

**DIGITAL TRANSFORMATION IN ROMANIAN ACCOUNTING PRACTICE
AND EDUCATION: IMPACT AND PERSPECTIVES**

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Abstract

Transformation of business models using digital technologies is depicted by the European Green Deal (EC, 2019) as a key factor in achieving sustainability goals. For the business environment, the digitalization of organizations entails changes in the accounting functions, correlated with the increase in the volume and nature of managed data. In this paper, we analyse the impact of digital technologies in the field of accounting. We also investigate the degree of adequacy of the Romanian higher education system to the educational needs associated with the digital skills required of professional accountants from different generations. We use data collected from the curricula of business bachelor's programs from the four largest university cities in Romania. Results illustrate the universities' potential for training specialists to assimilate and steer the digital transformation of the accounting profession.

Keywords: Digitalization, accounting education, European Green Deal, Romania.

JEL Classification: I25, M14, M15, M41.

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Introduction

“Digitalization is the use of digital technologies to change a business model and provide new revenue and value-producing opportunities; it is the process of moving to a digital business” (Gartner, 2020). Characterized by some authors as the most important paradigm shift in business history or, conversely, as a phase of technological advancement (Knudsen, 2020), digitalization generates effects on multiple levels: individual, organizational and societal. The World Economic Forum estimates that, during the next decade, 70% of the value created by the world economy will derive from fully or highly digitalized domains (WEF, 2020). In highly digitalized areas, “digital” education provided to the future labour market participants is more important than the primary capital accumulation, and higher education institutions have to consider this fact in order to maintain their relevance (Madsen, 2015).

These realities are also acknowledged by the European Union (EU). The European Green Deal (EC, 2019) describes digitalization as “key enabler” for reaching its objectives. The proposed policies involve the use of digital technologies to drive profound transformations of business models, able to induce accessible and interoperable “data-driven innovation”. Stronger regulation in the field of corporate reporting is also anticipated, as suggested by the commitment to standardize natural capital accounting practices and to review the Non-Financial Reporting Directive. The Green Deal recommends integrating sustainability concerns into corporate governance, by prioritizing sustainable and long-term development over short-term financial performance. Regarding the goal of informing investors “about the sustainability of their investments”, the Green Deal refers to the transparency of corporate reporting (financial and non-financial). The need to report information about the environment, climate, environmental risks and their mitigation opportunities creates new responsibilities for companies. In this context, we believe that digital transformation will impact the accounting field as a result of new realities regarding the type, volume, and characteristics of available data, and also of the requirements to provide “reliable, comparable and verifiable information” (EC, 2019) to buyers and stakeholders.

The effects of the digital transformation on the field of accounting are insufficiently studied in the literature, resulting in gaps between the advanced practice of digitalization and academic research, as well as between practice and education. Möller, Schäffer, and Verbeeten (2020) note that while academic research includes conceptual studies and a small number of empirical studies on digitalization in accounting, many companies have confirmed the impact of digitalization on accounting practices and organized special departments to guide the digital transition of marketing, human resources, financial and accounting functions. According to Coyne, Coyne and Walker (2021), accountants do not yet have access to training that will allow them to take on new roles as data analysts, IT auditors or participants in the development of information systems.

Consequently, we define the objective of our research: The evaluation of the way in which digital technologies transform the field of accounting, the accounting profession and the content of accounting education in Romania. We formulate the following research questions regarding the digital transformation in Romania:

- Q1. What are the digital technologies affecting accounting and the accounting profession?
- Q2. What is the educational offer of Romanian universities in the field of digital technologies?

Q3. How can the educational offer of Romanian universities in the field of digital technologies be improved?

The paper has the following structure. Section 1 outlines the available digital technologies affecting the content of the accounting function within organizations, and, by consequence, the accounting profession. In addition to the technologies mentioned by the Green Deal (artificial intelligence, cloud computing, Internet of Things) we include other potentially disruptive technologies in the investigated field (big data, blockchain, business intelligence, data analysis, software robots). In section 2, we develop on the context of digital transformation in accounting by correlating the phenomenon with the characteristics of different generations of professionals and accounting education. In section 3 we assess to what extent the offer of the main business universities in Romania covers the educational needs regarding the new technologies, and we identify ways to improve this offer. We analyse bachelor's programs in Accounting, using as reference the corresponding programs in Economic Cybernetics, Statistics and Economic Forecasting, and Economic Informatics. Finally, we outline our conclusions, research limitations and directions for future research.

1. Digital technologies impacting the accounting profession and the content of the accounting function within organizations

In the following, we use literature review to identify the available digital technologies and to explore their usefulness and impact in the field of accounting (Q1).

Accounting and technology have evolved together (Granlund and Mouritsen, 2003). The first major transformation of accounting systems was caused by the advent of computerized information systems in the '60s and '70s, which affected data recording and analysis techniques (Porter and Heppelmann, 2014). The second transformation took place during the late '90s and early 2000s, when the advancement of the World Wide Web and integrated information systems such as Enterprise Resource Planning (ERP) improved the information supply and changed the way in which information is acquired and provided within an organization. During that time, the relationship between technology and accounting was unidirectional: digital technologies have transformed accounting processes, while traditional reporting models were maintained, and have been affected by accounting to a small extent (Rom and Rohde, 2007). The simultaneous emergence of a large number of digital technologies brings the third wave of technology-driven transformations in accounting and the accounting profession. The relationship between accounting and technology becomes bidirectional, as it involves deeper changes of accounting practices, redefines the boundaries of accounting, redesigns the power and responsibility relationships within organizations, and changes the nature of information used in decision-making; in turn, digital technologies are flexible and can be modelled according to needs (Knudsen, 2020). Along with these changes, there is also an opportunity for the accounting profession to shape the evolution of technologies by getting involved in the technological development of organizations.

The European Green Deal acknowledges the informational usefulness of digital technologies throughout the supply chain and directly to the consumer. Thus, "digitalization can also improve the availability of information on the characteristics of products sold in the EU" (electronic product passport) and better inform consumers "on details such as where the food comes from, its nutritional value, and its environmental footprint". The Green Deal also refers to corporate reporting, by announcing future standardization of natural capital accounting

practices and a review of the Non-Financial Reporting Directive. The immediate implications of these policies entail the expansion of types and sources of the data that companies collect. To transactional accounting data there are added new data sets that, in the traditional accounting paradigm, would have been eliminated due to the lack of a direct link to an economic transaction (Knudsen, 2020). Data sets related to the supply chain, customer behaviour, product associations, etc. are significantly less structured, may be anticipatory and may assist decisions in different ways, when compared to historical data provided by the accounting system.

Digital technologies having an impact on accounting (specifically, accounting practices, corporate reporting and management reporting) require professionals to possess advanced digital competences and proper information systems' security-related abilities, that must be developed as part of their academic education. We believe that the key issue in choosing the right path when training future accounting professionals is to identify the technologies having the highest impact on the content of the accounting function within organizations.

At the heart of the digital transformation of accounting and the accounting profession, there are the existing and developing changes in terms of organization-related data, because accounting practices are, by nature, centred on a data set. Technologies having a disruptive potential for the accounting profession are those that allow the processing of very large volumes of data, beyond a human expert's power of analysis, which represent a form of evolution in accounting information systems. Digital technologies process transactions in real time and in full, without sampling, using not just the basic, accounting-specific numerical values, but also a set of additional information about the place, time, level of access, or the context in which numerical information were obtained or created.

The continuous increase in the volume of organization-related data is considered an axiomatic truth for several decades; lately, it has intensified as a consequence of digitalization, by the increase in the share of data produced by digital devices, which are continuously interfacing with new networks and data sources. Although in the coming years, about 75% of the world's population will be connected to the digital environment (Arthur, 2017), the most substantial sources of data today are no longer the human users, but the devices of the Internet of Things (IoT) generation – embedded devices – which exchange data without human intervention. Data produced by temperature sensors, smart cards or complex mobile networks is used by organizations to develop their business models and gain competitive advantages. Intelligent systems competing to perform the management function in highly digitalized organizations use such data to supplement transactional information, to formulate real-time evolution and reaction scenarios, directions of action, and in-depth analysis models. The need for metadata (data about data) required by control and audit systems contributes to the increase of the data volume. A similar effect is attributed to the need to model the supply of goods and services in accordance to customers' demands, made explicitly or anticipated by means of behavioural tracking processes.

An additional vector of organizations' digital transformation is the diversification of the data set used for decision-making. The conversion rate associated with web users' actions, the number of views for a certain post or ad, or a product's rating on social platforms (Viale, Gendron and Suddaby, 2017; Arnaboldi, Azzone and Sidorova, 2017) nowadays influence managerial decisions. The new types of data can be managed by professionals from various fields (accounting, marketing, IT), leading to a "hybridization" of the professional roles (Knudsen, 2020).

New data sets that are described by the generic term “big data” include traditionally structured data (relational, hierarchical or object-oriented), and unstructured data (such as values measured by IoT device sensors, or audio and video sequences). Thus, organizations have access to the main accounting transactional data and, simultaneously, to additional non-accounting data on customer habits and behaviour, which improves the adequacy of their supply, prices and risk assessment, assisting decisions in new ways. For most organizations, processing such data volumes far exceeds their own computing power and storage capacity, and is achieved by means of cloud-based services, which are much more scalable, flexible and financially efficient than the management of their own IT infrastructure and the related staff. Once involved in the big data phenomenon, accounting professionals need to gain knowledge about the technical, managerial, ethical and legal issues that they may face (Al-Htaybat and von Alberti-Alhtaybat, 2017). First, most data are customer-generated, and the organization does not own the data itself or the right to store it indefinitely, but the right to “borrow” it for analysis. Second, the processing of big data sets must be done as they are generated, without the data being stored (in the classical sense of the term), as it can lose relevance and expire rapidly, even in a few seconds. As a result, the many operations required in order to achieve the informational support for decision-making (sorting, cleaning, removing duplicates, etc.) must be performed in real time to efficiently achieve relevant results.

Blockchain is a technology used for structuring transactional data that was rapidly adopted in banking, and allows digital records of accounting transactions to be created and distributed within a network; it is considered a journalizing technology (Yang et al., 2020). Any user from within the network is able to add their own transactions to the shared log and to track all previous transactions. By its nature, the blockchain technology is appropriate for the management of accounting records. For example, in the case of a leasing transaction, the content may be processed so that documents issued by various parties are managed by blockchain technology in the same way as they would have been traditionally managed by the parties involved (sales agents, legal advisers, credit officers, financial supervisors, tax authorities, etc.). Thus, every contract, approval, certificate of ownership, payment instrument, right of use that the transaction involves can be traced to the source by exploring the blockchain structure attached to the transaction. The working model can be adapted to any accounting transaction or process. This approach has ensured the success of blockchain, starting with sectors where independent entities gradually complete the data set associated with a product and ensure its traceability through the digital passport.

It is estimated that by 2025, roughly 10% of the world’s gross domestic product will consist of transactions stored in a blockchain system (Ogee and Guinard, 2019). According to a recent study (Deloitte, 2019), the most common question for financial executives is not whether the blockchain will be successful or not, but how to proceed for their own organization to be successful in adopting the technology. It is expected that in all economic areas where trust relationships between partners are mediated by third parties (such as banks, insurers, or notaries), management applications will adopt blockchain technology. The phenomenon can affect users’ perception of transactions’ authenticity, a migration taking place from the direct communication with the documents’ issuer to a digital version where authenticity assurance is incorporated into the data set. Other foreseeable effects are an increase in productivity and transparency, and the forfeit of the efforts to verify paper-based documents. The blockchain impact can also be found in the audit and internal control activity, where it eliminates the need to reconcile multiple disparate journals, as well as the costs of turning to a central or independent authority in order to ensure the accuracy of those journals.

Adopting blockchain technologies faces a number of obstacles, such as:

- Regulatory and standardization bodies have not yet shown sufficient interest in the field. The European Green Deal is a significant step forward, as it recommends using blockchain.
- Blockchain is effective only if all involved parties have adopted the technology.
- The public nature of the blockchain makes any embedded transaction universally visible, which raises ethical, IT security and compliance issues.

In conclusion, the chances that an accounting professional needs knowledge in the field of blockchain are significant. Blockchain technology should already be part of academic education, with an emphasis on security issues (instead of the mathematical and technical foundations), as there is a widespread misconception that blockchain is by default secure and immune to security breaches (Kowalski, Lee and Chan, 2021; Zhang, Xue and Liu, 2019).

A different aspect of digitalization, the robotic automation of accounting processes, has already become a successful technology with a strong tendency to generalize (Harrast, 2020; Peng and Chang, 2019). A significant part of the accounting activity is already performed digitally and it involves various electronic devices and software applications (Cooper et al., 2019). The software robots used currently are able to access applications, retrieve data, use it in accounting computations, act according to guidelines, and disconnect at the end. The use of software robots does not necessarily involve smart decisions; instead, it is just a superior form of digital automation. The professional tasks of accountants are affected by the automation process to the extent they are routine or repetitive (invoicing, payroll, etc.). Software robots have the advantage of being able to overlap with the existing IT architecture without alterations, and are perceived by existing computer systems as users, not as new applications.

An application's ability to use a data set to improve its reactions and behaviour is known as machine learning (Holzinger, 2019), a distinct field of artificial intelligence, focused on the analysis of structured data. The most advanced form of the machine learning process is called deep learning and aims to analyse abstract or unstructured data. Applications in this category may, in the near future, have the ability to critically analyse accounting information in a structured form, but also to interpret it in the context of relevant unstructured information existing on the Internet in the form of images or text. Thus, the idea of obtaining software robots capable of copying human behaviour evolves with the artificial intelligence and machine learning techniques. Consequently, different levels of complexity and specialization directions for software robots are outlined: probots follow simple rules repeatedly; knowbots collect and store user information; chatbots are virtual assistants capable of answering users' questions or assisting them in real time. Organizations began to perceive the benefits of equipping software robots with learning capabilities that allow them to approach human user behaviour intelligently (Ding et al., 2020). In addition to the capacity to recognize objects and situations and to mimic reasoning, artificial intelligence computer systems have an essential quality: the ability to correct themselves and learn from their mistakes.

Bakarich and O'Brien (2021) assessed the receptivity of accounting specialists to the use of artificial intelligence technologies (especially robotic automation and machine learning). The results showed that, although these technologies are not widely used in accounting at the moment, professionals anticipate a significant impact during the next five years and are

receptive to these changes; the size of the company usually determines the variability of responses (Bakarich and O'Brien, 2021).

The literature review reveals that the technologies having the greatest influence on accounting in the near future are considered to be blockchain, robots and big data. Among these technologies, big data falls into the broader field known as data science, along with business intelligence (BI). BI incorporates the strategies and technologies used by organizations to turn data into information to support decision-making. Although not a digital technology in itself, BI is part of the analysis in this paper because it allows for the integration of digital technologies in order to gain competitive advantages.

2. Digital technologies in relation with demographics and education

Relevance of age cohorts in the digital world goes beyond traditional landmarks based on geographical location and population size. It is very likely that the economic power of each area will be reshaped according to the “digital specificity” of the population and that economic prosperity will change within a population, based on age groups (Pfeffer and Waitkus, 2021). Redefining the social contract between the business environment and the people inhabiting it seems to accelerate, the most obvious gaps being the one between those who were born “analogue” and those who were born “digital”.

The next decade will find the age group usually called “Generation X”, people born in the ‘60s and the ‘70s, in the last phase of their active life. In most geographical areas, people in this category were raised and educated in the spirit of capitalism, believing in meritocracy (Katz, 2017). As a result, this social group favours individualism and competitiveness, exhibiting a predilection for management systems that strictly measure and reward performance. Generation X currently dominates the top of the organizational hierarchies and has the power to set the operation parameters of economic organizations.

Benefiting from their privileged position in the workforce, the members of “generation X” will be able to further define the manner in which the next generation, born in the ‘80s and the ‘90s, aged 25 to 40, and described as “millennials”, now works (Amaro, Andreu and Huang, 2019; Kurz, Li and Vine, 2019). Millennials lived in a time of economic stability, were influenced by globalization and the development of the Internet, even if they spent the first part of their lives in a mostly analogue environment. Unlike the previous generation, millennials are not characterized by the desire to consolidate relationships with a particular organization, and they appreciate a management system that rewards immediate performance, instead of performance accumulated over an entire career.

The third generation relevant to the current business environment is made of people born between the second half of the ‘90s and 2010, generically called “generation Z” (Mladkova, 2017; Singh and Dangmei, 2016) and who now enter the labour market. This generation is made up of “digital natives”, for whom digitalization is not a new trend that must be adopted at a certain point in life (Kincl and Strach, 2021). For generation Z, the traditional business environment and the pre-digital world are strange and impossible to understand. Members of this generation consider it normal to communicate with large masses of people through social networks, emphasize the acceptance of as many different human types and lifestyles as possible and consider it more important to express oneself than to fit into the patterns enforced by the business environment. In the labour market, generation Z shows low

tolerance towards organizations that discriminate on the basis of social differences (Francis and Hoefel, 2018). By consequence, organizations influenced by generation Z workforce need flexible management strategies, as a confrontation between traditional values and values of the digital age can affect performance. Accounting practice, financial reporting and management reporting must adjust to this new organizational culture, in order to remain relevant in the long term.

The digital transformation of the business environment raises one important question: If things happening in real-life organizations are influenced by employees' education, to what extent is the academic environment able to prepare future employees to think and act in highly digitalized organizations?

The literature review shows that the academic environment is still searching for what can be considered managerial education properly adapted to Industry 4.0 and to predominantly digital organizations (Pettersson, 2021; Gaviria, Arango and Valencia, 2015). Changing the perspective of academia on the role and content of accounting education can stem from the radical changes in the way organizations collect, analyse and use data. It is considered that all companies that intend to become relevant in the market must develop their capabilities to extract the necessary information for the evolution of their business model (Pivk et al., 2013). However, it is difficult to ensure data integrity in the digital economic environment. A multi-year study by Ernst & Young (2021) reveals that security incidents affecting data integrity are perceived as the main threat to the global economy. Since the risk level associated with a dataset grows with its usefulness, it is paramount to educate future employees to develop correct "digital habits" and to know the consequences of eluding security protocols. In addition, the spread of the "work from home" model required the collection of sensitive and data, valuable for the organizations, from geographically dispersed employees using heterogeneous digital architectures, accentuating the risks associated with the data set.

Some authors believe that the accounting professional will need to understand not only the consequences of the increasing volume of data, but also those of the increasing variety, quality and speed of producing accounting data (Huimin and Guomin, 2020). Globally, accounting professionals may face decisions regarding the effectiveness of a cloud migration, the costs of reengineering a business processes, or the substantiation of an opinion on the flexibility or scalability of software-as-a-service offers using accounting data. It is very likely that accounting professionals will feel unprepared for such decisions.

In conclusion, in a business environment encumbered by intensified digitalization and the resettlement of regulations, the only thing that accounting practice and education cannot do is do nothing.

3. Digital technologies in the curricula of Romanian business universities

We aim to assess the impact of the digital transformation in the Romanian accounting education and its prospects, in the context defined by the European Green Deal (EC, 2019). The Green Deal emphasizes the role of digitalization for the transition to a sustainable, circular economy and allows us to anticipate important changes in reporting requirements for EU companies, which must be supported by the training of professionals. Accordingly, the successful transition of the accounting profession to a circular economy depends on the ability of academia to train specialists who can assimilate the new digital technologies and

assume new roles within the organization. “Activating education and training” will mobilize academic institutions by preparing a European competence framework to “develop and assess knowledge, skills and attitudes on climate change and sustainable development”; the EC will “provide support materials and facilitate the exchange of good practices in EU networks of teacher-training programmes” (EC, 2019).

We found generational characteristics to be relevant in terms of anticipating the impact of digitalization on accounting education and the accounting profession. Currently, the main contribution of higher education institutions to the training of professional accountants concerns generation Z, people under the age of 26, characterized as “digital natives”. The Green Deal also takes into account other generations of professionals, emphasizing their need for their “proactive retraining and development” in order to ensure transition and adaptability to new processes (EC, 2019). Universities can contribute to this goal through the educational offer tailored to the needs of generations Y (26-40 years old), X (40-60 years old) and even B (over 60 years old): master’s and postgraduate programs that complement the offers of professional organizations.

We use content analysis as a method for the research of educational practices in Romania on digital technologies that impact accounting (Q2), and we identify ways to improve these practices (Q3). Data sources are public. We use curricula and syllabuses published on their websites by faculties in the four largest university cities in Romania (based on the number of enrolled students): Bucharest University of Economic Studies – ASE, Babeş-Bolyai University of Cluj-Napoca – UBB (Faculty of Economics and Business Administration), “Alexandru Ioan Cuza” University of Iași – UAIC (Faculty of Economics and Business Administration) and West University of Timișoara – UVT (Faculty of Economics and Business Administration). Due to our interest in the academic training provided to future accounting professionals in the field of digital technologies, we surveyed the three-year bachelor’s programs in Accounting and Management Information Systems (CIG) offered by the selected public universities. For comparative purposes, we also surveyed the corresponding Economic Cybernetics (CE), Statistics and Economic Forecasting (SPE) and Economic Informatics (IE) bachelor’s programs, as these are typically considered to provide the ultimate undergraduate level of training in the field of digital technologies in the same Romanian universities. This led to number of 11 bachelor’s programs whose curricula includes 182 disciplines of interest. The criteria used to choose the disciplines from the curricula were the discipline and department names. From each syllabus, we collected the following information: addressed digital technologies, scope (a dedicated discipline or just a chapter), type (compulsory, optional, facultative).

We have eliminated from the data set the disciplines whose syllabuses are not accessible and those that do not address the analysed digital technologies (44 in total). This led to a number of 138 disciplines whose content was incorporated into the analysis of results. We considered the content of syllabuses for the 2019-2022, 2020-2023 and 2021-2024 classes. Data analysis was performed in a consistent manner and each discipline was only considered once, since we did not notice any significant content differences between syllabuses for different classes.

In the following, we performed a qualitative analysis of the information extracted from the educational offer of bachelor’s programs included in the sample, in order to highlight their performance and potential in training “digitally skilled” graduates. The rationale of this approach is our belief that the graduates’ success depends not only on accounting knowledge, but also on the ability to incorporate digital technologies in their own activity, their position

being stronger if they are the “architects” of digital transformations in their respective organizations.

In order to assess the extent to which *digital technologies with accounting implications* (DTA) are covered by each academic program, we computed the program’s *average score* indicator (AS) as a ratio between the total number of references to DTA and the number of disciplines covering DTA within each academic program. The results presented in Table 1 show that the disciplines in the CIG programs cover, on average, more DTAs than the disciplines in the other programs, which, by their nature, are more specialized and tend to focus on a single DTA within a discipline. This finding is valid for all categories of disciplines. DTAs included in the analysis are those for which the literature review indicated a significant impact in the field of accounting: Internet of Things (IoT), cloud, blockchain, data science, big data and artificial intelligence (AI).

Table 1. DTAs coverage in the curricula

Program	No. of disciplines (of which optional and facultative)						Total	Average score*		
	IoT	Cloud	Block Chain	Data Science	Big Data	AI		AS	ASC	ASO
ASE-CIG	0	4(3)	0	7(5)	1(1)	1(1)	13(10)	1.63	1.67	1.50
UBB-CIG	0	3(0)	0	7(3)	0	1(0)	11(3)	1.38	1.00	1.60
UAIC-CIG	1(0)	3(2)	0	4(3)	0	1(0)	9(5)	1.29	1.25	1.50
UVT-CIG	0	6(2)	0	8(3)	1(1)	1(1)	16(7)	1.33	2.33	1.00
Average	0.25	4.00	0.00	6.50	0.50	1.00	12.2(6.3)	1.41	1.56	1.40
ASE-CE	0	7(5)	0	14(13)	0	1(1)	22(19)	1.22	1.19	1.50
ASE-IE	0	11(10)	0	16(15)	0	0	27(25)	1.29	1.32	1.00
UBB-IE	0	6(6)	0	10(10)	1(1)	1(1)	18(18)	1.13	1.13	0.00
UAIC-IE	1(1)	6(6)	0	7(7)	0	0	14(14)	1.27	1.27	0.00
UVT-IE	0	12(7)	0	13(10)	0	5(3)	30(20)	1.50	1.54	1.60
ASE-SPE	0	7(5)	0	10(7)	0	0	17(12)	1.31	1.33	1.25
UAIC-SPE	0	2(2)	0	3(3)	1(1)	1(1)	7(7)	1.75	1.75	0.00
Average	0.14	7.29	0.00	10.43	0.29	1.14	19.3(16.4)	1.35	1.36	0.76

*AS – Average score per academic program = Total no. of references to DTA/No. of disciplines covering DTA per academic program; ASC – Average score per academic program based on compulsory disciplines; ASO – Average score per academic program based on optional and facultative disciplines

Source: Authors’ projections based on curricula and syllabuses from the faculties’ websites

The surveyed disciplines deal with one (73%) to four DTAs (1%). Given that some technologies (such as blockchain) are not covered by any discipline, we find the curricula to be perfectible. One aspect to consider is how to assimilate technologies in the curricula: including multiple DTAs within a single discipline, or separately. Technologies included in this study are quite dense in terms of content, and discussing several technologies within the same discipline is appropriate only if the aim is to become familiar with them, not to explain technical details. In the case of CIG programs, setting this goal would reveal a good connection with the business environment’s needs and can materialize in the form of a discipline that outlines the usefulness of DTAs for the field, while explaining the role of accounting in a contemporary digital organization.

Out of the 138 surveyed disciplines, 22 (16%) are entirely dedicated to the study of one DTA, and 116 (84%) include notions about DTA within a chapter or learning objective. The way

technologies are assimilated in the curricula of each bachelor program does not differ fundamentally for CIG when compared to the other specializations, since there are disciplines in CIG programs dealing with two, three or four technologies simultaneously. The same conclusion derives from the fact that the proportion of disciplines specialized on a single DTA is 14% at CIG and 17% at the other programs. As disciplines dedicated to one of the technologies involve a higher degree of specialization, their share is expected to be more significant in master's programs.

Given the variability of educational tracks determined by students' choices of optional or facultative disciplines, we separately surveyed the degree of DTA coverage based on the type of discipline: mandatory, optional or facultative. Findings regarding the average score (AS) are maintained, as the score continues to be higher for CIG programs as compared to other specializations, both for compulsory disciplines (ASC, Table 1) and optional and facultative disciplines (ASO, Table 1). The number of DTAs covered by optional and facultative disciplines influences a student's level of training. For a good harmonization of students' knowledge with the needs of the digital business environment, universities must pay attention to this issue, ensuring that all possible tracks adequately cover the relevant DTAs. In this regard, we can consider that a high degree of DTA coverage in compulsory disciplines mitigates the risk that the exercise of options will generate significant differences in terms of graduates' digital competences.

Any DTA has a level of complexity that requires for it to be studied within a dedicated discipline, for at least one semester. However, there are significant differences between DTAs in terms of the level of knowledge required from an informed user. We believe that, in the case of CIG programs, the purpose in relation to DTAs should be to ensure graduates' ability to use them successfully from the beginning of their careers, because the disruptive potential of digital technologies lies in the fact that they are rapidly enforced and become de facto standards in less than a decade. Training of user skills can be nuanced depending on each DTA, since, for example, the 'user' level is sufficient for blockchain, but not for data science. The level of digital skills required is higher in the case of DTAs that can be influenced by the professional accountant during the deployment and use phases (data science, business intelligence – for which we recommend an in-depth approach) than in the case of DTAs with which the accountant relates as a mere user (blockchain, software robots, cloud). From this point of view, we notice that there is a business intelligence discipline included in the ASE-CIG educational offer, which has no equivalent in other CIG programs. Business intelligence related aspects are included in the curricula of other universities, but not within the CIG specialization, nor as a separate discipline.

Vertical analysis reveals major differences in the importance that curricula place on each DTA (Figure 1).

The fact that out of the 138 disciplines, 99 deal with aspects of data analysis (in different forms and levels of complexity) derives from the several decades' tradition in the science of data design, administration and use. Also, as cloud-based technologies become ubiquitous, 67 disciplines address cloud and software-as-a-service. The link between the cloud and economics in general, accounting in particular, has been recognized for over a decade, while applications of artificial intelligence, robotic automation and machine learning are recent. The difference between the number of disciplines dealing with cloud technology (67) and those dealing with artificial intelligence (12) is a consequence of the difference in maturity between the two fields.

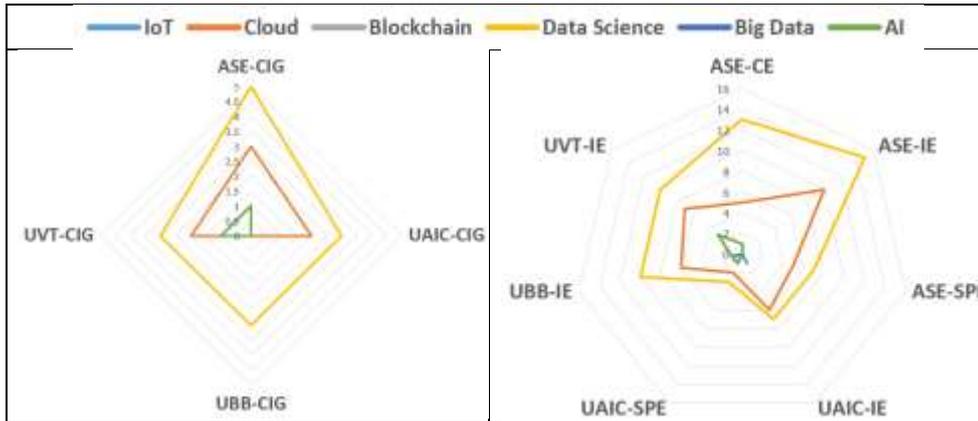


Figure 1. DTAs in the curricula

Source: Authors’ projections based on curricula and syllabuses from the faculties’ websites

We have chosen not to include big data among data science technologies, although they are largely compatible, and to analyse it separately, due to differences in the approach to data collection, storage and processing, as well as the high level of knowledge required in the field of mathematical analysis and calculus. Differences also seem to be recognized in the curricula: Just four disciplines in the bachelors’ programs deal with big data (two of which are included in the CIG curriculum), only one being fully dedicated to this subject. We consider that the current importance of the big data phenomenon for the digital business environment and for the accounting practice requires an in-depth approach. More precisely, we recommend incorporating the basics of big data in all CIG bachelor’s programs and continuing with an in-depth approach during master’s programs. The discipline’s complexity makes it fit the profile of master’s programs.

None of the analysed disciplines includes blockchain, a possible cause being its lack of regulation and standardization in accounting. Given that the Green Deal mentions blockchain and its growing importance on all levels of the business environment, we anticipate its assimilation to accelerate, and recommend incorporation into the curricula. Professional accountants will, most likely, employ it for user-level day-to-day operations, motivating us to recommend the assimilation of this DTA in bachelor’s programs.

The object of this study is the analysis of disciplines with rich or exclusive “information technology” content; as a result, the uneven diffusion of DTAs within the two families of curricula is predictable and justified. A quarter of the disciplines referring to digital technologies are included in CIG programs, while three quarters of them are found in CE, IE or SPE programs. It is normal for CIG programs to include fewer disciplines in the field of information technology than CE, IE or SPE programs. However, in the new paradigm of digitalization, CIG programs need to train graduates with similar but more specialized digital skills, targeted at DTA. The need is accentuated with each digital technology that appears, matures or generalizes.

Based on the results and interpretations presented, we believe that the strategy of CIG bachelor’s programs should incorporate objectives to help the profession turn the risk of becoming irrelevant (Quattrone, 2016) into the opportunity to assimilate and influence the digital transition (Knudsen, 2020). In this regard, new disciplines and chapters can be added

to the curricula and syllabuses, which will ensure graduates have the competence to become involved in the digital development of the organizations in which they operate. At the same time, the offer can be adjusted so that existing disciplines outside the scope of information technology assimilate DTAs, insofar as they are used in practice.

Conclusions

Digital data production and analysis tools provide the business environment with a new type of economic power and a new category of competitive advantages. Their impact is so strong that certain countries and geographical areas could change their economic and geopolitical status solely as a result of producing and exporting economically-relevant data. It can be estimated that digitalization will rewrite the social contract between people and the business environment, the largest gap occurring not between developed and emerging economies, but between generations born and educated in the analogue age and those from the digital age. These realities are assimilated into the EU's long-term strategies, which recognize the role of digitalization in ensuring the transition to a sustainable circular economy by means of the European Green Deal (EC, 2019).

For the accounting profession, digitalization brings risks and opportunities. The risks identified in this paper refer to the loss of attributes and attributions of the profession in favour of other specialists (marketing or IT, for example), loss of responsibilities, power within the organization or even legitimacy. Along with these risks, there is also the opportunity for the accounting profession to influence the evolution of DTAs, if it is involved in the technological development of organizations. Many DTAs are flexible enough to incorporate user needs as they arise. For example, social networks and platforms provide information in the form of ratings only insofar as they remain relevant to the public, adapting the content to the reactions of users. Cloud technologies, artificial intelligence and machine learning are flexible by nature. It is important for professional accountants to understand that they influence digital technologies even when they are not involved, as they allow other professional categories to forward own agenda. The only possibility for the future is the recourse to education, which allows professionals to steer it, instead of being annihilated by the change.

As the world of organizational management based on transactional accounting information disappears, an opportunity arises to develop the potential of accounting in a direction that is currently evolving. This context allows for more development possibilities than ever in the history of the field, the educational system's role being to support evolution. The analysis of disciplines that provide training in the field of DTAs from the universities in the sample revealed several ways digital competencies of accounting graduates can be improved. Although there is interest in DTA, their integration is not completed: some technologies, such as blockchain, are missing from the curricula, while others (big data, artificial intelligence) are treated informatively and do not provide the necessary digital competence. Depending on the DTA's level of complexity, we recommended including it in bachelor's or master's programs.

We contribute to the literature in several ways. First, we discuss the potential impact of the digitalization-based approach from the European Green Deal on accounting in general, and the accounting profession in particular; we outline the impact, usefulness and disruptive potential of each technology. Second, we correlate these aspects with the field of academic education, we question the adequacy of selected accounting bachelor's programs to the needs

of the digitalized business environment and we find ways to improve. Third, we propose practical solutions to improve the curricula.

Limitations of the research are derived from the methodology, data availability and timeframe. Given these limitations, we have identified a number of directions for future research. In terms of practices and the involvement of professional accountants in the process of digitalization, case studies and data collected directly from companies over a longer period can also provide information on the level of products' and processes' digital development. Although large entities are usually the first to be affected by changes, they are not the only ones affected by digitalization. For this reason, the perspective of other types of entities (small, medium-sized etc.) on the matter can be particularly valuable for trainers. In the field of education, we have limited research to bachelor's programs. We anticipate significant changes of competences in the field of accounting in higher education (bachelor's and master's) and professional bodies, designed to align education and training with the digital transition that the European Green Deal will entail.

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