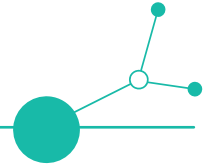


D1.1.1

Analysis report of digitalisation needs and challenges in CE and current state of digitalisation



Version 1

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ANALYSIS REPORT OF DIGITALISATION NEEDS AND CHALLENGES IN CENTRAL EUROPE AND CURRENT STATE OF DIGITALISATION

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EXECUTIVE SUMMARY

This report summarises the findings from Activity 1.1 within Work Package 1 of the Digi-B-Well project, detailing the digital transformation (DT) needs and challenges faced by small and medium enterprises (SMEs), public institutions, and academia within Central Europe. The primary aim is to identify digital capabilities that need to be enhanced to facilitate these sectors' transition into the digital era and improve their overall digital well-being.

Structure and Content: The report is organised into four main sections and starts with a literature review outlining current digitalisation trends, the economic, societal, and environmental drivers of DT, and the specific challenges each sector faces. The second section details the research methodology and sampling strategy designed to gather insights about Central Europe's particular digitalisation needs and challenges among project and associate partners of the project. The third section presents the research findings, while the fourth section discusses the implications of these findings for future stages of the project and the development of the project's methodological framework.

Methodology: Data collection was conducted via an online survey targeting representatives from SMEs, public institutions, and academic bodies across Central Europe. The responses were analysed using a network analysis method, which helped identify the primary groups of digitalisation needs and challenges, highlighting both commonalities and unique issues across the sectors.

Results: The analysis reveals that, alongside shared challenges like the digital skills gap and resource constraints, each sector faces unique hurdles in digital transformation. Specifically, SMEs are primarily impacted by financial and technological limitations, public institutions by regulatory and legacy system constraints, and academia by challenges in integrating digital tools into educational practices.

Recommendations: The report recommends developing sector-specific, multilevel strategies to address these challenges effectively. These strategies should focus on enhancing digital skills, addressing innovation resistance, improving managerial practices, and modifying organisational processes.



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ACRONYMS & ABBREVIATIONS

TERM	DESCRIPTION
AG	Augmented Reality
AI	Artificial Intelligence
CE	Central European
DT	Digital Transformation
IT	Information Technology
IoT	Internet of Things
SMEs	Small and Medium Enterprises
VR	Virtual Reality



D1.1.1.

Analysis report of digitalisation needs and challenges in Central Europe and current state of digitalisation

1. CURRENT STATE OF DIGITALISATION

1.1. Introduction

Digital transformation (DT) represents a crucial transition for organisations seeking to use digital technologies' potential to keep up with a rapidly evolving global economy. It refers to integrating digital technologies into various business processes and organisational functions and signifies a general shift toward innovation, agility, and resilience. This transition affects internal organisational structures and external engagements, influencing production methods, decision-making processes, and relationships with stakeholders, including customers, suppliers, and partners (Demirkan et al., 2016; Henriette et al., 2016).

The DT concept has evolved over the past decades. It can be traced back to studies in the 1980s that examined the adoption of information technology (IT) within organisations. Early research explored how IT systems could influence business performance and improve operations. Since then, global developments, such as advances in artificial intelligence (AI), cloud computing, the Internet of Things (IoT), and big data, have transformed the DT landscape into a complex, multidisciplinary research field involving areas such as strategic management, marketing, human resources, and operations management (Henriette et al., 2016).

Recent years have proved the DT's relevance and catalysed the adoption of digital tools and strategies. For today's organisations, DT is a question of technological implementation and business survival, as digital maturity becomes directly linked to competitiveness, operational flexibility, and customer engagement (Vial, 2019). For example, Bharadwaj et al. (2013) emphasise that competitive pressure has become a primary driver for DT, pushing companies to innovate rapidly or risk obsolescence.

Within Central Europe, the DT landscape is characterised by diverse levels of digital maturity, unique regulatory environments, various organisational constraints and historical developments that shape each organisation's approach to DT. The Central European (CE) region's SMEs, academic institutions, and public entities must navigate an evolving digital ecosystem where advanced technology adoption is essential but challenged by barriers such as resource limitations, skill shortages, and cultural resistance to change. Addressing these complexities requires strategic DT frameworks tailored to each sector's needs, emphasising not only technology adoption but also cultural, leadership, and workforce transformation.

This deliverable provides a structured analysis of DT needs and challenges across sectors, highlighting how academia, public institutions, and SMEs in Central Europe can approach DT with



an integrated, multidimensional strategy. We examine DT across different organisational levels – individual, group, organisational, and leadership – to offer practical insights for fostering a sustainable and inclusive digital transformation in the region.

1.2. Digitalisation Trends in Central Europe

DT is a strategic focus across sectors in Central Europe, driven by fast technological advancements, changing consumer expectations, and the need to remain competitive in a globalised digital economy. Emerging DT trends in this region include adopting digital platforms, cloud computing, AI, and the Internet of Things (IoT). These technologies change how organisations operate, innovate, and interact with stakeholders, although the specific DT needs vary across different sectors. For instance, SMEs often prioritise technologies like AI and IoT to enhance operational efficiency and customer satisfaction. At the same time, public institutions may focus more on developing digital platforms for service delivery and citizen engagement. On the other hand, academic institutions may emphasise cloud computing, big data, and digital learning platforms to foster research, collaboration, and innovative teaching methods. These distinctions highlight the importance of tailoring DT strategies to address the unique pressures and opportunities each type of organisation faces.

1.2.1. Key Technologies and Their Impact on Digital Transformation

Central Europe has seen growth in implementing advanced digital technologies across sectors, influenced by the region's industrial legacy, evolving market demands, and support from national and EU policies. Digital technologies such as AI and big data analytics are used to improve decision-making processes, enhance customer experiences, and drive operational efficiencies in SMEs (Teng et al., 2022). **Big data** enables organisations to collect, process, and analyse vast information to make informed decisions and predict trends. **AI** is promising in optimising complex workflows, automating routine tasks, and freeing employee resources for innovation and strategic tasks. **IoT** plays a transformative role in industries such as manufacturing and logistics, where real-time data collection and analysis allow for predictive maintenance, supply chain optimisation, and improved quality control. IoT integration is critical for enhancing productivity and operational agility, key competitive factors in the digital economy. **Cloud computing** has enabled greater flexibility and scalability, allowing organisations to access data and applications remotely, reduce IT infrastructure costs, and enhance collaboration across locations. Academic institutions and public bodies increasingly adopt cloud-based platforms to streamline services, facilitate remote learning and working environments, and support administrative functions (Watermeyer et al., 2020). **Virtual reality (VR)** and **augmented reality (AR)** are emerging technologies reshaping many sectors, including retail and education. They enable immersive experiences, providing new opportunities for training and customer engagement strategies. VR and AR also have significant potential for increasing productivity in design, prototyping, and remote collaboration across industries.

All these technologies also introduce **data privacy, cybersecurity, and regulatory compliance challenges**. Organisations must invest in cybersecurity measures to protect sensitive data and prevent breaches as digital transformation accelerates. Public institutions, which often handle



vast amounts of citizen data, face pressure to ensure robust data governance frameworks while adhering to regulatory requirements, such as the General Data Protection Regulation (GDPR).

1.2.2. Economic and Policy Drivers of Digital Transformation

Economic competition and globalisation are critical drivers of DT in Central Europe. The CE region's SMEs, which form the backbone of the economy, are increasingly pressured to adopt digital solutions to maintain competitiveness. Studies indicate that digital transformation can lower market entry barriers for smaller businesses, enabling them to compete more effectively with larger firms by enhancing resource utilisation and customer outreach (Li et al., 2022).

Government initiatives and funding from the European Union have also catalysed digital adoption in the CE region. Programs focused on innovation, digital skills development, and infrastructure improvements are pivotal in supporting SMEs, public institutions, and educational bodies. For instance, the EU's Digital Europe Programme promotes investments in AI, cybersecurity, and digital skills training, directly addressing critical DT enablers for CE organisations. Such initiatives foster digital readiness and create networks and collaborative opportunities for knowledge exchange and capability building (Garzoni et al., 2020).

1.2.3. Societal and Environmental Influences on Digital Transformation

The societal shift towards remote work and online services, accelerated by the COVID-19 pandemic, has highlighted the importance of DT across sectors. Academic institutions, public authorities, and SMEs have rapidly transitioned to digital platforms to maintain continuity in education, public, and customer services, revealing both the potential and the current gaps in digital infrastructure. This transition showed the uneven distribution of digital resources across organisations and underscored the importance of digital inclusivity, as the digital disparity remains a significant challenge.

Environmental sustainability is becoming an increasingly important consideration in DT strategies, especially as organisations recognise the role of digital technologies in supporting energy efficiency, resource management, and circular economy models. Digital solutions can optimise energy usage, reduce waste, and support environmentally friendly practices, aligning with the European Union's Green Deal objectives. By integrating sustainability into digital strategies, CE organisations can enhance their operational resilience while contributing to broader environmental goals.

1.2.4. Sector-Specific Implications and Trends

Digitalisation trends manifest differently across the primary sectors of interest – **SMEs, academia, and public institutions** – reflecting each sector's unique priorities, challenges, and structural characteristics.

- **SMEs:** For small and medium-sized enterprises, digital transformation focuses on enhancing operational efficiency, expanding market reach, and improving customer engagement. SMEs often adopt a gradual approach to digitalisation, constrained by limited resources and workforce expertise. Collaboration with innovation hubs and access to public funding are vital for overcoming these barriers. Trends in this sector highlight the increasing reliance



on digital marketing, e-commerce, and supply chain integration as the main drivers of competitive advantage (Garzoni et al., 2020).

- **Academic institutions:** Higher education institutions in Central Europe embrace DT to enhance digital competencies among students and faculty, adapt teaching methods to digital platforms, and broaden access to educational resources. However, academic institutions face challenges in aligning legacy systems with digital innovations and addressing the digital divide among students. Trends include the growing use of online learning management systems, AI-driven learning analytics, and digital collaboration tools, all reshaping traditional educational models (Zhang et al., 2021; Watermeyer et al., 2020).
- **Public institutions:** DT for public institutions emphasises digital service delivery, citizen engagement, and administrative transparency. Digital initiatives in the public sector are often aimed at improving accessibility and streamlining interactions with citizens, with a strong focus on e-government services. Public institutions face unique challenges related to data security, regulatory compliance, and resource constraints as they navigate the complexities of providing equitable digital access. The sector is increasingly adopting digital governance models, data-driven decision-making processes, and mobile applications to meet public needs efficiently (Febiri & Hub, 2021).

1.2.5. Future Outlook and Strategic Priorities

The DT trends in Central Europe point to a growing recognition that digital transformation is an ongoing, iterative process requiring a tailored approach for each sector:

- For **SMEs**, **developing** a strategic digital vision, enhancing digital literacy, and fostering partnerships are vital to sustainable digital transformation.
- **Academic institutions** prioritise digital skills development and hybrid education models, aiming to build an adaptable workforce for the future.
- Meanwhile, **public institutions** continue to focus on digital service delivery, emphasising data security and citizen-centric digital solutions.

As Central Europe progresses in its digital journey, collaborative efforts across sectors are essential to address challenges, capitalise on emerging technologies, and ensure a comprehensive approach to DT. These efforts include fostering innovation hubs, creating public-private partnerships, and developing frameworks for sustainable digital practices that can benefit organisations, employees, and society.

The table below summarises the DT opportunities described in the presented overview. The subsequent sections of the report are dedicated to the results of a survey conducted among representatives of academia, public authorities, and SMEs, providing a first-hand perspective on the digitalisation needs and barriers to DT in Central Europe.



Table 1. Overview of key DT challenges and opportunities in Central Europe

Key Challenges	Explanation
Digital Skills Gap and Technology Literacy	Insufficient digital skills hinder DT and affect SMEs, public institutions, and academia, requiring targeted upskilling and support to bridge this gap.
Financial Resource Constraints	Limited budgets prevent SMEs and public institutions from investing in essential digital tools, making them reliant on external funding.
Resistance to Change and Uncertainty	Employees may resist DT due to job security concerns and changes in workflows; strong leadership and change management needed.
Data Governance and Cybersecurity	Increased data vulnerability with DT; requires investment in secure platforms, regulatory compliance, and data protection protocols.
Key Opportunities	Explanation
Enhanced Productivity	Automation and digital tools improve efficiency, reduce errors, and optimise resources.
Market Expansion	Digital platforms enable SMEs to reach broader markets; academia benefits from remote learning.
Organisational Agility	Improved response time to market and public needs; supports faster adaptation to change.
Increased Collaboration	Digital transformation fosters partnerships across sectors, facilitating shared knowledge and resource access.
Sustainability and Resource Efficiency	Digital tools enable environmentally conscious practices, aligning with EU Green Deal and enhancing organisational resilience.

1.3. Objective

The primary objective of the following analysis is to understand and map the digital transformation needs and challenges specific to SMEs, academia, and public institutions in Central Europe. The aim is to provide insights that inform strategic frameworks tailored to each sector’s unique conditions and requirements, thus facilitating a more effective and inclusive digital transformation across the region.



2. METHODOLOGY

2.1. Data Collection

To gather first-hand information on the digital transformation needs and challenges faced by SMEs, academia, and public institutions in Central Europe, an online survey was created and distributed to representatives from each of these organisation types in the project partner countries (Croatia, Italy, Germany, Slovenia, Slovakia, Hungary, and Poland) who were further invited to participate in two online conferences. The survey included open-ended, interview-like questions about the specific needs and challenges or barriers to digital transformation experienced by the target organisation types. To support participants in the thinking process, prompt diverse ideas, and encourage comprehensive, detailed, and narrative responses, the questions were organised into four main thematic areas: (1) management and business operations, (2) digital culture and employee well-being, (3) technology and infrastructure, and (4) other digital challenges. These categories were selected to encompass the three main pillars of digital transformation outlined in the project proposal while allowing participants some freedom to express their expert opinions.

After the first round of data collection, The first online conference titled “Embracing Digital Transformation” was organized for project and associate partners. Its purpose was to share preliminary findings, facilitate further discussion, and explore key topics in depth. This event allowed us to gather valuable insights and contributions from project partners, associate partners, and thematic experts, aligning with our objectives for qualitative data collection. Moreover, this process paved the way for the next online data collection.

The Digi-B-Well project and associate partners collaborated to distribute the online survey to a broader sample, sharing the link with associated partners and other representatives from the targeted types of organisations. This approach aimed to include opinions from experts not directly involved in the project and achieve a diversity of perspectives. The survey remained open for approximately one and a half months to ensure a comprehensive collection of insights across the region and a balanced representation within the “triple helix” (i.e., public authorities, SMEs, and academia), thus enriching the dataset for D1.1.1.

The initial dataset included 56 responses, but after data cleaning and validation, a total of 36 responses were retained as valid cases. These responses comprised 12 representatives each from SMEs, public authorities, and academic institutions, ensuring a balanced sample across different organisational sectors in Central Europe. The final dataset was analysed, and a second online conference entitled “Digital and Healthy Organizations: Hope or Reality?” was organised to share the definitive results from the online surveys. Additionally, the best practices collected for D1.1.2 were shared and discussed among the participants during the conference. This broadened the conversation and established a connection between key needs and challenges and the potential strategies available for implementation in organizations. This step ensured that the outcomes contributed not only to completing the deliverables but also to enhancing the understanding of the core theme related to digital transformation.

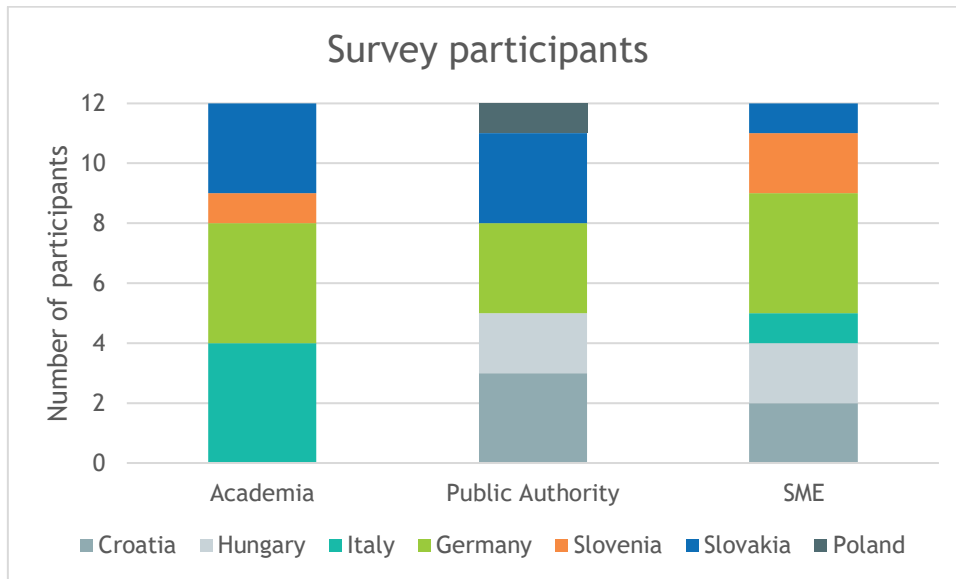


Figure 1. Survey participants' distribution among sectors and countries

The **SME sample** includes a variety of organisations of different sizes from multiple CE countries, representing a range of sectors. Most organisations (eight out of twelve) were micro-enterprises with 1-9 employees; one was a small enterprise with 10-49 employees, two were medium-sized with 50-249 employees, and one was larger, employing 250-499 people. The sample includes SMEs from Germany, Slovenia, Croatia, Italy, and Hungary. Sector representation among these SMEs spans manufacturing, consulting and professional services, construction and real estate, technology and software development, retail, and information and communication, offering perspectives from industries at various stages of digital advancement and transformation.

The **public authorities** in the sample were predominantly medium-sized institutions, with most employing between 50-249 or 250-499 people. Participants represented public offices across Hungary, Slovakia, Germany, Croatia, and Poland, providing a mix of local and regional government entities.

Academic institutions were represented by larger entities, with five of the twelve institutions employing over 1,000 people and the remainder employing between 500 and 1,000. The sample includes institutions from Italy, Germany, Slovakia, and Slovenia.

This variety of responses was sufficient to highlight the specific needs and challenges different organisations face in digital transformation. The collected qualitative data provided a strong foundation for in-depth analysis, enabling us to map key digitalisation needs and challenges and better understand Central Europe's digital transformation landscape.

2.2. Data Analysis Approach

The gathered data was analysed using a card sorting technique and network analysis. This allowed us to create conceptual maps of digitalisation needs and challenges, visualising the interconnected themes emerging from participants' responses. The study was conducted using group opinion mapping and visualisation methodology. A key feature of this methodology is the use of graphical



models to represent complex relationships between qualitative data visually, allowing researchers to identify clusters and profile opinions, attitudes, and trends.

The first step of analysis involved an AI-assisted card sorting technique (Lantz et al., 2019). Each individual need or challenge provided by survey participants was converted into a card (one need or challenge per card) and placed into two separate card banks. The needs bank contained 339 response cards, while the challenges bank included 334 unique cards. Both needs and challenges were initially pre-sorted independently by the AI into groups of cards with similar meanings. Then, three trained research experts independently reviewed the AI sorting, systematically analysed each of the needs and challenges cards, and regrouped them based on their meaning. For example, two challenges, *“Fear of new technologies”* and *“Fear that people could be replaced,”* might be grouped under *“Technology fear.”* Similarly, two needs, *“Providing opportunities for employees to acquire digital skills”* and *“Investing in employees’ digital competence acquisition,”* might be combined under *“Digital Competencies,”* and so on.

Following the expert sorting, the results were analysed using an AI-assisted semantic network analysis technique (Newman, 2004), enabling a structured exploration of themes and patterns within the qualitative data. The needs and challenges were organised into clusters based on recurring themes throughout the dataset and visualised as networks to illustrate the relationships between clusters and individual response cards.

Two separate networks were created for needs and challenges. Each network consists of nodes (dots) and edges (lines connecting the dots). Each dot represents a unique idea (a specific need or challenge mentioned by a participant), while each line represents a connection between two ideas. The size of each dot reflects its importance or impact; the larger the dot, the more connections it has with other dots, indicating its centrality and influence among the other needs or challenges. The colours of the dots represent clusters of semantically similar ideas, with dots of the same colour forming groups of related needs or challenges that might be addressed collectively. Thus, dots with stronger thematic ties appeared in the same colour and closer together, while those with fewer connections were displayed in different colours and spaced further apart. This spatial arrangement provided an intuitive view of the data structure, revealing how various needs and challenges relate to one another within the context of digital transformation.

The platform also allowed the conceptual maps to be viewed separately for each of the three organisational types in the Triple Helix model – SMEs, public authorities, and academic institutions. This segmentation enabled a more focused look at each sector’s specific needs and challenges, revealing both unique priorities and shared themes. By analysing the maps individually for each sector, researchers gained a clearer view of where these organisations aligned or differed in their digital transformation approaches, allowing insights to be tailored to each organisation’s specific context.

This blend of AI-assisted thematic clustering, visual mapping, and sector-specific analysis effectively captured the complexity of digital transformation needs and challenges across the three organisational types within the Triple Helix model. The methodology highlights both the distinct needs of each sector and the common ground between them, providing a solid foundation for developing targeted strategies within each organisational type.





3. FINDINGS

In this section, we describe the resulting networks of needs and challenges.

3.1. Overview of Needs in Digital Transformation

The figure below presents the network of digitalisation needs across all three organisational sectors.

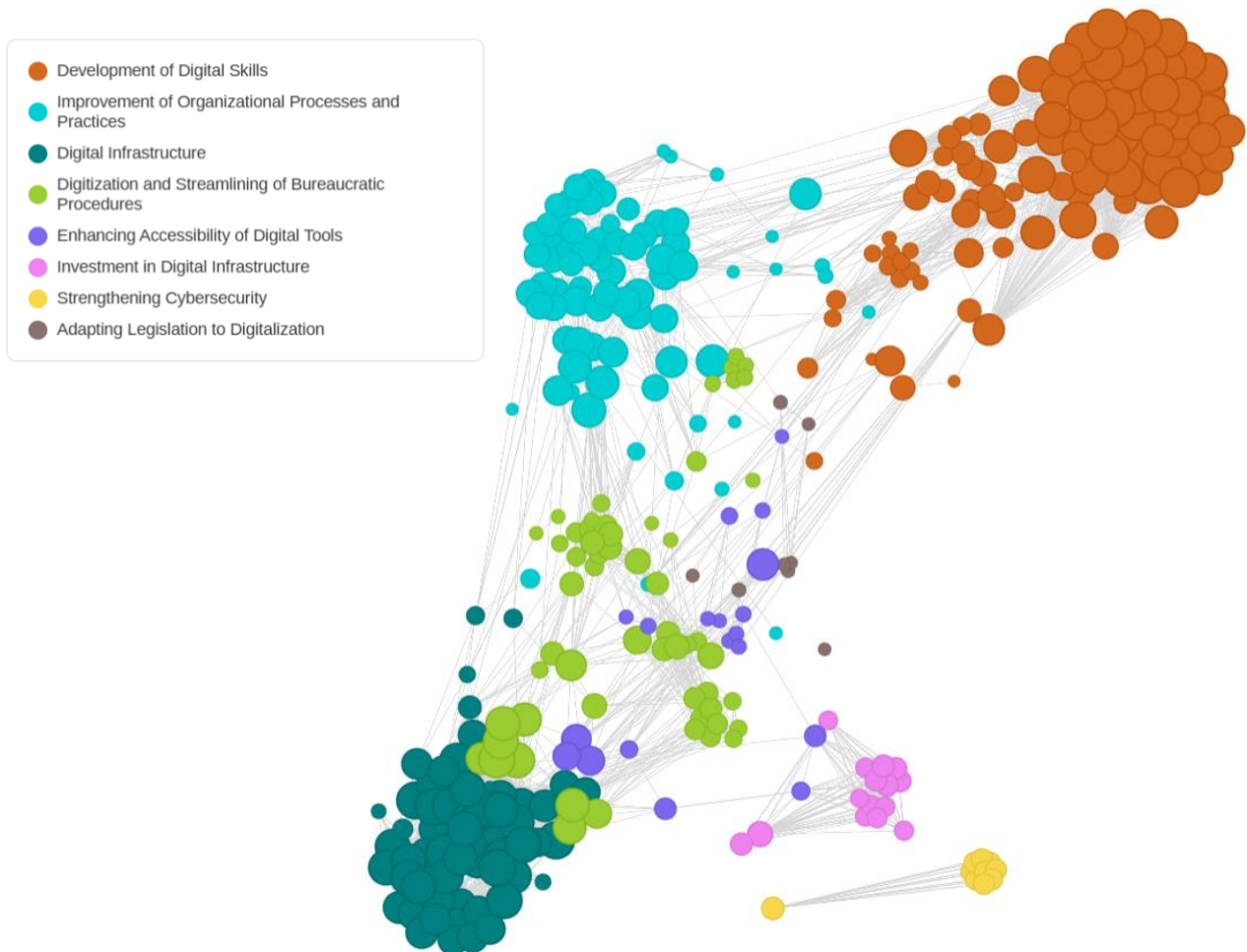


Figure 2. Network of digitalisation needs

The analysis identified **eight main clusters** of digitalisation needs within CE organisations. These clusters represent key areas for improvement that are essential for advancing digital transformation. Below is a comprehensive overview of each conceptual cluster, arranged from the largest and most important cluster to the smallest one.

3.1.1. Development of Digital Skills and Awareness Building

The largest cluster of identified needs, comprising more than a quarter of all ideas (95 responses), centres on developing digital skills and competencies and building awareness about digital



transformation. Organisations highlighted the need to equip employees with both foundational and advanced digital skills and foster a work culture that values continuous learning and adaptability. These clusters include the following main topics:

Enhancing digital skills and competencies of employees: A significant number of participants highlighted the need to strengthen digital skills among staff. This could be achieved by hiring new specialists with digital expertise or by upskilling and reskilling current employees through targeted training programs. These initiatives aim to improve digital literacy and build essential competencies, helping employees navigate new technologies confidently. Some examples of needs include *“Give the employees the possibility to enhance their digital skills”* and *“Need to hire/have only employees with digital skills.”*

Improving digital skills in the general population: Beyond employees, there is a recognised need to elevate digital skills among the broader population, including clients, students, and partners. Enhancing digital literacy across society is seen as vital for facilitating digital transformation, as it ensures that everyone involved – whether in a business, academic, or public context – can engage effectively with digital tools and processes. Some needs examples include *“When it comes to the general population, digital competencies on the national level should be significantly improved”* and *“Increase of digital skills of the clients / community / society and understanding of the digital tools, processes, data safety and reliability.”*

Building awareness around digital transformation: Participants emphasised the importance of clear communication to help people understand the goals and benefits of digital transformation. Raising awareness about digital tools and their value is crucial for encouraging employee and stakeholder buy-in. For digital initiatives to succeed, digital transformation’s added value must be clearly communicated and widely understood. Some examples of needs include *“The added value must be immediately recognised”* and *“Explaining the goals and benefits of digital transformation.”*

Cultivating a culture of innovation and lifelong learning: Organisations expressed a desire to foster an innovation mindset, curiosity, and openness to new ideas at the organisational level. Encouraging a culture that embraces change and supports continuous learning is seen as essential for keeping pace with technological advancements and ensuring that employees feel motivated to adapt. Some examples of needs include *“Cultivate a culture that embraces digital tools and innovation”* and *“Encouraging the innovation mindset.”*

Providing coaching and support: Many participants highlighted the need for accessible guidance and support to help both employees and the general population use digital tools effectively. This could include dedicated support roles or coaching resources to assist individuals who may struggle with new technologies, thereby reducing resistance and building confidence in digital adoption. Some examples of needs include *“Employees should not be left to their own when a new solution is introduced”* and *“In addition to training, offer individual coaching.”*

3.1.2. Improvement of Organisational Processes and Practices

The next largest cluster, comprising 75 ideas, focuses on the need for changes and improvements in organisational processes and structure to support digital transformation. This diverse group is united by the overarching goal of streamlining organisational processes to make them more agile, efficient, and adaptable. The main topics in this cluster are as follows:



Assigning responsibilities for the digital transformation process: There is a need for clearly defined roles and responsibilities in the digital transformation process. Each digital transformation initiative should have an assigned “owner” and a team responsible for its success, whose primary functions are to initiate, support, and sustain digital transformation efforts. Forming dedicated digital-focused teams composed of IT specialists and process experts can help ensure a smoother and faster transformation process. Some examples of needs include *“Assigning people who are responsible for pushing and supporting digitalisation processes. The digital transformation project should have its owner”* and *“Establishing clear institutional roles and responsibilities in order to improve coordination mechanisms for digitisation strategy and implementation.”*

Planning and prioritising digitalisation projects: Organisations increasingly recognise the importance of strategic planning for digitalisation. This cluster involves setting clear digitalisation goals, identifying priorities, and implementing the transformation step-by-step. By taking a phased approach and building on previous successes, organisations can improve their ability to manage change effectively. Some examples of needs include *“A new process should be introduced that would check the needs, possibilities and priorities of digitisation of work activities”* and *“Planning and prioritisation of digitalisation projects.”*

Employee involvement in decision-making: To make digital transformation successful, involving employees in decisions related to digitalisation goals and priorities is essential. Employee input should be valued and trusted, as their insights can guide more effective and practical digital solutions. Some examples of needs include *“Inclusion of employees in change processes”* and *“Receive feedback from the employees.”*

Management transformation: Leadership attitudes and practices must evolve to become more agile and innovation-focused. A shift in mindset among leaders is necessary to drive digital transformation effectively and to inspire an adaptable organisational culture. Some examples of needs include *“The attitude of the management towards IT has to change significantly...”* and *“Management change and new processes are necessary for its effective functioning.”*

Promoting digital health: Digital transformation also involves promoting digital well-being within the organisation. Policies that balance digital workloads and prevent burnout are needed to help employees maintain a healthy work-life balance in an increasingly digital environment. Some examples of needs include *“Introduction of new ways of working to promote a better work-life balance”* and *“To promote digital well-being, SMEs need to establish policies that balance digital workloads and prevent burnout.”*

3.1.3. Digital Infrastructure

The next cluster, encompassing 60 responses, addresses the need for technology updates and infrastructure improvements. Participants identified a wide range of essential tools, from basic items like printers, laptops, and stable internet connections to advanced technologies such as cloud computing and AI tools. These responses highlighted significant differences in technological readiness between sectors and within individual sectors across different countries. Examples of identified needs include *“Fast and powerful laptop,”* *“High-speed, reliable internet connectivity,”* *“AI tools – LLM, video generators, solutions cut out for the individual company.”*



3.1.4. Digitization and Streamlining of Bureaucratic Procedures

The fourth largest cluster, comprising 57 identified needs, focuses on the necessity of streamlining bureaucratic processes and minimising ineffective, repetitive tasks. The main topics within this cluster are as follows:

Reducing paper usage and digitizing processes: Many participants emphasised the need to reduce paper-based workflows and transition to digital documentation systems. This shift is seen as essential for speeding up processes, improving data accessibility, and enhancing efficiency across organisations. Some examples of needs include *“It is necessary to reduce the requirements to produce printed documents”* and *“Transitioning to digital document management to save space and improve accessibility.”*

Implementing standardisation and traceability in procedures: Participants highlighted the need for standardised digital tools and traceable procedures to unify processes across organisations. Tools such as document management systems were frequently mentioned as critical for improving communication, simplifying collaboration, and ensuring consistency in handling data and administrative tasks. Some examples of needs include *“Need to standardise digitalisation processes between and within universities...”* and *“For the successful exchange of data among all public participants, digitisation standards should be determined at the state level.”*

Automating repetitive tasks: The automation of routine and repetitive tasks was identified as a priority to reduce the administrative burden on employees. Automating these processes frees up time for employees to focus on more strategic, value-adding activities, accelerating digital transformation and improving overall organisational efficiency. Some examples of needs include *“Automating repetitive tasks to increase efficiency and reduce human error”* and *“Elimination of unnecessary reporting and administrative processes.”*

3.1.5. Enhancing Accessibility of Digital Tools

The next four clusters collectively represent less than 20% of the identified needs. The fifth cluster focuses on ensuring that digital tools are accessible, user-friendly, and inclusive for individuals with varying levels of digital proficiency, different age groups, and diverse financial means. This cluster encompasses 19 ideas emphasising that digital solutions must be affordable, easy to use, and supported by clear instructions or physical access points to assist users in confidently adopting technology.

Participants highlighted the importance of affordability and usability, particularly for small businesses, students, and low-income groups. For example, they called for *“affordable and easy-to-use digital tools for human resources, legal issues, and statistics for small companies”* and *“free availability of software for students and home use.”* Accessibility was also a major theme, with participants stressing the need for *“ease of access for seniors and persons who do not want or cannot use digital services.”* Additionally, there was a call for physical support points, where users could receive assistance from public authority representatives to complete digital tasks.



3.1.6. Investment in Digital Infrastructure

A smaller cluster, comprising 15 ideas, focuses on the critical need for financial resources and dedicated budgets to support digital transformation. Participants emphasised the importance of increased funding and resource allocation to ensure the successful implementation of digital tools and infrastructure.

Examples of identified needs include: *“Allocate sufficient resources for IT infrastructure, software, and training,”* *“More money to buy new technologies,”* and *“Allocating budget for digital investments.”* Participants noted that it becomes hard to upgrade outdated systems or adopt advanced digital technologies without adequate funding. They also stressed the need for targeted state subsidies and grants to help smaller organisations overcome financial barriers and ensure steady progress in their digital transformation efforts.

3.1.7. Strengthening Cybersecurity

The Cybersecurity cluster includes just 10 ideas but highlights a critical area as organisations become increasingly digital. Protecting data and ensuring robust cybersecurity measures are essential for maintaining trust and the security of digital systems. This cluster stands out as a distinct group, largely independent from other clusters, indicating its specificity and unique importance.

Some examples of needs in this cluster include: *“Strengthening cybersecurity measures to protect digital assets,”* *“Data privacy: people need to feel at ease knowing their data will be secure,”* and *“Secure infrastructure.”* Participants also emphasised the importance of security training, upgrading security infrastructure, and encrypting sensitive data to prevent unauthorised access.

3.1.8. Adapting Legislation to Digitalization

The smallest cluster, comprising eight responses, focuses on the need to adapt existing legislation and regulatory frameworks to align with the realities of digital transformation. Participants emphasised the importance of clear, updated legal guidelines that facilitate the adoption of digital technologies while ensuring fairness, transparency, and practicality.

Examples of these needs include: *“Legal and regulatory requirements have to be changed to enable the application of user-friendly and efficient technologies”* and *“Legislation adapted to digitalisation.”* Additionally, respondents highlighted the necessity of moving away from rigid compliance-focused mindsets to more flexible, needs-based approaches. For instance, they called for reforms to outdated practices, such as paper-based reimbursement processes, and for developing ethical guidelines for AI use to ensure transparency and fairness.

3.1.9. Overall analysis of the needs network

The qualitative analysis of digitalisation needs among CE organisations revealed a diverse set of priorities grouped into eight main clusters. These clusters highlight areas essential for fostering digital transformation, ranging from enhancing digital skills to improving infrastructure, processes, and regulations. The findings underline the interconnected nature of these needs, particularly the



critical balance between **human-centric strategies, technological advancements, and organisational processes**. The table below provides a summary of these clusters, including their focus areas, key examples, and relative importance based on the number of identified needs.

Table 2. Summary of Digitalisation Needs in CE Organisations

Cluster	Focus Areas	Key Examples	#
Development of Digital Skills and Awareness Building	Enhancing employee and population digital skills; fostering a culture of innovation and learning	<i>“Give the employees the possibility to enhance their digital skills”; “The added value must be immediately recognised”</i>	95
Improvement of Organisational Processes and Practices	Assigning responsibilities; strategic planning; employee involvement; digital well-being	<i>“Assigning people responsible for digitalisation”; “To promote digital well-being, SMEs need policies to prevent burnout”</i>	75
Digital Infrastructure	Upgrading technology; ensuring reliable tools and connectivity	<i>“Fast and powerful laptop”; “AI tools – LLM, video generators”</i>	60
Digitization and Streamlining of Bureaucratic Procedures	Reducing paper-based processes; standardisation; automating repetitive tasks	<i>“Transitioning to digital document management”; “Automating repetitive tasks to increase efficiency”</i>	57
Enhancing Accessibility of Digital Tools	Affordability; user-friendliness; inclusivity	<i>“Affordable digital tools for small companies”; “Ease of access for seniors”</i>	19
Investment in Digital Infrastructure	Allocating resources and funding for digital transformation	<i>“Allocate sufficient resources for IT infrastructure”; “State subsidies to overcome financial barriers”</i>	15
Strengthening Cybersecurity	Ensuring data privacy; robust security measures	<i>“Strengthening cybersecurity measures”; “Data privacy: people need to feel secure”</i>	10
Adapting Legislation to Digitalisation	Updating legal frameworks; promoting flexible and fair regulations	<i>“Legislation adapted to digitalisation”; “Ethical guidelines for AI use to ensure fairness”</i>	8

The visual analysis of the needs network highlights significant patterns. Two primary clusters – **Development of Digital Skills** and **Digital Infrastructure** – are positioned at opposite ends of the network. This placement is logical, as the first cluster focuses on people, their skills, competencies, and awareness, while the second revolves around various technologies.

The connection between people and technologies is bridged by two large intermediate clusters: **Improvement of Organisational Processes and Practices** and **Digitization and Streamlining of Bureaucratic Procedures**. This suggests that the success of digital transformation – whose main goal is to unite people and technology and enable them to work collaboratively – depends heavily on changes to organisational processes and procedures.



Interestingly, the cluster related to financial needs is positioned outside the main network, closer to the technology side. This indicates that while investments are necessary for updating technological infrastructure, financial support alone is insufficient to ensure people’s adoption and acceptance of these technologies. Successful digital transformation requires balancing technological advancements, process improvements, and human-centric strategies.

3.2. Overview of Challenges in Digital Transformation

The figure below presents the network of digitalisation challenges across all three organisational sectors in Central Europe.

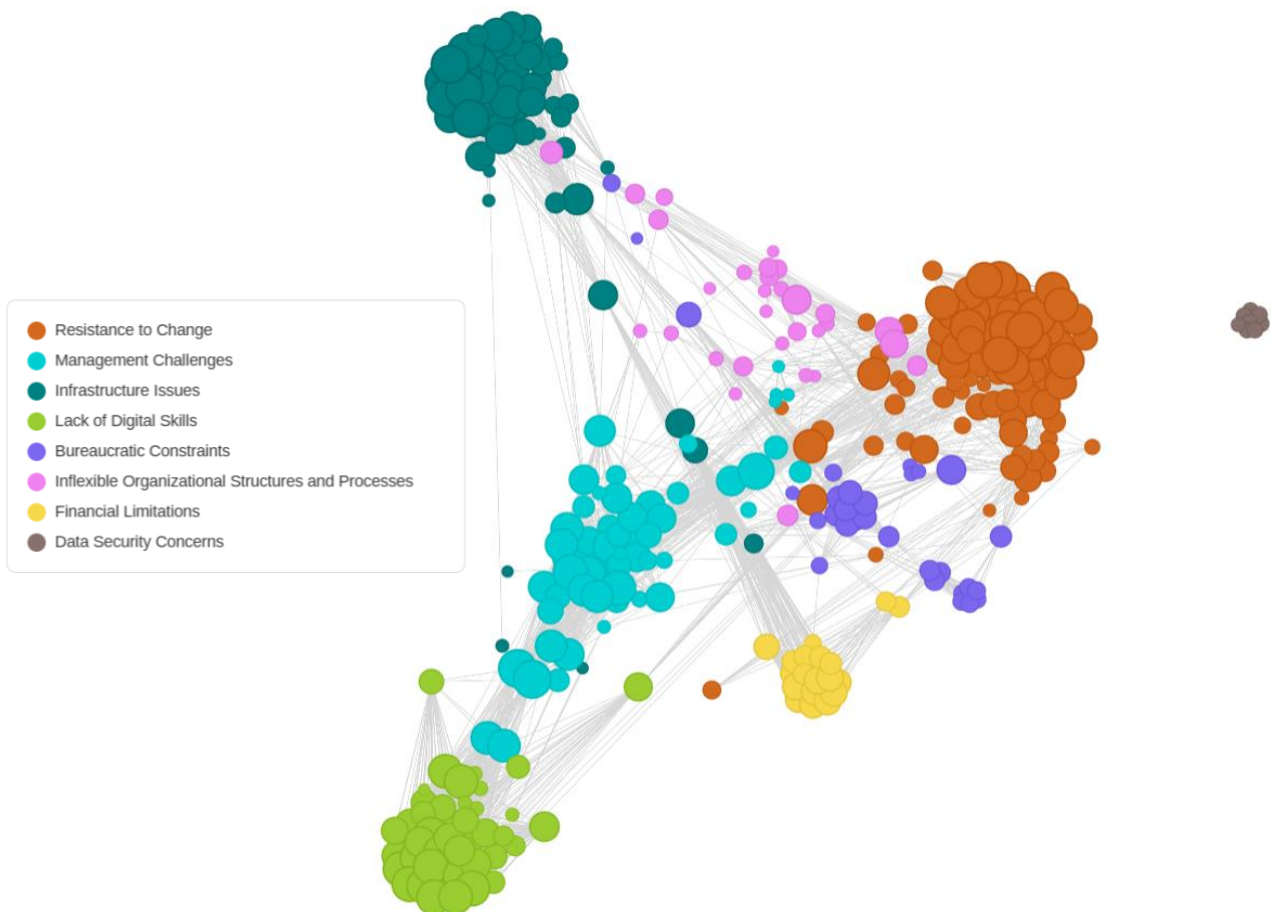


Figure 3. Network of digitalisation challenges

As with the needs, the analysis identified eight main clusters of digitalisation challenges within CE organisations. These clusters represent key barriers to advancing digital transformation. Below is a comprehensive overview of each conceptual cluster, arranged from the largest and most impactful to the smallest.

3.2.1. Resistance to Change

The largest cluster of identified challenges, comprising a quarter of all ideas (84 responses), is **Resistance to Change**. This cluster includes various reasons why management, employees, and



the general population resist adopting and using new technologies, as well as advancing digital transformation. The key themes in this cluster are as follows:

Fear of job loss and skill redundancy: Many participants highlighted that employees often fear that automation and digital tools could make their roles redundant. This fear fosters low trust in new technologies and reluctance to engage with them. For instance, some participants noted challenges such as *“Fear of losing jobs”* and *“Employees might believe that digital innovations could reduce the labor demand and create a social problem in the future.”*

“We’ve always done it this way” mentality: In many organisations, a deeply rooted conservative mindset hinders digital transformation efforts. Employees and leaders often resist changing established habits and workflows that have been effective in the past. Examples of these challenges include *“Sticking to old models of work and old familiar tools despite the new one being implemented”* and *“The biggest issue mindset of: we don’t need anything; it is good as it is.”*

Lack of awareness of digital transformation benefits: Another significant source of resistance is the lack of understanding of digital transformation’s goals and advantages. Employees may fail to see how adopting new technologies can benefit them or their organisation. This lack of motivation often stems from inadequate communication about the purpose and potential outcomes of digitalisation. Examples of these challenges include *“Poor communication on the outcomes of digitalisation”* and *“Low awareness of benefits and best practices.”*

3.2.2. Management Challenges

The second largest cluster of challenges, comprising 58 responses, focuses on issues related to leadership and management in driving digital transformation. This cluster highlights a range of barriers stemming from insufficient digital skills, outdated management practices, and resistance to change among leaders. The key themes within this cluster are as follows:

Resistance to innovation among management: Unlike the previous cluster, where resistance comes from employees, this theme focuses on hesitation at the managerial level. In some organisations, top-level management is reluctant to adopt digital solutions, fearing that such changes could disrupt the status quo. Examples of responses include *“As a matter of fact, in many organisations the management tends to reject innovations. In bigger cities, this isn’t much of an issue, but especially in rural regions...”* and *“Most managers and CEOs are 50+ and mostly don’t see a need to improve because they then need to learn new skills.”*

Inadequate digital skills in leadership: In addition to being resistant, many managers lack the digital skills to feel confident with new technologies and effectively lead in a digital environment. Participants frequently noted the shortage of digital literacy among top-level management. For example, responses included *“One of the significant barriers is the shortage of digital literacy and expertise within the management team and workforce”* and *“Lack of management digital competencies.”*

Outdated project management methods: Traditional management practices often fail to foster innovation and can hinder digital transformation. Participants highlighted issues such as micromanagement, rigid structures, and a lack of trust in employees. Examples of challenges include *“Micromanagement/lack of trust,”* *“Outdated management methods do not encourage*



acquisition and implementation of digital competencies,” and “Linear hierarchical management structure.”

Blurring work-life boundaries in digital work: As digitalisation blurs the boundaries between work and personal life, management must prioritise work-life balance to prevent burnout and respect non-working hours. Examples of challenges include *“Poor respect for time not allocated for work”* and *“High workload: there is a lack of time and personal resources to learn new technological solutions; under time pressure, it is easy to do things the old way.”*

3.2.3. Infrastructure Issues

The third largest cluster of challenges includes 57 responses and focuses on issues related to outdated, insufficient, or fragmented technological infrastructure. These challenges highlight the barriers posed by legacy systems, lack of integration, and uneven access to digital infrastructure. The key themes within this cluster include:

Outdated systems and equipment: Many organisations still rely on obsolete hardware, software, and communication channels that are incompatible with modern technologies. Examples include *“Old computers and systems that don’t work well with new technologies”* and *“Outdated communication channels.”*

Insufficient connectivity: Slow or unreliable internet connections were frequently mentioned as significant barriers. Participants noted challenges such as *“Limited access to high-speed internet”* and *“Unreliable internet connections.”*

Lack of integration and interconnectivity: Fragmented systems and platforms that do not communicate effectively hinder seamless collaboration and data sharing across departments and organisations. Challenges in this area include *“Low interconnectivity of systems between institutions,”* *“Lack of integration between various digital systems and platforms,”* and *“The diversity of tools used and the lack of their integration.”*

Complex and incomplete digital solutions: Participants noted that many digital tools are overly complicated, prone to bugs, or offered as partial solutions that require additional investment to be effective. Examples include *“Complicated and raw digital solutions with lots of bugs”* and *“Non-holistic approach: provider sold just a segment of the solution.”*

3.2.4. Lack of Digital Skills

The fourth largest cluster includes 44 responses and highlights challenges related to insufficient digital skills and expertise of employees and the general population. This cluster underscores the skill gaps and training deficits that hinder the adoption of digital transformation. Key themes within this cluster include:

Lack of digital skills among employees: Many organisations face a significant gap between the digital competencies of their workforce and the demands of digital workplaces. Employees often lack the necessary knowledge to use digital tools effectively. Examples include *“Not all employees have the necessary digital and technical skills”* and *“Employees in public authorities often do not have the appropriate qualifications to implement digital processes.”*

Shortage of IT and digital experts: Many organisations struggle to access qualified IT professionals and external experts. The lack of available skilled workers, particularly in server management and



digital systems maintenance areas, creates bottlenecks. Examples include, *“The shortage of skilled workers in Germany means the people needed to maintain servers are either not available or insufficient,”* and *“Well-trained IT departments do not exist.”*

3.2.5. Bureaucratic Constraints

The next cluster, which consists of 31 challenges, highlights the significant bureaucratic and legal challenges that hinder digital transformation. These issues revolve around complex regulatory environments, slow processes, and outdated legal frameworks, creating obstacles to adopting digital tools and technologies. Key themes within this cluster include:

Excessive bureaucracy: Many participants pointed out bureaucratic processes as burdensome and a significant hindrance to digital transformation. Examples include *“Red tape culture resulting in complex and long processes”* and *“Bureaucratic constraints.”*

Legal and regulatory challenges: Outdated legal frameworks, stringent regulations, and frequent legal changes create uncertainty and complicate the adoption of digital solutions. For instance, participants highlighted issues such as *“Legal and regulatory requirements make a meaningful digital transformation more difficult”* and *“The federal laws in Germany are a big obstacle. There are still many matters where the written form is mandatory.”*

Paper-based processes and resistance to digital alternatives: Despite advances in digital technologies, many administrative processes remain manual and paper-based. Participants noted challenges such as *“Requirement for paper documents”* and *“Manual and paper-based administrative processes.”*

3.2.6. Inflexible Organisational Structures and Processes

This cluster, comprising 30 responses, highlights challenges arising from rigid organisational structures and outdated processes that hinder digital transformation efforts. Key themes include:

Rigid hierarchies and traditional approaches: Many organisations have inflexible hierarchical structures and rely on established, function-based workflows, making it difficult to adapt to modern digital processes. Examples include *“Rigid hierarchical structures limit flexibility and adaptability”* and *“Organization of operations in the traditional established way.”*

Slow modernisation and process challenges: Participants pointed out slow progress in modernising processes and difficulty discarding outdated procedures. Examples include *“Difficulties in discarding old procedures”* and *“Processes need to be adjusted; they are not yet geared towards this.”*

Lack of flexibility: The lack of flexibility in workflows, systems, and organisational structures was a recurring issue. Participants noted *“Low flexibility”* and *“Fixed and unadaptable organisational processes.”*

3.2.7. Financial Limitations

The second to last cluster with 20 challenges highlights financial barriers slowing down organisational digital transformation. Key themes include:



Lack of funding and resources: A recurring issue is insufficient financial resources to support digital transformation initiatives. Examples include *“Lack of funding,” “Money,”* and *“Limited budgets can restrict investments in new technologies and talent.”*

High costs of digital solutions: The expense of implementing advanced technologies, hardware, and digital systems often exceeds the budgets of smaller organisations. Participants noted challenges such as *“Too expensive digital and hardware for small companies”* and *“High cost of digital solutions.”*

3.2.8. Data Security Concerns

The final cluster includes just eight ideas and highlights cybersecurity and data privacy challenges, which pose significant barriers to digital transformation efforts. Examples include *“Increasing cyber threats pose a significant risk to public authorities”* and *“Concerns about data security and privacy can hinder the adoption of data-driven approaches.”* Similar to the digitalisation needs, this cluster stands out as a distinct and independent group, separate from other clusters.

3.2.9. Overall analysis of the challenges network

The analysis of digitalisation challenges across CE organisations identified eight primary clusters that outline significant barriers to digital transformation. These challenges, ranging from resistance to change to data security concerns, illustrate the **multifaceted nature of obstacles** encountered in advancing digitalisation. The table below summarises these clusters, their focus areas, key examples, and their relative impact, represented by the number of identified challenges.

Table 3. Summary of Digitalisation Challenges in CE Organisations: Clusters, Focus Areas, and Key Examples

Cluster	Focus Areas	Key Examples	#
Resistance to Change	Fear of job loss, conservative mindsets, lack of awareness	<i>“Fear of losing jobs”;</i> <i>“We’ve always done it this way mentality”;</i> <i>“Low awareness of digital benefits”</i>	84
Management Challenges	Resistance at leadership level, inadequate skills, outdated practices	<i>“Lack of digital skills in management”;</i> <i>“Outdated project management methods”;</i> <i>“Blurring work-life boundaries”</i>	58
Infrastructure Issues	Outdated systems, insufficient connectivity, lack of integration	<i>“Old computers and systems”;</i> <i>“Limited access to high-speed internet”;</i> <i>“Low interconnectivity of systems”</i>	57
Lack of Digital Skills	Skill gaps among employees, shortage of IT experts	<i>“Employees lack digital and technical skills”;</i> <i>“Shortage of IT professionals”</i>	44
Bureaucratic Constraints	Excessive bureaucracy, legal challenges, reliance on paper processes	<i>“Red tape culture”;</i> <i>“Outdated legal frameworks”;</i> <i>“Requirement for paper documents”</i>	31
Inflexible Organisational Structures	Rigid hierarchies, slow modernisation, lack of workflow flexibility	<i>“Rigid hierarchical structures”;</i> <i>“Low flexibility in organisational processes”</i>	30



Financial Limitations	Limited funding, high costs of digital solutions	<i>“Lack of funding”; “Too expensive digital tools for small companies”</i>	20
Data Security Concerns	Cybersecurity risks, data privacy issues	<i>“Increasing cyber threats”; “Concerns about data security and privacy”</i>	8

The structure of the challenges network closely resembles that of the needs network but displays a more triangular configuration. The core clusters are at the triangle’s three vertices: **Resistance to Change**, **Lack of Digital Skills**, and **Infrastructure Issues**. These clusters represent the fundamental barriers to digital transformation, with **Resistance to Change** occupying a critical position.

As in the needs network, these core clusters are interconnected through **Management Challenges** and process-related issues, highlighting the pivotal role of organisational processes in bridging technological and human factors. However, unlike the needs network, **Management Challenges** form a distinct and independent cluster in the challenges network. This separation emphasises the critical importance of leadership and managerial interventions in overcoming barriers to successful digital transformation. The challenges network demonstrates the complex interplay between technological, human, organisational, and managerial factors, further stressing the need for coordinated efforts across these dimensions to ensure effective digital transformation.

3.3. Digitalisation Needs and Challenges in Different Sectors

Even though the different sectors (public authorities, academia, and SMEs) are very similar in the main clusters of digitalisation needs and challenges, they have different accents and different priorities. In this section, the main differences between sectors are discussed and summarised by each cluster identified in the previous section.

3.3.1. Sector Differences in Digitalization Needs

Development of Digital Skills is a priority for all three sectors, but **SMEs** have the greatest need in this area. They focus on training employees to use digital tools effectively and ensuring consistent skill levels across teams. **Public authorities** also emphasise the importance of improving digital literacy among employees, aiming to build capacity for better public service delivery. **Academia** concentrates on training faculty and students, ensuring educators are equipped with advanced skills and students gain the digital knowledge they need for their future careers.

In the **Improvement of Organisational Processes and Practices**, **academia** aims to simplify workflows and make administrative and academic tasks more efficient. **Public authorities** focus on modernising their operations to provide better and faster services. **SMEs** highlight the need to streamline their daily processes, saving time and reducing costs, which are critical for their resource-limited environments.

Academia expresses the strongest need for **Digital Infrastructure**, prioritising advanced tools, high-speed internet, and reliable systems to support research and teaching. **Public authorities** also show significant interest in upgrading outdated systems to improve their operational



efficiency. **SMEs** focus more on affordable and scalable solutions that fit within their budget constraints, reflecting their financial challenges.

Digitisation and Streamlining Bureaucratic Procedures is another important cluster. **Academia** emphasises reducing inefficiencies in administrative workflows, such as digitising documentation and automating repetitive tasks. **Public authorities** aim to simplify their bureaucratic processes, improving the speed and quality of public services. **SMEs** focus on minimising redundant processes to achieve quick operational improvements, often constrained by limited resources.

In the **Enhancing Accessibility of Digital Tools** cluster, **academia** has the highest focus, emphasising user-friendly tools that make learning and teaching more inclusive for students and faculty. **Public authorities** aim to improve access to digital tools for both employees and the public, making services more effective and accessible. **SMEs** show less interest in this cluster, prioritising tools with immediate business benefits over general accessibility.

For **Investment in Digital Infrastructure**, **SMEs** report the greatest need, reflecting financial barriers to upgrading their systems and tools. **Public authorities** also highlight funding challenges, as tight budgets often prevent necessary infrastructure improvements. **Academia** shows a moderate need, usually relying on government or institutional support for large-scale investments in digital technologies.

Strengthening cybersecurity is a significant concern for **public authorities**, who emphasise protecting sensitive citizen data and ensuring trust in their digital systems. **SMEs** also focus on cybersecurity, prioritising the protection of customer data and business operations from cyber threats. **Academia** places less emphasis here compared to the other sectors but still recognises the importance of securing research and institutional data.

Finally, **Adapting Legislation to Digitalization** is most important for **public authorities**, who need updated laws and policies to support digital transformation. **Academia** occasionally mentions this area, focusing on small administrative changes to facilitate their operations. **SMEs** do not highlight this as a concern, indicating that regulatory issues are not seen as a major barrier to their digitalisation efforts.

The number of needs in each cluster by sector and their main differences in digitalisation needs are summarised in the table below. The diagram under the table illustrates the relative importance of each factor for each sector.

Table 4. Differences in key needs between the sectors

Cluster	Academia	Public Authorities	SMEs
Development of Digital Skills	25*: Focus on training for both faculty and students.	29: Prioritises improving employee digital literacy for better public services.	41: Greatest need, focusing on upskilling employees for efficient tool use.
Improvement of Organisational Processes and Practices	17: Aims to simplify workflows and improve academic and administrative tasks.	23: Focus on modernising operations to deliver faster and better services.	34: Highlights streamlining daily processes to save time and reduce costs.



Digital Infrastructure	29: Strong need for advanced tools, reliable systems, and high-speed internet.	16: Upgrading outdated systems to improve efficiency.	15: Prioritises affordable, scalable solutions due to financial challenges.
Digitisation and Streamlining Bureaucratic Procedures	27: Focus on reducing inefficiencies like digitising documents and automating tasks.	15: Simplifying bureaucratic processes to speed up public services.	15: Reducing redundant processes for quick operational improvements.
Enhancing Accessibility of Digital Tools	9: Focus on user-friendly tools for inclusive learning and teaching.	7: Aims to improve access to tools for employees and the public.	3: Less emphasis, focusing on tools with immediate business benefits.
Investment in Digital Infrastructure	4: Moderate need, usually relying on institutional or government funding.	6: Significant challenge due to limited budgets for upgrades.	5: Greatest need, focusing on overcoming financial barriers for system improvements.
Strengthening Cybersecurity	4: Focus on protecting research and institutional data.	3: High priority to secure sensitive citizen data and maintain trust.	3: Significant focus on safeguarding customer data and business operations.
Adapting Legislation to Digitalization	2: Minimal mentions, mostly for small administrative adjustments.	6: High priority to update laws and policies for easier digital transformation.	0: Not seen as a major concern or barrier.

* Number of needs mentioned in each cluster for each sector.

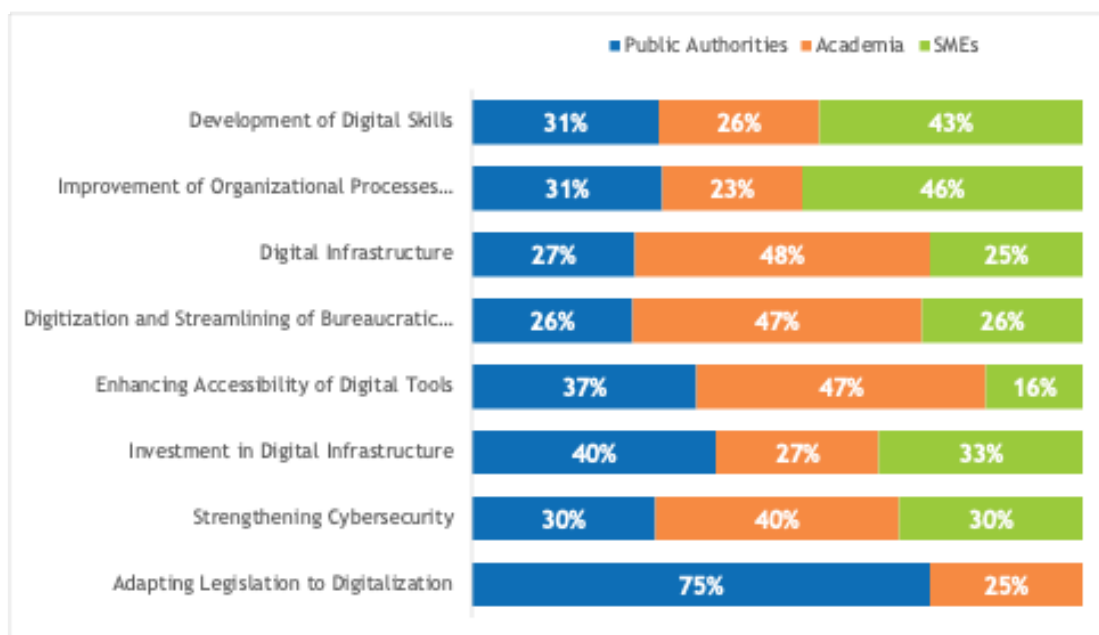


Figure 4. Proportions of the digitalisation needs in each cluster by the sectors



3.3.2. Sector Differences in Digitalization Challenges

Starting with **Resistance to Change**, **academia** often prefers traditional methods over newer digital approaches. At the same time, **public institutions** encounter resistance from employees who fear that new technologies might threaten their jobs or disrupt established workflows. **SMEs**, on the other hand, face a culture of reluctance to move away from familiar practices. They often focus on short-term outcomes, missing out on the long-term benefits of embracing new technologies.

Regarding **Management Challenges**, **SMEs** face significant hurdles, often related to adapting their business strategies to the fast pace of digital innovation. They must manage technology adoption and the transformation of their entire operational approach. **Public authorities** deal with layers of management that can slow decision-making, while **academia** is challenged by the need to balance academic freedom with effective governance.

Infrastructure Issues also present differences across the sectors. **Academia** lacks comprehensive IT solutions and struggles with securing adequate funding for technological advancements. **Public institutions** deal with outdated digital infrastructures, such as slow internet connections, that need upgrading. **SMEs** focus on implementing affordable and user-friendly solutions that can seamlessly integrate with their current operations.

The **Lack of Digital Skills** is evident across all sectors. **Academia** sees a significant gap in the understanding and application of digital tools among staff and students. **Public authorities** face variability in digital proficiency among employees, which can impact productivity and engagement. **SMEs** need training to ensure that all employees can effectively use digital tools.

Regarding **Bureaucratic Constraints**, **academia** is slowed down by outdated administrative processes that rely heavily on paper documentation. **Public institutions** struggle with lengthy procurement processes complicated by regulatory demands. **SMEs** are hindered by a national digital bureaucracy that limits their choices in digital services.

Inflexible Organisational Structures and Processes are a common problem across all sectors but manifest differently. **Academia** and **public authorities** deal with rigid hierarchical structures that hinder the adoption of flexible and responsive digital processes. **SMEs** often find that their existing practices have yet to evolve to accommodate the digital transformation, which can limit their agility and responsiveness.

Financial Limitations are a critical issue for **SMEs**, which often need more financial resources to invest heavily in digital technologies. **Public institutions** face budgetary constraints that can delay or limit the scope of digital projects. Reliant on external funding sources, **academia** faces uncertainties that can affect long-term digital strategy and implementation.

Finally, **Data Security Concerns** are crucial for all, but each sector focuses on different aspects. Safekeeping data is critical for **public institutions**, as they handle sensitive information. **Academia** must protect its research data and intellectual property, a crucial part of maintaining trust and securing funding. **SMEs** know that protecting customer and business data is important, but they might not always have the resources to do it right.



The table below summarises the number of challenges in each cluster by sector, along with their main differences in digitalisation challenges. The diagram under the table illustrates the relative importance of each factor for each sector.

Table 5. Differences in key challenges between the sectors

Cluster	Academia	Public Authorities	SMEs
Resistance to Change	26*: Struggles with adopting new teaching methods and technologies.	17: Concerns about job security and workflow disruption.	41: Reluctance to move from traditional methods, focusing on short-term costs.
Management Challenges	19: Balancing academic freedom with effective digital management.	14: Hierarchical decision-making slows digital adoption.	25: Reactive culture, waiting for external changes to prompt adaptation.
Infrastructure Issues	18: Needs advanced tools and systems to support digital education.	26: Outdated systems widespread, significant upgrades needed.	13: Seeks affordable, scalable tech solutions to fit budget constraints.
Lack of Digital Skills	12: Focus on enhancing staff and student digital competencies.	14: Varying levels of employee digital literacy affect efficiency.	18: Significant gaps in employee digital skills, critical for competitiveness.
Bureaucratic Constraints	11: Hindered by paper documentation and slow admin processes.	18: Lengthy procurement processes due to regulatory complexities.	2: Limited by national digital bureaucracy and vendor lock-ins.
Inflexible Organisational Structures and Processes	10: Rigid structures impede flexible digital process adoption.	10: Organisational setups misaligned with modern digital practices.	10: Existing processes not well-suited to rapid technological change.
Financial Limitations	4: Budget constraints affect ability to fund digital projects.	7: Budgeting issues delay or scale down digital initiatives.	9: Financial barriers limit investment in necessary technologies.
Data Security Concerns	3: Focus on securing intellectual property and research data.	4: High priority on protecting sensitive information.	1: Insufficient cybersecurity measures, vulnerability to data breaches.

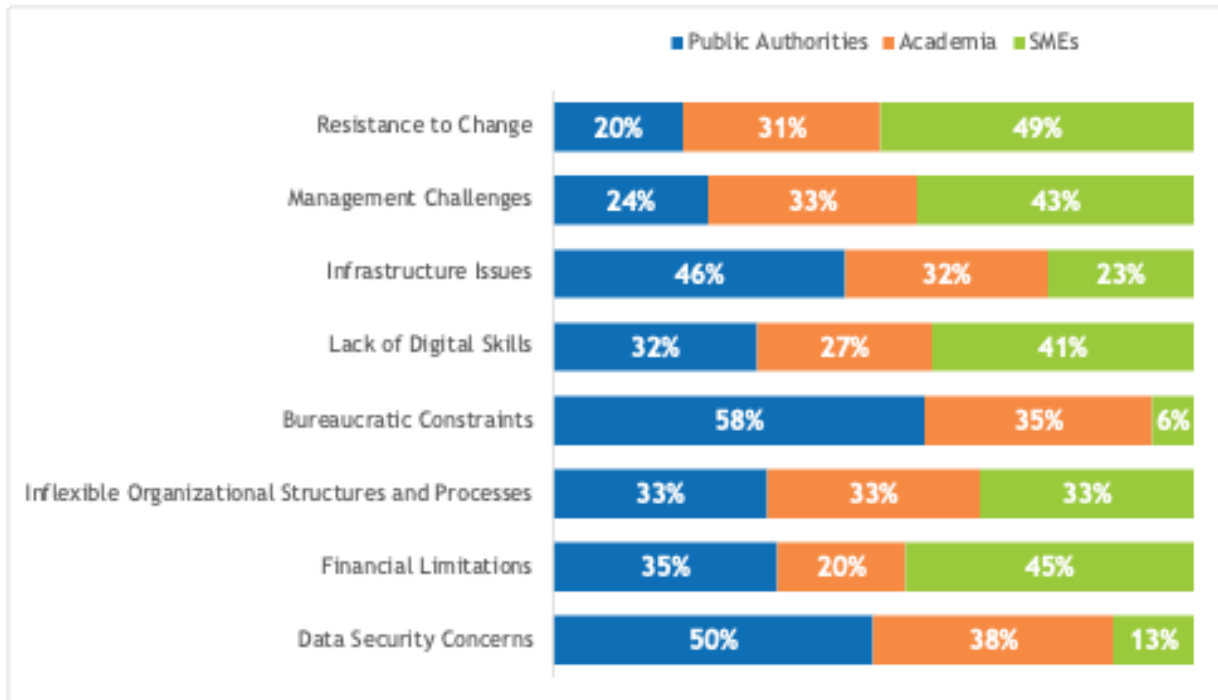


Figure 5. Proportions of the digitalisation challenges in each cluster by the sectors



4. DISCUSSION AND IMPLICATIONS FOR THE DIGI-B-WELL PROJECT

Our analysis identified the main clusters of digital needs and challenges in public institutions, academia, and SMEs, highlighting how they differ. Although the network structures for these needs and challenges are similar, the challenges network more strongly emphasises resistance to new technology and management issues. Considering technology, human and organisational factors, a comprehensive approach is necessary to address DT needs and challenges. A multilevel approach can help organisations navigate the identified barriers for a more sustainable and inclusive digital future.

The identified clusters and their corresponding needs and challenges align with different levels of workplace context, summarised by the IGLOO acronym. The IGLOO framework stands for Individual, Group, Leadership, Organizational, and Overarching context resources available at the workplace (Nielsen et al., 2018). The **individual** domain focuses on the characteristics, skills, knowledge, and motivations of individuals within the organisation. The **group** level addresses how teams and groups within the organisation function. It considers dynamics like team cohesion, communication, collaboration, and conflict resolution. **Leadership** is critical in shaping organisational culture, strategy, and direction. This domain focuses on leadership styles, effectiveness, decision-making processes, and aligning leaders with organisational goals. The **organisational** level refers to the structural and systemic aspects of the organisation, such as policies, workflows, resources, and organisational culture. Finally, **overarching context** refers to the broader external and internal environments that influence the organisation, including market conditions, societal expectations, laws, and organisational history.

The IGLOO framework was successfully used in the H-WORK European project. Our analysis revealed that these levels might also be applied to summarising DT needs and barriers, with the addition of a **technological** level transforming IGLOO into TIGLOO, where ‘T’ represents the level of technological needs and challenges. This approach enables us to map the clusters of DT needs and challenges identified in the research to the specific levels of workplace context, facilitating more targeted support and interventions to address these barriers effectively.

Table 6. Levels of needs and challenges of digital transformation

Level	Cluster of needs	Cluster of challenges
Technological	<ul style="list-style-type: none"> Digital Infrastructure Digitisation and Streamlining Bureaucratic Procedures Enhancing Accessibility of Digital Tools Strengthening Cybersecurity 	<ul style="list-style-type: none"> Infrastructure Issues Data Security Concerns
Individual	<ul style="list-style-type: none"> Development of Digital Skills 	<ul style="list-style-type: none"> Resistance to Change Lack of Digital Skills
Group	<ul style="list-style-type: none"> Development of Digital Skills Improvement of Organisational Processes and Practices 	<ul style="list-style-type: none"> Resistance to Change Lack of Digital Skills



Leader	<ul style="list-style-type: none"> • Development of Digital Skills • Improvement of Organisational Processes and Practices 	<ul style="list-style-type: none"> • Resistance to Change • Management Challenges • Lack of Digital Skills
Organisation	<ul style="list-style-type: none"> • Improvement of Organisational Processes and Practices • Digitisation and Streamlining Bureaucratic Procedures • Enhancing Accessibility of Digital Tools 	<ul style="list-style-type: none"> • Bureaucratic Constraints • Inflexible Organisational Structures and Processes
Overarching/social context	<ul style="list-style-type: none"> • Investment in Digital Infrastructure • Adapting Legislation to Digitalization 	<ul style="list-style-type: none"> • Bureaucratic Constraints • Financial Limitations

The next section discusses each sector's main DT needs and challenges at different levels. This multi-level approach will build a bridge for developing a methodological framework in the subsequent activities of the Digi-B-Well project.

4.1.1. Levels of DT Needs and Challenges in Academia

In academia, **technological** challenges stem from outdated systems that struggle to keep pace with modern research and administrative demands. The ability to process large datasets efficiently and integrate diverse digital platforms is particularly lacking. This limits the potential for interdisciplinary collaboration and the effective use of technological tools in teaching and research. Upgrades and standardisation are important to address these issues.

At the **individual level**, many academics and administrative staff lack the digital skills required to use new technologies efficiently. Participants reported that training opportunities are often insufficient, creating a knowledge gap and negatively affecting confidence. Resistance to change, particularly among more experienced staff, adds additional difficulty in fostering a culture of digital learning and innovation.

At the **group level**, collaboration might suffer due to fragmented communication, misaligned goals and interests of different functions and departments, and a lack of tools to support team efforts. Effective teamwork in academia relies on digital solutions that are not always available or user-friendly, which slows progress on shared goals.

Leadership within academia is frequently unprepared to guide digital transformation. Leaders lack the necessary digital literacy and tend to prioritise traditional approaches over innovative solutions. Without leadership support, change initiatives face resistance and fail to gain momentum.

On the **organisational level**, rigid structures and bureaucratic processes create barriers to implementing new technologies. The existing culture often resists innovation, favouring established practices over more efficient and flexible technology-driven alternatives. This hinders the flexibility needed for DT.



Finally, within a broader **context**, external regulations and societal expectations make DT more difficult. They create additional complexity in planning and executing digital transformation strategies.

4.1.2. Levels of DT Needs and Challenges in Public Institutions

Public authorities face challenges in upgrading their **technological** infrastructure. Many systems, particularly in rural areas, are outdated and unable to support modern digital services. Integrating communication platforms and ensuring compatibility between existing tools remains a significant obstacle.

At the **individual level**, there is a widespread lack of digital literacy among employees. Training opportunities are limited, leaving many staff members unprepared to manage new technologies. Older employees, in particular, are often resistant to digital transformation, viewing it as a disruption rather than an opportunity to improve workflows. A lack of understanding of digital tools and their potential benefits further complicates the situation.

Collaboration within **teams** and across departments is often hindered by inefficient communication channels. The lack of coordination and specialised teams to oversee digital transformation initiatives slows progress, leading to fragmented efforts and missed opportunities for improvement.

Leadership in public authorities often hesitates to adopt innovative solutions. Resistance to change among top-level managers, especially in smaller or more rural authorities, undermines efforts to modernise processes.

Organisational processes in public authorities are typically burdened by excessive bureaucracy and rigid hierarchies. These structures make it difficult to introduce flexible and streamlined digital workflows. There is a need for automatisation and digitisation.

The broader **context** for public authorities includes external pressures such as legal requirements, public expectations, and budget constraints. These factors create additional layers of complexity, making digital transformation challenging to execute effectively.

4.1.3. Levels of DT Needs and Challenges in SMEs

In SMEs, more **technological** infrastructure is needed to progress. Many businesses rely on legacy systems that are compatible with modern tools, creating inefficiencies and limiting growth. Business owners often face uncertainty when deciding which technologies to adopt, leading to delays in implementation and missed opportunities.

On the **individual level**, digital literacy is uneven across employees and managers. Many older leaders are resistant to learning new skills, preferring to maintain the status quo. Employees often lack the training necessary to adopt new tools effectively, and time constraints make skill development a low priority.

Team collaboration is another area of concern. Lack of coordination between IT and HR teams for digital projects and poor communication regarding DT goals create difficulties implementing changes.



Leadership in SMEs is often cautious about change, particularly when it involves significant investment in unfamiliar technologies. Managers may struggle to trust digital solutions or fail to see their value, which undermines efforts to align leadership with organisational transformation goals.

At the **organisational** level, many SMEs operate with rigid structures and traditional cultures that resist innovation. Processes often need significant adaptation to integrate digital tools effectively. Companies with progressive leadership tend to perform better, but these cases are exceptions rather than the norm.

The **external environment (overarching context)** presents additional challenges for SMEs. Access to funding and expertise is limited, and smaller businesses often need more resources to compete with larger companies in adopting new technologies. Government incentives and external support can play a key role in addressing these gaps.

Table 7. A multilevel approach to DT needs and challenges in three different sectors

Level	Challenges			Needs		
	Academia	PI	SMEs	Academia	PI	SMEs
Tech	Outdated systems and tools require modernisation and integration	Outdated IT systems	Reliance on legacy systems, uncertainty in technology choice	Advanced cloud-based and AI technology, data tools	Upgrading infrastructure, equitable access	Modern, cost-effective tools, integrated systems
Indiv	Skills gap in faculty and students; resistance to use new technology	Low digital literacy; resistance among older employees	Digital literacy gaps; reluctance to invest time in learning tools	Digital skills training	Training employees, supportive learning environments	Continuous training and upskilling, especially for leaders
Group	Disagreements between teaching staff and administration	Poor coordination; limited cross-departmental communication	Resistance to digital tools; preference for traditional interactions	Collaboration and communication solutions	Forming specialised IT teams; improving communication	Better communication, alignment on digital projects
Leader	Resistance to change among management; insufficient digital literacy	Resistance to change in management; lack of clear direction	Balancing DT vision with employee motivation; resource constraints	Leadership training in digital tools and processes	Digital literacy training and change management skills	Supportive leadership fosters DT success
Organ	Bureaucratic, inflexible processes; lack of strategies; conservative culture	Inflexible structures; excessive bureaucracy	Rigid company cultures and processes that resist change	Modernising processes; increasing flexibility	Redesigning bureaucratic processes for efficiency	Fostering innovation, process adjustments for automation
Over	External regulations; societal expectations	Bureaucracy and legislation	Budget and resource constraints	Aligning with national/global technological trends	Aligning strategies with national regulations	Need for external support



Addressing DT barriers and needs requires balancing technological, human, and organisational factors. Lack of digital skills, resistance to technology adoption, and outdated management practices emerged as recurring themes in all three sectors. Across all organisation types, a systematic alignment of policies, processes, and training initiatives with DT strategies is essential.

This analysis reinforces the importance of a coordinated, multilevel strategy to tackle DT challenges effectively. By aligning interventions with specific TIGLOO levels, organisations can navigate their unique barriers more effectively, moving faster toward digital transformation.



5. CONCLUSION

Successful DT in Central Europe’s different sectors requires a well-rounded approach that combines technological upgrades, developing people’s skills, and improving how organisations work. Our survey of academic institutions, public authorities, and SMEs across the region identified eight key DT needs and challenges groups. These groups highlight what organisations need to succeed and the main barriers they face. The figures below show the main groups of needs and challenges identified, along with their share of the total responses: 338 for needs and 332 for challenges.

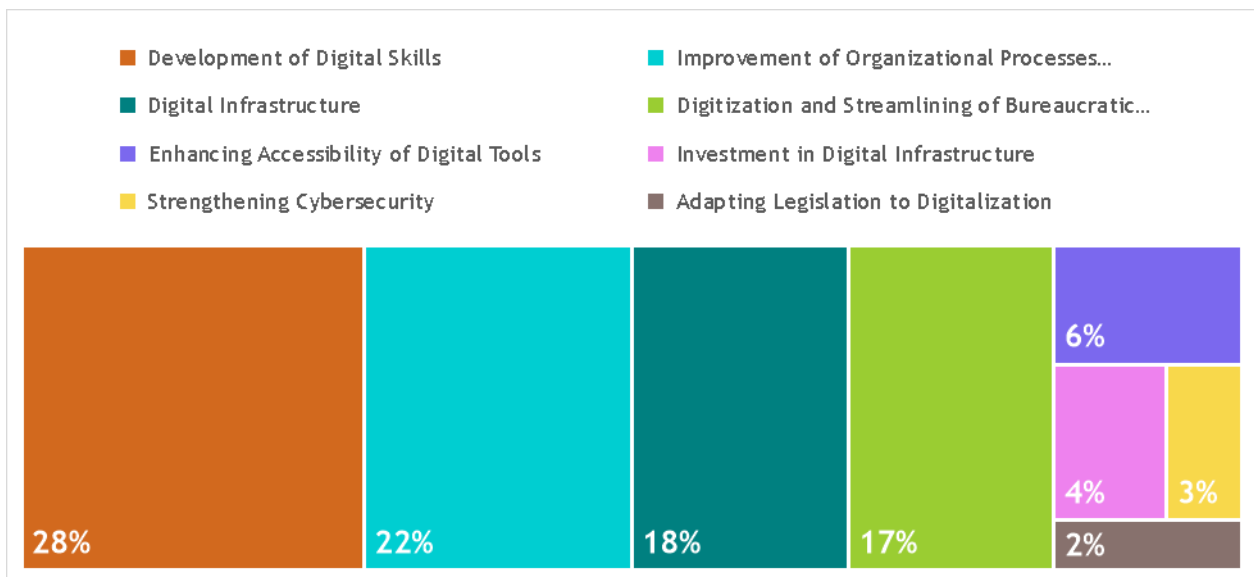


Figure 6. Proportions of the clusters of digitalisation needs

Figure 3.

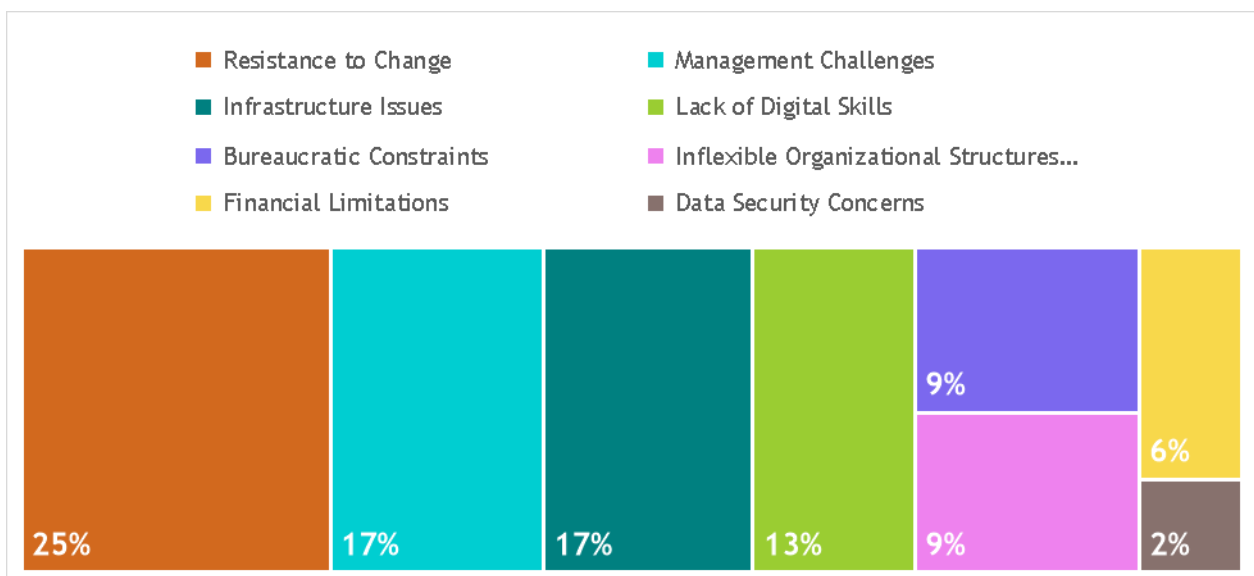


Figure 7. Proportions of the clusters of digitalisation challenges



Our findings show that simply upgrading technology is not enough. DT also requires changes in how employees and leaders think and work. Organisations must adapt their structures, procedures, and cultures to create an environment that supports change. While some challenges, like a lack of digital skills, old systems, and inflexible processes, directly match the needs of DT, others—such as resistance to change and leadership challenges—stand out as major obstacles that can slow down the transition even when all primary needs are satisfied. Many organisations see these issues as too challenging to overcome, making it even more important to provide guidance and support.

The analysis highlights the critical need for practical steps like improving digital skills, upgrading infrastructure, addressing resistance to change, and improving digital governance. By focusing on these areas, organisations can overcome barriers and improve their readiness for the digital era. The diverse challenges identified in this report underline the importance of tailored solutions that fit each sector's needs and priorities. Academic institutions, for example, need better infrastructure and training to support modern teaching and research. Public authorities must streamline processes and upgrade outdated systems to provide better services. SMEs face the challenge of limited resources and need clear strategies to adopt the right technologies and stay competitive.

A multilevel approach is essential to address this diversity of needs and challenges. This means focusing on individuals, leadership, and the organisation as a whole. Resistance to change, for example, can be addressed through better communication, strong leadership, and a workplace culture that values innovation. Leaders play a key role in driving digital transformation, but they often need more training and a willingness to adapt to new working methods. Frameworks such as the enhanced TIGLOO model can support organisations in addressing DT challenges at multiple levels – technological, individual, group, leadership, organisational, and overarching contextual factors. Central Europe can significantly increase its chances of advancing DT by aligning multilevel strategies with sector-specific needs, challenges, and shared regional objectives.

The analysis presented provides a solid foundation for the Digi-B-Well project, which will develop tools and strategies to help organisations in Central Europe succeed in their DT. The project can promote digital well-being and create a stronger, more innovative region by supporting academia, public authorities, and SMEs in these efforts.



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