

COMPETENCY REQUIREMENTS FOR SAP S/4HANA: A COMPARATIVE ANALYSIS OF STAKEHOLDER PERSPECTIVES

Joanna PALONKA^{1*}, Małgorzata PAŃKOWSKA²

¹ University of Economics in Katowice, Faculty of Informatics and Communication, Department of Informatics;
joanna.palonka@ue.katowice.pl, ORCID: 0000-0001-5056-649X

² University of Economics in Katowice, Faculty of Informatics and Communication, Department of Informatics;
malgorzata.pankowska@ue.katowice.pl, ORCID: 0000-0001-8660-606X

* Correspondence author

Purpose: This study aims to identify and analyse perceptions of the core and critical managerial competences that enable effective performance in technologically advanced environments supported by SAP S/4HANA.

Design/methodology/approach: A review of relevant literature, analysis of job postings from headhunter platforms, and a survey of current and prospective SAP S/4HANA users in Poland.

Findings: The results revealed differences between the two groups in the perceived importance of technical and end-user competences. Active users, drawing on practical and experience-based perspectives, prioritized these competences differently compared to potential users, whose assessments were influenced more by theoretical or academic backgrounds. Notably, social competences were valued similarly by both groups, underscoring their universal relevance across roles and levels of experience.

Research limitations/implications: The sample was limited to two defined groups, and the questionnaire contained specialized terminology that may have been challenging for some respondents. The survey required familiarity with IT and SAP-supported processes, and some users demonstrated gaps in basic SAP knowledge. Future research should broaden the respondent base and consider adopting more structured research conditions to enhance data quality and depth of analysis. These steps would support a more comprehensive understanding of the competences required for effective work within SAP-supported ecosystems and help refine related educational strategies.

Practical implications: The research suggests that both educational institutions and businesses need to adapt their training and development strategies to better align with the competences required for effective use of SAP S/4HANA. This will not only benefit individual employees but also contribute to the overall success and competitiveness of the organizations they work for.

Originality/value: This paper offers a comprehensive analysis of essential managerial competences in technologically advanced environments supported by SAP S/4HANA. By comparing perceptions of current and prospective users with educational programs and industry expectations, it provides valuable insights into gaps between education and real-world needs. This contribution is relevant to educators, industry professionals, and policymakers aiming to improve competency alignment in SAP ecosystems.

Keywords: competences, skills, SAP S/4 HANA, ESCO, I-ERP.

Category of the paper: Research paper.

1. Introduction

The Enterprise Resource Planning systems (ERP) are marketed as an off-the-shelf product as well as a cloud-based service. Whichever delivery method is applied, ERP systems ensure the information processing for a wide range of configurable standard business processes. Therefore, the ERP system implementation follows the business process reengineering. However, the processes are not static and their continuous change is included in the business architecture of the company using the ERP system. Although ERP systems are very large to ensure the holistic processing of company's data, they are operating to integrate the whole supply chains, as well as to provide data analytics and reporting for decision-making. Year-by-year the essential ERP systems are being integrated with other applications from the same or other software producers. The development and exploitation of the software portfolios by the companies in value chains create the information management ecosystems. The ecosystems' employees are expected to be competent to cope with information management challenges. Competence centers in the business units typically experience high workloads due to many ongoing and competing projects. Beyond a continuous implementation of new processes, the employees learn new versions of software as well as new software packages including particular functionalities. Under such conditions it is hard to argue that a static set of competences is enough. This investigation aims to examine the competences of users operating within ERP ecosystems, using the next-generation intelligent business suite SAP S/4HANA as a case example. As the latest evolution in SAP's ERP portfolio, S/4HANA integrates advanced technologies and real-time analytics, serving as a practical example for examining the competences needed in today's technology-driven organisations.

To achieve our objective, we analysed what competences are announced by head hunters and required by the potential employers, i.e., SMEs and big companies in Poland. Next, we developed a questionnaire to ask the SAP users in Poland what competences are important for them. That investigation results were confronted with course proposals provided by the SAP University Competence Center (SAP UCC).

The rest of the paper is organised as follows. The first section covers various interpretations of competences, their classifications, e.g., ESCO, models, and theoretical background. The next section includes survey descriptions and its results analysis. The third part covers the SAP UCC arguments concerning the SAP S/4 HANA competences. The final section includes conclusions and some recommendations for Higher Education Institutions (HEIs).

2. Competences' interpretation and standardisation

The Intelligent Enterprise is its ability, supported by technologies, to optimise their resources' usage. The factors having a positive impact on the business organisation include organisational culture, employees competences, and their motivation (Thannhuber, 2005). According to Jenab et al. (2019), competences are the employees abilities needed to perform their roles successfully within the business organisation. They should be definable, measurable, observable, and critical for each company. They are unique for each enterprise, created, developed, and verified inside the company. They are expected to provide guidelines that enable identification, evaluation, and development of individual behaviour. Bakici and Canboy (2020) argue that individual competences, also called employee competences, are skill sets and knowledge that people bring with them to perform tasks successfully. The individual competences are divided into technical and behavioural competences. The first ones are an individual's abilities to perform tasks (e.g., the use of programming language by software developers), the second – refer to an individual's abilities to behave properly and knowledgeably in a work-related context. Eschenbrenner and Nah (2014) explain that competence definitions are consistent with definitions of expertise, which includes knowledge, skills, abilities, personal traits, and cognitive capabilities.

Mesaros et al. (2017) focused on development managerial competences as an integral part of the knowledge society initiatives. Managerial competences are very important for better decision-making through the ERP systems. Charland et al. (2015) have studied competences of the ERP learners. Their research was based on the Competency-Based training, learning, and knowledge Theory (CBT), which originates from the studying of behaviours and expected results in the field of education, where the competences refer mostly to the effective mobilisation of individuals in a given situation. Cox (2025) emphasized the need to differentiate competence and competency. Competence includes skills, knowledge, understanding the core concepts, rules, and procedures, while competency is useful to measure soft skills, or performed roles, behaviours, or knowledge, which skills are appropriate to use and when, how well the rules and procedures are understood. Dimitratos et al. (2014) argue that competences are a source of competitive advantage for contemporary enterprises. Competences are the combination of activities and processes, which allow the firm to exploit opportunities and generate values (Srivastava, 2005). The competence space can be a useful framework for considering various business strategies. Competence-Based Theory provides an important explanation of competences' importance for business strategy, global ecosystems' specialization and cooperation, as well as assets orchestration (Wallin, 2012). Competence-Based Theory is based upon the other theories, i.e., resource-based theory, knowledge-based theory, which emphasize the importance of organisational resources and capabilities in creating values for firms. Akbulut (2015), while considering what motivates students to study enterprise

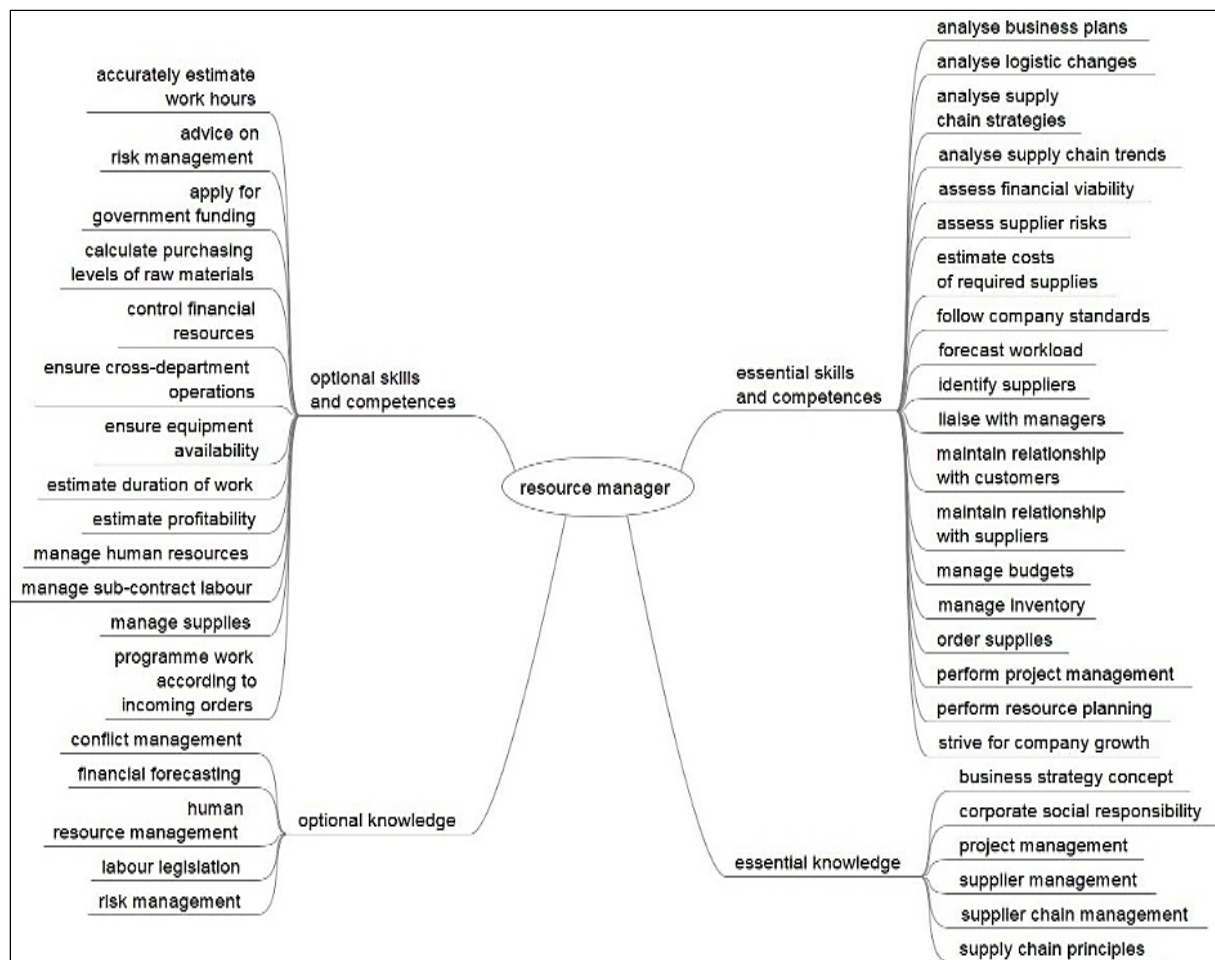
systems, has found that the domain specific self-efficacy, outcome expectations, and personal interests shape the students' aspiration to learn and develop competences. Those considerations are based on the Social Cognitive Career Theory, which as well as the Cognitive Load Theory (Wilhelm-Weidner, 2020) are theoretical background of the technical and business competences development at contemporary enterprises.

Sattelmaier and Pawlowski (2025) provided a study on theoretical foundations and methodological approaches used for competency model development. Their review emphasizes the Dynamic Capabilities Theory, Self-Determination Theory, and Competency-Based View.

Beyond those theories, teachers involved in ERP system deployment may develop teaching methods particularly suitable for such systems. The Model of the Learning Process based on the work of Dreyfus and Dreyfus (Baumgartner, Payr, 1996) covers transformation from novice to expert in ERP system usage. For a novice, the learning practice is limited to exercises, while the competent person understands rules and facts, hence the expert can focus on problem solving. Contrary to the learning theories, this approach does not consider competence to be the final goal of learning. The expert not only solves problems but also is able to construct them in complex real-life contexts. The learning process starts from simple structured tasks and processes towards constructing complex contextual tasks, moving from basic behavioural learning towards cognitivism and complex group work. Schreiner and Wiesner (2023) highlight competency models as the foundation for teaching, learning and assessment as they are needed for designing curricula, preparing teaching materials, and establishing assessment standards. Modeling competences requires the identification of their concepts and the structure of internal relationships. In each case, the competency model should be based on a theoretical framework for teaching. This view is typical for universities, which are oriented towards study programme development and accreditation. However, business organisations, in their interests to employ the most suitable employees, may be more concerned with competency standardisation.

Therefore, according the International Competence Baseline (ICB), the International Project Management Association (IPMA) has identified four components of competences (i.e., knowledge, skills, personal attitudes, and experience) located in three domains (i.e., people and interactions among them, practice for projects and programs, and context, within which initiatives are run). The European Commission has introduced the multilingual classification of Skills, Competences, Qualifications, and Occupations (ESCO) to improve the supply of information on skills demand in a labour market and to standardize information on skills (Chiarello et al, 2021). The aim of the ESCO dictionary is to support job mobility across Europe and integrate the internal labour market by offering a common understanding of competences. Therefore, for example, according to the ESCO, the process officers should have competences allowing them to identify, document, and maintain the processes that are necessary to be implemented in an enterprise. Hence, the process officer should be able to review existing processes, evaluate improvements, elaborate internal documents and support the operations of the enterprise to meet the Key Performance Indicators (KPIs). That profession as well as a resource manager are applicable for the ERP system exploitation (e.g., SAP S/4 HANA).

Figure 1 covers identification of critical competences of resource managers.

**Figure 1.** Resource manager competences in the ESCO.

Source: own elaboration.

According to the ESCO v.1.2.0, the general competences are subdivided into four groups, i.e., essential knowledge, essential skills and competences, optional skills and competences, and optional knowledge. Resource managers are responsible for management of the organisational resources assigned to actual and potential projects. The managers are connected with various departments to monitor resources and communicate any issues having an impact on the organisation effectiveness.

3. SAP S/4 HANA competences identification

In general, ERP systems cover a suite of business modules that can serve and support various business functions, i.e., management reporting, manufacturing management, maintenance of equipment, transportation management, materials management, quality management, human capital management, accounting and financial management, project and

procurement management, advanced planning and scheduling, e-commerce and sales force automation, investment and environment management, business intelligence and knowledge management, supply chain management and data warehousing (Rajapaksha, Singh, 2012). Nowadays, the Intelligent Enterprise Resource Planning (I-ERP) is implemented as an extension of the ERP system with the Machine Learning algorithms (Jenab et al., 2019). The SAP S/4 HANA is an integrated system that delivers the latest industry best practices and business application solutions on-premise or on the cloud network. It offers efficient, agile, and affordable functionalities strictly integrated with other SAP solutions to ensure increase of productivity, long-term strategic benefits, and growth of market share. Those challenges encourage business organisations to ensure appropriate capabilities, through their generation, combination, and exploitation of knowledge. Schrieck et al. (2021) have identified the SAP capabilities, i.e., technology-related capabilities, relationship-driven capabilities. Jung and Lehrer (2017) have provided wider classification of system users' competences, as follows:

- Subject-specific skills, focused on understanding domains of software within organization.
- Social skills, showing interest in other people and their concerns.
- Personal skills, including ability and willingness to independently acquire new knowledge, and to learn and deal with changing situations.

Figure 2 includes the authors' proposal of capabilities needed for SAP S/4HANA.

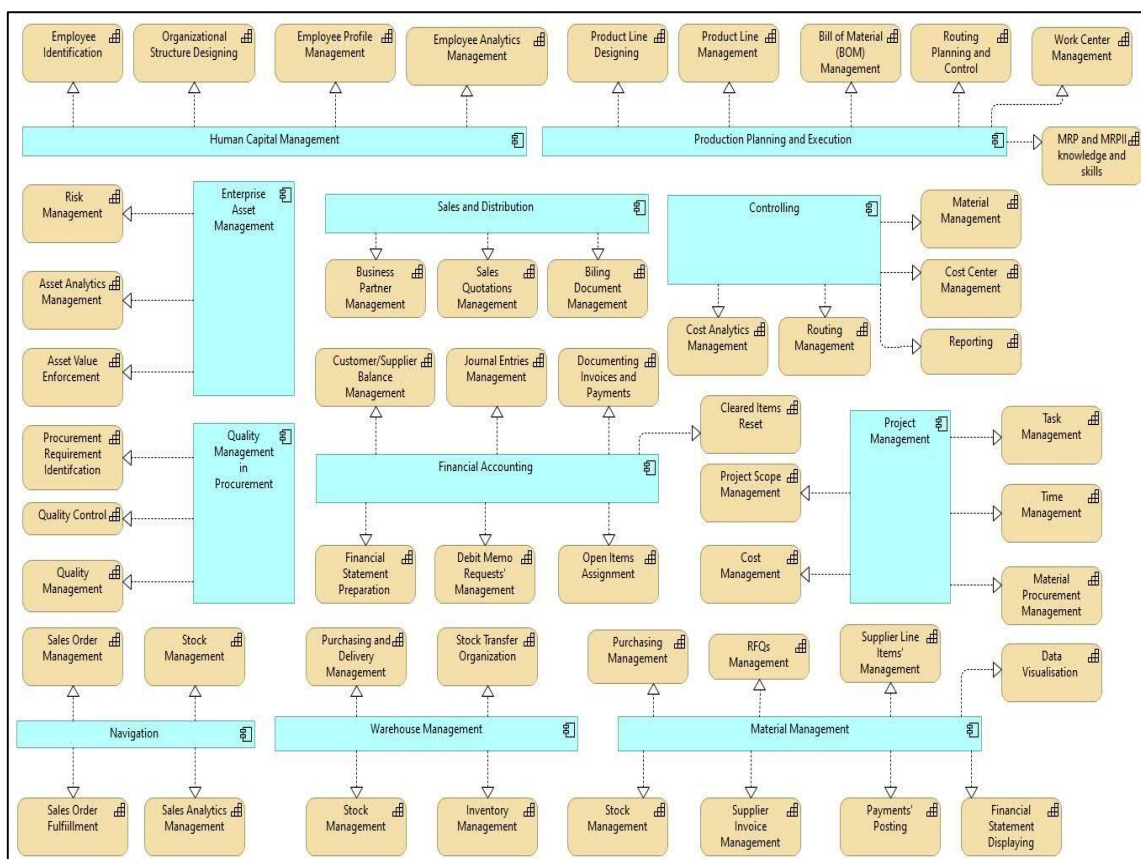


Figure 2. SAP S/4 HANA Competence Identification.

Source: own elaboration.

The basic business capabilities result from the software system functional decompositions. According to Alvarez (2022) business capabilities are „hidden” in processes, information and data, technology, and people, e.g., internal and external stakeholders’ knowledge, skills, experiences and social competences, organisational structure, or decision making frameworks. Usually, the SAP S/4 HANA system users have a prerequisite knowledge to be able to apply the software, as well as they have the IT competences, and analytics skills as the necessary prerequisites to the further extended usage of the SAP solutions.

Following the publications provided by Alvarez (2022) and Hassan (2022), authors proposed the SAP S/4 HANA capabilities identification (Figure 2). Therefore, for example Human Capital Management requires management capabilities concerning employee identification, organisational structure design, employee profile management. Beyond that, Employee Analytics Management capability is needed. Analysis of the Figure 2 permits for inference that SAP S/4 HANA usage requires management capabilities, i.e., finance, logistics, quality management, product management, project management, and human capital management. Hence, the end users should have management, finance, controlling, logistics competences. Beyond that the analytics and IT competences are needed. However, other competences, e.g., marketing or system conversion, software customization with ABAP are not included in the SAP S/4 HANA learning process, and they would need a separate software and learning time.

Following the idea of Intelligent Enterprise, the SAP UCC at Technical University of Munich as well as at University of Magdeburg offer a technology platform as a service for teaching SAP products, i.e., SAP S/4 HANA. SAP products are accessible only by HEIs online in the developed Teaching and Learning Environments (TLEs) (SAP UCC, 2024). The SAP S/4 HANA is provided with data of a fictitious model company named Global Bike. The SAP UCC have provided not only SAP S/4 HANA system, but also other products, i.e., SAP HANA Platform, SAP Analytics Cloud (SAC), Supply Chain Planning, SAP Data Warehousing, SAP Business One, or Process Mining with SAP Signavio. Simultaneously, SAP UCC provides teaching materials, practical exercises, and case studies. The SAP S/4 HANA is offered as a ten-day block course. Therefore, students can learn the integrative business processes in some business areas, i.e., Bike Sharing, Controlling, Enterprise Asset Management, Financial Accounting, Human Capital Management, Material Management, Production Planning and Execution, Project System, Quality Management, Sales and Distribution, Warehouse Management, and Navigation. The courses and learning materials provided by SAP UCC are ordered to provide comprehensive knowledge on those integrative business areas, hence other individual HEIs have the opportunity to provide teaching in similar ways and with usage of the Global Bike data. In that way, the SAP UCC is able to ensure a unified and easy way of teaching their products, and create a global community of SAP products’ users. Although they focus on SAP products’ teaching, they neglect other business and social competences development. Many HEIs using just the SAP software and materials are not able to educate the resource managers having the ESCO competences as they are required.

4. Research methodology

This paper aims to explore how core and critical competences of managers operating within ecosystems supported by SAP S/4HANA are perceived. To achieve this goal, a survey was conducted to assess the perception of key managerial competences in such environments.

The competences used in this study were derived from a prior analysis of the demand for employee skills related to SAP S/4HANA in the Polish job market. This analysis was based on job postings published in July 2024 on the following platforms: indeed.com, infoPraca.pl, LinkedIn, nofluffjobs.com, oferty.praca.gov.pl, rocketjobs.pl, and theprotocol.it. All selected postings contained the keyword “SAP S/4HANA” (Pańkowska, Palonka, Rizun, 2024). The identified competences were categorized into three groups: technical, end-user, and social competences.

The resulting list of competences was verified against the competences that can be achieved upon completion of SAP UCC courses. Based on this, a structured questionnaire was developed using Google Forms. The survey was divided into four sections:

Section 1 – Respondent Information - this section included questions about the respondent’s professional background, such as company profile, industry, department, position, duration in the current role, and experience with SAP solutions (including the currently used version, previous versions, planned upgrades, modules in use, and completed SAP training courses).

Section 2 – Technical competences – this section included questions regarding the respondent’s knowledge and experience:

- With HANA, UI5, FIORI and SQL.
- In implementing, migrating, and optimising SAP solutions, especially transitioning from earlier versions of SAP ERP to SAP S/4 HANA.
- In designing robust and scalable IT architectures that align with business goals, with deep knowledge in integration, preferably SAP Cloud Platform, and SAP product and architecture knowledge.
- With SAP Analytics Cloud.
- In configuring and customizing SAP solutions to integrate with other SAP modules and external systems, ensuring smooth data flow and process alignment.
- With key integration points with other SAP modules such as Ariba, Master Data Governance (MDG), and Warehouse Management System (WMS).
- In reading and understanding ABAP code.
- In defining Process Integration (PI) or ABAP interface programs with third-party entities (e.g. invoicing, EDI), including simple debugging, Business Application Programming Interface (BAPI), Business add-ins (BADI) and user queries.

- In ensuring compliance, security, and efficiency within the SAP S/4HANA access control framework including activities such as advising on and approving access requests, as well as collaborating with stakeholders to optimise role assignments.

Section 3 – End-user competences – this section included questions about the respondent's knowledge and experience in:

- familiarity with the functions and capabilities of SAP S/4HANA in the following modules: Finance (Financial Accounting (FI), Controlling (CO), Treasury and Risk Management (TRM)), Logistics & Supply Chain Management (Materials Management (MM), Sales and Distribution (SD), Production Planning (PP), Quality Management (QM), Plant Maintenance (PM), Extended Warehouse Management (EWM), Transportation Management (TM)), Manufacturing & Engineering (Production Planning for Process Industries (PP-PI), Product Lifecycle Management (PLM), Manufacturing Execution (ME), Human Capital Management (HCM), Customer & Service Management (Customer Service (CS), Customer Relationship Management (CRM), C/4HANA)), Analytics & Reporting (Business Warehouse (SAP BW/4HANA), SAP Analytics Cloud (SAC)), Project Management, Governance, Risk & Compliance (GRC), Advanced Compliance Reporting (ACR), Deposit Management (DM)/Banking Platform (BP) and providing functional support for these modules;
- providing support in the handling of processes: Record to Report (R2R) or Procure-to-Pay (P2P);
- understanding of cross module dependencies;
- implementation of new customers based on a decentralized SAP Warehouse Management (WM) system integrated with the S/4 HANA system.

Section 4 – Social competences – this section included questions about the respondent's knowledge and experience in:

- working in agile, virtual and cross-functional teams,
- ability to act as liaison between the business and technical worlds,
- supporting the collection and analysis of requirements from business departments and providing advice on functional, methodological and process-oriented solutions,
- communication and presentation skills, with the ability to design and deliver high-impact presentations,
- quick understanding and the ability to provide and receive constructive feedback,
- strong analytical and conceptual strengths,
- ability to prioritize and organise work effectively,
- ability to manage conflict situations,
- excellent command of English and German languages (written and verbal),
- willingness to travel.

For the purpose of this study, a qualitative investigation was conducted to examine opinions on how core and critical managerial competencies enabling effective performance in technologically advanced environments supported by SAP S/4HANA are perceived. The study involved 6th-semester Bachelor's students, Master's students in Informatics and Econometrics, as well as postgraduate students enrolled in the programme "Applications of SAP S/4HANA in Organisations" at the University of Economics in Katowice. The sample selection was non-random, based on purposive and convenience sampling.

The data was collected using an online questionnaire. Both Computer-Assisted Web Interviewing (CAWI) and Paper and Pencil Interviewing (PAPI) methods were applied. The questionnaire was distributed to respondents to assess the perceived importance of selected competences. A 5-point Likert scale was used, with the following values: 5 - essential, 4 - partially essential, 3 - complementary, 2 - partially redundant, 1 - redundant. To evaluate the significance of each competency category among current and prospective SAP software users, the arithmetic mean was calculated for responses in the relevant sections.

5. Results

To assess the perception of core and critical competences of managers operating within ecosystems supported by SAP S/4HANA, a survey was conducted in March and April 2025. The study targeted both active and potential users of SAP software from Polish organisations across the manufacturing, trade, and service sectors.

A total of 81 respondents completed the questionnaire. They were divided into two groups:

- Active Users, i.e. individuals who currently use SAP solutions in their professional work.
- Potential Users, i.e. individuals who may use SAP solutions in the future but currently have limited or no hands-on experience with it.

The **Active Users** group consisted of 37 respondents using various SAP solutions (SAP R/3, ERP, S/4HANA). Among them: 12 were employed in the manufacturing sector, 6 in trade, and 11 in services. They represented a diverse range of industries, including: finance and insurance, metallurgy and foundry, mining and drilling, energy, construction, automotive, healthcare, food, transportation, forwarding, and logistics. The departments they worked in included: finance and accounting, controlling, human resources, production planning, procurement and warehouse management, logistics, customer service, and IT. These respondents reported using SAP modules such as: FI, CO, MM, HCM/HR, PM, WM, SD, Forecasting and Replenishment (F&R), Supply Chain Management (SCM), APO, QM, PP, and CS. Additionally, the group included 4 interns/trainees and 5 individuals actively seeking SAP-related employment. The maximum reported work experience with SAP solutions

in this group was 17 years, including up to 5 years with SAP S/4HANA.

The **Potential Users** group comprised 44 respondents, mainly students, including 2 individuals with no prior exposure to SAP software. Survey results were analysed separately for each group across the following three sections: Technical Competences, End-User Competences and Social Competences.

Table 1 displays the arithmetic means, based on survey data, representing the perceived importance of competences within the *Technical Competences* section.

Table 1.

Arithmetic mean values of perceived importance for technical competences based on survey data

Technical competences	Active Users	Potential Users
1. Proficient knowledge in:		
1.1. HANA	3,65	3,50
1.2. SAP UI5	2,68	2,93
1.3. Fiori	3,54	2,91
1.4. SQL	2,81	3,8
2. Experience in:		
2.1. Implementing SAP solutions	3,35	3,3
2.2. Migrating and optimizing SAP solutions, especially transitioning from earlier versions of SAP ERP to SAP S/4 HANA	3,51	3,2
2.3. Designing robust and scalable IT architectures that align with business goals, with deep knowledge in:		
2.3.1. Integration, preferably SAP Cloud Platform	2,84	3,18
2.3.2. SAP product and architecture knowledge	3,08	3,14
2.4. SAP Analytics Cloud	2,86	3,50
2.5. Configuring and customizing SAP solutions to integrate with other SAP modules and external systems, ensuring smooth data flow and process alignment	3,32	3,50
2.6. With key integration points with other SAP modules such as		
2.6.1. Ariba	2,54	2,41
2.6.2. MDG (Master Data Governance)	2,49	2,91
2.6.3. WMS (Warehouse Management System)	2,92	2,95
3. Basic to strong ABAP know-how with proficiency in reading and understanding ABAP code	2,24	2,66
4. Defining Process Integration (PI) or ABAP interface programs with third-party entities (e.g. invoicing, EDI), including simple debugging, Business Application Programming Interface (BAPI), Business add-ins (BADI) and user queries	2,32	2,84
5. Knowledge and experience in:		
5.1. Ensuring compliance, security, and efficiency within the SAP environment	2,92	3,50
5.2. Preparing access control structures in S/4HANA (i.e. various aspects of access management, from advising and approving access requests to collaborating with stakeholders to optimize access roles)	2,70	3,18

The analysis of the data presented in Table 1 reveals the average levels of competency importance (measured on a 5-point scale from 1.00 to 5.00) within the *Technical Competences* section:

- among **Active Users**, average ratings range from 2.24 to 3.65. The highest-rated competences were: 1.1, 1.3, 2.1, 2.2, 2.3.2., and 2.5, while the lowest ratings were observed in categories 3 and 4.

- among **Potential Users**, average ratings range from 2.41 to 3.80. The most highly rated competences included: 1.1, 1.4, 2.4, 2.5, and 5, whereas the lowest ratings were assigned to 2.6.1 and 3.

The remaining sections were analysed using the same approach.

Table 2 presents the mean importance levels of competences within the *End-User Competences* section.

Table 2.

Arithmetic Mean Values of Perceived Importance for End-user Competences Based on Survey Data

End-user competences	Active Users	Potential Users
1. Knowledge and experience in handling business processes in the SAP S/4HANA modules:		
1.1. Finance		
1.1.1. Financial Accounting (FI)	3,41	3,45
1.1.2. Controlling (CO)	3,24	3,57
1.1.3. Treasury and Risk Management (TRM)	2,84	3,52
1.1.4. Accounts Payable / Accounts Receivable (AP/AR)	3,03	3,36
1.2. Logistics & Supply Chain Management		
1.2.1. Materials Management (MM)	3,84	3,39
1.2.2. Sales and Distribution (SD)	3,7	3,32
1.2.3. Production Planning (PP)	3,11	3,14
1.2.4. Quality Management (QM)	2,86	3,14
1.2.5. Plant Maintenance (PM)	2,59	3,14
1.2.6. Extended Warehouse Management (EWM)	3,03	3,23
1.2.7. Transportation Management (TM)	2,62	3,2
1.3. Manufacturing & Engineering		
1.3.1. Production Planning for Process Industries (PP-PI)	2,51	3,23
1.3.2. Product Lifecycle Management (PLM)	2,46	3,32
1.3.3. Manufacturing Execution (ME)	2,57	3,36
1.4. Human Capital Management		
1.4.1. Human Capital Management (HCM)	2,68	3,11
1.4.2. SAP SuccessFactors	2,62	3,05
1.5. Customer & Service Management		
1.5.1. Customer Service (CS)	2,65	3,45
1.5.2. Customer Relationship Management (CRM)	2,78	3,5
1.5.3. C/4HANA	2,62	3,14
1.6. Analytics & Reporting		
1.6.1. Business Warehouse (SAP BW/4HANA)	3,49	4,07
1.6.2. SAP Analytics Cloud (SAC)	3,62	4,09
1.7. Project Management (PM)		
1.7.1. Project System (PS)	2,78	3,55
1.8. Governance, Risk & Compliance (GRC)	2,46	3,45
1.9. Advanced Compliance Reporting (ACR)	2,08	2,98
1.10. Deposit Management (DM) / Banking Platform (BP)	2,24	3,02
2. Knowledge and experience in:		
2.1. Understanding of financial processes such as accounting, asset management, financial consolidation, and financial reporting	2,86	3,59
2.2. Planning, coordinating, and driving large financial transformation projects	2,57	3,55
2.3. Integrating SAP CO with other modules, including but not limited to SD, Supply Chain and Manufacturing	3,03	3,25

Cont. table 2.

2.4. Managing operational data related to procurement, including SAP contracts, price lists, supplier master data, and central training materials for procurement process	3,16	3,18
2.5. Providing services and capabilities to oversee and perform conceptual and analytical activities within the Procurement area	2,97	3,32
2.6. Developing detailed plans, timelines and objectives for PLM projects	2,43	2,95
2.7. In-depth knowledge of R2R processes	2,32	2,82
2.8. Strong understanding of P2P business process	2,46	3,25
3. Experience in:		
3.1. Working with the SAP FI module on S/4HANA, including General Ledger Accounting, Accounts Receivable, Accounts Payable, Asset Accounting, Bank Accounting, Embedded Analytics, and Reporting	2,97	3,5
3.2. Utilizing the SAP CO module on S/4HANA, covering Overhead Cost Controlling, Product Cost Controlling, Profitability Analysis, Profit Centre/Segment Reporting, Material Ledger, Profit Center Accounting, Embedded Analytics, and Project Systems/Enterprise Portfolio and Project Management (EPPM)	2,92	3,27
3.3. Deep understanding and hands-on experience with SAP MM and Supplier Relationship Management (SRM) modules on S/4HANA, including configuration, customization, and integration	3,22	2,86
3.4. Configuring SAP QM modules to support business-specific requirements, including Quality Planning, Quality Inspection, and Quality Control processes	2,54	2,95
4. Knowledge and experience in:		
4.1. Creating Bills of Materials (BOMs) and Master Recipe (MR)	2,76	2,84
4.2. Implementing system changes outside of the Master Data Governance (MDG) scope, including creation of new material codes in SAP S/4HANA for BOMs and Master Recipes for finished goods	2,86	2,89
4.3. Defining and agreeing on usage standards and recipes	2,46	2,98
4.4. Updating BOMs and recipes in line with current business requirements	2,46	2,91
4.5. Implementing annual Annual Operating Plan (AOP) changes	2,35	2,95
4.6. Implementing new customers using a decentralized SAP Warehouse Management (WM) system integrated with S/4HANA	2,59	3,09
5. Understanding of cross-module dependencies (PP/PI, QM, FI/CO, MM, WM, SD) as well as master data in MM, QM, and PP	3,38	3,25
6. Providing support in business process management across SAP S/4HANA modules	3,05	3,18

In the *End-User Competences* section:

- among **Active Users**, the average importance ratings range from 2.08 to 3.84; the highest-rated competences included 1.2.1, 1.2.2, 1.6.2, 1.6.1, 1.1.1, 1.1.2., 5, and 3.3, while the lowest-rated were 1.9, 1.10, 2.7, and 4.5;
- among **Potential Users**, ratings ranged from 2.82 to 4.09, with the highest ratings assigned to 1.6.2, 1.6.1, 1.1.2, and 1.7.1; the lowest-rated competences included 2.7, 1.9, and others related to the implementation of specialized tasks.

Table 3 presents the mean importance levels of competences within the Social Competences section.

Table 3.

Arithmetic Mean Values of Perceived Importance for Social Competences Based on Survey Data

Social competences	Active Users	Potential Users
1. Experience in working with:		
1.1. agile methods/Kanban	3,22	3,52
1.2. agile, virtual and cross-functional teams	3,43	3,89
2. Ability to act as liaison between business and technical stakeholders	3,76	3,98
3. Supporting the collection and analysis of business requirements	3,78	4,07
4. Effective communication throughout the SAP implementation lifecycle	3,81	3,8
5. Providing advice on functional, methodological and process-oriented solutions	3,76	3,61
6. Excellent communication and presentation skills, including the ability to design and deliver impactful presentations	3,84	3,66
7. Quick understanding with the ability to provide and receive constructive feedback	4,22	4,27
8. Strong analytical and conceptual thinking skills	4,59	4,66
9. Ability to conduct conceptual work	4,05	4,05
10. Result-oriented team player with a collaborative mindset	4,27	4,27
11. Ability to:		
11.1. prioritize and organize work effectively	4,35	4,39
11.2. work autonomously with a high level of proactivity	4,38	4,43
11.3. handle and resolve conflict situations	3,84	3,86
12. Proficient in spoken and written communication in:		
12.1. English	4,43	4,86
12.2. German	2,35	2,8
12.3. Other languages	1,78	2,43
13. Willingness to travel	2,57	2,48

In the *Social Competences* section:

- among **Active Users**, ratings ranged from 1.78 to 4.59; the most highly valued competences were 8, 12.1, 11.2, and 11.1, while the least important was 12.2;
- among **Potential Users**, ratings ranged from 2.43 to 4.86; the highest-rated competences were 12.1, 11.2, and 11.1, while the lowest-rated were 12.2, 13, and 12.3.

The results highlight differences in the perception of key competences between active and prospective users of SAP S/4HANA. Technical and end-user competences were prioritized differently by each group. Active users, drawing on practical and experience-based perspectives, placed different emphasis on these competences compared to prospective users, whose assessments were more influenced by theoretical or academic backgrounds. In contrast, social competences were valued similarly by both groups, underscoring their universal relevance across roles and experience levels. These findings provide deeper insight into user needs within technologically advanced ERP ecosystems and provide a foundation for further research aimed at better aligning education and professional development with real-world requirements.

6. Discussion and conclusions

In this study, authors focus on presentation of various expectations concerning SAP S/4 HANA education. The ESCO system analysis permitted for the identification of resources manager competences, which could be useful on the position of manager using that ERP system.

The ESCO model is linked to the European Learning Model v.3 (ELM v.3), which is developed to ensure the interoperability and credential exchange, recognition of and trust in qualifications across Europe (EC, 2023). The ELM is multilingual, and fully aligned with existing open frameworks and standards, including the European Qualifications Framework for Lifelong Learning (EQF). The ELM is to support the comparability, transparency and portability of all data related to learning. The ELM ontology does not define the ERP manager competences (as they are identified in the ESCO system, but it is useful in defining the education requirements. A ELM Ontology of Concepts covers:

- specifications what can be learned through occupational profiles, competence frameworks, curricula, skill classification,
- opportunities describing an offer by an educational organisation, which leads to a learning outcome,
- credentials describing a claim about the individual, e.g., attendance certificate, degree, diploma supplement, letter of recommendation.

The ELM Learning Activity Specification includes:

- Learning Achievement, i.e., a description of a set of knowledge and skills used with responsibility and autonomy, which may be acquired. These sets are formulated and included in the ESCO system.
- Learning Activity, i.e., any action, which may lead to the acquisition of knowledge, skills, or responsibility and autonomy, e.g., workshop, courses of actions are provided by the SAP UCC, because of their teaching methods and materials.
- Learning Assessment, i.e., the process of establishing to which a learner has attained particular knowledge, skills, and competences against criteria such as learning outcomes or standards of competence, e.g., the way of measurement of acquired knowledge. That role should belong to the HEIs.
- Learning Entitlement, describing the right to practice a profession, take advantage of a learning opportunity or join an organisation as a result of the acquisition of knowledge, skills, responsibility and autonomy. That right belongs to the business recruitment organisations, i.e., headhunters formulating particular requirements and monitoring markets' needs.

However, beyond that, there are additional groups having particular desires, beliefs, and intentions. Those groups cover actual business employees i.e., active users as well as future employees, i.e., students, or potential users of SAP products.

In general, the SAP product learning is provided in two ways: by SAP UCC or by SAP dealers, i.e., product vendors or deployment service providers. The education of SAP products at HEIs is under the control of SAP UCC. Through the University Alliances (UA) program, SAP UCC supports practical education by giving teachers and students worldwide access to the latest SAP technologies. SAP UCC expects universities and vocational schools to integrate SAP software into their teaching and training programs. SAP UCC provides its users, as well as its partner Academic Competence Centres (ACC), with all necessary learning materials and services. Through the SAP Learning Hub (SAP LH), HEIs have access to the Academic Edition central collaboration platform for the global SAP UA program, including learning materials and announcements about SAP-supervised educational courses. The SAP LH AE portal users' learning interests are mostly focused on SAP S/4 HANA, SAP Signavio, and SAP Analytics Cloud. Polish universities collaborate with other HEIs only within the SAP UCC framework. Polish universities providing courses on SAP S/4 HANA are as follows, divided into public and private schools:

- Public universities:
 - AGH University of Kraków, Faculty of Computer Science.
 - University of Economics in Katowice.
 - University of Economics in Poznań, 10-day trainings for the SAP UA certificate.
 - Łódź University of Technology, Faculty of Physics, Computer Science, and Applied Mathematics.
 - Częstochowa University of Technology, Faculty of Management - in cooperation with BPX, Wielton, and SAP UA.
- Private universities:
 - Kozminski University, Warsaw.
 - High School of Computer Science and Management, Rzeszów.
 - The Chartered Institute of Logistics and Transport, Wrocław.
 - WSB MERITO University in Warszawa, Wrocław, Łódź, Szczecin, Chorzów-Katowice, Toruń, Bydgoszcz, Poznań, and Opole.

In addition, some HEIs provide specialised courses:

- Software engineering for SAP S/4 HANA and ABAP language programming – WSB MERITO University in Chorzów and Bydgoszcz.
- Production planning with SAP S/4 HANA – WSB MERITO University in Gdańsk, Gdynia, Poznań, Szczecin, Łódź, Toruń, Opole, Bydgoszcz, and Chorzów.
- Financial Accounting in SAP S/4 HANA for SAP ERP FI Professionals – Altkom Akademia, Warsaw.

This study explored the perceptions of core and critical competences among active and potential users of SAP S/4HANA within the context of Polish organisations. The results revealed differences between the two respondent groups in how they assess the importance of technical and end-user competences. Active users, with their practical and experience-based

perspective, demonstrated a different prioritization compared to potential users, whose evaluations were shaped by a more theoretical or academic background. Notably, social competences were similarly valued by both groups, indicating their universal relevance across roles and levels of experience.

These findings suggest a clear need to reconsider current educational and training approaches related to SAP software. In particular, they emphasize the importance of integrating practical, hands-on components into academic programs to better prepare potential users for real-world SAP environments.

However, the study is not without limitations. The sample was limited to two defined groups, and the questionnaire included specialized terminology that may not have been fully accessible to all respondents. Furthermore, the form required familiarity with IT and SAP-supported business processes, and there was a lack of control over how and in what conditions the survey was completed. Some active users also displayed knowledge gaps regarding basic SAP solution information (e.g., version or modules in use).

Future research should aim to expand the respondent base, and conduct the study in a controlled setting to improve data quality and depth of analysis. These steps will allow for a more comprehensive understanding of the competences required for effective work within SAP-supported ecosystems and help refine educational strategies accordingly.

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