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Data Management Competencies – A Need for Digital Age

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Abstract

Our lives are shaped by digital technology, which requires expansion to new capabilities and technologies that can support the speed of digital change and business trends.

Education is the main pillar to ensure the transition to the digital age, with data literacy leading society toward sustainable growth. Implementation strategy plays an important role in digital transformation, both in adapting to digital changes and integrating new educational plans based on solid methodological tools.

Data are becoming monetized business assets. Statista revealed that there will be just over 180zb of data produced by 2025 in the world, while Forbes shows that 95% of companies need to manage unstructured data.

The purpose of this research is to present data management and the core capabilities around this concept to prepare global citizens independent of their role in society to face the challenges that will affect the labor market.

Key words: Digitalization; Labour market; Data management; Data monetization
J.E.L. classification: I0; J2; O3

1. Introduction

In the context of current society state, according to Gartner studies, information is essential, but the most valuable input comes from the use of data. The data-driven culture reinforces continuous performance improvement to create customer care centric business providing another hint about data driven enterprise and usage of cutting-edge new technologies.

There is multiple reasoning in which data helps to improve the quality of people's lives, can help decision makers, can influence the usage of different strategies translated into increasing competitiveness on the market or all reasoning simultaneously. Thus, the concept of data management is developed, which represents the totality of the processes necessary to manage different activities throughout the cycle of development or substantiation of a decision. Even though the need to increase data competencies appears frequently in the private environment, the skills should be developed during schooling. The capabilities mirror each other in the need to teach learners about the form and format of data and databases, the management of that data, the curation and reuse of data, and the metadata used to describe that data(Qin and D'Ignazio, 2010; Carlson et al., 2011; Piorun et al., 2012; Prado and Marzal, 2013; Schneider, 2013; Coombs, Malinowski and Nurnberger, 2019). Overall, there is solid consensus in the literature of competencies regarding the major themes that should be addressed in data education.

Major players in the digital industry have invested in research studies, and the results lead to the benefit of developing the skills and competencies necessary for the analysis and informational exploitation of data.

2. Theoretical background

The digital age requires professionals to develop essential skills for effective data management and adaptation to an ever-evolving technological landscape. These are necessary for the effective management and use of data in various professional contexts, especially in response to the evolving demands of the digital landscape.

Skills such as data management, digital literacy, and adaptability to technological changes are fundamental to the success of professionals in the digital age. They allow the management of data complexity and effective use of digital tools, thus contributing to meeting the demands of a dynamic and constantly changing professional environment.

A strong data governance culture is vital to harnessing data-driven technologies. One example is the USDA-ARS partnerships that demonstrate the transformative impact of collaboration in data management for agricultural research (Harmel et al., 2021). At the same time, understanding the quality and limitations of big data is essential, given the risks of distortions due to digital divides, which requires meticulous analysis to avoid errors in data use (Baur et al., 2020; Büchner, Hergesell and Kallinikos, 2022).

When it comes to essential skills for effective data management and adaptation to the current technological context, digital literacy plays a central role in the efficient processing and use of information. Professionals must be able to operate using various digital tools and interact effectively with modern interfaces. These skills are recognized as essential for the future workforce, especially in higher education, where digital skills contribute to integration in complex technological environments (Mei, Feng and Cavallaro, 2023; Maulidevi et al., 2024).

Conversely, adaptability to technological change is indispensable in the context of accelerated technological progress. Professionals in industries such as hospitality and tourism need to adjust their practices to integrate new digital tools and methodologies (Cheng et al., 2023). Similarly, in educational institutions, the adoption of emerging technologies is necessary to meet user requirements, reflecting a general need for flexibility in various professional fields (Nkuebe, 2017; Busulwa, Pickering and Mao, 2022; Mei, Feng and Cavallaro, 2023).

The impact of data management skills on professional effectiveness in digital environments is multifaceted, involving the need for organizations to embrace digital transformation, develop relevant skills, and recognize the importance of emotional intelligence. These elements are necessary to improve workforce capabilities and ensure success in an increasingly digital world (Jason, Hung and Ida, 2023; Akter et al., 2024).

These findings demonstrate that the advances in digital transformation and the demand for data management skills are not isolated phenomena but are closely linked to the accessibility and adoption of digital infrastructure at a societal level. Thus, as organizations improve their workforce capabilities, the broader context of the digital readiness of the population becomes increasingly important. In Romania, for example, the expansion of internet access has laid the foundation for the integration of digital skills into education and vocational training, creating opportunities to align individual skills with organizational needs. However, reducing the gap between infrastructure and skills development remains an urgent challenge, as seen in the discrepancies between the average number of Romanians and the European Union (EU) in terms of digital skills.

According to the data provided by Eurostat, in the period 2013-2022 there is a significant increase in Internet access in households in Romania, the 2019-2021 pandemic period being noted, where the level reached approximately the average of the EU. Thus, a favorable context is created for the digitization of education and digital skills in Romania. However, a low level of digital skills acquired by Romanians can be observed, compared to the average of the European Union.

Figure no. 1 Digital skills overview from 2021 onwards

Individuals' level of digital skills (from 2021 onwards)
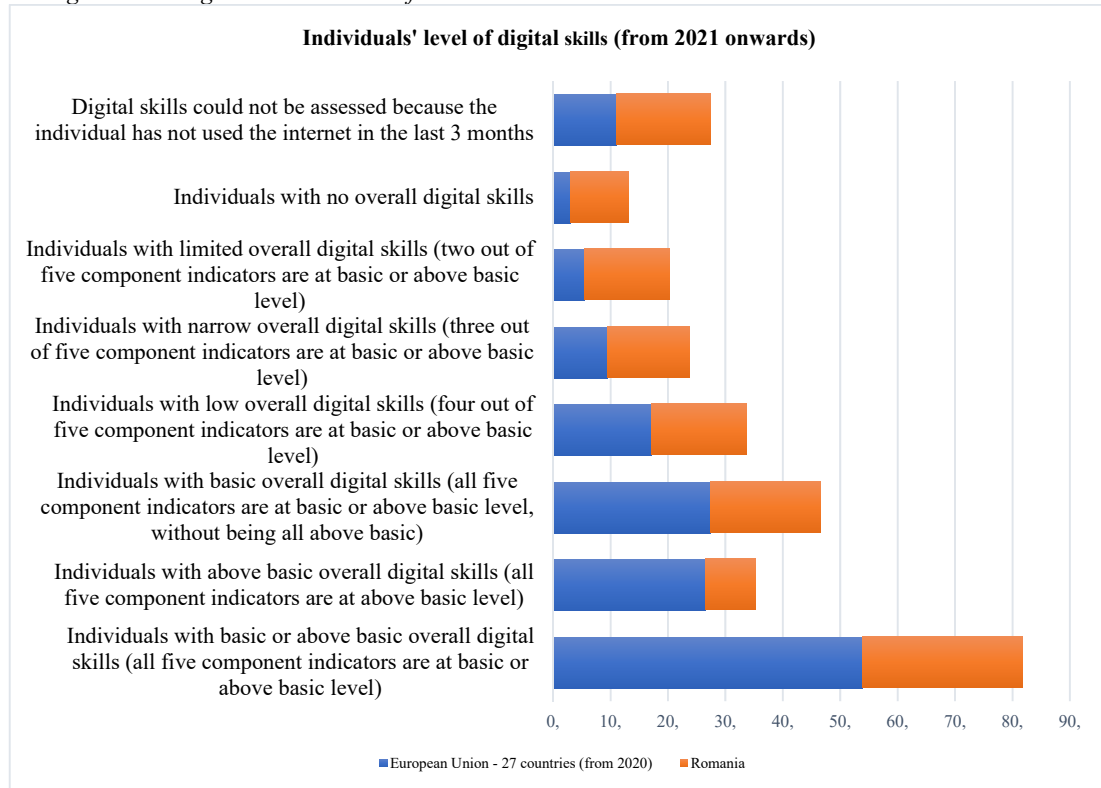
Source: Eurostat

According to Statista, by 2025 the volume of data will reach approximately 180 ZB, while Gartner claims that more than 70% of companies will redirect their focus to the storage and analysis of large volumes of data. Also, an interesting aspect is captured by Forbes, according to which 95% of companies must adapt to the storage of unstructured data. To all these statistics is added the pandemic context generated by COVID-19 which has accelerated the digitization and use of data. With all this context, the role of Data Scientist or Data Engineer become one of the most sought-after and well-paid roles in the field of data.

3. Research methodology

This research was conducted using a qualitative methodology with the aim of exploring the impact of data management skills on professional performance in an ever-changing digital era. Thus, the literature review stage was the first step in identifying the essential dimensions of data management, such as governance, data quality, and data integrity (Wang and Strong, 1996; Black and van Nederpelt, 2020).

A key aspect of the study was the development of a competency matrix using the 360-degree feedback method to assess the level of data literacy within organizations. The approach was chosen to obtain a comprehensive and objective assessment of employee skills given that this type of feedback allows for the collection of information from multiple sources, including superiors, colleagues, and subordinates, which provides a holistic view of individual skills, thus resulting in a more complete and accurate assessment (Workhuman Editorial Team, 2024).

In the research, this tool was used to identify both strengths and areas that require development in terms of data management and use. Thus, the use of the competency matrix to assess data literacy skills enabled the identification of employee training levels in terms of data management and use, with the aim of improving their capabilities through specific training. An example of a similar approach is the research conducted by QlikTech International (2022), which showed that the majority of business decision-makers lack confidence in their data literacy skills, highlighting the need for

systematic and objective assessments of data skills at the organizational level. The matrix was validated through 360° feedback, providing a broader view of the current skills and the necessary development directions.

Another important aspect of this research is the analysis of the collaboration between higher education institutions and the private sector to meet labor market demands. The proposal to develop specialized educational programs that support the development of digital and data management skills, as already highlighted by Moldoveanu and Narayandas (2019), shows the importance of integrating them into university curricula to meet the demands of current industries. Based on this methodology, strategic recommendations were formulated to improve digital literacy and data management skills, proposing a more integrated and practice-oriented approach that would allow organizations to quickly adapt to new technological requirements and maximize their performance through optimal use of data (Souza and Rose, 2024). Thus, to support the implementation of the proposed strategic recommendations, it is necessary to deepen the understanding of the essential dimensions of data management, given the complexity of this concept, which encompasses various activities, such as the integrated management of data from various sources, quality assurance, and governance. Addressing these aspects, along with the development of an efficient storage system architecture, is essential to support organizations in quickly adapting to new technological challenges and maximizing data value to improve performance.

4. Findings

4.1. Data Management Dimensions and Core Capabilities

Data management is a multidimensional concept that captures activities from several angles including data storage, data integration from multiple source systems, data quality, data governance, data storage system architecture or database management systems.

Data Governance is one of the main capabilities of data management and refers to the management of security, availability, integrity, and use of data. One of the main objectives of data governance is to remove the use of siloes data in organizations and use it in a documented and centralized way. This decentralized way of using data can arise primarily from the speed with which information is propagated across different systems, the use of data by different departments that do not have a centralized way of working or an architecture that helps better coordination and synchronization. Data governance aims to harmonize these data from the systems through a collaborative process, with the participation of interested stakeholders from different angles of the organizations. Another goal of data governance is to ensure that data is used appropriately, both to avoid introducing potential data errors into systems and to block the misuse of personal data. This can be achieved by creating uniform data usage policies, along with procedures for monitoring usage and enforcing policies on an ongoing basis. In addition, data governance can help strike a balance between data collection practices and privacy mandates. In the context of data governance, skills are required to understand source data systems, functionally document technical variables, and take responsibility and ownership of data as it stands and any subsequent changes.

Another very important dimension of data management is data quality. Researchers were concerned about the quality of the data, so a number of 15 dimensions are identified (Wang and Strong, 1996), but later these were narrowed down to 6 with no less than 65 sub-dimensions (Black and van Nederpelt, 2020). These are: Accuracy, Completeness, Consistency, Timeliness, Validity and Uniqueness.

Data Integrity is the process of bringing together data from multiple sources with different formats to create a unified view. Data and digital transformation are in a symbiotic relationship. Thus, from the need to increase the skills of understanding data in the context of the aggressive digitization of society correlated with the financial performance of companies based on factual decisions, an index was developed to capture the degree of education in the field of data (Data Literacy Index). According to a study conducted by (QlikTech International AB, 2022), 76% of key business decision makers lack confidence in their data literacy skills.

As organizations become data-driven, poor data literacy will become a growth inhibitor. According to the Data Literacy Index, Europe has the highest score globally, where Germany, the UK or France are mature players in terms of data literacy. Although the values of this indicator are low in ASIA, Singapore stands out with the highest literacy rate worldwide.

From the desire to increase the financial performance of companies, they invest in the digital education of employees, this being a balance between technical and behavioural skills. Technical skills include programming languages (Python, R, SQL), data modelling methods, econometric analysis methods and tools, probability, and statistics. From the sphere of behavioural skills, we can mention creativity, critical thinking, teamwork, storytelling, or the ability to react quickly and solve problems.

4.2. Business Trends and How Higher Education Can Answer to the Needs

Data literacy has become a mandatory skill for all the organizations data-driven. Smart strategy consists in shaping the future and answering to the business needs relying on available means. Main purpose of our study is to create a framework to assess skills level in a company and how this can be improved with a cross collaboration between private and public business and higher education system.

In order to assess the level of data literacy of employees is the definition of a skills matrix. The steps to obtain such an array would be:
- Establishing the skills needed in the organization/project – avoid mentioning irrelevant skills
- Assessing the skill level of each subject in the sample or total population – using a 360-feedback form to avoid over- or under-estimation
- Assessing the direction of development of interest for each subject in the sample or total population
- Organizing the information obtained at the previous points in a matrix

Applied to data management core capabilities, a proposal for such a matrix can have the following format:

Table no. 1 Data matrix skills

|		Topic 1	Topic 2	Topic 3	Topic 4	Topic 5	Topic 6
		Seniority level/interest	Seniority level/interest	Seniority level/interest	Seniority level/interest	Seniority level/interest	Seniority level/interest
Hard skills	Data architecture						
	Databases						
	Data integrity						
	Data governance						
	Programming						
	Data modelling						
	Probabilities and statistics						
	Econometrics						
Soft skills	Team work						
	Creativity						
	Critical thinking						
	Analytical mindset						
	Stakeholders management						
	Storytelling						

Source: Authors research

The skills matrix is telling a story about current data literacy level can be increased and to have impact in an organization the main thing to do is to start in an early phase to educate people before a project wrap ups or bad financial figures happens.

Even though data literacy is an important pillar for data driven organizations transformation, most of them lack this set of skills. One of the potential mitigation solution would be the education around data literacy even from high school supported by universities. When it comes about the direction of universities to support the optimization of the skills needed by public and private businesses, the operating model between the two big entities should answer to those strategic questions:

- What transformation is needed?
- What is the optimization that can be done to the current state?
- What are the risks by not taking any action or what would be the consequences of a late reaction?

To support data driven organizational changes, universities should redesign their strategy in terms of set of skills provided. Following Hammer ad Champy's business process redesign, this process would consist in a sequence of steps and close collaboration with companies (Figure no. 2).

Figure no. 2 Hammer and Champy's business process redesign model
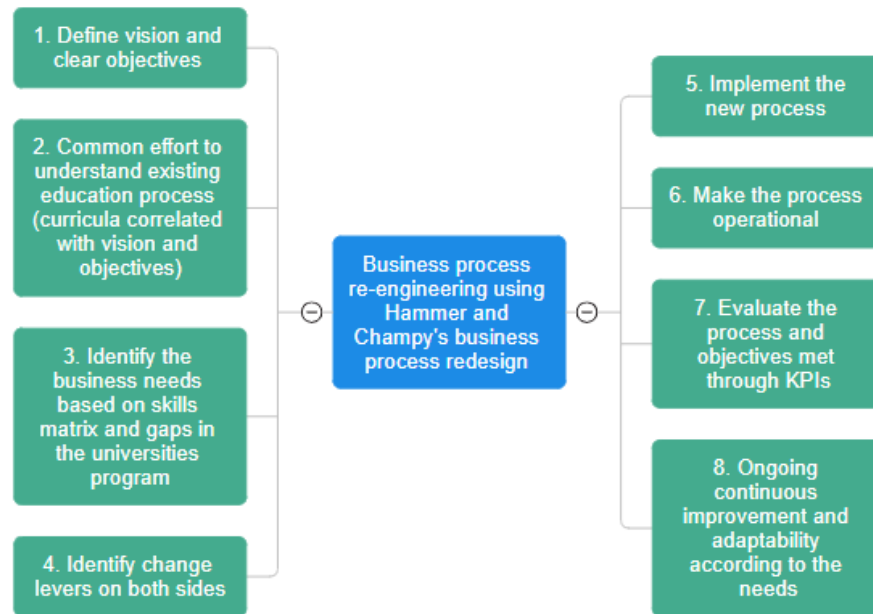
Source: Authors research

There are two main categories of actions to be taken: first of all, the collaboration between universities and companies should happen under clear objectives and a common understanding of existing gaps from both sides.

The goal is to filled-in those gaps and keep students motivated and engaged in a learning curve with clear outcome. For instance, one of the possibilities in case if a skill is missing (Eg. Data quality) an option is that the company team up with a proxy university and create a program that will allow students to have access to the corporate universe and business by applying their knowledge and even doing trainings to increase it in order to answer to the need. In this way the learning curve is applied on business needs.

5. Conclusions

Increasing data literacy skills and data-supported capabilities is a strategic answer to answer as society. More and more companies are investing in AI that rely on excellent data capabilities that will help to have better results but with resources spent in a more efficient way. In executing this strategy, a reliable partner is higher education with the mission to adapt their programs to develop specialized human capital ready to integrate on the labor market.

Thus, within organizations, an approach is needed that allows the integration of data analysis and, implicitly, new emerging technologies (Davenport, 2006; Benjamin, Amajuoyi and Adeusi, 2024). All of this requires, on the one hand, employee skills to make informed decisions and, on the other hand, provides a competitive advantage in the business environment because of their ability to easily adapt to customer preferences or changing market conditions (Hammer and Champy, 1993; Hossain et al., 2024). In this regard, universities must include in their curricula programs that are developed

in collaboration with the business environment to help future employees/leaders adopt a continuous learning mentality.

Lifelong learning is essential for individuals, especially in the context of technological change, when it is important not only to succeed in the labor market but also to be able to exercise optimal professional and intellectual capacity. Thus, joint projects can be conducted through partnerships with universities and educational institutions to reduce skill gaps (OECD, 2021). Also, the results of such collaboration are beneficial to all actors involved. In the case of teachers, they can understand the demands of the labor market and teach practical skills (World Economic Forum, 2020).

Lack of action or delay in transformation can have negative consequences at both personal and organizational levels. The lack of immediate educational reform can limit the acquisition of the necessary data literacy skills at the individual level, which, at the organizational level, is reflected in limiting productivity and competitiveness (QuantumBlack AI by McKinsey, 2022; McKinsey - AI & Analytics, 2024). If a company with a data-driven culture encourages continuous improvement of organizational performance and integrates new technologies into its activities, it is necessary to have motivated employees with relevant skills so that they can create truly differentiated experiences for customers and employees, will always adapt to market demands, and will exclude the risk of being overtaken by the competition (Gartner, 2024b; 2024a) .

The role of education is also important, with universities being considered a fundamental pillar in supporting organizational change, adopting the business process redesign model proposed by Hammer and Champy (1993). This requires a rethinking of traditional methods and the development of close industry and business collaborations. Thus, in addition to promoting online learning and micro-level certification, an interdisciplinary approach is needed that combines data science, which would highlight the fact that the partnership between academia and industry is essential for innovation and workforce training (Moldoveanu and Narayandas, 2019).

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