

Skills and Knowledges Expected in Digital Transformation's Era



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Abstract Digital transformation involve a series of structural changes in all aspects of businesses' operations and strategies. Moreover, it involves a constant reevaluation of employees' capability to adjust to new conditions and needs. Recognizing existing skills and knowledges is important for businesses viability while cultivation of desired competencies needed for digital transformation is essential for growth and competitiveness. Proposed research uses data, coming from European Skills, Competences, Qualifications and Occupations (ESCO) database, in order to provide information about existing and forthcoming needs in terms of skills and knowledges. Managers' and Professionals' occupations are examined to reveal frequent appearing and interesting skills and knowledges. Results indicate a wide complexity of skills as far as Professionals are concerned, while Managers have an interesting variation of future skills related with supply chain management. Research contributes on understanding which skills and knowledges format Managers and Professionals, two major importance occupations regarding businesses digital transformation and development of future employees.

Keywords Skills · Knowledges · Competencies · Managers occupation
professionals occupation' · Digital transformation · ESCO database

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1 Introduction

The choice of applicants that will be successful as employees is a subject of interest among companies' top management. A successful candidate should have characteristics and abilities associated with technical issues indicated by his high intelligence quotient score. These skills are referred as "hard skills" and their nature is mostly cognitive, technical or knowledge based.

In order to be successful, an employee should also have the necessary qualities called "soft skills" that allow him to communicate effectively, to build interpersonal relationships and interact at workplace by applying effective leadership, mediating or negotiating. The effective communication includes the ability of cautious listening and fluently speaking and the demonstration of empathy to others. Soft skills are the traits, the behaviors and the attitudes described as intangible and nontechnical (Seetha 2014). The soft skills are prerequisites to applying effectively technical knowledge and skills in the working area. Schulz (2008) indicated the importance of soft skills in an individuals' personality. All interpersonal traits and attitudes that make an employee distinguish among other employees are the soft skills he possesses (Oladokun and Gbadegesin 2017).

Even though the importance of skills and competencies is wide accepted, the framework under which labor market is structured seems to have changed significantly over the past ten years. First of all, recruitment procedure significantly relies on social media and talent platforms. Moreover, there is an increased mobility, with people changing jobs more frequently than in previous years, while geographical boundaries have been reduced and distance working reshaped what was regarded as occupational standards. So there is a growing need for required skills/competencies recognition accompanied with training procedures for both existing employees and newcomers in labor market. Such a need is further strengthened by employers' tension to move from low-digital skills jobs to new ICT-based ones (European Commission 2022).

Current research work contributes in recognizing most significant skills and knowledges between those occupied as "Managers" and "Professionals". The European Skills, Competences, Qualifications and Occupations (ESCO) database is used to extract patterns about both occupations' characteristics and structured profiles in terms of skills and knowledges, while most frequent mixtures are discussed. ESCO is a European multilingual classification database, describing, identifying and classifying more than 13,000 professional occupations and more than 3000 skills relevant for the EU labour market.

"Managers" occupation was selected as a result of its decision-making nature, leading internal changes and implementing digital transformation or any other business operations. Understanding which skills and knowledges format Managers occupations can reveal which competencies are evaluated as significant in the business world. According to Katz (1974), effective managers should have technical skills, human skills and conceptual skills. Companies train their managers according to company's standards. The conceptual skills of a manager contribute to vision the

future, to make plans and come to decisions for the best of the company (Weber et al. 2009). Moreover, “Professionals” are responsible for training future and existing employees, alongside with research and new knowledge development. Proposed occupation is cultivating future labour force’s competencies and it is important to enlighten its occupational characteristics.

In the next sections, the research theoretical background is presented, alongside with the problem to be addressed and the research issues to be answered. The measures evaluating significance of skills and knowledges are then presented and most significant results are revealed. Finally, practical implications, limitations and future research recommendations are provided.

2 Theoretical Background

Competencies on a working environment are composed of activities, attitudes, skills and knowledge correlated with job performance and are measurable (Sisson and Adams 2013). Employees’ working performance is a function of his basic knowledge and the soft skills he possesses (Oladokun and Gbadegesin 2017). Basic knowledge is acquired in higher educational institutions and enhanced through practical experience. This indicates the insufficiency of academic education alone to equip people with skills and competencies required for their effective performance at a working environment (Singh and Jaykumar 2019). The importance of interpersonal skills, of communication skills, of technology literacy skills and of skills for emerging business practices, as sustainability production, will increase in the near future (Krpálek et al. 2021). Flexibility and sensitivity are also important factors affecting employability.

Dynamic changes in digitalization and automation of management procedures requires qualitative knowledge management. “Human” is a key factor in business administration and streamline of the system is required. The requirements of the market for the necessary competencies and soft skills are increasing. Also increases the necessity of interdisciplinary knowledge, digital literacy, and competence-based management (Krpálek et al. 2021).

According to Vroom’s “Expectancy Theory” (Vroom 1964) there is a relationship between the effort put at work, the performance accomplished and the expectation of rewards as result of the performance. Someone has a motive to acquire skills or competencies since they believe that a good performance will lead to desired outcomes (Seetha 2014). Bray and Howard (Bray and Howard 1983) focused on managerial competencies by relating the personality and the motives someone has: the motive of advancing faster than the colleagues, and the motive of achieving high standards at work even when these standards exceed the necessary standards to satisfy their superiors (Weber et al. 2009). E-government and digitalization increase the demand for enhanced employee competences in the areas of information and communication technologies. Technical skills and cognitive knowledge are required to entry-level professionals. As their experience increases, the human skills become necessary to upgrade their interpersonal relationships and manage effectively others,

to interact with others and invest in team building. Since managers are more qualified and motivated, they exhibit higher levels of consciousness, openness and positive personality traits towards employee management. Stevens and Campion (Stevens and Campion 1994, 1999) developed a measure of “Knowledge, Skills and Abilities (KSA)” for effectively staffing teams at working environment. Between setting organizational goals and employee commitment the tacit knowledge is a valuable mediator.

Hard competencies are a combination of technical and cognitive knowledge and of skills, acquired by education, training and working experience. Soft competencies are behavioral attributes, values, including ethics, attitudes and emotions expressed through effective communication and interaction with others, in leadership, teamwork and interpersonal relations. A competency model is a descriptive measure that identifies all knowledge, skills and behaviors necessary to perform effectively in an organization (Lucia and Lepsinger 1999). Technical skills and abilities are required to entry-level professionals. As their experience increases, the human skills become necessary to upgrade their interpersonal relationships and manage effectively others, to interact with others and invest in team building. They defined five dimensions of competencies such as: “conflict resolution, collaborative problem solving, verbal and non-verbal communication, setting specific goals and performance management, planning and coordinating information and tasks to form role expectations” (Weber et al. 2009).

Boyatzis (1982) was the first author that attempted to make a list of competencies that would relate the managers’ performance effectiveness to specific competencies. According to his list of competencies, managers’ performance was classified at superior, average and poor. According to Boyatzis, more than 25 per cent of the variance in managers’ performance could be attributed to these competencies. Performance leads the earning capacity of an employee. He concluded at six clusters of competencies namely: “goal and action management, leadership, human resources management, directing subordinates, focus on others, and specialized knowledge” (Boyatzis 1982).

According to Sandwith (1993), five areas of managerial competencies were identified, as: 1. Conceptual/creative: consisting of cognitive skills, 2. Leadership: make plans and turn them to actions, 3. Interpersonal: skills to communicate effectively with others, 4. Administrative: skills on the management of the organization, 5. Technical: skills and knowledge on the job (Sisson and Adams 2013). Competencies are talents brought at workplace exceeding rational behavior (Robotham and Jubb 1996; Seetha 2014). Leadership style based on individual competencies requires the implementation of a model capturing all aspects of work in the digital world. According to Krpálek, et al. (2021) the leadership style and the perceived development of employees’ skills, have influenced employees’ work commitment. Effective management includes professionalism, reliability, information management, coping with uncertainty and working under pressure, dealing with high levels of stress.

By studying the soft skills necessary for each business environment, recruiters have a better chance to match the right candidate ensuring in that way retention of employees. The selection process improves, the training process is easier, the

company may apply improved development programs and the performance evaluation is strengthened resulting at an increased profitability (Weber et al. 2009). Ibrahim et al., (2017), on research of managers in Malaysian private companies, resulted that the methodology of training to acquire skills significantly predict the employee work performance. Authors support the “time–space learning” as prominent training methodology to transferring knowledge and skills to employees. Gibler et al. (2020) researched on corporate real estate managers from Australia, Hong Kong, the UK and the USA. He researched on knowledge and skills necessary for effectively practicing corporate real estate management. The factor analysis he performed resulted at eight factors representing the core skills and knowledge including: “strategic management skills, physical property skills, knowledge of external threat, globalization, financial management skills, technology skills in traditional business functions areas and interpersonal skills”. Similarly, Tunde Oladokun (2012) concluded that “financial performance skill, corporate strategic planning, productivity skill, space management and customer/employer management skill” are the most important skills required for real estate management surveyors (Oladokun and Gbadegesin 2017).

In the retail industry and in the hospitality industry candidates are expected to have competencies in customer service, in fluent communication, and also have interpersonal and intrapersonal skills and other soft skills, as a basic entry-level requirement. But in the service sector, a gap is observed between the qualified entry level employees and their availability. Employees are lacking not only hard skills but also soft skills necessary for professional success. They lack intrapersonal skills, they are insufficient on customer service, and they have difficulties with time management. According to Singh and Jaykumar (2019), this gap is increasing slowly and steadily in time.

Digital Transformation raise new requirements in all aspects of business life, from business models and new technologies (Acatech 2016), up to new job requirements and unique specialized skills' set needed (Grzelczak et al. 2017; Kergroach 2017). Additionally, it changed job requirements in a direction that expected skills and knowledges being not always obvious (Maisiri et al. 2019). It is wide accepted that a gap exists between existing employees' skills needed before Industry 4.0 (Prifti et al. 2017) and skills required to successfully implement digital transformation (Shvetsova and Kuzmina 2018).

Moreover, new skills and competencies needed are not exclusively technologically oriented (Schallock et al. 2018) but should exceed technological parameters (Cotet et al. 2017) including soft—skills such as life-long learning, deep knowledge of different disciplines, behavioral skills (Prifti et al. 2017), alongside with interpersonal skills, confidence/motivation, ethics/integrity and critical thinking (Foutty 2019).

Such a framework led to the need for skills and competencies recognition (Lorenz et al. 2015; Zinn 2015), as well as to the development of training programs for practical skills, soft skills, values, entrepreneurship capabilities and other competencies (Selamat et al. 2017). Research on the topic should specify which skills and competencies are more valuable in order to facilitate their reaching goals on digital transformation.

3 Problem

Even though Digital Transformation and Industry 4.0 have a strong technological orientation (Baur and Wee 2015), human factor should not be neglected or ignored (Kargas et al. 2022b) as a result of the increased level of skill's/knowledge's complexity required from the workforce of the future (Maisiri et al. 2019). Employees' characteristics, skills and knowledge are gaining research interest as a source of development (Gkika et al. 2022) and as a mean to reach innovation (Kargas et al. 2022a).

Current paper focus on enlightening which are the current needs on skills/knowledges alongside with tensions on skills/knowledges related with innovation development, when it comes with occupations such as "Managers" and "Professionals". Proposed research aims on revealing existing patterns between executives of these two occupations and recognizing in which skills and knowledges does innovation lies between, as a mean to gain a competitive advantage under digital transformation's era.

4 Research Objective and Questions

Research's objectives are to discover frequent or interesting patterns related with the occupations of "Managers" and "Professionals" by using data gathered from the ESCO database. A frequent collection of skills and knowledges (itemset) could indicate the core requirements within the same occupation hierarchy, revealing existing situation in both "Managers" and "Professionals" occupations. Likewise, interesting variations among similar occupations could signal an innovation pursuit leveraged by technological interventions or market advancements at the same occupations.

Research questions answered under current research are:

- Which are the frequent patterns of skills and knowledges when it comes to "Managers" and "Professionals" occupations?
- Which are the interesting patterns of skills and knowledges when it comes to "Managers" and "Professionals" occupations?
- Do exist patterns of skills and knowledges promising a more innovational orientation?

5 Research Design

Research methodology is based on discovering key associations between the various Skills and Knowledges regarding each occupation described in previous sections. Proposed methodology is suitable for exploratory research purposes (Agrawal et al.

1993) and is part of the machine learning field. Association rules used to express patterns between occupations and skills/knowledges are:

- **Support:** is the percentage of groups that contain all of the items listed in that association rule compared to the total items in the category.
- **Lift:** is a measure of importance and express the deviation of the rule from the model of statistic independency between the antecedent (if) part of the rule and the consequence. In other words, a part of the itemset has a positively (favour) into a specific item and empirically when $Lift > 2$ it is considered as rule for further elaboration.

High support indicates an expected mixture of skills/knowledges regarding the occupations of Managers and Professionals, while high lift value indicates interesting variations which highlight certain areas of innovation. The relationship between the Occupation's collection and the Skills/Knowledges' collections is supported by an intermediate data set listing the occupation, the associated skill and competences and whether a knowledge or skill has essential (or optional) role for an occupation. Analysis conducted reviewed optional skills and knowledge as required in order to in depth study all existing possible relations.

6 Findings

Conducted analysis targeted two distinct occupations, namely "Managers" and "Professionals". Each occupation is described through an occupational profile, containing description, scope and a list of skills and knowledges that are considered as essential on a European scale.

Managers occupations' category involve tasks of planning, organizing and evaluating activities in any type of organization (governmental or enterprises) as a whole or at the level of organizational unit, while as part of the job it is included the formulation/reviewing of rules, regulations or policies as well (European Commission 2022). Proposed occupation is classified into four major sub-groups: (a) Chief Executives, Senior Officials and Legislators, (b) Administrative and Commercial Managers, (c) Production and Specialized Services Managers and (d) Hospitality, Retail and Other Services Managers.

Professionals occupations' category involve tasks of increasing stock of knowledge, applying scientific concepts and theories and teaching about the foregoing (European Commission 2022). Proposed occupation is classified into six major sub-groups: (a) Science and Engineering Professionals, (b) Health Professionals, (c) Teaching Professionals, (d) Business and Administration Professionals, (e) Information and Communications Technology Professionals and (f) Legal, Social and Cultural Professionals.

At a first level of analysis, the twelve (12) most frequent appearing skills/knowledges for both occupations were detected. Table 1 presents these frequent appearing skills/knowledges which are totally different from the one occupation to

Table 1 Most frequent appearing skills and knowledges

A/A	Managers' occupation	Professionals' occupation
1	Manage staff (skill)	Perform scientific research (skill)
2	Manage budget (skill)	Perform project management (skill)
3	Create solutions to problems (skill)	Think analytically (skill)
4	Recruit employees (skill)	Speak different languages (skill)
5	Adhere to organizational guidelines (skill)	Manage personal—professional development (skill)
6	Have computer literacy (skill)	Scientific research methodology (knowledge)
7	Maintain relationship with customers (skill)	Write scientific publications (skills)
8	Use different communication channels (skill)	Mentor individuals (skills)
9	Ensure customs compliance (skill)	Applying teaching strategies (skill)
10	Perform financial risk management in international trade (skill)	Publish academic research (skill)
11	Maintain relationship with supplies (skill)	Think abstractly (skill)
12	Employment law (knowledge)	Teach in academic or vocational contexts (skill)

the other. Such a diversity is the result of each occupation's nature and the different priorities set to effectively perform it.

As far as Managers' occupation is concerned, all items have a relative frequency of more than 20%, while “manage budget” and “manage staff” have an item relative frequency of more than 40 and 60% respectively. In contrast when it comes to Professionals' occupation the twelve most frequent appearing skills and knowledges have a small relative frequency of 0.1%, with “Perform Scientific Research” and “Perform Project Management” exceeding 0.2%. Such a condition indicates that Professionals have a larger variety of skills and knowledges, while there exist no skill or knowledge being decisive for the occupation's formation. Finally, it is worth mentioning, that for both occupations under research, only one item out of the twelve most frequent appearing skills/knowledge represents a knowledge, while all the rest include skills oriented items.

At a second level of analysis and in order to enrich our understanding “Support” measure was investigated. What is valuable with “Support” is that helps identify rules that are worth considering in order to expand our analysis. Such rules can include the number of Skills/Knowledges that form an itemset. In such a case the higher the “Support” the more information can be extracted regarding the relationship between its items. Research put emphasis on investigating itemsets of at least four (4) Skills/Knowledges and the frequency of appearance among all managers' occupations.

When it comes to Managers' occupation, results are presented in Fig. 1, revealing that in the core of the above—mentioned analysis lie Skills/Knowledges such as:

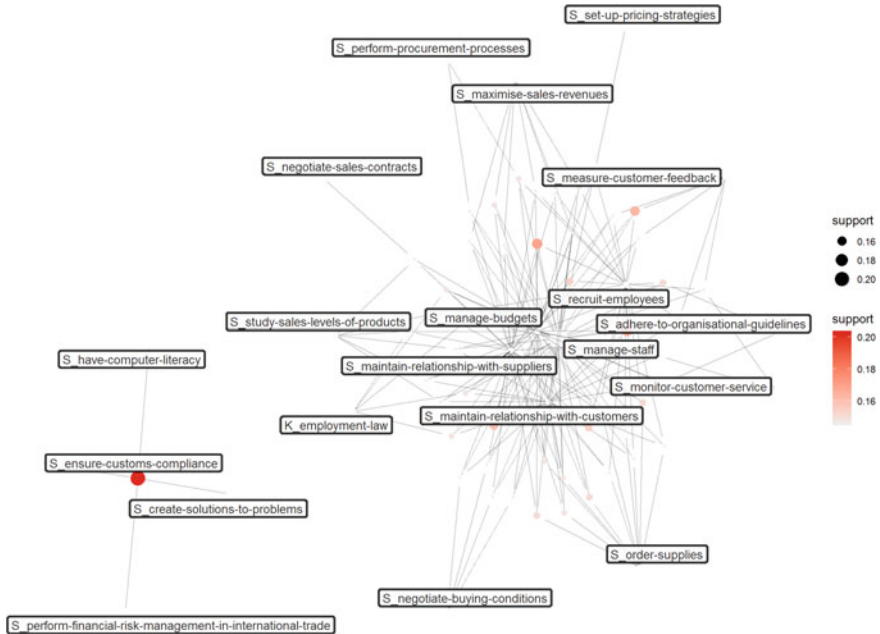


Fig. 1 Managers’ support graph

1. Manage Staff (Skill),
2. Manage Budget (Skill),
3. Maintain Relationship with Customers (Skill),
4. Adhere to Organizational Guidelines (Skill),
5. Maintain Relationship with Suppliers (Skill),
6. Recruit employees (Skill)
7. Employment Law (Knowledge),
8. Monitor Customer Service (Skill) and
9. Study Sales—Levels of Products (Skill).

These eight (8) skills and one (1) knowledge are more frequently appearing when itemsets of fours are studied. The first six are also having a high frequency appearance when studied as stand-alone measures, while the rest four seem to be the most frequent appearing supplementary skills (Fig. 1).

At the same time, Professionals’ occupation has a large number of skills contributing to its formation. There exist 3 times more skills required in Professionals than in Managers. More precisely there exist thirty-one (31) skills formatting the proposed occupation, while there exist no specific knowledge. Namely, the skills more frequently appearing when itemsets of fours are studied include:

1. Communicate with a non-scientific audience (Skill),
2. Synthesize information (Skill),

3. Promote open innovation in research (Skill),
4. Operate open-source software (Skill),
5. Draft scientific or academic papers and technical documentation (Skill),
6. Promote the transfer of knowledge (Skill),
7. Apply blended learning (Skill),
8. Interact professionally in research and professional environments (Skill),
9. Apply research ethics and scientific integrity principles in research activities (Skill),
10. Manage intellectual property rights (Skill),
11. Manage research data (Skill),
12. Apply for research funding (Skill),
13. Think abstractly (Skill),
14. Evaluate research activities (Skill),
15. Manage findable—accessible—interoperable and reusable data (Skill),
16. Develop professional network with researchers and scientists (Skill),
17. Promote the participation of citizens in scientific and research activities (Skill),
18. Disseminate results to the scientific community (Skill),
19. Conduct research across disciplines (Skill),
20. Think analytically (Skill),
21. Manage open publications (Skill),
22. Manage personal, professional development (Skill),
23. Publish academic research (Skill),
24. Mentor individuals (Skill),
25. Increase the impact of science on policy and society (Skill),
26. Write scientific publications (Skill),
27. Promote inclusion in research (Skill),
28. Demonstrate disciplinary expertise (Skill),
29. Speak different languages (Skill),
30. Teach in academic or vocational contexts (Skill),
31. Perform project management (Skill).

Comparing the above-mentioned skills and the most frequent appearing stand-alone skills, there exist only two differentiations. “Scientific Research Methodology (Knowledge)” and “Applying Teaching Strategies (Skill)” even though being frequent appearing they seem to be excluded from itemsets of four skills (Fig. 2).

At a third level of analysis, “Lift measure was studied in order to provide evidence about unexpected occurrences of Skills/Knowledges, revealing where innovation exists regarding managers’ occupation category. Figure 3 provide such evidence, by revealing most prominent and less expected Skills/Knowledges, when it concerns Managers’ occupation. Namely there exist the below mentioned six (6) Skills, while only one (1) Knowledge is included (Fig. 3):

1. Handle Carriers (Skill),
2. Minimize Shipping Cost (Skill),
3. Manage Freight Payment Methods (Skill),

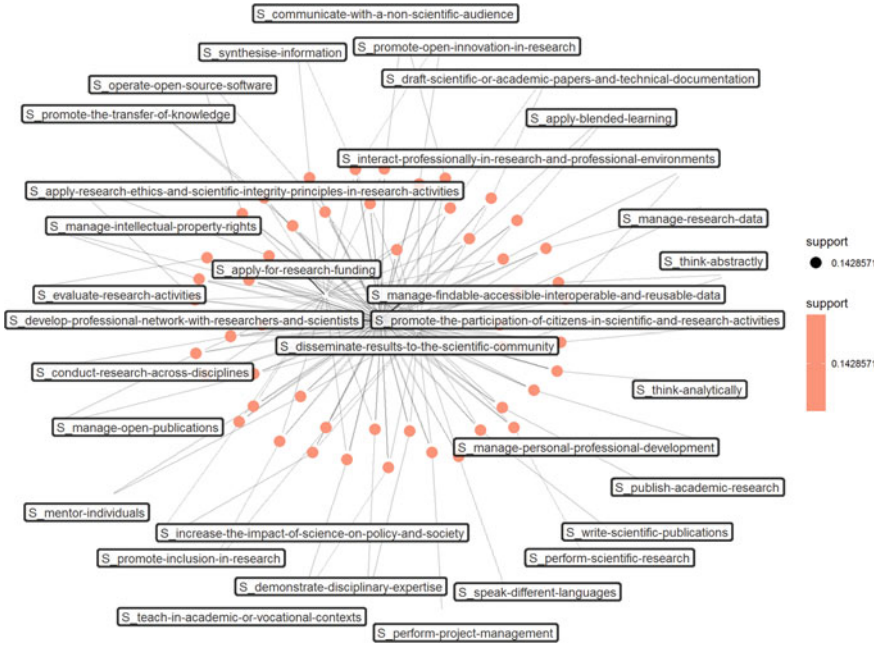


Fig. 2 Professionals' support graph



Fig. 3 Managers' lift graph

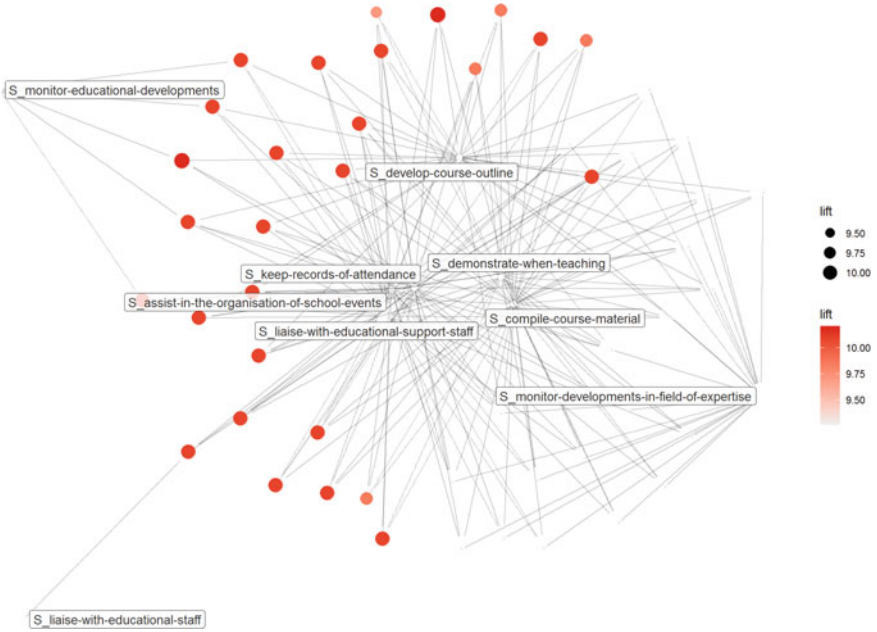


Fig. 4 Professionals’ lift graph

- 4. Hazardous Freight Regulations (Knowledge),
- 5. Carry out Inventory Control Accuracy (Skill),
- 6. Ensure Regulatory Compliance Concerning Distribution Activities (Skill) and
- 7. Forecast Distribution Activities (Skill).

Regarding Professionals’ occupation most prominent, less expected, innovational skills are presented in Fig. 4. There exist nine (9) such skills, while no Knowledge is included. Namely these skills are (Fig. 4):

- 1. Monitor educational development (Skill),
- 2. Develop course outline (Skill),
- 3. Demonstrate when teaching (Skill),
- 4. Keep records of attendance (Skill),
- 5. Assist in the organization of school events (Skill),
- 6. Compile course material (Skill),
- 7. Liaise with educational support staff (Skill),
- 8. Monitor developments in field of expertise (Skill),
- 9. Liaise with educational staff (Skill).

7 Contribution

Proposed results contribute to reveal existing and prominent skills and knowledges when Managers and Professionals occupations are studied. Regarding Managers occupation there exist six (6) skills and one (1) knowledge that seem significant in both single view analysis (frequency of appearance) and itemset analysis (itemset of four). Table 2 presents the full list of skills and knowledges under both analyses conducted. Moreover, current research contributes on revealing which skills and knowledges seem more appropriate to help managers meet business operations’ needs over a complex network of activities and shared resources. Results indicate a tension of expanding managers’ competencies related with supply chain management, which is strongly associated with companies’ digital transformation under Industry 4.0 framework, while less emphasis is put on Employees—Suppliers—Customers.

As far as Professionals are concerned, results contribute on understanding the occupation’s complexity when it comes to competencies needed. There exist ten (10) Skills, but no Knowledge that seem significant in both single view analysis (frequency of appearance) and itemset analysis (itemset of four). Most of these skills are related with self—competencies and less with mentoring or people management. A totally different view exists when it comes to interesting variations, where most prominent skills are related with supporting activities and teaching. Such a framework indicates the need to transform interaction with audience to a more interactive, digital experience.

Table 2 Managers’ significant skills and knowledges

Single view	Itemset view
Manage staff (skill)	
Manage budget (skill)	
Recruit employees (skill)	
Adhere to organizational guidelines (skill)	
Maintain relationship with customers (skill)	
Maintain relationship with suppliers (skill)	
Employment law (knowledge)	
Create solutions to problems (skill)	Monitor customer service (skill)
Have computer literacy (skill)	Study sales—levels of products (skill)
Use different communication channels (skill)	–
Ensure customs compliance (skill)	–
Perform financial risk management in international trade (skill)	–

8 Practical Implications

Results enlight which are the most important and promising skills and knowledges when it comes to Managers and Professionals occupation. Such a contribution can be of high importance in business, academic and training level. In business level results can reveal convergencies/divergencies of existing skills and knowledge between existing situation and optimal condition as described in the paper. Gaps can be covered with training for both existing employees and newcomers. Moreover, promising—interesting skills and knowledges revealed provide valuable information regarding forthcoming tensions when it comes to managers or professionals, indicating areas for future competencies' empowerment.

In academic and training level results enlight areas of existing or future expertise, indicating what market evaluate as significant. Academic and vocational training include both knowledge cultivation and skills raise. Their proportion, the depth of analysis and the areas of expertise under train should be constantly adjust to current and future needs. Especially when it is expected the passing to the digital era, under the Fourth Industrial Revolution (Industry 4.0), such a adjustment it is more and more necessary for national economies in order to maintain their competitive advantage and for employees so that to remain in the labor market.

9 Limitations

Proposed methodology is applied to the most recent data coming from ESCO. This kind of analysis can be characterized as a “snapshot” of current situation when it comes to skills and knowledges of selected occupations. Even though it provides in depth analysis of existing data, it lacks information regarding changes and progresses conducted during the past years. Such a limitation makes difficult to understand which skills and knowledges gained or lose significance while digital transformation passed from research interest to operational implementation in many sectors. Conducting analysis in regular basis, when ESCO's data change, could provide valuable information and restrict proposed limitation's significance.

10 Recommendations for Further Research

As far as future research is concerned, expanding analysis across Atlantic Ocean could provide valuable information. In U.S.A. there exist O*NET OnLine, a database similar to ESCO, that follows a distinct approach and classification. Extracting data and comparing results can provide significant results regarding “interesting” patterns of skills and knowledges that can drive innovation development. It should be taken into account that the structures of these two databases are different, making any

comparisons difficult at the point without significant data manipulation in order to homogenize results.

Moreover, as part of future research could be the use of Dominance Analysis (DA) as a mean of predictive modeling, for tensions in skills and knowledges required in the future. It is methodology that can be used to compare the relative importance of each skill and each knowledge in relation to the occupation under research. Dominance Analysis can provide more valuable prediction since it goes beyond just the decomposition of the focal model fit statistic, by producing three distinct results for each skill/knowledge to compare contribution to the proposed occupation as a whole.

References

- Acatech, D.A.D.T.: *Kompetenzentwicklungsstudie Industrie 4.0*. Dortmund (2016) <https://docplayer.org/24401230-Kompetenzentwicklungsstudie-industrie-4-0.html> (August 26, 2021).
- Agrawal, R., Swami, A., Imielinski, T.: Database mining: a performance perspective. *IEEE Trans. Knowl. Data Eng.* **5**(6), 914–925 (1993)
- Baur, C., Wee, D.: *Industry 4.0 is more than just a flashy catchphrase. A confluence of trends and technologies promises to reshape the way things are made* (2015). <https://www.mckinsey.com/business-functions/operations/our-insights/manufacturings-next-act>. Accessed 27 2021
- Boyatzis, R.E.: *The Competent Manager: A Model for Effective Performance*. Wiley, New York (1982)
- Bray, D.W., Howard, A.: The AT & T longitudinal studies of managers. In: New York, U.S.A. (ed.) *Longitudinal Studies of Adult Psychological Development*, pp. 266–312. Guilford Press (1983)
- Cotet, G.B., Beatrice A.B., Violeta-Carmen Z.: Assessment procedure for the soft skills requested by Industry 4.0. In: 8th International Conference on Manufacturing Science and Education – MSE 2017. 1–8, Trends in New Industrial Revolution (2017)
- European Commission.: *ESCO Occupations*. (2022). https://esco.ec.europa.eu/en/classification/occupation_main. (October 20, 2022)
- Foutty, J.: *Aspire to lead in Industry 4.0? Hone your soft skills*, Wall Str. J. (2019). Available at: <https://deloitte.wsj.com/articles/aspire-to-lead-in-industry-4-0-hone-your-soft-skills-01548295337> (Accessed: 26 August 2021)
- Gibler, K., Black, R., Moon, K.: Time, place, space, technology and corporate real estate strategy. *J. Real Estate Res.* **24**(3), 235–262 (2020). <https://www.tandfonline.com/doi/abs/10.1080/10835547.2002.12091095>. Accessed 5 Jan 2023
- Gkika, E., Ntanos, S., Komisopoulos, F., Drosos, D.: *The impact of global competition dimensions on economic development*. In: *ISPIM Connects Athens—The Role of Innovation: Past, Present, Future*. LUT Scientific and Expertise Publications, Athens (2022)
- Grzelczak, A., Kosacka, M., Werner-Lewandowska, K.: *Employees competences for Industry 4.0 in Poland—preliminary research results*. In: 24th International Conference on Production Research, ICPR 2017, 139–44 (2017)
- Ibrahim, R., Boerhannoeddin, A., Bakare, K.K.: The effect of soft skills and training methodology on employee performance. *Eur. J. Train. Dev.* **41**(4), 388–406 (2017)
- Kargas, A., et al.: *Tracing innovation with skill and competences*. In: *ISPIM Connects Athens—The Role of Innovation: Past, Present, Future*, on 28–30 November 2022. Event Proceedings, 1–11, 2022. Order number in series, vol 110. LUT Scientific and Expertise Publications (2022a). ISBN 978-952-65069-1-3
- Kargas, A., Giannakis, A., Foukas, I.: *Recognizing skills and competencies required under industry 4.0's framework for achieving business digital transformation*. In: Mirjana, P.-B., Çağlar, D. (eds.) *Management Strategies for Sustainability, New Knowledge Innovation, and Personalized*

- Products and Services, pp. 1–34 (2022b). <https://orcid.org/0000-0001-6157-1761>. Accessed 9 Jan 2022.
- Katz, R.: Skills of an effective administrator. *Harv. Bus. Rev.* **52**(6), 90–102 (1974). <https://hbr.org/1974/09/skills-of-an-effective-administrator>. Accessed 5 Jan 2023
- Krpálek, P., et al.: Formation of professional competences and soft skills of public administration employees for sustainable professional development. *Sustainability* **13**, 5533 (2021). <https://www.mdpi.com/2071-1050/13/10/5533/htm>. Accessed 5 Jan 2023
- Lorenz, M. et al.: Man and machine in Industry 4.0: how will technology transform the industrial workforce through 2025? (2015)
- Lucia, A.D., Lepsinger, R.: The art and science of competency models: pinpointing critical success factors in organizations. Jossey-Bass/Pfeiffer (1999). <https://www.wiley.com/en-us/The+Art+and+Science+of+Competency+Models%3A+Pinpointing+Critical+Success+Factors+in+Organizations-p-9780787946029>. Accessed 5 Jan 2023
- Maisiri, W., Darwish, H., van Dyk, L.: An investigation of industry 4.0 skills requirements. *S. Afr. J. Ind. Eng.* **30**(3), 90–105 (2019)
- Oladokun, S.O., Gbadegesin, J.T.: Adequacy of core knowledge and soft skills in the performance of professional employees of real estate firms in Nigeria. *Prop. Manag.* **35**(2), 132–149 (2017)
- Prifti, L., Knigge, M., Kienegger, H., Krcmar, H.: A competency model for ‘Industrie 4.0’ employees. In: 13th International Conference on Wirtschaftsinformatik (WI), St. Gallen, Switzerland, pp. 44–60 (2017)
- Robotham, D., Jubb, R.: Competences: measuring the unmeasurable. *Manag. Dev. Rev.* **9**(5), 25–29 (1996)
- Sandwith, P.: A hierarchy of management training requirements: the competency domain model. *Public Pers. Manag.* **22**(1), 43–62 (1993). <https://journals.sagepub.com/doi/10.1177/009102609302200104>. Accessed 5 Jan 2023
- Schallock, B., Rybski, C., Jochem, R., Kohl, H.: Learning Factory for Industry 4.0 to provide future skills beyond technical training. *Proc. Manufac.* **23**, 27–32 (2018)
- Schulz, B.: The importance of soft skills: education beyond academic knowledge. *NAWA J. Lang. Commun.* 146–154 (2008)
- Seetha, N.: Are soft skills important in the workplace? A preliminary investigation in Malaysia. *Int. J. Acad. Res. Bus. Soc. Sci.* **4**(4) (2014)
- Selamat, A. et al.: Higher Education 4.0 Current Status and Readiness in Meeting the Fourth Industrial Revolution Challenges. *Redesign. High. Educ. Indus.* **1**, 23–24 (2017) Available at: <https://pdfcoffee.com/higher-education-40-current-status-and-readiness-in-meeting-the-fourth-industrial-revolution-challenges-1-pdf-free.html> (Accessed: 27 August 2021)
- Shvetsova, O.A., Kuzmina, A.D.: Development of engineering personnel in the era of the fourth industrial revolution. In: Proceedings of the 3rd International Conference Ergo-2018: Human Factors in Complex Technical Systems and Environments, Ergo 2018, Institute of Electrical and Electronics Engineers Inc., pp. 45–48 (2018)
- Singh, A., Jaykumar, P.: On the road to consensus: key soft skills required for youth employment in the service sector. *Worldw. Hosp. Tour. Themes* **11**(1), 10–24 (2019)
- Sisson, L.G., Adams, A.R.: Essential hospitality management competencies: the importance of soft skills. *J. Hosp. & Tour. Educ.* **25**(3), 131–145 (2013). <https://www.tandfonline.com/doi/abs/10.1080/10963758.2013.826975>. Accessed 5 Jan 2023
- Stevens, M., Champion, M.: The knowledge, skill, and ability requirements for teamwork: implications for human resource management. *J. Manag.* **20**(2), 503–530 (1994)
- Stevens, M., Champion, M.: Staffing work teams: development and validation of a selection test for teamwork settings. *J. Manag.* **25**(2), 207–228 (1999)
- Tunde Oladokun, T.: An evaluation of the training needs of Nigerian estate surveyors for corporate real estate management practice. *Prop. Manag.* **30**(1), 86–100 (2012)
- Vroom, V.: *Work and Motivation*/WorldCat.Org. Wiley, New York (1964). <https://www.worldcat.org/title/work-and-motivation/oclc/243731>. Accessed 5 Jan 2023

Weber, M.R., Finley, D.A., Crawford, A., Rivera, D.: An exploratory study identifying soft skill competencies in entry-level managers. *Tour. Hosp. Res.* **9**(4), 353–361 (2009). <https://journals.sagepub.com/doi/10.1057/thr.2009.22>. Accessed 5 Jan 2023

Zinn, B.: Conditional variables of “Ausbildung 4.0” – Vocational education for the future. *JOTED* **3**, 1–9 (2015)



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