	Strategic management	0%	25	Learning	17%	25	Curiosity	1%
26	Contract management	17%	26	Commercial management	0%	26	Persuasion	17%	26	Customer relationship management	0%
27	Planning the location of logistics facilities	17%	27	Industrial management	0%	27	Customer Focus	0%	27	Change management	0%
28	Product demand planning	17%	28	Third party management	0%	28	Adaptation	0%	28	Motivation	0%
29	Packaging	17%	29	Just in time	0%	29	Autonomy	0%	29	Trust	0%
30	Controlling	17%	30	Market regulation	0%	30	Curiosity	0%	30	work under pressure	0%
31	Business management	17%	31	International market regulation	0%	31	Dynamism	0%	31	Business ethics	0%
32	E-commerce	17%	32	Planning the location of logistics facilities	0%	32	Innovation	0%	32	Objectivity	0%
33	Quality management	17%	33	Product demand planning	0%	33	Critical Thinking	0%	33	Macro view	0%
34	Auto-Cad	0%	34	Packaging	0%	34	Proactivity	0%	34	Conflict management	0%
35	Business Intelligence	0%	35	Controlling	0%	35	Resilience	0%	35	Flexibility	0%
36	Lean	0%	36	Business management	0%	36	Responsibility	0%	36	Multicultural Awareness	0%

Table 6. Competencies in Supply Chain Management

Skills	Skills	Skills	Skills
Ability to learn quickly	EDI	Manage relationships	Quantitative athlete
Ability to perform under pressure	Enterprise resource planning	Manage relationships with suppliers	Quantitative methods
Ability to prioritize planning and organizing	Enthusiasm	Management control	Receiving and fulfilling orders
Ability to see the big picture	Entrepreneurship	Management/Strategy	Reconfiguration of supply chain structures
Ability to work under pressure	ERP	Marketing and Distribution Channels	Recruit/Hire
Account Management	Ethical Awareness	Marketing management	Regional Planning
Accounting	Extroverted personality	Material Handling	Registration Information Management
Achieve goals	Finance	Meeting facilitation	Regulations related to registrations
Acquisition	Financial management	Metrics and performance	Relative performance
Adapt to change	Flat	Microeconomics	Resilience
Adaptation	Flexibility	Microinformatics	Responsibility
After-sales service and support	Focus on processes/Flows	Modeling	Reverse logistics
Ambition	Focus on the result	Motivate others	Sale
Analytical	Forecast	Motivation	Schedule
Analytical ability	Foreign language	MRP	Scheduling
Analytical reasoning	Foreign Language\English	Multicultural Awareness	Scrap recovery and disposal
Assertiveness	Foreign Language\French	Multifunctional Awareness	Self confidence
Auto-Cad	Foreign Language\German	Multifunctional coordination	Self motivation
Autonomy	Foreign Language\Spanish	Multimodal logistics	Self-directed learning
Awareness of Organizational Culture	Foreign trade	Negotiate	Self-discipline
Barcode and data scanning	Future threats/options	Negotiation	Shopping
Basic IT	General Business Administrator	Objectivity	Software knowledge
Benchmarking	General Performance	Operational logging tasks	Spreadsheet and database
BI	Global Issues	Operations/SCM	Spreadsheet Skills
Business and Government	Globalization of transport and logistics	Oral communication	Statesman
Business and Society	Handling of returned goods	Order Management	Statistical analysis
Business Ethics	Hearing Capacity	Organization	Statistics
Business History	Human resource Management	Organizational outsourcing and alliances	Stock Management
Business Law	Industrial engineer	organizational psychology	Storage
Business strategy	Industrial Sociology	Outsourcing Problems	Storage Management
Change management	Industry Knowledge	Packaging	Supervise other people
Change management	Information and electronic environments	Pan-European logistics	Supplier selection and evaluation
Choosing the mode of transport	Information flow integration	Parts and service support	Supply Chain Awareness
Commercial Writing	Information systems management	People management	Supply chain location and design
Communication	Initiative	Performance measurement	Supply chain management
Computer athlete	Innovation	Personal cares	Supply of Materials
Computer Programming	Insurance and Real Estate	Personal creativity	Systems concept
Computer Science	Integration of information flow and external	Personal dress	Team
Conflict management	International Business	Personal Integrity	Team Management
Creative	International logistics	Personnel Movement	Team work
Creativity	Interpersonal	Persuasion	Term
Critical Reasoning	Interpersonal Relationship	Planning	Time management
Critical Thinking	Inventory Management	Postponed manufacturing	Time management
Cross docking	IT	Presentation skills	To delegate
Curiosity	JIT	Priorities	Tracking
Customer Focus	Knowledge of the latest techniques	Prioritization	Train/mentor
Customer response	Leadership	Proactivity	Training
Customer service	Lean	Problem Analysis	Transport and Traffic Management
Database Capacity	Learn new procedures	Problem solving	Transport Engineer
Dealing with stress	Learning	Procurement	Transport planning
Decision making	Legal, security and international trade	Product Projects and New Product Introduction	Transportation and logistics
Decision power	Listen and empathize	Production Management	Trust
Decision-making ability	Listening	Production schedule	Trusting
Depends on Insights	Location of facilities	Project	Voice communications
Development of IT systems, ERP	Logistics in emerging markets	Project management	Warehouse Design
Distribution	Logistics management	Public relations	Warehouse Management
Dynamism	Macroeconomics	Push and pull system	Work relationships
E-commerce	Maintenance and repair	Quality management	Written Communication
Economic geography	Manage customer relationships		

Table 7. Hard Skills Dictionary

Hard Skills	
Skill Category	**Descriptions**
Storage	Knowledge in warehouse management
	Warehouse management expertise
	Manage and optimize the activities of reception, storage and shipment of finished products
	Experience in the Logistics Management of a warehouse
	Prepare, monitor and secure loading and unloading
	Supervise and manage warehouse logistics flows
	Manage the activities of reception, storage and shipment of finished products and/or raw materials
	Coordination of warehouse logistics flows (reception, storage and delivery)
AutoCad	Notions of Auto-Cad
	Knowledge of reading and interpreting technical drawings
BI	Power BI, Access, and Navision
	Knowledge of Power BI
	Knowledge of Powertools and/or Power BI
Foreign Trade	Experience in International Trade
	Knowledge of cargo activity and freight forwarders
	Knowledge of Customs Legislation and Documentation
	Experience in the three types of operations will be valued: Sea/Air/Land
	Knowledge in import and export processes
	Knowledge of incoterms for export within the European Union
Distribution	Distribution and logistics management
	Experience and knowledge of the transport and logistics sector
	Organize and plan routes and shipments
	Distribution operation for sales channels
	Relevant professional experience in functions in the area of national distribution
	Experience in transport management
E-Commerce	Experience in Logistics ideally in the retail/e-commerce sector
	Have knowledge of E-Commerce and Digital Marketplace platforms
ERP	SAP
	SAGE X3
	SAP MRP
	SAP ERP/PP/iPPE or MES System
	Knowledge of ERP – M3 or SAP
	Primavera
	Experience in the use of information systems in the logistics area,
	Knowledge of ERP SAGE
	PHC
Quality Management	Optimization of the logistics process
	Design and develop improvement projects
	Knowledge of IATF16949, ISO 9001
	Experience in analysis of quality management procedures in production processes
	Knowledge FSC, CIPR, ISO 9001 and 14001, 45001
Account Management	Customer Service Roles
	Experience in Large Account Management
	Experience in contact with customers of different sizes and complexity
	Customer Management
	Experience in the field of customer support
Team Management	Leadership and team management skills and motivation
	Team management
	Experience in team leadership
	People development
	Proven experience in leading teams
	Experience in leading teams
Project Management	Knowledge in Project Management methodologies
	Experience in Project Management and Logistics
	Excellent project management skill set
Stock Management	Get to know stock management tools
	Domain of Stock Management and Management of Flows and Materials
	Control of stocks, expirations, obsolete and products in stock
	Ensure the supply of a range of items, ensuring efficient management
	Knowledge of costing systems associated with stock management and logistics
	Movement/invoicing and inventory control
Logistics Management	Knowledge of value chain management and logistics
	Knowledge in the field of logistics
	Experience in the area of Logistics Management (internal logistics and/or customers and suppliers
	Support activities related to supply chain optimization, efficiency and effectiveness
	Experience in the logistics sector
	Coordinate Supply activities with the Production & Engineering and Logistics areas
	Competencies in Logistics, Management and International Trade
Lean	Knowledge of Lean methodologies
	Continuous Improvement / Lean / Kaizen Knowledge
	Application of LEAN tools
	Lean/SixSigma Education
	Knowledge of Lean/Kaizen quality tools and improvement projects
Foreign Language	German
	German language
	Fluent in German
	Spanish
	Spanish Language
	Fluent in Spanish
	French
	Knowledge of the French language
	Proficiency in the French language
	Fluent in French
	English communication skills
	English
	Fluency in English
	Good knowledge of the English language
	Written and spoken fluency in English
Microinformatics	Computer skills, at the level of Excel, Word and Outlook
	Good knowledge of Microsoft Office tools
	Solid knowledge in MS Office software (Especially in Excel
	Interest in computer science and knowledge at the MS-office level
	Knowledge of Excel
	Good computer skills from the user's perspective
	Solid computer knowledge, namely Advanced Excel
	MS Office, Pptx and Excel
	Good knowledge in the use of Microsoft Office and Google tools
	Strong computational skills, including Microsoft Office applications (Word, PowerPoint, Excel)
Modeling	Good knowledge of SIMIO, SIMUL8 simulation software
	Modeling
Procurement	Shopping experience
	Consolidated experience in strategic procurement functions
	Procurement
	Experience in purchasing, procurement and negotiation processes
	Supplier portfolio management
	Global sourcing experience
	Promote optimal relationships between suppliers and the company
	Contact and select suppliers

Table 8. Soft Skills Dictionary

Soft Skills	
Skill Category	**Descriptions**
Adaptation	Ease of adaptation
	Adaptability
	Flexible person
	Adaptability
Learning	Great capacity for learning and assimilation of content
	Eager to learn how to work with new tools
	Willingness to learn
Autonomy	Ability to work independently
	Autonomy
	Standalone profiles
Analytical Capacity	Analytics
	Analytical skills
	Operational data analysis capability
	Ease in managing a high volume of information and correlating complex processes
	Critical analysis and in constant search for process improvement
	Strong analytical competence
	Analytical thinking
Communication	Communication
	Communication Skills
	Ease of communication
	Excellent communication skills (verbal and written)
Creativity	Creativity
	Creative person
	Thinking outside the box
Curiosity	Curious
	Intellectual curiosity
Dynamism	Dynamic
	Dynamism
Customer Focus	Strong customer and results-oriented
	Customer focus
	Customer knowledge
	Be customer-focused
Focus on Results	Results-oriented
	Results-oriented
	Ability to work for objectives
	Focus on results
Time Management	Demonstrated ability to prioritize tasks and have effective time management
	Time management
	Ability to handle multiple tasks, set priorities, and negotiate successful solutions
	Efficient time management skills
	Good time and priority management
Initiative	Initiative
	With a spirit of initiative
	Capacity for initiative
Innovation	Being innovative
	Innovation
	Openness to Change and Innovation
Leadership	Leadership and team management skills and motivation
	Leadership
	Leadership Skills
	Team development and leadership
	Ability to lead
Negotiation	Excellent trading skills
	Negotiation
	Strong negotiation skills
	Strong aptitude for trading
Organization	Organization
	Organizational capacity
	Task organization
	Organized
	Good organizational and coordination skills
Critical Thinking	Solution-oriented
	Critical spirit
	Attention to detail and critical thinking
Persuasion	Persuasion
Planning	Planning
	Planning capacity
	Strategic planning and execution thinking
Proactivity	Proactive
	Proactivity
	It is intended to be proactive
	Proactive spirit
Resilience	Resilient
	Resilience
	Excellent resilience
Problem Solving	Troubleshooting
	Good problem-solving skills
	Problem-solving and pressure-based work skills
	Easy problem solving and rapid design of innovative solutions
	Problem-solving skills
	Problem management
Responsibility	Sense of responsibility
	Responsibility
	Responsible person
	Accountable
Decision Making	Decision making
	Decision-making capacity
	Decision-making capacity
	Decision-making power
Teamwork	Teamwork
	Ease of working in a team
	Team spirit
	Ease and enjoyment of teamwork
	Ability to relate, work in a team
	Team player

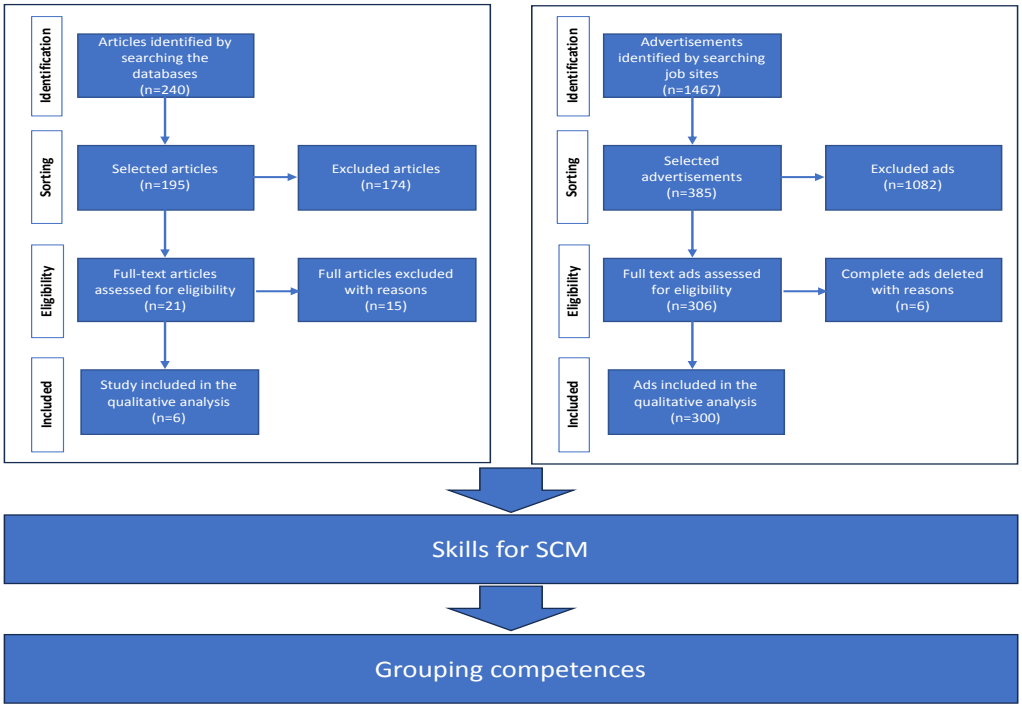

Fig. 6. Methodological approach

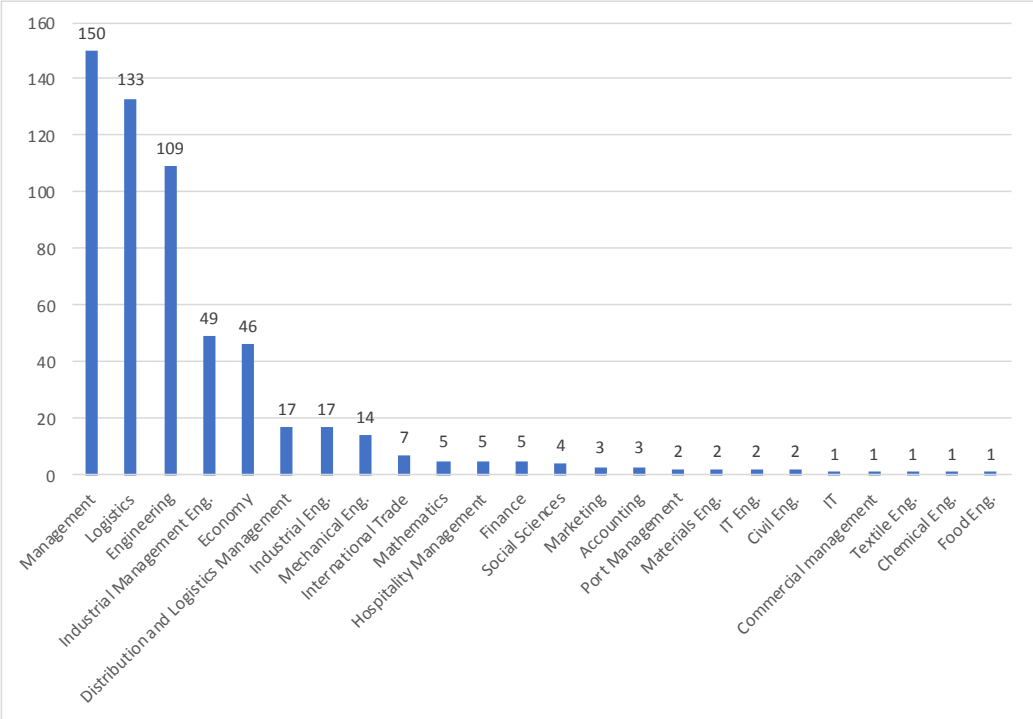

Fig. 7. Degree areas required in the advertisements

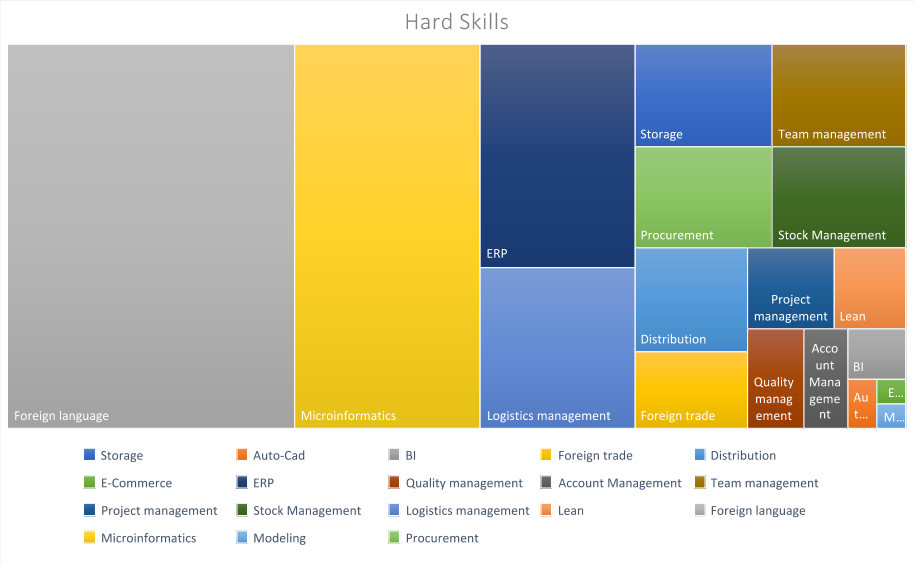

Fig. 8. *Hard skills* identified in job advertisements.

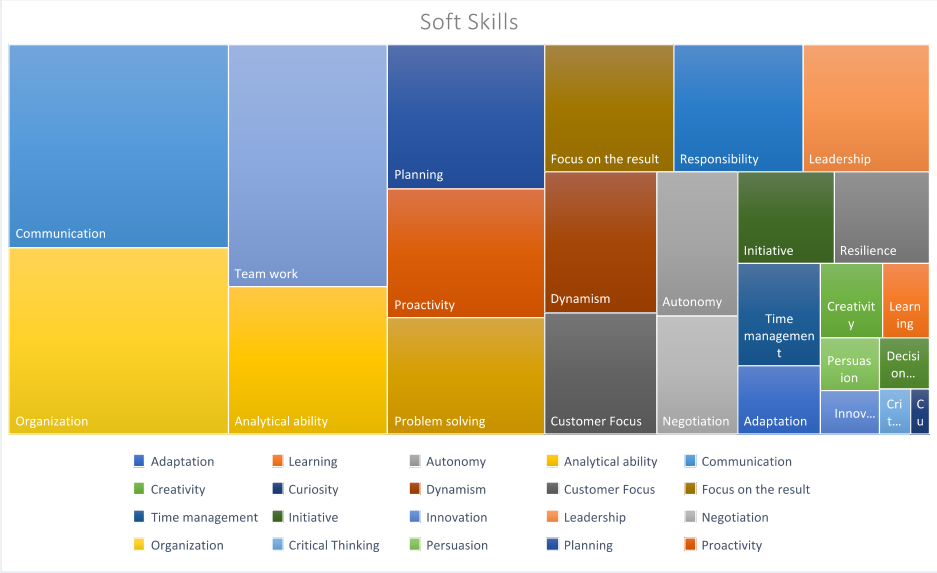

Fig. 9. *Soft skills* identified in job advertisements

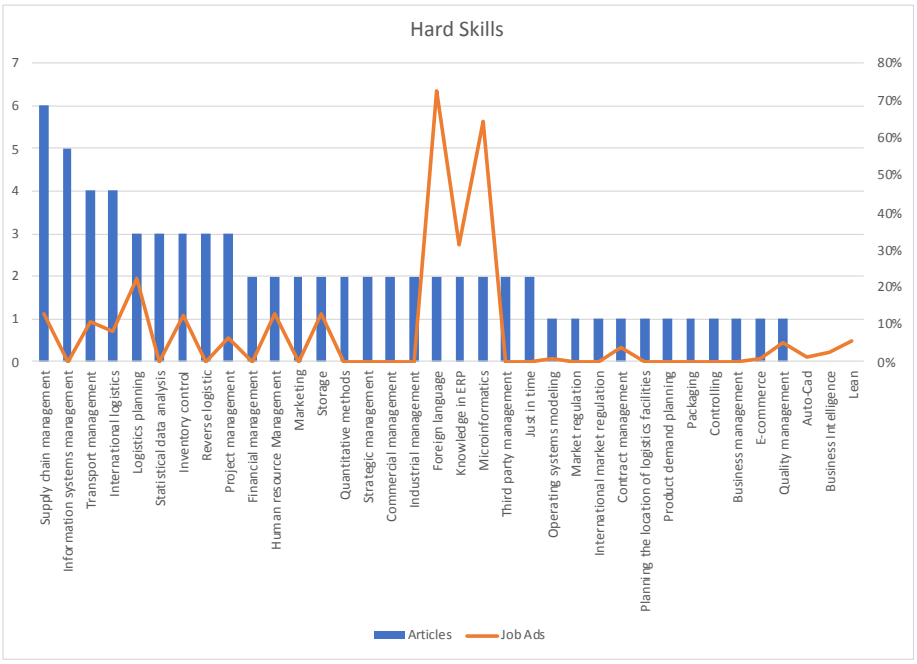

Fig. 10. *Hard Skills* identified in articles and advertisements

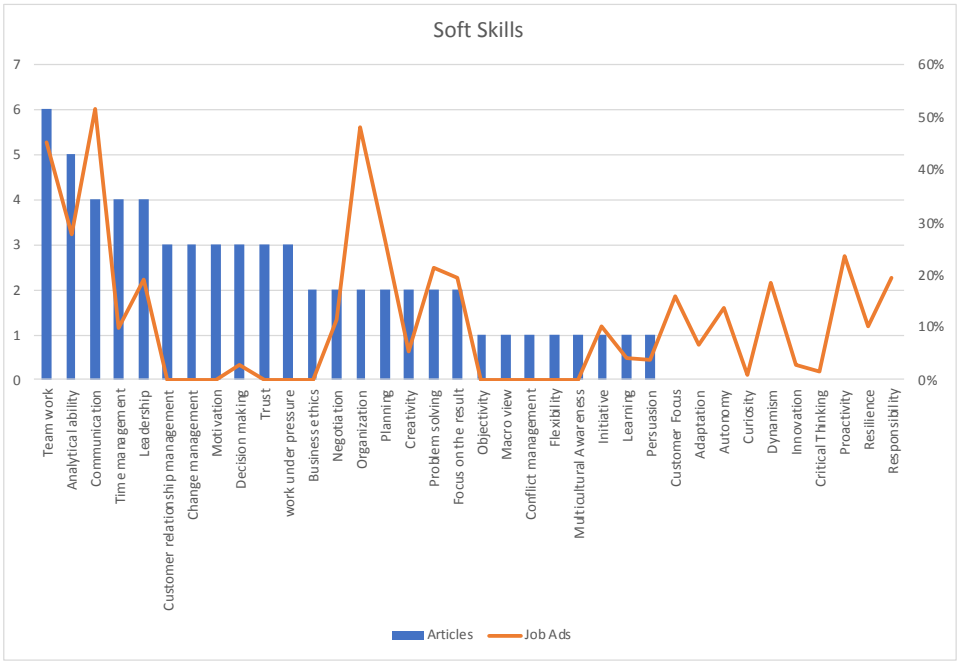

Fig. 11. *Soft Skills* identified in articles and advertisements

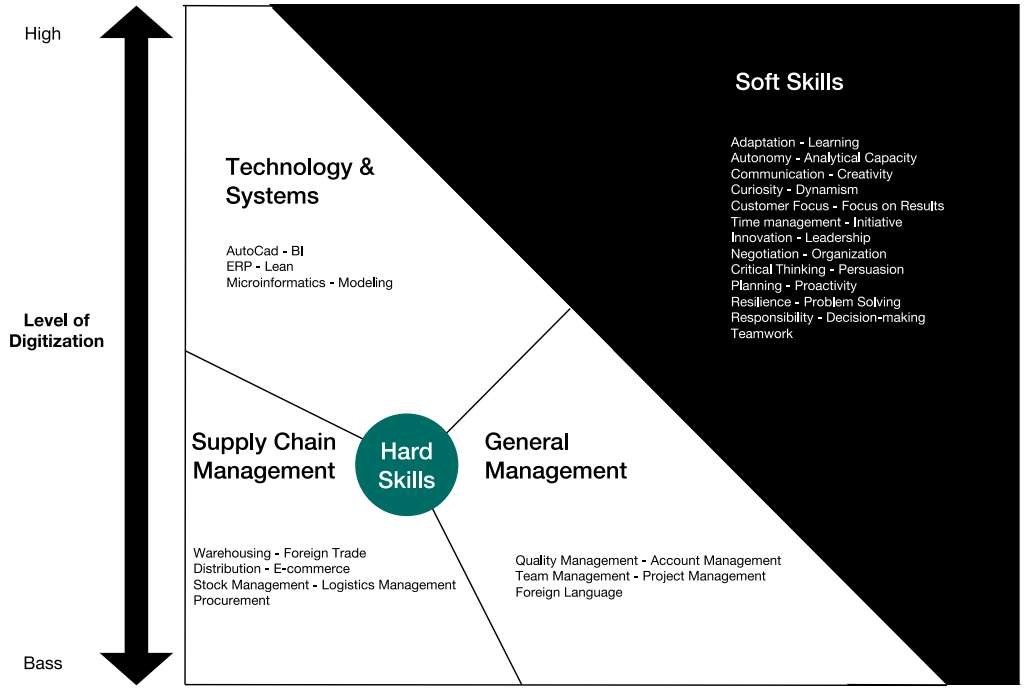

Fig. 12. Skills in the transformation process digital