# On tasks and soft skills in operations and supply chain management: analysis and evidence from the O*NET database

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## Abstract

**Purpose** – The purpose of the study is to identify the soft skills and abilities that are crucial to success in the fields of operations management (OM) and supply chain management (SCM), using the O*NET database and the classification of a set of professional figures integrating values for task skills and abilities needed to operate successfully in these professions.

**Design/methodology/approach** – The study used the O*NET database to identify the soft skills and abilities required for success in OM and SCM industries. Correlation analysis was conducted to determine the tasks required for the job roles and their characteristics in terms of abilities and soft skills. ANOVA analysis was used to validate the findings. The study aims to help companies define specific assessments and tests for OM and SCM roles to measure individual attitudes and correlate them with the job position.

**Findings** – As a result of the work, a set of soft skills and abilities was defined that allow, through correlation analysis, to explain a large number of activities required to work in the operations and SCM (OSCM) environment.

**Research limitations/implications** – The work is inherently affected by the database used for the professional figures mapped and the scores that are attributed within O*NET to the analyzed elements.

**Practical implications** – The information resulting from this study can help companies develop specific assessments and tests for the roles of OM and SCM to measure individual attitudes and correlate them with the requirements of the job position. The study aims to address the need to identify soft skills in the human sphere and determine which of them have the most significant impact on the OM and SCM professions.

**Originality/value** – The originality of this study lies in its approach to identify the set of soft skills and abilities that determine success in the OM and SCM industries. The study used the O*NET database to correlate the tasks required for specific job roles with their corresponding soft skills and abilities. Furthermore, the study used ANOVA analysis to validate the findings in other sectors mapped by the same database. The identified soft skills and abilities can help companies develop specific assessments and tests for OM and SCM roles to measure individual attitudes and correlate them with the requirements of the job position. In addressing the necessity for enhanced clarity in the domain of human factor, this study contributes to identifying key success factors. Subsequent research can further investigate their practical application within companies to formulate targeted growth strategies and make appropriate resource selections for vacant positions.

**Keywords** Human factor, Operations and supply chain management, Soft skills, O*NET, Job profiles

**Paper type** Research paper

## 1. Introduction

Competences have been widely discussed in academic literature, with Marin-Zapata *et al.* (2022) and D'Orazio *et al.* (2020) defining them as the ability of a professional to achieve their



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job objectives. Teodorescu (2006) highlights a distinction between "competence" and "competency," with the former being the performance that leads to efficient fulfillment of the organization's objectives and the latter being the characteristics that lead to successful performance. Competency frameworks aim to define the skills, knowledge, attitudes and behaviors necessary for success, while competence frameworks define the steps individuals must take to consistently achieve their role's objectives (Teodorescu, 2006). Skills, as defined by Spencer and Spencer (1993), are the ability to perform a certain task, with the classification of "hard skills" and "soft skills" differentiating technical and human-related abilities, respectively. Boyatzis (1982) and Spencer and Spencer (1993) have laid the foundation for studying competencies. These two works have been the mainstays of research on the subject, and this is made evident by the fact that they count a total of 22′242 citations in Google Scholar. Boyatzis defines a job competency as "an underlying characteristic of a person which results in effective and/or superior performance in a job"; along the same lines, for Spencer, a competency is "an underlying characteristic of an individual that is causally related to criterion-referenced effective and/or superior performance in a job or situation". The "underlying" character, which both scholars adopt, indicates that a competency is a fundamental aspect of the personality and deeply rooted in the individual's being, so much so that an individual may not be able to describe it or may not even realize that he or she possesses it. The two studies also agree that a competency has an impact on performance, and Spencer adds that this impact must be measurable according to specific or standard criteria (criterion-referenced). Boyatzis divides competencies into three categories: the first comprises motives, which are the thoughts and concerns about a goal that guide an individual to engage in certain behaviors and perform certain actions and traits, which are the characteristic ways in which a person disposes in response to a certain set of stimuli. The third type of competencies recognized by Boyatzis is skills: a skill is defined as the ability to apply a system or sequence of behaviors that are functionally related to achieving a goal. Applying a skill therefore boils down to the performance of a single action, but of many actions that contribute in some way to solving the problem and carrying out the performance. Moreover, the single achievement of a goal does not prove the possession of a skill: a person who possesses a skill can generally apply it in any situation and context.

Spencer presents a slightly different division and definitions. According to him, the competencies can be as follows:

(1) Motives: anything that a person constantly thinks about or wants and that conditions their actions. Motives hence guide individuals' behavior towards certain actions;

(2) Traits: psychophysical characteristics and consistent responses to specific situations or information;

(3) Self-Concept: attitudes, values and self-image of an individual's knowledge in specific content areas.

Spencer argues against overvaluing competencies related to possessing information, as he believes that the ability to find information is more important and that knowledge alone does not guarantee the ability to act on it. Competencies are classified into knowledge and skills, which are easily detectable and motives, traits, and self-concept, which are more hidden. Although knowledge and skills are easy to develop through vocational training, motivations, traits and self-concept are harder to improve and often serve as selection criteria, representing excellence or weaknesses within companies.

The issue of skills required to perform specific activities is garnering increasing attention due to the growing problem of skills mismatch. Brunello and Wruuck (2019) point out that this is an issue of considerable importance as it refers to the gap between supply and demand

for skills, while at the microlevel it refers to the misalignment between the level of skills available and required workers and about the capacity of the work force to perform well in its role. The various authors emphasize the need for a closer interaction between the two sides of the labor market, supply and demand, with the aim of better tracking the skills that are considered essential for performing certain activities. The various authors highlight the need for further investigations in order to better define the capabilities that are considered essential for performing tasks in the OSCM environment.

When we speak of the "human factor", we mean the contribution to operations made by the fact that it is a person, and not a machine, that performs these operations (Janota *et al.*, 2022). It is evident that there are human characteristics and capabilities that a computer cannot replicate, and therefore many activities are destined to be carried out exclusively by people: these are usually the activities on which the success of an organization or in general the success of complex operations depends. This is why researchers' attention has focused on the study and evaluation of the human factor within performance in all fields, and many agree that technical skills and knowledge are necessary, but not sufficient to guarantee optimal performance, for which they do come into play (Cacciolatti *et al.*, 2017).

The human factor has an important impact on performance (Latorre *et al.*, 2016), and this was clear early on to the authors who laid the foundations for the study of competence (Spencer and Spencer, 1993; Boyatzis, 1982). However, the recognition of this importance was not immediate, but took time and especially the advancement of disciplines such as psychology and sociology. Today, there are many who identify the human factor as a fundamental component of effective performance. Numerous studies highlight the fact that soft skills are complementary to hard skills (Stek and Schiele, 2021). Regarding this, some believe that possessing considerable technical skills or theoretical knowledge is not enough if one does not have those transversal skills that allow one to apply them consistently and effectively in the work environment, on the one hand, and to implement them without too much difficulty, on the other (Wesley *et al.*, 2017). According to this view, soft skills give hard skills the plasticity they need to develop and remain up-to-date, and consequently effective, in circumstances that may vary (Cimatti, 2016), or, put another way, appropriate implementation of hard skills depends on soft skills (Wats and Wats, 2009). As reported by Foutty (2019), the rise of Industry 4.0 has made uniquely human traits, such as creativity, curiosity and empathy, more important than ever, and only individuals with such skills can help organizations adapt and compete where machines and technologies cannot. However, globalization allows increasingly frequent interactions between individuals and companies from different countries and continents, and increasing competition in this way makes communication and interpersonal skills crucial for long-term success (Onsardi *et al.*, 2019).

Considering soft skills or even abilities important for the achievement of results can be difficult, as they form the basis of competence and therefore remain less visible and measurable, while, on the contrary, hard skills are pragmatically involved in the achievement of goals or the performance of tasks (Tsirkas *et al.*, 2020). More generally, it is difficult to link soft skills or abilities with the different tasks or tasks that each individual is required to perform in order to achieve the work objectives of their role (D'Orazio *et al.*, 2020). Many of the studies that attempt to prove the usefulness of soft skills are based on interviews and/or surveys (Divleli and Ergun, 2015; Essex *et al.*, 2016; Maes *et al.*, 1997) which, although aimed at experienced people, could be influenced by personal opinions and therefore be considered not very objective. The main proof of the lack of recognition of the importance of soft skills is in the fact that their absence among workers' competences is continually denounced (Doggett and Jahan, 2016). If they were universally regarded as determining factors for job success, institutions and organizations, starting with universities, would be more committed to their development in individuals and there would be no such lack. Instead, soft skills are neglected at school (Clarke, 2016) and university level (Stewart and Wall, 2016), so much so that young

people do not consider them real skills, avoiding talking about them during interviews and excluding them from their CVs (Clarke, 2016).

Various research have dealt with the phenomenon of a soft skills shortage. The phenomenon is actually broader and does not only concern soft skills: a skills shortage occurs whenever employers are unable to find staff with the skills they need on the labor market (Brunello and Wruuck, 2019). This shortage is a limitation for organizations in terms of productivity, for innovation and the adoption of new technologies (Doggett and Jahan, 2016). In 2013, a survey conducted by the society for manufacturing engineers (SME) found that 9 out of 10 manufacturing companies have difficulty finding a skilled workforce, 64% say productivity losses are due to the skills gap, 56% believe that skills shortages have negatively impacted their growth and 78% consider the absence of qualified candidates to be one of the top two factors limiting their hiring (Doggett and Jahan, 2016). With regard to soft skills specifically, their shortage in the labor market has also been investigated and confirmed by LinkedIn, one of the leading online platforms connecting professionals and companies, which through a survey addressed to 291 hiring managers in the United States found that 59% of them believe that soft skills are hard to find. The trend was confirmed by the same platform in the 2018 Emerging Job Report, with soft skills identified as having the most gaps. Recent studies show how this deficit, which not only affects young people, can lead to annual losses of millions in lost production (Clarke, 2016) and is one of the causes of graduate unemployment (Seetha, 2014). Many graduates are believed to be deficient in key soft skills, such as effective communication, public speaking and presentation skills, and collaboration (Anthony and Garner, 2016), and these deficiencies are more severe in those taking science and engineering courses (Schulz, 2008). The issues surrounding the identification of relevant characteristics for specific roles within a company have been addressed to some extent through the development of international databases like O*NET. However, there remains a need for further clarity on the impact of 'soft' individual attributes. To address this gap (Anthony and Garner, 2016; D'Orazio *et al.*, 2020; Stek and Schiele, 2021), this study aims to investigate the following research questions within the OSCM sector, using the O*NET database:

(1) What are the key soft skills and abilities required in the OSCM field?

(2) How do these soft skills correlate with job activities and contribute to organizational performance?

Through this analysis, we seek to provide valuable information on the role of soft skills in the OSCM domain and their potential significance for organizational success. The results will contribute to a better understanding of the critical attributes that influence performance in this sector, enabling more effective talent recruitment and management strategies. In the following sections, we will analyze how these human-related aspects are handled in OM and supply chain management (SCM) and then proceed to an analysis of the main occupational databases. The final part of the article will present the analysis conducted and the results reached to answer the research questions while also considering possible further developments of the work.

## 2. Materials and methods

### *2.1 Contextualization of relevant literature*

Up to this point, we have spoken of OM and SCM without clarifying the nature, tasks and responsibilities of these two areas of management, which cannot be ignored to contextualize the proposed work and fully understand it. There is considerable confusion around the two concepts and particularly regarding the relationship between them in academic literature and

organizations (Rossetti and Dooley, 2010). This is due to the fact that the field of SCM emerged during the 1990s as a fusion of several disciplines that until then coexisted almost independently: logistics, supply management and operations. Therefore, depending on the sources one consults, one may find that OM falls under SCM, or otherwise that the two functions are complementary, or at other times the proposed definitions are practically the same.

OM is the field of administration that focuses on designing, managing, and improving the production process to ensure efficient use of resources and meet customer demands (Gino and Pisano, 2008). Supply chain can be defined as a network of organizations that work together to generate value in the form of products and services for the end consumer (Christopher, 2016). SCM is the active management of the supply chain to coordinate flows and maximize value for the end customer (Hanfield, 2021). OSCM is the planning, development and improvement of all process steps that create goods or services of value to the consumer, and individual competences are recognized as a key factor in achieving superior performance (Jacobs and Chase, 2020; Derwik and Hellström, 2017). Skills and abilities in this area are increasingly in demand, as they are essential for relationships between businesses and individuals within the supply chain (Gino and Pisano, 2008). As already discussed, individuals constitute one of the most important resources within an organization: whether they are managers, employees or workers, their skills and abilities are among the main factors for the success and competitive advantage of the company (Barney, 1991). As defined by Human Resource Management (HRM) experts, recruitment is the process by which individuals with the right skills are prompted to apply for a job in an organization, in a timely manner, and in sufficient numbers. Since the objective of Human Resource (HR) is to identify and hire the person who, it is believed, can best fill the vacant role, it is necessary to first study that role: this is done through the job analysis process whose two main outputs are the job description and the job specifications. The job description explains all the tasks, functions and responsibilities that a position entails, as well as providing information about the work environment (Goldstein *et al.*, 2017). On the other hand, job specifications concern the characteristics that the person occupying that role must possess and thus describe knowledge, skills and other characteristics needed to succeed in that job (Goldstein *et al.*, 2017). In short, the standard process consists of the completion of the job analysis to understand the nature of the job, which is followed by the preparation of the job description, usually including detailed job specifications, then used in recruiting and selection (Ellington *et al.*, 2015).

Consider job specifications in particular. As we have already seen, these are descriptions of the characteristics needed to perform successfully in a job and play a crucial role in both the recruitment and selection phases. In the recruitment phase, an individual can only determine whether to apply for the role by understanding what an employer is seeking. In the selection phase, competencies serve as a reference point for decision makers to make informed decisions (Ellington *et al.*, 2015). The characteristics included in Job Specifications are usually referred to by the acronym KSAOs "knowledge, skills, abilities, other characteristics" (Goldstein *et al.*, 2017; Ellington *et al.*, 2015). Regarding soft skills, there are conflicting opinions about their presence in job descriptions. Some believe that they should not be included since, being generic, they can be ignored by candidates, create confusion or even discourage qualified individuals. According to this opinion, only specific skills should be included in job descriptions and soft skills should be assessed later, through an interview or a dedicated attitudinal assessment. Others, on the contrary, think that job descriptions should just be flexible and relatively generic, since including technical knowledge and skills can cut out individuals who do not possess them, but who could easily develop them. In this sense, what to look for are soft skills such as learning ability, motivation and spirit of adaptation. In fact, HRM experts who write job descriptions for recruitment include soft skills alongside hard skills: an analysis conducted in 2015 on millions of

job advertisements showed that on average one in three of the required skills can be considered soft, and in more technical fields, such as information technology (IT) or engineering, one in four (Burning Glass Technology, 2015).

Soft skills are crucial during the recruitment and selection phases, whether they are directly sought through job descriptions or assessed afterward. With the current dynamic working environment characterized by globalization and continuous technological innovations, companies prefer to hire people with the right skills to adapt to change and learn, rather than those with a lot of knowledge and technical skills that may soon become obsolete. Employers prefer soft skills as they guarantee stability, facilitate personal growth and allow staff to stay for a long time with superior performance. The Indeed portal, one of the most widely used job posting sites, reports that soft skills such as motivation, seriousness, conflict resolution, learning skills and initiative are given great weight during the hiring process. A survey of 400 employers revealed that they value soft skills more than technical skills, with interpersonal skills, critical thinking and personality-related skills being the most important (Binsaeed *et al.*, 2017).

In order to meet the demand for skills and also provide their standardization, states and organizations have used systems to classify occupations and the information associated with them (Rentzsch and Staneva, 2020). The dictionary of occupational titles (DOT), developed by the US Department of Labor, is one of the first works produced in this regard "to standardize occupational information to support job placement activities", as stated in its introduction. First published in 1938 and subsequently revised in 1949, 1965, 1977 and 1991, the DOT contained the listing and description of numerous occupational figures (more than 12′000 in its fourth edition), as well as a series of quantitative variables later used by social scientists for a variety of reasons, from the study of the sociology of work to the sociology of health and the analysis of child development (Hadden *et al.*, 2004). With the same intentions, the International Labor Organization (ILO), a United Nations body with the aim of protecting and promoting labor rights, developed the International Standard Classification of Occupations (ISCO). The first version of ISCO, ISCO-58, was adopted in 1957, and has been followed by three updates: ISCO-68, ISCO-88, ISCO-08, the latest version adopted in 2007. Similarly, to the DOT, in the first two versions of ISCO, occupations were divided into several levels and then described in terms of function, responsibility and especially tasks. In ISCO-88 for the first time, skills take on a fundamental role: it is decided to subdivide the occupations precisely according to the skills required to perform the planned tasks.

After the mid-1990s, difficulties began to be experienced by labor market bodies in using these means to match supply and demand: skills and competences, and no longer occupations, were considered the crucial factor for job placement (Markowitsch and Plaimauer, 2009). Thus, in order to complement these classification systems, numerous works were developed to specifically describe skills and competences: in Austria the "AMS-Qualifikationsklassifikation", in Germany the "Kompetenzenkatalog", in France "ROME", in Sweden "Taxonomy_DB", in the United States the O*NET database (Markowitsch and Plaimauer, 2009), designed to replace the DOT.

One of the systems that has succeeded in effectively reconciling occupations and skills is the European skills, competences, qualifications and occupation (ESCO), a project of the European Commission first published in its full version in 2017. The ESCO is a system for identifying and classifying relevant skills, competences, qualifications and occupations in the European labor market (European Commission, 2017); it is based on three pillars: occupations; skills; qualifications. The strength of the ESCO database is the considerable interconnection between the occupations pillar and the skills pillar: for each occupation one can find the skills and knowledge required, divided into "essential" and "optional", and vice versa for each skill one can find the occupations in which it is required (European Commission, 2022).

*2.2 Methodology and work approach*

In light of the substantial focus on the significance of soft skills in current academic and industrial literature related to operations and SCM job roles, several inquiries persist concerning the precise connection between soft skills and operational responsibilities. Consequently, this study endeavors to shed light on these inquiries through the presentation of a comprehensive methodology and an in-depth exploration of these associations. "To answer the research questions, the occupational database on which work has been carried out is the occupational information network (O*NET). This was developed during the 1990s by the United States Department of Labor, in collaboration with a group of public and private organizations, to replace the DOT, which was considered too closely linked to industry and blue-collar jobs and not appropriate for the new information and service-oriented economy (Mariani, 1999). O*NET is constantly updated every year through the collection of data from the work of occupation experts, companies, databases, associations and ordinary users. The current version is O*NET 26.2, released in February 2022. The structure underlying O*NET, namely the content model, was developed following a careful analysis of occupations and organizations, and identifies and provides, for each of the occupations, the most important information about the job, the expected tasks, the necessary skills and the work environment (O*NET, 2022).

This information is organized into six categories:

(1) *Occupation-specific Information*: information, elements and details that individually characterize the analyzed occupation; it is the main sphere and in some contents it may specify the information contained in the other spheres, with details concerning the required skills, tasks, tools and technology used, etc.;

(2) *Occupational requirements:* includes the typical activities required in the occupation under examination and information regarding the work context from a physical, social and structural point of view, from which specific requirements for the worker may derive;

(3) *Experience Requirements:* requirements related to previous work activities and explicitly related to certain types of current activities; this sphere includes background experience, certifications, licenses and training data;

(4) *Worker Requirements:* individual attributes and skills developed or acquired through training and experience, related to job performance as they relate to the performance of tasks;

(5) *Worker Characteristics:* persistent characteristics that can influence both performance and the ability to develop skills and learn information necessary for effective performance; they can have an impact on the individual's attitude towards tasks and towards the work environment;

(6) *Workforce Characteristics:* contains information and data about the labor market and the characteristics of the sector in which the occupation is located; this part is carried out in collaboration with specialized bodies such as the Bureau of Labor Statistics, the Department of Commerce, the Census Bureau and the Employment and Training Administration, all of which are US government bodies.

The variables considered in conducting the database analysis were tasks, skills, abilities and work activities. The tasks are specific to each occupation, i.e. they are individually designed and written down according to what, according to the data collected, are the tasks and responsibilities of the occupational figure. Each task is then assigned a label chosen between "Core" and "Supplemental" and an importance value, from 0 to 100, to indicate its weight within the responsibilities of the role.

As far as the other variables are concerned, O*NET provides a list of skills, abilities, and work activities and presents it in full for each professional figure, flanking each item with an importance value, again from 0 to 100. Skills are divided into two broad groups:

(1) Basic skills, defined as skills that facilitate the acquisition of knowledge and competences and cross-functional skills, defined as skills that facilitate the performance of activities common to several jobs

(2) Skills are defined by O*NET as "attributes that influence performance"; they are understood as characteristics linked to nature and personality, and in this they differ from abilities, which are instead described as developed competences

The first categorization is into cognitive skills, psychomotor skills, physical skills and sensory skills; each category is broken down again into a total of 15 subcategories, which contain 52 skills organized and defined as follows.

Finally, work activities indicate the activities that the individual in the analyzed role is typically called upon to perform. O*NET envisages three levels of work activities, namely generalized work activities, intermediate work activities and detailed work activities. In particular, for the first level there is a list, which is reported in its entirety for each occupation and whose items are weighted with an importance, on a par with skills and abilities, while for the next two levels only the most important activities are reported to which no weight is assigned.

When structuring the work, the first step taken was the analysis of the aforementioned database. In particular, we examined the key areas of focus for the study, which are within the scope of the field of study, i.e. OM and SCM. Within these areas of study, we then examined the professional roles that had a comprehensive description of the responsibilities and a classification of the soft skills suitable for carrying out the job. Finally, to identify and understand the most important activities and tasks within operations and SCM in the study, nine professional figures were identified in the O*NET database. The identified professional roles and a brief description of each are now presented:

(1) *Supply Chain Manager*: This role involves overseeing and managing various aspects of business operations such as production, sales, warehousing, distribution and financial forecasting. The aim is to reduce costs while improving accuracy, service quality and safety. The job also involves evaluating current procedures and identifying opportunities for optimization to meet business needs. Additionally, the position involves directing the handling, storage and processing of inventory.

(2) *General and Operations Managers*: The job involves planning, directing and coordinating the operations of public or private organizations that may have several departments or locations. The role includes developing policies, managing daily operations and planning the use of material and human resources. Typically, the job is performed through supervisors who are subordinate to the position.

(3) *Transportation, Storage and Distribution Managers*: The job requires planning, directing and coordinating transportation, storage, and distribution activities according to company policies and relevant laws and regulations.

(4) *Industrial Production Managers*: The role involves planning, directing and coordinating the activities and resources necessary for the manufacture of products while meeting the company's cost, quality and quantity requirements.

(5) *Purchasing Managers*: The job involves planning, directing and coordinating the activities of responsible purchasers and all workers involved in the purchase of materials, products and services.

(6) *Industrial Engineers*: The position involves designing, developing, testing and evaluating integrated systems for managing industrial production processes. The job includes analyzing factors such as human labor, quality control, inventory control, logistics, material flow, cost analysis and production coordination.

(7) *Logistics Engineers*: The role involves designing or analyzing operational solutions for optimizing transportation, network modeling, process and method analysis, cost containment, capacity enhancement, routing and delivery optimization, and information management.

(8) *Logistics Analysts*: The job requires analyzing product delivery and supply chain processes to identify areas for improvement and propose solutions.

(9) *Production, Planning, and Expediting Clerks*: The position involves coordinating and expediting work and material flows within or between departments of an organization based on the production schedule. The job includes reviewing and distributing work, production and delivery schedules, communicating with departmental supervisors to track work progress and completion dates, and preparing reports related to inventory levels, costs and production issues.

The analysis methodology presented in this paper was structured as follows:

(1) An initial step involved studying and analyzing the O*NET database, identifying professional roles that could serve as a robust basis for quantitative analysis to bolster the presented work.

(2) Once the suitable professional roles were identified for the purpose of this study, complete profiles with scores for each work activity, ability, skill and task were downloaded.

(3) An analysis of th ese elements was then performed to retain only those falling within the realm of human "soft" skills. This classification was based on recent literature contributions in this area (Anthony and Garner, 2016; D'Orazio *et al.*, 2020; Stek and Schiele, 2021; Fantozzi *et al.*, 2022).

(4) A correlation analysis was subsequently conducted, gradually becoming more stringent, resulting in a pool of representative characteristics capable of addressing the research questions.

(5) Finally, the obtained results were validated through an ANOVA analysis, replicating the method with another set of professional roles, which confirmed the validity of the work presented in this paper.

Now, let's delve into the specific details of how each of these steps was conducted and the results obtained from each iteration.

Once the professional roles were identified, the complete profiles with their respective scores for each role were downloaded, enabling a quantitative analysis of the professional profiles. The analysis steps followed were as follows, in sequence:

(1) Creation of a matrix of the relative importance of each soft skill for each professional role, relating it to the tasks to be performed by each role

(2) Successively, for each of the professional figures mentioned above, it has been possible to obtain the relative importance of their main characteristics (i.e. tasks, skills, abilities, work activities) from the O*NET database

(3) Then a matrix was created for each occupation, on whose rows skills and abilities were placed, and on whose columns work activities were placed. Each element of the

matrix is the product of the importance indicated by O*NET, for the figure relating to the matrix, of the two variables characterizing its row and column.

Two further matrices were then created, maintaining the variables assigned to rows and columns: the first shows, for each skills-work activity or ability-work activity pair, the average of the products calculated in the occupation matrices. In this way, it was shown which combinations of variables retain their high importance in all figures, with the matrix of averages and which ones show less dispersion. The same analysis was reperformed by skimming more selectively, and second, a correlation analysis was carried out between the skills/abilities and the work activities. Thus, this latter evaluation allows us to determine the skills/abilities that are directly impacting the OM and SCM work activities, and to derive specific guidelines for their management and, ultimately, improvement.

When assessing the characteristics present for each professional figure, skills, abilities and work activities were considered as variables that determined the achievement of the tasks defined for each figure. However, from the totality of skills, abilities and work activities, only a part was considered, removing all those related to a technical sphere, instead keeping those related to a dimension close to that commonly known as soft. Hence, among the skills, those linked to theoretical knowledge, such as "science" and "mathematics", and those purely technical, were removed. The starting 35 skills have thus been reduced to the following 19 in Table 1.

The same flow applies to professional figures' abilities, shown in Table 2. The analysis led to the examination of a total of 52 abilities, all extracted from the O*NET databases, while staying within the scope of this study the abilities removed are the quantitative, psychomotor, physical and sensory ones, which, according to the definitions, are far removed from the human and soft sphere that one wants to investigate. The following are the 18 considered for the analysis.

The skimming done on the work activities has been more articulated, and it is presented as follow.

(1) First of all, the "physical and manual activities" were removed, as they were considered unimportant in the OSCM

| ID | Skills |
|---|---|
| S1 | Reading Comprehension |
| S2 | Active Listening |
| S3 | Writing |
| S4 | Speaking |
| S5 | Critical Thinking |
| S6 | Active Learning |
| S7 | Learning Strategies |
| S8 | Monitoring |
| S9 | Social Perceptiveness |
| S10 | Coordination |
| S11 | Persuasion |
| S12 | Negotiation |
| S13 | Instructing |
| S14 | Service Orientation |
| S15 | Complex Problem Solving |
| S16 | Judgment and Decision Making |
| S17 | Systems Analysis |
| S18 | Systems Evaluation |
| S19 | Time Management |

**Table 1.**
Initial set of soft skills

**Source(s):** Table by authors

| ID | Abilities |
|---|---|
| A1 | Oral Comprehension |
| A2 | Written Comprehension |
| A3 | Oral Expression |
| A4 | Written Expression |
| A5 | Fluency of Ideas |
| A6 | Originality |
| A7 | Problem Sensitivity |
| A8 | Deductive Reasoning |
| A9 | Inductive Reasoning |
| A10 | Information Ordering |
| A11 | Category Flexibility |
| A12 | Memorization |
| A13 | Speed of Closure |
| A14 | Flexibility of Closure |
| A15 | Perceptual Speed |
| A16 | Visualization |
| A17 | Selective Attention |
| A18 | Time Sharing |

**Source(s):** Table by authors

**Table 2.**
Initial set of abilities

(2) Then the "Complex and technical activities" were discarded, as they were judged either too generic, such as "Working with computers", or too specific, such as "Repairing and maintaining electronic equipment", and therefore not very indicative for the work to be carried out.

(3) Finally, pairs of work activities were identified that, according to the proposed definitions, were very similar: it was decided to keep only one variable for each of these pairs, and the variable with the highest average importance was chosen in the professional figures considered.

This results in 26 work activities, shown in Table 3, from the initial 41.

With the aim of collecting the most significant abilities and soft skills, we proceeded in successive steps to skim the samples shown in the tables above. In this sense, we considered the information contained in the O*NET database for the information regarding skills, abilities and work activities pertaining to each of the nine selected professional figures. The importance of each variable, which in the database is reported as a value between 0 and 100, was rewritten as a value between 0 and 1, for convenience of analysis, operating in a simple proportion. Subsequently, the average importance was calculated for each of the variables illustrated, and, on the basis of this, a second skimming was carried out: all variables with an average importance value of less than 0.6 were removed, thus obtaining a set of 11 skills, 8 abilities and 19 work activities, then again retaining only those with an average of more than 0.7, thus arriving at 4 skills, 5 abilities and 7 work activities. In Figure 1 below (the list of adopted acronyms can be found in Appendix), a correlation analysis was then carried out to identify which skills and abilities were the most significant, thus revealing a pool of nine skills and abilities among the most significant in explaining the work activities considered.

We finally arrive at a set of abilities and skills, in Table 4, which have an average degree of importance of 0.7 and ultimately represent the set of characteristics most significant in the performance of activities related to the professional roles considered in operations and SCM. Note that all correlations related to the abovementioned set of skills were found to be statistically relevant, with an $R^2$ greater than 90%.

| ID | Work activities |
|---|---|
| WA1 | Getting Information |
| WA2 | Identifying Objects, Actions, and Events |
| WA3 | Guide, Direct, and Motivate Subordinates |
| WA4 | Estimating Quantifiable Characteristics of Products, Events or Information |
| WA5 | Judge the Qualities of Objects, Services or People |
| WA6 | Evaluate Information to Determine Conformance to Standards |
| WA7 | Analyzing Data or Information |
| WA8 | Making Decisions and Solving Problems |
| WA9 | Thinking Creatively |
| WA10 | Update and use relevant knowledge |
| WA11 | Developing Objectives and Strategies |
| WA12 | Organizing, Planning Work and Prioritising |
| WA13 | Interpreting the Meaning of Information for Others |
| WA14 | Communicating with Supervisors, Colleagues and Subordinates |
| WA15 | Communicating with People Outside the Organization |
| WA16 | Establishing and Maintaining Interpersonal Relationships |
| WA17 | Assisting and Caring for Others |
| WA18 | Selling and Influencing |
| WA19 | Resolving Conflicts and Negotiating |
| WA20 | Working with or for the public |
| WA21 | Developing and Building Teams |
| WA22 | Training and Instructing Others |
| WA23 | Leading, Managing and Motivating Subordinates |
| WA24 | Administrative Activities |
| WA25 | Hiring Organizational Units |
| WA26 | Monitoring and Controlling Resources |

**Source(s):** Table by authors

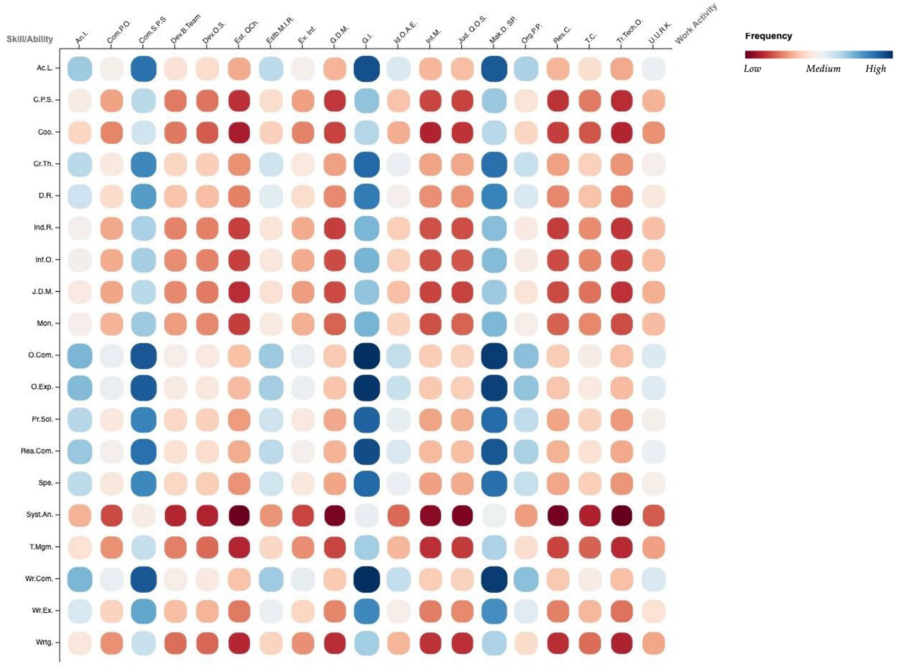
**Table 3.** Initial set of work activities

To effectively demonstrate the validity of the identified relationships, three different single-factor ANOVA analyzes (Montgomery and Runger, 2013) have been performed with the aim of evaluating the values of skills, abilities and work activities for the different professional figures. This analysis is specifically relevant to show that the values of the considered job figures are reasonably variable in relation to their characteristics, and hence they can be assumed to be significant for our purposes.

To achieve this objective, additional professional figures from six different organizational clusters have been chosen from the O*NET database and appended to the initial dataset. To ensure the same numerosity in each of the clusters, nine job roles have been selected for each of the given clusters, leading to an overall number of professional roles equal to 63. The profiles are briefly summarized as follows in Table 5.

Starting from the above-mentioned professional figures extracted from the O*NET database, the numerical values of related skills, abilities and work activities have been extracted. Successively, to demonstrate that the characteristics of each of the different figures are significant for our study, three single-way ANOVA analyzes were performed. Note that, to concentrate on the most relevant elements of the figures, only features with numerical values equal to or greater than 0.7 have been considered within the ANOVA evaluation, while the others have been discarded. A description of the three different single-way ANOVA analyzes (Montgomery and Runger, 2013) is reported below in Table 6.

From the previously reported ANOVA analyze specifications; it has been possible to replicate the evaluation for the three different dimensions: skills, abilities and work activities. Therefore, the results of the assessment are reported in the following Table 7.




**Source(s):** Figure by authors

**Figure 1.**
Matrix plot correlation between skills/abilities and work activities

| ID | Skills and abilities |
|---|---|
| S2 | Active Listening |
| S5 | Critical Thinking |
| A8 | Deductive Reasoning |
| A1 | Oral Comprehension |
| A3 | Oral Expression |
| A7 | Problem Sensitivity |
| S1 | Reading Comprehension |
| S4 | Speaking |
| A2 | Written Comprehension |

**Source(s):** Table by authors

**Table 4.**
Main soft skills and abilities in the OSCM field

The ANOVA analyzes show significant *p*-values, thus allowing us to refuse all the null hypotheses. This leads to state that the considered characteristics namely, the specific skills, abilities, work activities – report distinctive values, respectively, for the many professional role profiles, the different profiles in operations and supply chain cluster, and the various organizational clusters. In conclusion, the data considered are significant to be evaluated and to determine relationships in terms of correlation between the hard and soft aspects of the individual.

| Cluster | Professional role |
|---|---|
| Finance | Financial Quantitative Analysts |
| | Personal Financial Advisors |
| | Securities, Commodities, and Financial Services Sales Agents |
| | Credit Counselors |
| | Financial Examiners |
| | Credit Authorizers, Checkers and Clerks |
| | Treasurers and Controllers |
| | Bookkeeping, Accounting and Auditing Clerks |
| | Financial Managers |
| Human Resources | Human Factors Engineers and Ergonomists |
| | Human Resources Specialists |
| | Human Resources Managers |
| | Social and Human Service Assistants |
| | Human Resources Assistants, Except Payroll and Timekeeping |
| | Industrial-Organizational Psychologists |
| | Training and Development Managers |
| | Compensation, Benefits and Job Analysis Specialists |
| | Training and Development Specialists |
| Information technology (IT) | Computer and Information Systems Managers |
| | Computer Systems Analysts |
| | Information Security Analysts |
| | Computer Network Support Specialists |
| | Database Administrators |
| | Database Architects |
| | Software Quality Assurance Analysts and Testers |
| | Computer Systems Engineers/Architects |
| | Business Intelligence Analysts |
| Legal | Legal Secretaries and Administrative Assistants |
| | Paralegals and Legal Assistants |
| | Lawyers |
| | Judicial Law Clerks |
| | Title Examiners, Abstractors and Searchers |
| | Arbitrators, Mediators and Conciliators |
| | Compliance Managers |
| | Secretaries and Administrative Assistants, Except Legal, Medical and Executive |
| | Administrative Law Judges, Adjudicators and Hearing Officers |
| Marketing | Marketing Managers |
| | Search Marketing Strategists |
| | Market Research Analysts and Marketing Specialists |
| | Advertising and Promotions Managers |
| | Securities, Commodities, and Financial Services Sales Agents |
| | Public Relations Specialists |
| | Sales Representatives, Wholesale and Manufacturing, Technical and Scientific Products |
| | Sales Managers |
| | Sales Engineers |
| Operations and supply chain | Supply Chain Manager |
| | General and Operations Managers |
| | Transportation, Storage, and Distribution Managers |
| | Industrial Production Managers |
| | Purchasing Managers |
| | Industrial Engineers |
| | Logistics Engineers |
| | Logistics Analysts |
| | Production, Planning and Expediting Clerks |

**Table 5.**
Overall dataset of professional roles chosen for ANOVA

(*continued*)

| Cluster | Professional role |
|---|---|
| R&D | Clinical Research Coordinators |
| | Biofuels/Biodiesel Technology and Product Development Managers |
| | Social Science Research Assistants |
| | Computer and Information Research Scientists |
| | Natural Sciences Managers |
| | Biochemists and Biophysicists |
| | Soil and Plant Scientists |
| | Materials Scientists |
| | Molecular and Cellular Biologists |

**Source(s):** Table by authors

**Table 5.**

*ANOVA 1*: The 63 professional role profiles are considered by comparing the related numerical values of the skills/abilities/work activities
*ANOVA 2*: Only the 9 professional role profiles in the Operations and Supply Chain organizational cluster are considered by comparing the related numerical values of the skills/abilities/work activities
*ANOVA 3*: The 7 organizational clusters are considered by comparing the related average numerical values of the skills/abilities/work activities for the professional role profiles within each of the clusters

**Source(s):** Table by authors

**Table 6.**
Description of the single-factor ANOVA analyzes

| Dimension | Type of analysis | F | *p*-value | F Crit |
|---|---|---|---|---|
| Abilities | ANOVA 1 | 5.85 | 1.51E−04 | 2.40 |
| | ANOVA 2 | 5.19 | 1.83E−03 | 2.61 |
| | ANOVA 3 | 10.39 | 2.11E−05 | 2.69 |
| Skills | ANOVA 1 | 6.45 | 5.39E−05 | 2.40 |
| | ANOVA 2 | 3.67 | 1.22E−02 | 2.61 |
| | ANOVA 3 | 12.20 | 5.25E−06 | 2.69 |
| Work Activities | ANOVA 1 | 8.89 | 3.77E−09 | 2.12 |
| | ANOVA 2 | 7.86 | 3.67E−06 | 2.27 |
| | ANOVA 3 | 8.09 | 7.75E−06 | 2.32 |

**Source(s):** Table by authors

**Table 7.**
Results of the ANOVA analyzes

## 3. Results and discussion

Let us now look at the significance of the results highlighted in the previous section.

First and foremost, as the main outcome of this work, we have a set of skills and soft skills that, with a correlation equal to or greater than 0.9, are critical in successfully performing the assigned tasks within the roles considered for the operations and SCM sectors. This type of result is further supported by the ANOVA analysis conducted on a set of 7 other organizational clusters, encompassing a total of 67 professional positions. This analysis allowed us to reject the null hypothesis, thus validating the set of skills and abilities as genuinely significant. The results obtained ultimately enable us to validate the following set:

(1) Active Listening

(2) Critical Thinking

(3) Deductive Reasoning

(4) Oral Comprehension

(5) Oral Expression
(6) Problem Sensitivity
(7) Reading Comprehension
(8) Speaking
(9) Written Comprehension

Such results, obtained through a rigorous and replicable methodology, also lead to interesting considerations regarding the applicability of these findings in various societal contexts. However, these considerations will be explored in more depth in the following section. For now, let's focus on discussing the resulting set from the work presented. Firstly, it is evident that some of the skills or abilities highlighted as priorities for working in the OSCM sector are directly related to the main activities to be performed for the most common job roles. In fact, skills such as critical thinking are essential to perform problem-solving activities. In fact, based on the definition of Scriven and Paul (2007) who describe it as the disciplined ability to conceptualize, apply, analyze, synthesize and/or evaluate information gathered or generated by observation, experience, reflection, reasoning or communication, it is evident how essential it is to actively and competently perform a large number of activities required in the field we are studying. Similarly, it is possible to observe how other skills such as fluency of ideas and originality or instruction, while important in the skill set, are not central to the skills required of OSCM professionals.

Instead, it deserves brief discussion of some skills such as: Complex problem solving, judgment and decision-making skills were excluded from the final list of competencies/skills. A possible answer to this question could lie in the fact that the group highlighted in Table 4, reports competences that are broadly applicable to all contexts in which an OSCM professional may find himself/herself and are declined, and thus essential for the performance of almost all required tasks. On the other hand, more vertical competences for phases such as negotiation or problem solving are very important for a smaller group of tasks and therefore remained out of the final list. The sequential skimming process used led to a rather significant set of skills and competences, starting with an initial set of 37 characteristics, shown in Tables 1 and 2, and arriving at a pool of 9 through a correlation evaluation also presented in the work of Zhou *et al.* (2016) and Mishra and Ghrera (2017), which proved to be significant in explaining the performance of the Work Activities, as also depicted in Figure 1, required for the professional roles analyzed. This kind of result may also pave the way for an evaluation of these aspects in the framework of the OSCM: different weights can be assigned to the various competences in order to take into account a hierarchy between the more and less important ones. From a practical point of view, the results achieved and the applied approach can provide valuable support in standard human resource management endeavors, including recruitment, selection and promotions, to mitigate issues such as skills mismatch. Establishing a clear correlation between job activities and required competencies can aid in identifying and selecting personnel best suited to perform specific tasks, thereby enhancing individual performance and, consequently, benefiting the overall success of the companies involved. Addressing these kinds of human-related aspect is one of the most significant aspects within the field of behavior operations management (Gino and Pisano, 2008). Moreover, further developments could lead to different rankings depending on the most suitable role for each candidate in the personnel selection phase.

## 4. Implications

### *4.1 Impact on company and academy*

The presented work has a significant impact on the themes related to the human factor in operations and SCM. By focusing on the identification of soft skills and abilities crucial for

success in these domains, the study contributes to enhancing the understanding of the human element's role in organizational performance. The findings provide valuable insights into the correlations between individual characteristics and tasks required in the OSCM environment, emphasizing the importance and possible impacts within appropriate industrial performance measurement systems (PMS). While acknowledging some limitations, which will be discussed in the conclusion, the obtained results hold promising implications worthy of examination. The defined set of soft skills and abilities, along with their correlation analysis, enables the explanation of a wide array of activities essential for effective performance in OSCM roles. These findings have practical applications for human resources management, recruitment and career evaluation within organizations, offering potential for enhancing workforce efficiency and effectiveness. Moreover, the research contributes to bridging the gap between academic theories and industrial practices, enabling organizations to develop tailored assessments and tests for evaluating individual attitudes and aligning them with job requirements.

The study thus highlights the significance of focusing on the development of targeted methods for assessing the identified characteristics as a result. These considerations can be approached from two main angles:

(1) Employees evaluation process: when it comes to the recruitment of new employees, the evaluation of individuals' soft skills should hold particular importance. A deficiency in these elements could result in lower levels of performance in fulfilling the work activities required for the role. Similar considerations can be extended to the assessment process for internal promotions, which should be adjusted to measure these elements effectively.

(2) Academic Pathways: these findings also impact the structuring of academic pathways. On one hand, the previous points aim to shift the focus in corporate assessment processes. However, the implications of these results also raise questions about the modification of university curricula to integrate teaching methods geared towards developing a set of skills suitable for effective performance in the corporate environment.

### *4.2 Implication for the body of knowledge*

The conducted study falls within the realm of behavioral OM research. More specifically, the results obtained provide significant support for research activities that center on the analysis of soft skills and their impact on workplace performance important (Binsaeed *et al.*, 2017; Rentzsch and Staneva, 2020; Stek and Schiele, 2021). Furthermore replicating the analysis using other databases, such as ESCO or job descriptions published by companies and comparing the results would contribute to a more robust theoretical foundation. Additionally, validating the findings by seeking feedback from domain experts would provide further confirmation of the results obtained. Moreover, developing structured frameworks to consolidate the information obtained and devising methods to measure this within possible maturity models could be explored as interesting lines of work. Lastly, including tests to assess these characteristics within university programmes and evaluating long-term professional trajectories in relation to varying levels of these personal attributes could provide valuable insights. The strengths of the approach presented lie in the ANOVA validation of the results obtained and the set of characteristics identified seems to be convincing in explaining the tasks required by personnel working in the OSCM sector; however, more in-depth investigations could also analyze which of the work activities contribute most significantly and weigh these differently with respect to the skills required to perform them. In any case, it is worth emphasizing how, from a practical point of view, the

results achieved and the approach used may prove to be of support in the typical activities of human resources management, such as recruitment, selection, and promotions, in order to counteract phenomena such as the skills mismatch: a clear link between activities and skills may facilitate the recognition and selection of personnel who are really suited to perform certain tasks, thus favoring the achievement of results by individuals and companies (Ployhart *et al.*, 2014).

Finally, further integrations could deepen these competencies by investigating methods for their evaluation and/or for measuring their impact on performance, up to the creation of models for predicting success in various OSCM positions based on the evaluation of these characteristics.

## 5. Conclusions

The proposed work analyzed the links and correlations between the activities and skills that characterize the main roles in Operations and SCM. The analysis of the literature revealed some critical issues concerning the impact of soft skills on performance, their importance in markedly technical areas and their evaluation (Boyatzis, 1982; Cheung *et al.*, 2015; Stek and Schiele, 2021). We therefore wanted to establish, through an examination of the O*NET database, which soft skills are the most relevant for operating in OSCM. In this way, the most important activities were first identified, and then, through the study of their correlations with the calculation of the main statistical indicators and the creation of linear regression models, we arrived at a set of nine soft skills and abilities, which were identified as fundamental to operating in the relevant sector.

The work presented has made it possible to define a set of skills and competences belonging to the generically defined soft sphere of individuals' characteristics.

However, despite conducting a valid analysis using the ANOVA method for validation, there are several limitations that should be highlighted:

(1) The study was restricted to a specific set of professional roles within the OSCM sector, for which all necessary data were available in the O*NET database.

(2) The choice of database for conducting the study may yield different results compared to using other databases.

(3) The study was conducted purely theoretically, and empirical validation of the results in real-world company settings would be necessary to confirm or refute the findings.

The limitations notwithstanding, the implications and potential future developments in this field remain of particular interest. The work has effectively integrated aspects that have not been fully explored in the literature, given the growing interest in operational excellence and human excellence. By identifying the most relevant soft skills for OSCM professionals, the study sheds light on critical issues surrounding their impact on performance, especially in technically oriented areas.

The comprehensive analysis of correlations between activities and skills has resulted in a set of nine fundamental soft skills and abilities essential for success in OSCM. This finding can serve as a foundation for defining targeted growth strategies and appropriate resource selections in companies, enhancing workforce efficiency and effectiveness. The study's contribution lies in bridging the gap between theoretical concepts and practical applications in the field of human factor, aligning individual characteristics with job requirements. Finally, as the demand for skilled professionals in OSCM continues to rise, the research presented here addresses a significant aspect within the domain of behavior operations management. With further developments, the knowledge gained from this study can contribute to driving excellence and efficiency in operations and SCM practices.

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## Appendix
## Step by step methodology explanation

STEP 1. Identification of professional figures:

In order to identify and comprehend the most important tasks within OSCM, nine professional figures were identified from the O*NET database. These figures represent the primary tasks performed in OSCM-related roles. The selection of these figures aimed to ensure representation of diverse job roles while providing detailed descriptions of the activities and abilities/skills needed for correlation analysis.

STEP 2. Identification of variables:

For the choice of variables, skills, abilities and work activities were selected. Work activities were preferred over tasks, as they were uniform across all chosen professional figures, simplifying the analysis. Tasks, being diverse and specific to each occupation, required extensive analysis and categorization, which could lead to approximate results depending on the categorization method.

STEP 3. Variable screening:

To identify only dimensions within the scope of research, a pool of variables was identified from the database. Skills related to theoretical knowledge, such as "science" and "mathematics," were removed, along with purely technical abilities. Screened work activities excluded physical and manual activities, deemed less significant in OSCM. Complex and technical activities, either too generic or too specific, were also discarded.

STEP 4. Data Analysis:

Data collection began by extracting information from the O*NET database for skills, abilities and work activities related to each of the nine selected professional figures. Importance scores ranging from 0 to 100 were transformed into values between 0 and 1 for analysis convenience. Using Microsoft Excel, variables were organized into tables based on their importance, facilitating necessary analyses. A second screening was performed by removing variables with an average importance score below 0.5. Subsequent matrix analysis highlighted combinations of variables maintaining high importance across all figures (average matrix) and those exhibiting lesser dispersion (standard deviation matrix).

STEP 5. Validation using ANOVA methodology:

To validate the analysis steps, three single-factor ANOVA analyses were performed to evaluate the values of skills, abilities and work activities across different professional figures. These analyses demonstrated reasonable variability in the characteristics of the considered job figures, substantiating their significance for the study. The analysis was replicated across six different business areas, yielding significant $p$-values, further validating the conducted study.

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