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## Economic Interferences



## Amfiteatru Economic recommends

# Digital Transformation in the Context of European Union's Green Deal

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The European Union currently faces several economic, social, and environmental challenges. Our future depends on a transition from a linear economy toward a circular/green economy. It is currently one of the most important priorities in the EU and a major preoccupation for policy makers, industry and academia.

We are witnessing a transformation of today's society toward an increasingly digital society; this trend is called Industry 4.0 and more broadly Society 5.0. Both concepts have one thing in common, that is smart technologies, which is predicted to exponentially increase in market value and scope with time. These technologies have the potential to completely take over all of production through interconnected systems, also known as Internet of Things/Cyber-physical systems, in turn eliminating the need for human monitoring/intervention in tasks through machine learning/artificial intelligence algorithms.

The EU Member States' ambitious commitment to become climate-neutral by 2050 requires transformation in all economic sectors and entails important social changes. In achieving this goal, digitalization will play an essential enabling and catalytic role.

Policy and decision makers are looking at the potential of smart technologies to help contribute to a green economy. Over 95% of solid waste comes from industry, which means that a sustainable future needs to see a revolution in industry, with better resource and waste management. By reducing waste and circulating it through the supply chain and value network, our global footprint on the environment can be significantly reduced. Green economy smart technology applications have already saved companies millions of euros in the past decade and it is estimated that €700 billion can be saved per year worldwide, if initiatives are funded to circulate materials instead of throwing them away. This can help both grow the industry and reduce the negative side effects of the industry on the environment.

For sustainable economic development and social cohesion, in addition to technological advancement, social transformation is also required. Further development of digital technologies will influence and be influenced by public support, changing social attitudes, social decision making, risk and loss aversion and various other human factors in different economic situations. It is important to study these attitudes, as Industry 4.0 and Society 5.0 smart technologies will eventually be applied to all aspects of life, such as digital education, digital policing, digital resource management, mobile and internet applications and much more. We are already seeing the digitalization of government, cities, villages, factories, education, as well as transport and logistics. We are all going to be participating in these

developments, so it is important to study the perspective/attitudes of different groups and individuals on these developments and potential changes in attitude and behaviour that can lead to a more sustainable future.

Issue 59 of the *Amfiteatru Economic* journal is dedicated to investigating the complexity and novelty of the ongoing digital transformation phenomenon affecting both economy and society, which requires our response and adaptation by providing novel concepts, ideas and models. Following a rigorous peer review, the published articles contain original approaches to the phenomenon of digitalization, analyzed from different and multiple perspectives. In our opinion, the results of the research in published articles contribute to a better understanding of this complex phenomenon – the literature is thus expanded both by research applied to theories and concrete models.

The article *"Cyberspace Ecologism 4.0": Between Software Softeners of and Hardware Hardships on the Natural Environment* investigates the relationship between digitalization and ecology by highlighting possible connections between the virtual cyberspace and the physical natural environment and the translation of a great part of the world and social life into cyberspace, especially in the wake of the Fourth Industrial Revolution.

The issue addressed in the article *"Adopting Sustainability and Digital Transformation in Business in Romania: A Multifaceted Approach in the Context of the Just Transition"* is that of how sustainability and digitalization in companies affect the way the company innovates, manufactures products, affects costumer relationships and logistics. The study explores the responses from professionals, executives, and managers, either from local or multinational companies from different sectors, and uses structural equations to analyse the data.

The article *"Sustainable Transformation of Romanian Companies through Industry 4.0, Green Production and Environment Commitment"* develops an econometric model that establishes the link between green performance, digitization, green production and environmental engagement, using structural equation modelling. Thus, the article identifies key elements that help companies transform digitally and sustainably.

The article *"Quantifying the digitalisation impact on the EU economy. Case study: Germany and Sweden vs. Romania and Greece"* looks to conceptualize, validate and test the "development of digitalisation econometric model". The authors did this in regards to how the European Union envisions the development of the data economy, i.e. by studying the long-term likelihood of the EU's baseline scenario, the high growth scenario and the challenge scenario.

The article *"Avoiding Digital Divide in European Union through European Green Deal"* reviews literature and uses multidimensional analysis to study internet access for households in countries in the European Union. They look at the digital divide and how it will be influenced by the European Green Deal.

The article *"Digital Transformation, Financial Performance and Sustainability: Evidence for European Union Listed Companies"* investigates the beneficial effects of digitalization on efficient use of natural resources, reduction of pollution, and looks at how motivated companies are to transformation into a sustainable company. They achieve this by studying a large sample of companies in the European Union and how the financial market responds to companies that wish to digitalize and become more responsible.

The article *"The Green Deal – Dynamizer of Digitalization in Tourism: The Case of Cluj-Napoca Smart City"* uses a questionnaire to study 38 hotels in regards to the European Green deal. They sought to verify whether hotels have heard of the Green Deal, and to determine whether they have adopted any measures to reduce energy consumption and improve waste management. Finally, they looked at whether or not hotels have increased the rate of digitalization as a result of the COVID-19 pandemic.

The article *"Vegetables Consumers' Profile in the Context of Digitalization: Evidence from Romania"* seeks to analyse differences in consumer profiles and methods of payment used in online purchasing of fresh vegetables from local producers. They surveyed Romanian companies involved in vegetable farming. They also studied the preferences and preparedness of vegetable producers and consumers for digital transformation, and how vegetable producers need to adapt to the digital needs of consumers.

The article *"Examining the Correlations Between Industry 4.0 Assets, External and Internal Risk Factors and Business Performance Among Hungarian Food Companies"* investigates how various risk factors can affect business performance of Hungarian food companies, such as the development and investment risk factors associated with a company planning on developing or using Industry 4.0 technology.

The article *"Urban Agriculture Digital Planning for the European Union's Green Deal"* used digital agricultural data acquired from the geographic information system AGRO-GIS and used it to calculate and predict potential urban agriculture that can be developed from abandoned horticultural lands and greenhouses in urban areas.

This issue deals with digitalization and sustainable development, and the articles found within it are diverse and accurate representations of problems and opportunities for companies, particularly in regards to social responsibility and digital transformation, as well as the benefits that can occur when companies upgrade their digital systems by creating more environmentally friendly business models. The articles imply that digitalization is a topic that needs further study, particularly since the literature supports the idea that digitalization can lead to a more sustainable world. This is a much needed change that can help us battle the threat of global climate change and create a better future for coming generations.

**Member of the Editorial Advisory Board,**
**Andrej Bertoncelj**

# Contents

## Digital Transformation in the Context of European Union's Green Deal

# "CYBERSPACE ECOLOGISM 4.0": BETWEEN SOFTWARE SOFTENERS OF AND HARDWARE HARDSHIPS ON THE NATURAL ENVIRONMENT

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**Abstract**

Planet Earth, with its plethora of natural (im)balances, has a venerable age of 4.54 billion years; the (industrial) imprint placed by the human species on it, considered to be not negligible, counts of just little over two centuries; while the digital/IT&C/virtual existence of man, in what we call cyberspace, is reduced to just a few decades. An amorphous world, hastily assimilated to the Internet, the cyberspace is the sum or, better said, the synergy created by links between computers (and other compatible devices), servers, routers and various items of global IT and telecommunications infrastructures. A sort of fiefdom for tech computing power, but also a field of geo-political-economic power calculus, the cyberspace raises another dilemma: is it the salutary alternative to the bodice of a physical environment subject to depletion/plunder and degradation/pollution of its scarce resources? This article aims to capture, in an original way, how the translation of a great part of the world and social life into cyberspace, especially in the wake of the Fourth Industrial Revolution, relieves the natural environment/climate of Anthropocene pressures (e.g., via optimizations of production processes, favoured by artificial intelligence etc.), or, on the contrary, a less noticeable aspect, how it worsens certain components of it (e.g., via the amplified need for energy or for rare minerals, critical to new technologies etc.). Moreover, the above-mentioned ecological alleviations (labelled as of software nature) and (hardware) aggravations brought by digitalization are duly emphasized and evaluated in the light of the (un)intended consequences occurring at the highly sensitive intersection between markets (private practices) and states (public policies), pointing to the case of the European Union.

**Keywords:** cyberspace, natural environment, technology, ecology, markets, states, economic calculation, public policies.

**JEL Classification:** K32, N54, N74, O13, O14, P00, Q55, Q56

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**Introduction**

The history of mankind is defined by *technological revolutions* through which man has found new means to tame nature, to combine and process its elements so as to better satisfy his needs and wants. With each jump, mankind has shaped not only its own socio-cultural and economic structure, but nature itself. This series of ever more alert transformations is visible since the dawn of agriculture – which facilitated the transition from a nomad lifestyle to a sedentary one, thereby leading to the establishment of the first human settlements – to the industrial revolutions in the 18th and 19th centuries which have massively changed the face of not just the economy, but of society, in general, then to the digital revolution at the twilight of the 20th century, when information emerged as an economic commodity and factor of production, bringing us to the ongoing Industrial Revolution 4.0, where we witness an acceleration of automation and the integration of communication, data collection and data mining technologies. Economic activities, regardless of their nature, require a supply of resources based on a triarchic structure: the *energy* needed to maintain operations, the *raw material* that will be processed to generate added value and crucial *information* for making optimal decisions. In this (eco)system that has become planetary/global, we see an increase in attention granted to the impact of *technologies* on the *natural environment*, with a focus on the (mostly negative) medium-and-long term consequences. Of course, there are also (scientific) opinions that encourage greater moderation in deflecting onto mankind *all* of nature's hazards (Schneider, 2020; Topan, 2021): if science ceases to be a sceptical-competitive process in which the accumulated conclusions could be rationally and responsibly contested, then science risks being of no use at all.

This article particularly questions the relationship between digitalisation and ecology, by highlighting possible connections between *the virtual cyberspace* and *the physical natural environment*; is the former an "alternative" to the latter?; does it mitigate the shortcomings/threats that nature has been facing due to the "excessively physical" existence of man?; or, rather, is this "virtual-ness" merely an illusion since any kind of soft(ware) has its hard(ware) requirements, intensive in physical raw materials and energy? Cyberspace has become a term that broadly describes the many interconnected cyber-technologies (Huidobro, 2021; Kerttunen, 2018). We have come to understand cyberspace as something that somehow exists all by itself: a collection of the aforementioned technologies. When people think of the cyberspace, they often associate it with concepts such as the internet, digitalisation, technology etc. Nevertheless, these cyber-technologies and this cyberspace have no existence in and of themselves: they are, in turn, part of a broader environment that hosts them, which Akhgar and Brewster (2016) coin *cyber-ecology*. The internet, the electronic devices and other technologies within cyber-ecology (or "cybernetic ecosystem") are mere cybernetic organisms that would have no meaning or identity of their own beyond their interaction with their environment. The problem therefore moves towards the relations between these two environments/ecosystems: can the cyberspace aid natural processes currently in a human-induced disequilibrium to regain their balance via complementarities (e.g., superior computing power to optimise productive operations) or substitutions (e.g., by relocating consumption habits to the virtual dimension of life) – which we henceforth call the "soft side"? Or, on the contrary, will it simply add to the pressure on the environment – its "hard side" (e.g., by a growing need for critical supplies and energy)?

In this dilemmatic landscape, the most synthetic presentation of the 21st century's *zeitgeist* can be expressed thusly: environmental problems are the main challenge faced by the human race, while digital solutions are the main opportunity that our species can avail itself of for various problems, including those relating to our environment. Against the backdrop of public pressures caused by increased awareness of the current ecological challenges and the opportunity of digitalisation, national and supranational decision-makers have set out to undertake the necessary measures to resolve the problems threatening our natural environment by making use of digital solutions to as great an extent as possible. In other words, public authorities are counting on "technological" efficiency to tackle an otherwise "juridical" issue – that pertaining to the liberties/responsibilities of the exploitation of quantitatively and qualitatively critical resources. The present paper is structured according to the following line of reasoning: once a review of the existing literature is performed, we proceed with the main reflection on the relationship between *law* and *legislation* and how it favours synergies or conflicts between the digital and ecological transformations of contemporary society (e.g., at the level of the European Union); the next two sections take stock of the virtuous and vicious links between (digital) cyberspace and the (physical) natural environment, pinpointing a series of unintentional consequences born of a legal framework that, by enforcing the digitalisation and greening of the economy/society, it causes disequilibria and instability in the "eco/system"; in order to give our analysis a particular scope, we further discuss the "case" of the auto industry in Romania. The original component of our present paper is derived from drawing attention to the vital need for *realism* so as to maintain even (or, perhaps, especially) a viable kind of *idealism*.

## 1. Literature review

Cyberspace – whether it duplicates the real world or usefully complements it – electronically perpetuates human action with its social, cooperative, as well as statal, coercive expressions. Societal events have their own metabolism in the cyberspace, augmented by the nature of the information society, while at the same time they create opportunities and threats to freedom and democracy. Beyond all the benefits of cybernetizing human existence – at the level of mega-processes, but also in a mundane sense –, cyberspace hides dangers not only from the perspective of totalitarian regimes previewed in the dystopias of Orwell, Huxley or Zamiatin, where computers, artificial intelligence, robots etc. are used to monitor almost all the facts in the lives of their citizens, but also in covert control, in the name of democracy, aimed at filtering beliefs and actions and re-instilling a "majority" fed systematically by pseudo-information packaged in bits distributable at the speed of light (Jora, 2018). Apparently wide, the cyberspace can also "squeeze" us (for instance, how will *we* be in the *Metaverse*?).

Cybernetics is the science of control and communication *intra* living or automatic systems, but it is also the science of communication *inter* "animal" and "machine" (Tabacchi, Termini, 2017), hence between *nature* (given) and *nurtured* (artificial). Cyberspace is also the "jurisdiction" that "governs" the logic of the connection between cybertechnologies (created by human intelligence) and nature/environment. In this new type of posthumanism – viz., where humanism assumes that man is autonomous, conscious, intentional and exceptional by the power to change the course of events, posthumanism sees action as determined by dynamic forces in which man participates, but does not intend or control them completely, as in cyberspace – new questions arise. One of them: can cyberspace help

man, with his environment, by saving him from the plunder and degradation of natural resources? An answer to this question can be formulated regarding both the paths of the relationship of *homo cyberneticus* (the *new* technological man, yet not teleologically altered) with the old natural environment (of the continuous Anthropocene).

***"The reverse look"***

To begin with, let's look at the ecological realm from the point of view of the digital: is a vast consumption of natural resources necessary to ensure the existence of cyberspace? As McCarthy and Ondaatje (2002) note, scarce (natural) resources are allocated to meeting informational needs – obviously, not everything can be reduced to *software*; there is also a *hardware* component that necessitates raw materials and energy. In this case, a reinterpretation of the first question reads as: is the cyberspace capable enough to contribute more to relieving the environment from anthropogenic pressure than it consumes for ensuring its own existence? Or, from another perspective, is the cyberspace a viable alternative (to the protective measures that the human should take towards the environment) by the mere fact that it shifts the human's attention from his eminently physical nature, providing him with a new route to access prosperity?

Sceptics answer the two questions using two broad types of arguments: that of the *ecological footprint* and that of *legal asymmetry*.

*The ecological footprint*. New technologies and hyperconnectivity associated with cyberspace do not come without challenges (European Commission, 2021). Some jobs will be lost through automation – in the EU alone, in 2018, about 14% of adult workers faced very high risks for this reason, being estimated that, in the future, 50% of currently globally existing jobs could be automated, differently between countries and sectors. But beyond social disruptions, the digital transition poses environmental problems in several ways: (i). it can increase electronic waste (or e-waste) (European Parliament, 2021); (ii). it will amplify the energy demand, for example a huge one when it comes to supporting the processes that are based on blockchain technologies, especially on the cryptocurrency component (Cho, 2021); (iii). the use of scarce resources ("rare earths"), amid uneven global distribution, fierce geopolitical competition and low recycling rates, will favour the use of relatively more environmentally invasive/toxic technologies (DW, 2021).

*Legal asymmetry*. Cyberspace is considered an unconvincing alternative to physical space (more strongly related to the natural environment) because it is not well enough regulated and harmonized globally: there is not enough international consensus regarding the rules and principles that govern the cyberspace (Han, 2018), which increases the unpredictability/uncertainty of those who would like to migrate with components of their businesses towards it. Lessig (2006) considers that this failure to regulate cyberspace is partially offset by the fact that it is to some extent regulated from within, that there are communitarian codes of conduct, on the basis of which netizens act when browsing online. Biegler (2003) even considers that cyberspace is impossible to regulate, simply because it does not respect the contours of national borders and the jurisdictions defined by them (Ruijgrok, 2021), putting entrepreneurs between the Scylla (of endless opportunities) and the Charybdis (of unlimited threats).

***"The look forward"***

Let's now see how cyberspace opens up new opportunities for productivity management, metabolizing useful data for managerial decisions (Jeske et al., 2020), productivity being, in principle, an ally of ecology. *Business intelligence (BI)* tools provide visual representations following the analysis of historical data, as well as those data accessed in real time, and the continuous development of user-friendly interfaces makes BI tools more and more accessible. Decision makers' access to both historical and real-time data means unprecedented volumes of data that can be analysed and used to increase productivity and, as El-Thalji et al. (2020) show, this also leads to strategic implications, as corporate strategies will be reoriented to new productivity opportunities. A general belief that data would represent the "new oil" of the industry is beginning to take shape: the metaphor is based on the idea that both oil and data can be of major importance for industrial production, but only after prior processing (Taffel, 2021).

*The artificial replaces the natural, protecting it*. Steps have already been taken towards greater respect for the environment with the help of computing technologies, such as 3D printing, through which new artificial resources are created in order to be used as valid substitutes for natural resources, which can thus be much better preserved (Kutukova, 2019). Thus, digital technologies can help stop the vulgarization of natural resources and, through their better use, to inclusively support biodiversity.

*The accessibilization of ecologically critical information*. According to Lévêque (2003), the main contribution of cybernetics to a cleaner ecosystem is that it provides the informational and communicational means for actors in the economy to exchange knowledge among them so that they can make concentrated decisions that better protect the natural resources (if, of course, they wish this). Proper access to relevant information is essential for economists/administrators/entrepreneurs to substantiate/make optimal decisions.

For this to happen, a clear understanding of the eco-system and of the polluting factors is needed; cybernetics can shed more light into complex matters that often confuse decision-makers. To Kalymbek et al. (2021), this is nothing else than a step towards civilization. Only when the human being will stop his chaotical decisions regarding the use of resources and will improve them by the adoption of digital innovations, the environment will become a natural, innate ally again.

But here as well, in educating and norming behaviours, one must understand the consequences of opposing *artificial laws to the laws of nature* (including *of human nature*). In the next section, a logical analysis will be performed on two levels: (i). the "legal problem" – *law* versus *legislation* and (ii.) the "institutional problem of economic systems" – the consequences of *state intervention* in *market laws*. In its extension, concrete instances can be pursued in which the digital and ecological (legislated) targets are synchronized or undermined.

## 2. "Law" and "legislation", "digitalization" and "ecology": some parallels and intersections, compromises and synergies

The following analysis avoids weighting social costs against benefits – due to the epistemological/methodological limitations of such an endeavour (Iacob, 2016) –; what we

propose is more modest (and, yet, much more scientifically robust): we shall analyse the consequences that stem from employing certain means, i.e., what results follow from abiding the law (and the laws of the market) versus the consequences of enacting legislation that seeks to change the way in which the market would allocate resources, towards a given end, i.e., achieving eco-efficiency through an effective allocation of resources with the help of digitalization. This approach will prove useful for understanding that although some legal norms are the product of democratic decision-making, they lead to unintended consequences – e.g., applying different/divergent types of rules for tackling a problem can produce unanticipated disequilibria with adverse consequences.

The distinction between *law* and *legislation* (Leoni, 1991; Kinsella, 1995; van Dun, 2009; Hayek, 2012) can be achieved, with the least amount of ambiguity, by beginning with the concepts of *liberty* and (property) *rights*. By *law* – here to be understood as "natural" and "rational law", and whose contradiction would go against human nature and would imply logical contradictions (Rothbard, 2003; Hoppe, 2010) – we mean the respect for the absolute sovereignty of each individual over his own person (self-ownership) and those material goods, viz., scarce resources which are obtained through the use of economic, voluntary means (appropriation, production, exchange, gift or inheritance). As long as the legal norms do not come into conflict with the physical integrity of private property or the voluntary given consent of all the parties involved, we can affirm that all social relations are in accord with the *law*, in other words, they are *legitimate*.

By *legislation* we understand the sovereignty of the legislator. Its will is expressed through enactments (e.g., acts of parliament, regulations that emanate from the executive branch) which can be in accord with the *law*, namely, by recognizing justly obtained private property rights, or contrary to it. For example, anti-social acts like murder or theft represent, without any shadow of a doubt, infringements of both *law* and *legislation*. In this case, we can say that the *legislation* entirely reflects the *law*. Conversely, the partial sanctioning of pollution and the permission granted for the continuation of such anti-social behaviour as long as the polluter pays a tax or acquires a given number of green certificates ("pollution rights") represents an act that goes against the *law*, but which is permitted by the statutory *legislation* (Rothbard, 1998).

When the *law* and the acts of *legislation* coincide, social relations tend to be harmonious, while any deviations from socially compatible behaviour are only accidental and supressed by the law through the means of legislation. However, when the law is at odds with the enacted legislation, social relations tend to be systematically short-circuited, conflict substitutes harmony. If the scope of any law is to make peaceful social cooperation possible in the context characterized by scarcity, legislation can be at odds with this requisite, leading to more conflict that it addresses. This discussion also touches upon the difference between *capitalism* – the order that stems from private property – and *interventionism* – the incomplete order in which the state acts to deviate the allocation of resources through regulation, taxes, and inflation from the way their lawful owners would have chosen.

The discussion related to solving the *ecological* problem by the use of the *digital* potential can be organized starting from the *law-legislation*, respectively *capitalism-interventionism* matrix (Figure no. 1). There are four planes with overlapping surfaces, as well as solitary surfaces.

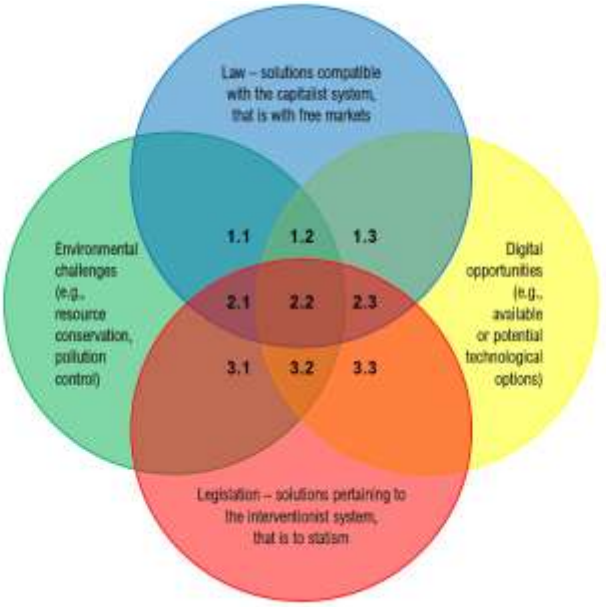


**Figure no. 1. Environmental challenges and digital opportunities at the intersection with the law and legislation**

*Deciphering diagram (I) – "Law = legislation" in matters concerning digitalization and the environment*

Pertaining to the two discs that depict the subject matter of the *law / capitalism, the market economy*, respectively the area of *legislation / interventionism, statism,* we can say that where these two surfaces are superimposed (*2.1*, *2.2*, *2.3*) only commonly addressed solutions are available, i.e., the legitimate resolutions are entirely reflected by the legislation. This means that the law and legislation are in harmony, which leads to social cooperation and the rapid resolve of potential conflicts.

*Discussion.* Here we could place a legal provision which states that the owner of an energy resource, for instance petroleum, can freely dispose of it, as it is his purview if and at what price he will sell it. What makes petroleum an economic resource is its scarcity when related to the needs that can be satisfied by its use (Reisman, 2003). This fact is recognized as such by the individual that embarked upon the geological exploration for the oil deposit and who committed the necessary complementary resources for this endeavour. This individual has employed only economic means (private property and contractual agreements) to identify (what was until the moment of its discovery) a potential resource which had not been claimed and significantly transformed before him by any other person. Consequently, we can assert that there is no one else that has a stronger, better justified claim on the oil deposit under discussion. Also, considering that the given resource did not belong beforehand to anyone else – until that moment it was not even clear if its existence was known –, it cannot be maintained that the act of appropriation has affected the physical integrity of a third party's property (Herbener, 2009). If the full control over this resource is recognized as such by the legislation in force, the *de jure* and *de facto* owner having all his

consequent rights acknowledged, including that of disposing of the oil as he deems fit, we can say that the legislation reflects the law, an ideal situation from a social point of view.

Starting from the aforementioned example, we can now add to our discussion the other two spheres: the challenge posed by the environmental related issues, respectively the technological/digital opportunity.

*Discussion*. The *2.2* area represents the surface where all four spheres are superimposed. The law and legislation are in harmony, similarly with the previous example, and the same thing applies to the challenge represented by the environment and the digital opportunities. In matters regarding our example, this means that the owner of the given resource chooses to invest in available digital solution to increase the economic efficiency of his operation. By employing monetary calculation, the owner finds it's lucrative to invest in the technological solution which he appreciates to be the optimal way forward considering the future price of the oil that is going to be extracted and offered for sale. The life span of the investment, the timing of the drilling operation and the sale of the output are harmonized in light of the prevailing interest rate (the intertemporal price), while at the same time accounting for the future evolution of the sale price and the costs implied by the production process. In this way, the available stock of fossil fuel is permanently economized, thus reflecting to the best possible extent the present and future preferences of the consumer. Thus, the rationalization of the use of natural resources becomes manifest through monetary calculation. An individual who is willing to undergo a longer time interval before tapping the oil resource (someone who is more optimist when it comes to the future price of the respective resource) can opt to buy the entire deposit from its current owner. Therefore, in area *2.2*, the decisions pertaining to resource extraction, investing in more efficient technology, and storing up resources implicitly reflect the preferences of all members of society, the interaction between all individuals thus tend to be harmonious (the precondition for "social efficiency").

In what concerns the areas *2.1* and *2.3*, we are still at the intersection between law and legislation, but only one of the other spheres – the environmental challenge and the opportunities represented by digitalization – coincides with the two planes that correspond to the rules of the game.

*Discussion.* Basically, area *2.1* represents the scenario in which the environmental problem can be addressed in a way which is both lawfully and legally compliant but in which technological solutions cannot be economically employed: there is either no available technological solution for that specific problem, or the costs of the technological solution make it economically unviable, as the prospective profit calculations reveal that it is not worth addressing the respective ecological challenge by directing capital toward it. For instance, maintaining the pristine state of certain ecosystems, until now undisturbed by human activity, implies, by definition, withholding the use of any intrusive technology – it goes without saying that this constraint becomes laxer as wireless technology and satellite imagery are perfected, however we must keep in mind that there are still clear limitations in what technology can achieve in this case. Regarding those activates where digitalization cannot be economically employed for protecting the environment, there are numerous examples that can be put forward. Capital continues to be scarce, i.e., it can be more profitably employed toward achieving other ends, to be allocated toward certain environmental objectives. For example, we could refer to the lack of economic viability of electric cars. This segment proliferated thanks to the substantial direct and undirect

(e.g., the charging infrastructure) subsidization that it received. Without this state-sponsored allotment, this technology would not be able to compete, at least for the time being, with autos powered by internal combustion engines. Our society must accumulate more capital so that investing in such technologies may become viable – a question of economic growth and waiting.

*Deciphering diagram (II) – "Law ≠ legislation" in matters concerning digitalization and the environment*

We will continue our analysis by referring to those interactions that can be subsumed under the aegis of areas *1.1*, *1.2*, and *1.3*. We are in the scenario in which the *de jure* owners want to pursue a certain type of action which is not permitted by the statutory legislation, although it is a lawful action – namely, it does not damage in any way the physical integrity of a third party's property.

*Discussion.* Area *1.2* in our graph includes digitally and environmentally wise feasible/ profitable opportunities which are also regulated by the state. For instance, we can conceive of a situation that falls under "triangular interventionism" (Rothbard, 2009), in which a company wants to install sensors for monitoring air quality but the legislation expressly prescribes what equipment is to be used and what suppliers are licenced to offer the necessary services, thus forbidding any alternative solution – see the literature on rent-seeking (Tullock, 1967) and that on the costs of regulation (Stigler, 1974). Areas *1.1* and *1.3* encompass those scenarios in which the free market identifies environment or digital solutions, but the state has enacted regulations that prohibit their implementation or make them prohibitively expensive through the taxes it imposes. Some examples: for *1.1* – the 19th century legislative acts that exempted industrial pollution from tort law provisions fearing that the strict application of the common law would have retarded industrial development (Rothbard, 1998), or the expropriation for reasons of "public utility" of natural resources, otherwise more valuable ("on the market") left specifically unexploited (e.g., the Brazilian Amazonian forest), or the supplementary taxation of those individuals that want to keep their land uncultivated; for *1.3* – the idea of "the stifled entrepreneurial process" (Kirzner, 1995; Ikeda, 1997) comes as a consequence of regulation like that which seeks the elimination by 2030 of all petrol and diesel powered cars, thus forcing a transition process which comes with a number of impossible to gauge costs (e.g., freezing up all R&D expenses that could have produced even more efficient internal combustion engines thus replacing a potentially more eco-friendly solution with pollution-generating alternatives like toxic battery residue and electricity which is sourced from unregenerable sources)

In what concerns the areas *3.1*, *3.2*, and *3.3*, we are in a situation in which the stipulations of the legislation go against the grain of the requirements set forth by the law, ignoring even the economic costs involved by the decisions that seek to direct resources toward the objectives that are preferred by the legislator when it comes to the environment and digitalization. The three areas include those situations that fall under the incidence of interventionism, an expression of statism.

*Discussion.* Area *3.2* of our graph can accommodate the EU's strategic documents, like the *European Green Deal* (Comisia Europeană [European Commission], 2019) and *Shaping Europe's Digital Future* (Comisia Europeană [European Commission], 2020). Here we include all public policy measures that seek to bring about a *New Digital Green Deal*, namely, to mobilize the potential of the new technologies to address the environmental

risks. All these proposals ignore the logic of private property, attempting to accelerate the market's natural processes and to alter the structure of the economic sectors – an economy which is "greener" and "more digitally advanced" compared with the outcome that the unhampered market would have produced. As we are going to show in the following section of the present paper, all digital opportunities also involve costs. Area *3.2* includes such subjects as "the entrepreneurial state" (Mazzucato, 2018), a concept which can be integrated in the wider literature concerning the industrial policy and the state as promoter of economic development. More recent discussions related to the *Great Reset* have been undertaken in the same spirit. Whether the state is a good innovator or entrepreneur and what does its track record tell us about its performance in these areas since it arrogated to itself such objectives have generated much controversy among the economic profession (Lerner, 2009; Rothbard, 2015; McCloskey & Mingardi, 2020). In this regard, we will also refrain from engaging in this intellectual dispute, in order not to strive too far from the subject matter of our article. We will have to settle with pointing out that economics is far from reaching a consensus in matters concerning the (in)efficiency of the state *qua* investor – or, from an even higher vantage point, its (in)efficiency as active player and referee.

Next, there will be a discussion about concrete situations in which, including interventions in markets, by pursuing public policy objectives in the area of digitization and/or greening, the relationship between cyberspace and the environment becomes either harmonious or antagonistic (Figure no. 2).

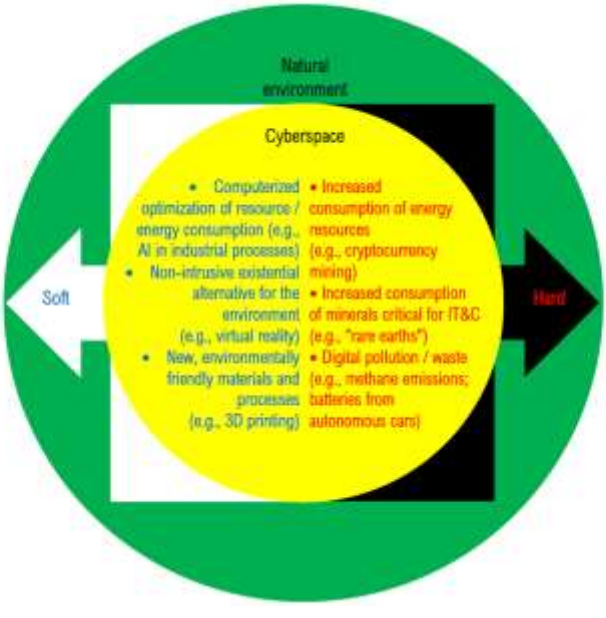


**Figure no. 2. Software softeners of and hardware hardships on the natural environment by means of cyberspace**

**3. The "soft(ware)" side. The digital relieves the environment: the computerization of eco-friendly production processes**

The first inference that this study advances is that according to which the impact of digitalization, of the cyberspace (as a sum of digital solutions), is favourable to greening, especially on the "soft" side of the relationship. Computational power, that reached unprecedented values during the Industrial Revolution 3.0, can be used to minimize consumption of material resources and energy, pollution and ecological imbalances in the new 4.0 paradigm, dominated by key-technologies such as Artificial Intelligence, Big Data, Quantum Computing. Because digitalization is a relatively new ingredient in the economy, it is not yet clear how much and what kind of effect it has on businesses – ecological, but, above all, economic. The main concern in this regard is that while digitalization helps highly polluting industries to improve their environmental performance by reducing the harmful effects of problematic production technologies, which have been replaced by "green" versions, this does not necessarily and immediately translate in a higher total productivity of the factors of production.

This idea is in line with the previous analysis "of principle": against the background of an inconclusive way of internalizing negative environmental externalities – error of legal design that does not clearly address pollution in the logic of property rights, but as failure of the free market (Cordato, 2004) –, there are obvious delays at the level of the economic agent, due to the profitability calculations that would not recommend investments in technology/digitization. Businesses are adapting relatively slowly due to high transition costs, related transformations of business models, as well as the many question marks still associated with the transition to a greener economy (von Wecus and Willeke, 2015). The call for public interventions to accelerate digitization and make the economy more environmentally friendly is the "expeditious" technical-political route, but economically and socially "expensive" when ignoring the fact that there are also national (Wasko et al., 2011) or sectorial (Krever, 2020) specificities: e.g., in the European Union, "one size fits all" is anti-convergent and anti-cohesive (Jora et al., 2021).

Under certain conditions, publicly regulated requirements may be considered compatible with the economic situation. In the spirit of the German *Industrie 4.0* policy, Haag et al. (2018) propose a framework (appreciated to be viable) for digitizing the industry in six stages: i. companies collect raw data on the natural resources used (e.g., energy consumption extracted from suppliers' invoices); ii. more advanced software extracts relevant information through data mining; iii. further, machine learning tools process data; iv. now come the algorithms and automation tools, which analyse the data obtained to predict production results, offering a better overview; v. the computer suggests decisions to improve resource allocation and increase efficiency; vi. fully automated systems are put into operation – business intelligence analysis tools are correlated with sensors on the production equipment, and various hardware and software components make and implement decisions themselves (artificial intelligence).

*Case Study: Romania and the 4.0 Automotive Industry*

Long considered one of the most harmful industries (both in terms of manufacturing and of the use of the resulting products), the automotive industry is now "forced" by the great European powers (viz., Germany) to reinvent itself for polluting less. Reinvention involves, in addition to the adoption of electric or hybrid alternatives to current fuel engines, the use

of industrial digitization. Currently, Romania is one of the European countries with a wide network of car component manufacturers. Although only Dacia (in Mioveni/Colibași) and Ford (in Craiova) assemble cars in Romania, many other companies produce parts over here without which vehicles from many other corners of the planet could not be finalized: Continental (tires, with working units in Timișoara, Sibiu, Carei, Brașov and Iași), Autoliv (safety systems, Brașov, Lugoj, Sfântu Gheorghe, Reșița, Onești and Rovinari), Walor (passive safety components, Sfântu Gheorghe), SubansambleAuto S.A. (gearboxes, Sfântu Gheorghe), Preh (multifunctional switch parts, Ghimbav), Schaeffler Group (bearings, Cristian/Brașov), Star Assembly (gearboxes, Sebeș), Leoni AG (cables, Mioveni, Pitești, Bistrița and Arad) etc.

These are just some of the factories of car parts manufacturers in Romania. Bringing together the effects of all of these manufacturing processes, there is a strong pressure on the environment. Although beneficial to the economy, the boom in the automotive industry can be a threat to nature. Precisely in this context, Romania can profit from the coexistence of "soft" (high speed internet) and "hard" (the presence of the automotive industry in the country) benefits. By the fact that most of these companies are owned by foreign capital, but also by Romania's membership in an EU in full dual transformation – digital and green –, the pressures of digitalization/greening from abroad will have effects in Romania. Willingly or unwillingly, Romania must align its car industry with both trends. Quality internet can help the faster exchange of information to support more efficient decision-making on resource allocation, with an impact on mitigating the adverse effects of this large industry. In addition, the use of smart software solutions in the automotive industry can pave the way for a circular economy in which the reuse of resources to optimize and extend the lifecycle and, consequently, to avoid waste.

Moving on, the digitization of the domestic automotive industry would not be possible without the existence on the local market of several players in the IT and telecommunications sector, able to provide the necessary digital solutions such as cybersecurity, Robotic Process Automation (RPA), artificial intelligence and machine learning (AI and ML), Big Data Analysis. The providers of such solutions are already present on the Romanian market (IBM Romania, Oracle Romania, Ericsson Romania, Endava Romania, Atos IT Solutions, UiPath, Microsoft Romania, Cognizant Technologies, NTT Data etc.), but equally important is the existence of IT&C consultants who to assist companies (from various industries, such as the automotive industry) implement these solutions. In the absence of a sufficiently digitally/IT-educated staff at the clients' inhouse, consultants can be the link to fill the gap created by the lack of digital qualification among the clients' employees. But, in order for Romania to have specialists in digital skills who can support customers in implementing eco-friendly technological solutions, it is also necessary for schools, high schools and universities to fulfil their role of training these staff.

In addition to the "macro" discussion about the Romanian automotive sector, an example from the "micro" level (economic agent) deserves to be discussed. Thus, one of the examples appreciated as successful industrial digitization in the local automotive market is the company SKF Romania, part of the Swedish group SKF, one of the world's largest manufacturers of bearings and, at the same time, one of the leaders in global industrial digitization. In Sweden, SKF is in a permanent race to equip Big Data and Industrial Internet of Things (IIoT) solutions to extend the life of factory equipment. Through IIoT, for example, sensors, production equipment and other industrial equipment are connected

to the company's internet network to analyse and store data about production and factory activity. The values resulting from the data analysis are made available to equipment operators who can establish development directions for each equipment or for each production line (Kuka, 2021). It should be noted, in context, that one of the biggest enemies of productivity, but also of environmental quality, is the unforeseen shutdown of production capacity due to technological failures.

In order to reduce the incidence of such situations, SKF equips its factories with the latest digital solutions, so that factory managers and production managers can have real-time data on the state of the equipment (e.g., the state of the production lines) and, on the basis of these data, make decisions with a direct impact on production (Vesely, 2020). For example: how much longer can the assembly line be allowed to operate until the next service intervention becomes necessary? As a member of the SKF group, the Romanian subsidiary is also exposed to European eco-digital trends. Although it only offers sales and maintenance service in Romania, the digitalization of the subsidiary has consisted in the development of computer applications available on intelligent mobile communication platforms (smartphones and tablets) that optimize the relational marketing between the company and customers, so that intervention times are reduced (Jurnalul de Afaceri, 2019). A faster solution to the problems that arise leads to a more satisfied customer who can resume operations without wasting too much time and without wasting many other resources during these timeouts. In essence, even the smallest detail that increases the reliability and the efficiency of some economic processes, regardless how trivial, is an indirect form of environmental protection, by the reduction of associated waste.

## 4. The "hard(ware)" side. Where the digital and the green clash: pollution generated by... non-polluting technologies

The second inference advanced by the present study is that there is also a negative impact of digitalisation on the environment, particularly originating in the "hard" side of cyberspace. Digitalisation, automation and the 4.0 industry in general bring their own environmental challenges, by increasing requirements for electric energy, an increasing need for the production of technologically advanced gear, capable of running software that grows ever more sophisticated, complex and demanding (which implicitly means a greater need to exploit Earth's resources through still polluting processes), while the solution to mitigate these negative outcomes is sought in a mix of public institutions and policies.

Yet, in a way, many such unfavourable developments on the digital-environmental axis can be considered tributary to certain misalignments of public policies in this area which, in spite of claiming a certain type of synchronicity and symbiosis, generate inherent disequilibria and instabilities precisely due to the "artificial" nature of coercive regulations, relative to the "organic-ness" of markets. We do not hold the naive perspective of "deregulated markets" (or unregulated, according to the supporters of statist regulations), but rather that of markets regulated on the basis on legitimate relations that enable responsibility and are consolidated in contracts with properly articulated and safeguarded property rights.

The complexity of negative phenomena associated with the expansion of cybernetic and digital technologies on the ecosystem, beyond the primary impact that can be measured – e.g., high consumption of energy and scarce minerals, along with the various

disintegrating/polluting outputs, such as the emissions of noxious substances in the processes of obtaining and utilising energy and critical materials –, leads to the emergence of new analytical fronts. For example, the "internal" political acceleration of digitalisation and greening reverberates at an "external" level, leading to new geopolitical tensions and pressures. We shall outline two such evocative mini-case studies.

*Case study #1: The energy balance account of cryptocurrencies*

Cryptocurrencies, an exponent of the ongoing digitalisation trend (Smirna, 2021), have seen an immense increase in their popularity starting with the year 2017, being worth 49.318 Euros according to the Bitcoin – Euro exchange rate as of 13 October 2021. They are not a product of state mechanisms, but rather a reaction, in the digital world, to the latter's habitual intrusions, although states are attempting to become relevant in the realm of blockchain as well. The momentum of cryptocurrencies is linked to such attributes as: the safety of transactions guaranteed by the application of blockchain technologies (which register the entire transaction history), its decentralised nature (thereby allowing access from anywhere in the world which bypasses the political risk of assets being blocked), the anonymity of transactions and the possibility of managing transactions directly (without the aid of brokers or other middlemen), according to European Business Review (2021). Analyst L. Sokolin, cited by Cadigan et al. (2017), believes that the growth of the Bitcoin is an inevitable step in the overall trend towards digitalisation. That said, the impact of cryptocurrencies on the environment is itself a cause for concern. Reiff (2021) notes that the Bitcoin as well as other cryptocurrencies require immense amounts of energy for the computations they perform while mining, whereas 65% of all such operations are conducted in China which uses electricity provided mainly by coal power. Moreover, the author warns that, as the price of the Bitcoin continues to grow, the mining process will become that much more inefficient because, although the number of transactions remains constant, the volume of required computation will grow. An analysis by Cho (2021) leads to a similar conclusion, namely that Bitcoin transactions consume up to 121.36 Terawatt-hour, which is comparable to Argentina's total electricity consumption. However, there are also optimistic outlooks on the ecological role of the Bitcoin, with a notable remark from the United Nations (2021), i.e., that, despite the environmental dangers associated with Bitcoin transactions, the transparency and security generated by the blockchain technology can also be used to prevent certain activities from the informal economy that can negatively affect the environment, such as illegal fishing.

*Case study #2: Digital pollution and digital waste*

The digital "invasion" of the environment can take two forms: pollution by overexertion in certain activity in cyberspace and the waste resulting from the conclusion of the moral/physical lifecycle of equipment and gear. Digital pollution occurs when the activity of users in cyberspace causes negative externalities, meaning there is a "digital carbon footprint" associated with web surfing or posting on social media, hence the corrective concept of "Green IT". Digitalisation is considered an option to diminish "analogical" pollution (e.g., paper waste), but we need to bear in mind the odd turn that digital consumption can take: the growth of the digital carbon footprint (Bridges and Eubank, 2020), associated with irresponsible digital consumption containing spam email, trojans, other viruses etc. (da Silva et al., 2020). Misra et al. (2021) point out that the acceleration of the Industrial Revolution 4.0 will lead to greater digital pollution, exemplified by 5G technologies, which mean greater web navigation speeds, faster data transmission and

greater volumes of multimedia data exchanges: the greater the online "traffic", the more computing power and energy will be required. Nwankpa și Datta (2017) claim that there must be a balance between the exploration and exploitation of digital solutions, otherwise the "new crude oil" as we know it risks being just as dangerous as the classical one, if used excessively. Aside from this, there is pollution generated by electronic and electric waste – the so-called *e-waste* – which covers an array of various products that are discarded once they are used: large household appliances (washing machines and electrical heating devices) make up more than half of the electronic waste collected, followed by IT and communications equipment (laptops, printers), consumption equipment and photovoltaic panels (video cameras, fluorescent lamps) as well as small household appliances (vacuum cleaners, toasters). The problem occurs the moment such equipment is not recovered: in the EU, the leading world champion in the circular economy (especially as regards *policy* targets), less than 40% of electronic waste is recycled.

**Conclusions**

It is not yet clear what is the net result of the "eco-balance" that follows from the transitioning of a large part of the world and social life to cyberspace. We have, on the one hand, some lessening of the anthropogenic pressure on the environment/climate (e.g., by optimizing some production processes, as enabled by Artificial Intelligence etc.). On the other hand, we have the build-up, by no means negligible, of the pressure on some components of the natural environment (e.g., by the expanding need for energy or rare minerals, which are critical requirements for the new technologies etc.). We categorized the possible ecological relaxations to come on the "software" side of digitization, and tensions as being tributary to the "hardware" side. The discussion is important not only for reporting the spontaneous intersections and interactions between two global megatrends – digitalization and cleaning up the environment –, but also to signal that, beyond the limited predictability of these reciprocal reverberations, some specific issues become manifest when they are tackled as a matter of public policy.

What we attempted to draw attention to in this analysis is that, beyond the good intentions of policy makers when they issue norms that seek to bring about a change for the better in long term habits (even though it is admitted they may be costly for now), we must not omit the unintended consequences that appear when the legislative process exceeds what is deemed lawful/legitimate by the abiding citizen. Forcing the pace of human "progress" via a virulently interventionist/statist approach, even when it employs in addition to regulations financial incentives (paid also from public resources), results in behavioural distortions on the part of economic agents (eviction but also rent-seeking), discoordination of the structure of production (under- and over- investments), economic and social instability in various sectors, leading to the withering away of (individual) responsibility in the name of (social) responsibility.

The mathematician Gottfried Leibniz once said *"natura non facit saltus"* ("nature does not make jumps"), to describe the evolutionary character of natural change. Looking back at the history of human activity through the millennia, it becomes clear that industrial revolutions, the produce of the incremental accumulation of inventions and improvements, lead to betterment of human life which, although appearing gradual from the point of view of subjective experience, seems to be a succession of veritable jumps when one considers

their timing on the grand scale of history. What is keep in mind is that throughout this suite of evolutionary and revolutionary developments (or devolutions) there is a lesson to be drawn, which amounts to a "jump off into the unknown": you can either succeed or commit an error when you impose on people certain means and claim that you know better than them what their goals are; but you invariably fall into error when you "debase" individuals making them the silent means of "all too high" goals.

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# ADOPTING SUSTAINABILITY AND DIGITAL TRANSFORMATION IN BUSINESS IN ROMANIA: A MULTIFACETED APPROACH IN THE CONTEXT OF THE JUST TRANSITION

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**Abstract**
This study investigates the many facets of sustainability and digital transformation in business in the context of the fair transition, which will generate multiple challenges and opportunities for companies in various industries. In such a context, a solution to increase resilience and adapt to the fair transition can be identified in the lessons learned by companies due to the application of sustainability and digitization and by understanding the various elements underlying these dimensions. Thus, in order to identify the various elements of this complex framework in practice, based on a semi-structured narrative review of the literature and quantitative analysis, exploring aspects such as the reasons and catalyst factors of the adoption of sustainability and digitalization in companies, the interpenetration of the two concepts in the practice of companies (in production, innovation, customer relationship, logistics, etc.), as well as the associated opportunities and challenges. The research bridges a gap in the academic literature, highlighting the relationships between the digital transformation of business and the adoption of sustainability in companies as a conducive basis for responding to the challenges of the just transition. The analysis details the dimensions of sustainability and digital transition in business in an exploratory model made using structural equations through SmartPLS software applied based on a quantitative study to which 154 professionals, executives, and managers, responded, from local and multinational companies, in different fields of activity. The results obtained after processing 128 valid answers out of the initial 154 are relevant both for the theoretical understanding of the challenges and the practical benefits associated with the digital transformation of business in the context of the development of sustainability strategies. Future lines of investigation are also highlighted.

**Keywords:** sustainability in business, digital transformation, just transition, structural equations, SmartPLS

**JEL Classification:** L19, M10, M15, Q01, Q56

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## Introduction

The just transition, which the European Union recently defined as a priority strategic objective addressing both climate change and social inclusion, could prove to have both positive and negative microeconomic effects in the future. To meet the imperatives of a just transition, companies will need not only financial resources or compliance with the European policies and regulations but also new ways to understand productivity and competitiveness, as well as innovative redesigns of products, services, or even business models that are part of the broader paradigm of sustainability. Increasingly more managers are paying attention to the idea of sustainability and incorporating it into the daily existence of organizations, and in many cases, use, in this regard, digital tools. Therefore, to design effective business models and decisions, understanding digital business transformation processes coupled with the broader framework of adopting business sustainability is a necessity today, in the complex context of global competition and just transition. We mention that in this article, we chose to use the terms "digital transformation" and "digitization" as synonyms (Brennen and Kreiss, 2016), even though there are authors who differentiate between them (Gray and Rumpe, 2015)

This study investigates the multiple facets of the relationship between sustainability and digital transformation within the broader framework of the just transition imperative. The necessity and opportunity of this research are given by the catalytic element of European policies regarding the transformations generated by the just transition. However, the theoretical framework is that of the simultaneous adoption by companies of two new phenomena: ESG (ecological, social, and governance) criteria of sustainability and digital transformation, considered as favorable options for increasing resilience and organizational agility in the context of fair transition – a phenomenon whose possible consequences on companies have not been sufficiently studied so far. The paper aims to cover the literature gap of the relationship between sustainability in business and digital transformation. The topic of sustainability in business is mainly discussed in literature from narrow perspectives and practical evidence (Porter and Terry, 2012), while the alignment of digitalization with sustainability investigates mainly particular technical aspects (Feroz et al., 2021). Thus, the correlations between the dimensions of sustainability and the digital transformation in companies are identified, highlighting the positive impact of digitalization on business results and the adoption of sustainability in companies, which is an advantage for businesses in the context of challenges of fair transition.

Given that the challenges of fair transition are not yet clearly identified at the firm level, as we will demonstrate in the paper, the authors consider the context created by it as a frame of reference for the development of new managerial tools based on practical experience in adopting sustainability and digital transformation (de Novaes and Brunstein, 2013; Lahtinen and Yrjölä, 2019). The paper is structured as follows: literature review, the definition of research hypothesis, methodology, and analysis, discussions, and conclusions.

## 1. Literature review

The just transition is an approach that economic agents have begun to be aware of relatively recently, especially in the context of the European Commission's public position. The latter announced the adoption of the JTM (Just Transition Mechanism), which will mobilize a budget of at least 65-75 billion euros in the period 2021-2027 so that "no one is left behind"

(European Commission, 2021). As this framework is incipient, the academic literature has addressed the issue of just transition rather from the perspective of meta-analyses (Heffron and McCauley, 2018; Galcogzi, 2020), studies that explore the effects on employment (Rosemberg, 2010; Stevis and Felli, 2015), impact on the industrial environment (Clarke and Lipsig-Mummé, 2020; Tomassetti, 2021), supra-state policies (Cameron et al., 2020; Heyen et al., 2020; Plant and Lucchese, 2021), state policies (Voicu-Dorobanțu, 2021; Krawcenko and Gordon, 2021) and regional policies (Pactwa et al., 2019; Janikowska and Kulczycka, 2021), focusing on concerns about possible inequities that may result from this process and on the direct and indirect effects at the level of employment and, in extenso, on communities.

The subject of challenges and preparation of companies for the just transition in the literature is still meagre, with a few exceptions that explore the issue tangentially, by sectorial investigation of possible responses of energy companies (Goddard and Farrelli, 2018; Bainton et al., 2021) and by formulating practical recommendations for investors (Robins et al., 2019; Busu et al., 2020). However, beyond the frameworks imposed by regulation in specific sectorial contexts, increasingly more managers are proving a change of mentalities that translates into efforts to achieve a balance between creating economic, ecological, social, and cultural value and permanently streamlining business models. (de Novaes and Brunstein, 2013; Lahtinen and Yrjölä, 2019, Vrânceanu et al., 2020). Such initiatives are found in a wide range of options, from sporadic actions to structured projects and specific articulated strategies, included in companies' overall strategy.

In this context, we can estimate that the just transition is a little-known conceptual framework at the company level, based on an incipient organizational mechanism. At the time when this article was written, there was no comprehensive study of managers' or employees' perceptions of changes in the fair transition, and the only analyses in this field were conducted at well-defined levels as a sector of activity and geographic coverage of workers directly affected by fair transition (Medugorac et al., 2020). A fair transition requires new rules of competitiveness, which highlight the need for adaptation in order to become more sustainable in a digital world, too, so that firms' responses to the challenges of a just transition will be influenced by the extent to which they are already familiar with the concept and practice of business sustainability, and the tools and lessons of digital transformation can be helpful for the development of the required skills (Jenkins and Naude, 2019). A fair transition will be a far-reaching framework, and sustainable leadership will be required to ensure the resilience of companies and their development (Avery and Bergsteiner, 2011). Moreover, on the background of this resilience there will be an increasingly digitalized and interconnected world, so the correlation between the adoption of sustainability and the digital transformation must be all the more understood.

Like sustainability, digital transformation is not necessarily an end in itself but is an essential facet of business strategies and practices, becoming a lever for sustainability in multiple situations by generating tools (Pappas et al., 2018; Sivarajah et al., 2020), through the indirect effects involved (Bieser and Hilty, 2018) or through the emergence of new managerial mentalities (Von Kutzschenbach and Daub, 2021). New digital business models are influenced by the technological evolution and aim to implement digital service-oriented policies that ensure long-term business sustainability (Ruggieri et al., 2018).

To draw the theoretical framework of the complex relationship between sustainability and digital transformation in companies in the context of just transition, the authors conducted a semi-structured narrative analysis of the literature, a solution considered suitable for a

multidimensional exploratory study aimed at identifying as many relevant facets of research as possible (Snyder, 2019). Thus, bibliographic sources containing academic papers listed in recognized databases, reports of internationally renowned consulting agencies, and statistical data aggregators were analysed, which were selected after eliminating papers with an inconclusive methodology or considered as presenting redundant information. Following the documentation approach, the following thematic areas were identified to outline a complex framework of the relationship sustainability – digital transformation in companies: (1) motivations for adopting sustainability in companies; (2) dimensions of sustainability within companies and in the relationship with customers and business partners supported through digital tools; (3) internal communication in companies of sustainability and digital transformation; (4) results of the adoption of sustainability in companies and the use of digital tools to support it.

Companies adopt sustainability as a result of different external and internal factors, with varying degrees of influence (Vătămănescu et al., 2016). One of the most frequently cited internal factors in this regard is the need to reduce operational costs by reducing resource consumption (Rothenberg, 2007; Berg et al., 2015; Álvarez-García and Del RíoRama, 2016). Firms adopt sustainability strategies and/or practices in a complementary way to the cost reduction objective to increase efficiency and improve their business model (Alsayegh et al., 2020), due to the need to avoid vulnerabilities (Mota et al., 2019; Cardenuto and Buluran, 2021) and to the existence of innovation capacities and capabilities that promote sustainability (Rauter, et al, 2019; Läpple and Thorne, 2019). Depending on the field of activity, the adoption of sustainability in business is a way to reduce and weigh risks, especially in areas strongly influenced by the reduction of available resources, such as in the coffee and chocolate industries (Mota et al., 2019; Carodenuto and Buluran, 2021). As in any strategic approach, the adoption of sustainability in business depends on the managerial vision (Millar et al., 2012), being highlighted different degrees of alignment with business strategies (Caputo et al., 2017), which varies from incipient strategy to independent, at integration. Adopting business sustainability is also driven by employee expectations (Lee and Chen, 2018), especially in the case of digital natives (Pînzaru et al., 2016), which can be a factor of boosting organizational culture that favours sustainability projects (Baumgartner, 2014). Companies choose to invest in sustainability in order to maintain a favourable reputation that in turn meets consumer expectations (Treapăt et al., 2018; Zbuchea, 2013): for example, the reputation of CSR (corporate social responsibility) projects is an essential factor in influencing the choice of French consumers of banking services (Statistical, 2021a). A share of 59% of company managers who consider that they gain value from sustainability programs actively promote the products and services' sustainability attributes, and 27% propose sustainable brands (McKinsey, 2021). All these motivations in adopting sustainability in business seem to outperform the legislative-regulatory factor (Lamoureaux et al., 2019) or self-regulate (Dashwood, 2014).

Sustainability can be sustained through digital transformation, as long as smart tools adopted or lessons learned from digitization processes are translated into sustainability strategies and projects for sustainability through digitization; this is evident in the case of supply chains (Muñoz-Villamizar, 2019), where collaborative platforms that give access to big data (Wu et al., 2017) are increasingly common. In the case of production, the type of impact – positive or negative – on ecological sustainability is debatable (Chen, 2020). However, technological opportunities at the equipment level are numerous, directly impacting the reorganization of work and processes (Stock and Seliger, 2016). Achieving the objectives of energy efficiency

and reduction of waste and water consumption through smart solutions adapted to logistics facilities are found in the plethora of smart digital solutions that support the sustainability of companies, in multiple variants: 5G solutions (Chew et al., 2020), big data (Qolomany et al., 2016). External communication of CSR approaches is done digitally, through social networks (Troise and Camilleri, 2021), not only to maintain the excellent reputation of the company but also in order to attract consumers interested in the sustainability attributes of products and services (Kollat and Falache, 2017; Gupta et al., 2021). Market research on the various CSR elements of companies can also be done through digital tools, such as social networks (Glozer and Hibbert, 2017).

The digital transformation of the practice of sustainability itself seems inevitable, given the multitude of areas of sustainability (e.g., in pollution control, waste management, sustainable production, etc.) that are transformed by digital solutions such as IoT (Internet of Things), AI (artificial intelligence), big data, social networking, analytics, cloud and mobile technologies (Feroz et al., 2021). In order to use digital tools to support business sustainability, both management support and the integrated vision through which sustainability is an integral part of the business strategy are essential (Epstein et al., 2010; E&Y, 2018). For the vision to be shared, it is necessary to have continuous internal communication on the two topics, sustainability and digitalization, and continuous training of employees. Internal communication is needed to increase employees' awareness of both what sustainability means – for example, more than half of the Hungarian population does not know what sustainability means (Statista, 2021b) – and to present technical solutions for sustainability projects and in order to increase employee involvement in such projects (Duthler and Dhanesh, 2018). Employee training is specific to high-performing companies in terms of sustainability. It is often done with external educational partners (Stachová et al., 2019), covering concrete solutions and future problems of future work, such as those raised by the generalization of AI in sustainability projects (Goralski and Tan, 2020).

The main expected results of the adoption of sustainability supported by digital tools come from: increasing efficiency and reducing costs – product development, operational, regulatory compliance (McKinsey, 2021); risk management (Mota et al., 2019; Carodenuto and Buluran, 2021); adapting to consumer expectations (Ahmed et al., 2020; McKinsey, 2021); employee loyalty (Gill, 2015); gaining competitive advantage (Sroufe, 2018; Polzunova and Kostygova, 2019; Iliescu, 2020). In other words, most of the motivations for adopting sustainability in business are expecting concrete benefits for companies, such as cost reduction, more efficient risk management, adapting to consumer expectations, stimulating innovation, attracting and hiring staff, a better reputation, etc. The best-performing companies, which also obtain maximum value from adopting sustainability, are characterized by strategic vision (Maassen, 2018) and concrete implementation of scenarios, objectives, and KPIs – key performance indicators (McKinsey, 2021).

## 2. Description of research hypotheses

The research hypotheses were deduced from the literature presented above. Based on their testing, the authors defined a model that shows how internal and external drivers of sustainability influence digitalization, which further influences both sustainability and its outcomes. Even if companies intensely discuss various aspects of sustainability and digital transformation,

highlighting qualitative connections between the two concepts, the academic research, which measures the actual relationships between the two inside companies, lag behind.

Most available articles investigate the instrumental dimension of digitization in supporting sustainability, highlighting technical solutions and case studies (Wu et al., 2017; Muñoz-Villamizar, 2019; Chew et al., 2020). Some authors draw attention to the impossibility of determining whether digitization has only positive effects on sustainability (Chen et al., 2020), and the subject seems to be the beginning of a systematic investigation. However, some studies analyse – separately – the issue of digital maturity (Gill and VanBoskirk, 2016) and the maturity of firms' sustainability strategies (Baumgartner and Ebner, 2010).

The present projected model is based on the following research hypothesis:

- H1. DIG → SUST: Digitalization influences sustainability practices in companies. This hypothesis is in line with previous studies: Kollat and Farache, 2017; Feroz et al., 2021.
- H2. ISDRIV → DIG: Internal drivers of sustainability influence digitalization in companies. H2 is in line with by previous studies: Epstein et al., 2010; E&Y, 2018; McKinsey, 2021.
- H3. ESDRIV → DIG: External drivers of sustainability influence digitalization in companies. H3 is in line with previous studies: Feroz et al., 2021; Chew et al., 2021; Chen et al., 2021; McKinsey, 2021.
- H4. SUST → OUTSBENEF: Sustainability practices influence the perceived benefits of companies. H4 is in line with previous studies: Sroufe, 2018; Mota et al., 2019; Ahmed et al., 2020; Alsayegh et al., 2020; Carodenuto and Buluran, 2021; McKinsey, 2021.
- H5. DIG → OUTSBENEF: Digitalization has positive impact on organizational outcomes. H5 is in line with the studies of: Qolomany et al., 2016; Stock and Seliger, 2016; Glozer and Hibbert, 2017; Wu et al., 2017; Muñoz-Villamizar, 2019; Chew et al., 2020; Chen et al., 2020; Troise and Camilleri, 2021; Gupta et al., 2021.

## 3. Methodology and analysis

The main objective of this research is to build and validate an exploratory model, using structural equations, on the relationship of sustainability and digital transformation, in the conceptual framework presented above and based on the research hypotheses stated above. In order to investigate and develop this relational model, Smart-PLS has been used. It allows identifying cause-effect relationship models even when considering a complex set of items/situations (Benitez et al., 2020).

Data was collected using an online survey during August and September 2021. We obtained a convenience sample comprising 154 participants working in Romania in multinational and domestic companies (see Table no. 1). After validating the database and eliminating corrupt answers, the final sample consisted of 128 persons representing various types of companies. Convenience sampling has several advantages, such as flexibility, ease of acquiring data, and low costs. Nevertheless, it also presents some limits, such as not investigating a representative population sample and, therefore, being possible to include biased respondents. In order to reduce these limits, we recruited participants mainly via LinkedIn and using a snowball technique. In this way, respondents are more likely to be outside researchers' circles and are interested in the investigated phenomena, possibly being more informed about and critical of them.

**Table no. 1. Socio-demographic characteristics of the respondents**

| Characteristic | Structure | No. | % |
|---|---|---|---|
| **Work experience** | 1-5 years | 5 | 4.3 |
| | 6-10 years | 23 | 19.8 |
| | 11-15 years | 27 | 23.3 |
| | More than 15 years | 61 | 52.6 |
| **Job Level** | Executive position / management | 81 | 63.3 |
| | Operational position | 47 | 36.7 |
| **Size of the company** | 1-10 employees | 4 | 3.1 |
| | 11-50 employees | 20 | 15.6 |
| | 51-250 employees | 17 | 13.3 |
| | 251-1000 employees | 29 | 22.7 |
| | More than 1000 employees | 58 | 45.3 |
| **Type of the company** | Domestic company | 41 | 32 |
| | Subsidiary of an international company | 69 | 53.9 |
| | Headquarters of an international company | 18 | 14.1 |

The sample considered for analysis includes 128 respondents employed in companies operating in Romania, who completely answered the questions in the questionnaire and whose companies operate in different fields of activity: agriculture - 3; audit and consulting - 5; automotive, logistics & transportation - 7; FMCG and retail - 18; energy, oil, water treatment - 11; banking and finance - 32; health - 2; IT - 9; media and telecommunications - 15; technology, metallurgy, semiconductors - 11; others - 15. As table no. 1 shows, the respondents have significant experience in business and mainly work for large international companies operating in Romania in managing positions (81 respondents out of 128). Therefore, their views on the subject investigated would be informed and relevant, compensating the vulnerabilities associated to convenience sampling. The structure of the sample (Tabel no. 1) ensures a broad perspective on the investigated aspects both through the fields of activity covered and through the professional experience of the respondents.

The survey consists in a 35-items questionnaire, defined as discussed in the literature. Respondents were invited to rate these items presented in table no. 2 using a five-point Likert scale (1 = not at all; to 5 = to a very large extent). The respondents also provided information on their work record (years of work experience and the job position) and on their organization (type of business and size).

The main constructs selected in correlation with the literature review are Digitization, Sustainability, Sustainability Factors and Results. The first construct, Digitization, was designed as a reflective factor comprising 5 items, referring to the extent to which the company is oriented towards digital transformation. The second construct, Sustainability, was assessed through 5 items, which investigate sustainable organizational attitudes and practices. The third reflective construct, Drivers of Sustainability, contains two main categories, internal factors, and external factors. The internal factors are structured in 7 lines, while the external ones have 6 dimensions. The latest construct, Results, includes 12 items. Table no. 2 presents the items included in the questionnaire, structured on the main lines of investigation.

**Table no. 2. Structure of the variables**

| Main construct | Items |
|---|---|
| **Digitalization** | DIG01. My organization provides my co-workers or me with the resources or opportunities to obtain the right skills to take advantage of digital trends.<br>DIG02. My manager encourages me to innovate with digital technologies.<br>DIG03. My organization considers digital technologies as an opportunity.<br>DIG04. I am satisfied with my organization's current reaction to digital trends.<br>DIG05. I am confident about my leadership's understanding of relevant digital trends and emerging technologies. |
| **Sustainability** | SUST01. My organization has key performance indicators for sustainability projects.<br>SUST02. My manager encourages me to participate in sustainability actions and behaviour at work.<br>SUST03. Sustainability is part of our organization's culture.<br>SUST04. Employees in my organization receive training on integrating sustainability practices in everyday work.<br>SUST05. Employees across the organization understand how sustainability efforts align with the overall strategy. |
| **Organizational internal drivers of sustainability** | ISDRIV01. The top management's sustainability-oriented vision.<br>ISDRIV02. The employees' evolving expectations and behaviour towards sustainability.<br>ISDRIV03. The shareholders' sustainability-oriented vision.<br>ISDRIV04. Improvement of the operating model or business model.<br>ISDRIV05. Assessing the vulnerability of current business model.<br>ISDRIV06. A culture of the ongoing improvement process.<br>ISDRIV07. A momentary trend on what is fashionable in business. |
| **Organizational external drivers of sustainability** | ESDRIV01. Evolving customer behaviours and preferences toward sustainability.<br>ESDRIV02. New standards in regulatory compliance.<br>ESDRIV03. Proactive investment in fighting disruption.<br>ESDRIV04. Increased competitive pressure.<br>ESDRIV05. Business partners' evolving business models and expectations.<br>ESDRIV06. Growth opportunities in new markets. |
| **Organizational outcomes of sustainability** | OUTSBENF01. Satisfy changing customer expectations.<br>OUTSBENF02. Increase design re-use.<br>OUTSBENF03. Reduce product development costs.<br>OUTSBENF04. Reduce product costs.<br>OUTSBENF05. Reduce regulation compliance. costs<br>OUTSBENF06. Driving competitive advantage through stakeholder engagement<br>OUTSBENF07. Fostering innovation.<br>OUTSBENF08. Reducing operational costs.<br>OUTSBENF09. Attracting and engaging employees.<br>OUTSBENF10. Improving risk management.<br>OUTSBENF11. Building and maintaining good reputation.<br>OUTSBENF12. Being an actor that contributes to overall social sustainability. |

The proposed model was tested with SmartPLS 3.3.3 software. Despite its limitations, at present, it is one of the reliable tools we have for complex models and proved its reliability in different research situations (Hair Jr et al., 2017). Figure no. 1 presents the measurement model using SmartPLS.

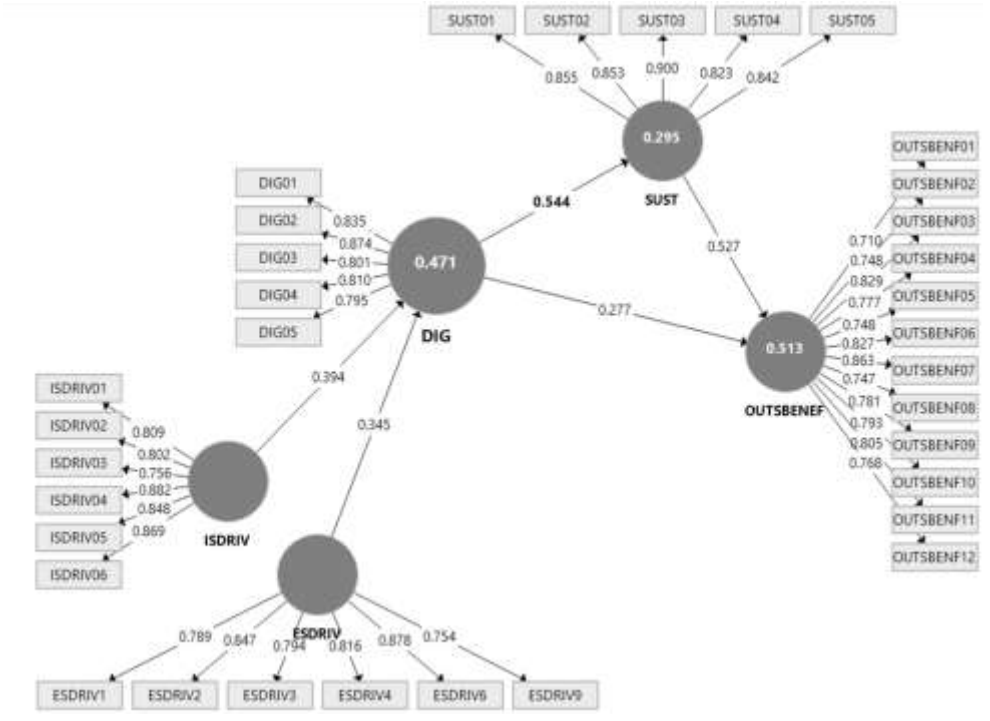


**Figure no. 1. Structural model with path coefficients**

In order to check the reliability of the multi-item measurements, we used Cronbach's Alpha tests for each main dimension. We used SPSS software and we found that all indexes are reliable, as Cronbach's Alpha coefficient is: Digitalization (5 items) - 0.897; Sustainability (5 items) - 0.912; Internal drivers (7 items) - 0.864; External drivers (6 items) - 0.884; Outcomes (12 items) - 0.947. The measurement model conforms to all reliability and validity criteria, according to the SmartPLS assessment, as presented in table no. 3. For all variables, Cronbach's $\alpha > 0.7$; rho_A > 0.7; composite reliability (CR) > 0.8; average variance extracted (AVE) > 0.5. It shows that the model has distinct constructs, explains more than 50% of the variance of its items, and satisfies the reliability validity criteria.

**Table no. 3. Reliability and convergent validity**

| Variables | α | rho_A | CR | AVE |
|---|---|---|---|---|
| **DIG** | 0.882 | 0.889 | 0.913 | 0.678 |
| **SUST** | 0.908 | 0.913 | 0.931 | 0.731 |
| **ISDRIV** | 0.909 | 0.917 | 0.929 | 0.687 |
| **ESDRIV** | 0.898 | 0.903 | 0.922 | 0.663 |
| **OUTSBENEF** | 0.943 | 0.946 | 0.950 | 0.615 |

All other criteria for validity have been checked. Outer loadings for all items are bigger than 0.7; therefore, the items passed the convergent validity test. Discriminant validity and Collinearity statistics (VIF) also proved valid. All VIF values are below 4; therefore, no collinearity problem was detected. The SRMR value is of 0.068, lower than 0.08, indicating

a good model fit. The bootstrapping procedure was considered for evaluating the structural model, resulting in another confirmation of the model.

The most substantial relationships detected consist in (1) Digitalization positively influences sustainability, and (2) Sustainability positively impacts the perceived benefits. The model validates all hypotheses (see Table no. 4).

**Table no. 4. Effects inference**

| Path | Path coefficient | Mean | Standard deviation | T Statistics | P Values | Hypotheses |
|---|---|---|---|---|---|---|
| **DIG -> SUST** | 0.544 | 0.555 | 0.055 | 9.796 | 0.000 | H1 supported |
| **ISDRIV -> DIG** | 0.394 | 0.406 | 0.096 | 4.107 | 0.000 | H2 supported |
| **ESDRIV -> DIG** | 0.345 | 0.342 | 0.114 | 3.036 | 0.003 | H3 supported |
| **SUST -> OUTSBENEF** | 0.527 | 0.531 | 0.083 | 6.341 | 0.000 | H4 supported |
| **DIG -> OUTSBENEF** | 0.277 | 0.281 | 0.094 | 2.957 | 0.003 | H5 supported |

The model validates all assumptions (see Table no. 4). Thus, hypothesis H1 (DIG → SUST: Digitization influences sustainability practices in companies) is confirmed ($\beta = 0.544$; T-value = 9.796; $p < 0.05$), showing a positive and significant influence. Hypothesis H2 (ISDRIV → DIG: Internal sustainability factors influence digitalization in companies) is confirmed ($\beta = 0.394$; T-value = 4.107; $p < 0.05$). Therefore, there is a significant relationship between the internal factors of sustainability and the digitization process, especially in terms of assessing the vulnerability of the current business model, the culture of the process of continuous improvement, and the current trend towards what is fashionable in business. Hypothesis H3 (ESDRIV → DIG: External sustainability factors influence digitalization in companies) is also confirmed ($\beta = 0.345$; T-value = 3.036; $p < 0.05$). Significantly contributing items are in particular new standards in terms of regulatory compliance, evolving business models and business partner expectations, and increasing competitive pressure. Hypothesis H4 (SUST → OUTSBENEF: Sustainability practices influence the benefits perceived by companies) is confirmed ($\beta = 0.527$; T-value = 6.341; $p < 0.05$). Also, the hypothesis H5 (DIG → OUTSBENEF: Digitization has a positive impact on organizational results) is confirmed ($\beta = 0.277$; T-value = 2.957; $p < 0.05$).

## 4. Discussions

The data obtained in the study cover some of the gaps in the literature, completing practical studies in the academic literature (Porter and Terry, 2012) and supplementing, by the comprehensive structure of the items in the questionnaire and by covering the areas of activity and size of respondents, the sporadic character of the scientific debate about the relationship between sustainability and digitalization (Ferroz et al., 2021), beyond technical options.

The research on companies operating in Romania confirms a significant influence of the digital transformation on sustainability practices in organizations. The two main dimensions identified are the provision of resources or opportunities to obtain the right skills to take advantage of digital trends (DIG01) and encouragement to innovate with digital technologies (DIG02), confirming literature findings (McKinsey, 2021). Considering the sub-dimensions of sustainability, the most relevant identified by respondents is the inclusion of sustainability

in the organizational culture. Also, key performance indicators for sustainability projects are appreciated, which supports previous discussions that emphasize the need for objectives and KPIs in the planning of sustainability projects (Păun-Zamfiroiu and Pînzaru, 2021; McKinsey, 2021). The study also reveals that Romanian employees consider that internal drivers are more influential than external drivers of sustainability. Even more, their impact is not so much direct: rather, it influences digital transformation, which, in turn, influences sustainability practices. To the best of our knowledge, this provides fresh insight into the state-of-the-art as previous literature has not tackled these relationships in-depth.

The model confirms a strong relationship between sustainability practices and the perceived benefits, confirming previous studies (McGill, 2015; Vătămănescu et al., 2016; Sroufe, 2018). Digital transformation also has a positive impact on organizational results, obtaining benefits such as meeting changing customer expectations; increasing the degree of reuse of projects; reducing product development costs; reducing product costs; reducing regulatory compliance costs; stimulating competitive advantage by involving stakeholders; encouraging innovation; reduction of operational costs; attracting and hiring staff; improving risk management; building and maintaining a good reputation; positioning the company as an actor that contributes to overall social sustainability.

The most important results highlighted by this model are driving competitive advantage through stakeholder engagement, fostering innovation, reducing product development costs, and developing organizational reputation – all of which are essential elements for increasing resilience in the context of profound transformation, as we can expect the just transition for most companies in the future.

## Conclusions

In a world that is accelerating the move to a just transition, companies will soon face significant challenges in terms of strategies, tactics, practices, and processes. The just transition, currently analysed by the literature, especially at the macro level, will represent an institutional framework that will lead to profound changes. The mechanisms of resilience and development companies will be tested, regardless of the field of activity. Research prior to the launch of this institutional approach correlates sustainable leadership with business development, and the digital transformation of business is imperative for any company. Thus, a solid foundation for accelerating adaptation to meet the new conditions of a just transition is the adoption of sustainability by firms – and in the context of an extensive digitalization of the economy and society, sustainability can no longer be decoupled from the digital transformation.

This study covers multiple research gaps today, with theoretical and practical value. Thus, the results obtained are relevant for many areas of activity that have not been studied as rather distinct sectors being investigated. At the same time, the study demonstrates a direct relationship between sustainability and digitalization: digitalization influences sustainability practices, and the factors that lead to the adoption of sustainability, internal and external, influence the digital transformation of companies. This aspect not only covers current theoretical gaps, but it also has practical relevance for managers: the study demonstrates a positive impact of both the adoption of sustainability and digitalization on companies' results, which has both theoretical relevance and practical implications by supporting the benefits that the two approaches – sustainability and digitization – generate.

The main limitations of the present study are given by the convenience composition of the sample and by its application exclusively in Romania. Other limitations refer to the self-reported measures used in the research instrument, which may imply a certain degree of subjectivism.

This paper is the first of its kind in Romania and operates an exploratory model for companies present on the domestic market. However, since most respondents hold managerial positions, which means access to theoretical managerial training from international sources, we can assume that this study may have translatable conclusions for other markets, an element that could be investigated in the future. Other future research directions could investigate the impact of internalizing sustainability and digital orientation in organizational cultures at the managerial and/or employee mentality, familiarity with the concept of just transition in an institutional context, and concrete measures in this context in sustainability strategies of companies.

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# SUSTAINABLE TRANSFORMATION OF ROMANIAN COMPANIES THROUGH INDUSTRY 4.0, GREEN PRODUCTION AND ENVIRONMENT COMMITMENT

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**Abstract**
The main aim of this research article is to develop an econometric model in order to establish the influence of green performance on digitization, green production and environment commitment. The data was collected through a questionnaire- based survey on companies' representatives. The analysis was made using the Partial Least Square – Structural Equation Modelling (PLS-SEM) with the statistical software SmartPLS. The results of the research confirm the three hypotheses. Thus, green performance of Romanian companies has a positive impact on green production, digitization and environment commitment. The novelty consists in the interconnected analysis of the four variables (green performance, digitization, green production and environment commitment), the research highlighting valuable results that can be used by the companies to improve their green performance, using green production and digitization. The paper offers a picture of the sustainable transformation of Romanian companies based on the industry 4.0, green production and environment commitment, highlighting the interdependence of the analysed variables. The research is helpful for companies that want to be more responsible towards the environment and the community.

**Keywords:** digitization; industry 4.0., sustainability, environment commitment, green performance, green production.

**JEL Classification:** M10, M12, M13, M14, M15, M21

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**Introduction**

Companies' competitiveness can be measured through the lens of their capacity to cope with dynamic changes within the industry 4.0. According to Deloitte (2021), this industry refers to "a new industrial revolution", in which "advanced manufacturing techniques" combine themselves with "Internet of Things to create manufacturing systems that are not only interconnected, but communicate, analyse and use information to drive further intelligent action back in the physical world". Numerous research articles (Ejsmont, Gladysz and Kluczek, 2020; Beltrami et al., 2021; Khan, Ahmad and Majava, 2021) focus on the link between industry 4.0 and sustainability. Thus, proving that there is a strong connection between these two concepts is helpful for managers who want to give a more sustainable direction to their companies (Beltrami et al., 2021). According to the United Nations (2021), sustainability refers to three pillars: "economic, social and environmental". Our research focuses on environment and takes into account variables such as green performance, green production and environment commitment. The paper makes the connection between digitization and the third pillar of sustainability. The importance of sustainability for generating loyalty among customers is highlighted by Bodor et al. (2021). Dinu (2020) highlights the role played by green directions of companies when customers make the decision to buy a product.

As climate change is a worrying reality, companies are now becoming more responsible and incorporate various solutions to reduce the carbon footprint and, also, to be more environment friendly. Entering the industry 4.0, by making important steps towards digitization and having a greener vision towards the future of the company, bring important benefits for both the business and the community. Acciarini et al. (2021) argue that there is a strong connection between digitization and sustainability, the former determining the companies to have a more sustainable approach in developing their businesses. Esses, Csete and Nemeth (2021) talk about "sustainability and digital transformation" and their research proves "a strong relationship" between the variables. Chen, Despeisse and Johansson (2020) analyse the relation between digitalization and environment sustainability, showing that there are both positive and negative implications of the technologies specific to the industry 4.0, on the environment. Besides digitization and environment commitment, our research takes into consideration two other variables, such as green performance and green production. Green performance reflects the capacity of companies to protect the environment and reduce the negative impact of their activities. According to Tseng et al. (2011, p.367), green performance "is vital for enterprises in making continuous improvements to maintain sustainable competitive advantages". Wagner and Schaltegger (2004) also analyse the impact of green performance on the competitiveness and economic performance of companies, underlying the importance of being more friendly to the environment. According to the European Commission (2018), green production or green manufacturing "is the solution for reducing production waste", in order to manufacture products with increased life spans. The present paper represents a starting point for future research that can use the novelty brought by our contribution in defining some of the items for the analysed variables. On one hand, these variables were approached in an interconnected manner in order to analyse the impact of companies' green performance on digitization, green production and environment commitment. On the other hand, we added new items for the studied constructs, contributing to the research in this area.

The paper is structured on the following sections: the literature review regarding the analysed topic; the research methodology; the results and discussions; and the last section presenting the conclusions, the limitations of the study, and also the future research directions.

## 1. Literature review

The present research analyses the impact of green performance on digitization, green production and environment commitment, in accordance with similar findings in this field. This approach is important for companies' representatives who want to be more responsible and sustainable, understanding that being greener means having an important competitive advantage.

### 1.1. Conceptual background

Green performance is analysed in several works (Wagner and Schaltegger, 2004; Tseng et al., 2011; Ionescu, 2021; Sharma et al., 2021). The authors highlight the role of green performance in the sustainable transformation of companies. Nowadays, more consumers choose to buy products and services from companies who protect the environment, are more efficient in using natural resources and reduce their waste. Thus, green performance indicators, which "assess the energy efficiency of a resource or system" (Chen et al., 2011) can be used by every company. They can be tailored to each field of activity, underlying: resource usage; water and energy consumption; produced waste and capacity to reduce it; durability of products brought on the market; implementation of circular economy principles (Jasch, 2000; Hermann, Kroeze and Jawjit, 2007; Kipp et al., 2012; Mahmoud and Ahmad, 2012). According to Hermann, Kroeze and Jawjit (2007), green performance indicators compare a standard index, established by the company's manager or by the industry, to the performance registered by that company, in order to make the necessary corrections for the company to become greener and more sustainable. May, Hao and Carter (2021) highlight the connection between the green behaviour of the employees and the organisation's sustainability, connection which is mediated by trust and the identification with the organisation.

Digitization refers to the digital transformation and represents the central point of the industry 4.0. Ghobakhloo (2020) analyses the benefits brought by digitization to sustainability, these two being interconnected. McKinsey (2015) defines "industry 4.0 as digitization of the manufacturing sector, with embedded sensors in virtually all product components and manufacturing equipment". Cohen (2021) approaches sustainability in the context of the extended digitization in the smart cities, which facilitates data collection with the aim of using it for developing a greener environment. Klymenko et al. (2019) highlights the role of digitization and the transformations brought by the industry 4.0, which help companies collect valuable data from supply chain, thus making more informed and responsible decisions, in accordance to the principles of sustainable development. Also, the authors Valaskova, Ward and Svabova (2021) showed that big data analysis and automatization contribute to the development of sustainable production systems. Many of these features reflecting digitization have been implemented rapidly during the COVID-19 pandemic, since 2020. While a part of the employees worked from home, the digital transformation of the companies had become a necessity. This transformation had important benefits on the environment. Moreover, companies that were more environment

friendly made the transition to digitization easier, using technologies within the industry 4.0 to reduce waste and recycle.

Green production, also known as green manufacturing or sustainable production, was studied in many research works (Baines et al., 2012; Paul, Bhole and Chaudhari, 2014; Bag et al., 2021; Sharma et al., 2021). This way of production can represent a competitive advantage for companies with an environment friendly orientation towards all production processes. Baines et al. (2012) reached the following conclusions: green production is about reducing the negative impact, while enhancing the positive impact on the environment; the concept evolved from waste reduction to a more efficient way of using resources; there are incentives from the government and a pressure from the community representatives to implement greener technologies in production processes. Maruthi and Rashmi (2015) focus on the necessity to adopt green manufacturing, due to the fact that industrialization came with more and better products on the market but, at the same time, more resources were used, while the generated waste and the greenhouse gas emissions increased at an alarming level. Several researchers also underlined the impact of certain sectors of the economy on the emissions of chemical pollutants in the atmosphere (Marcu et al., 2016).

As Davis, Green and Reed (2009, p.173) state, the environment commitment is a "theoretical construct that predicts environmental behaviour". The commitment to protect the environment is a statement of the companies, but their actions really matter for mitigating climate changes and reducing carbon footprint. Davis, Le and Coy (2011, p.257) developed a model to predict the "willingness to sacrifice", deriving from environmental commitment. Their study approaches the subject from an individual perspective, but companies act in a similar manner. Environment commitment is also closely linked to the standard of living. Several authors included in their analysis variables that have an influence on the standard of living: population, density of the population and inflation rate (Florea, Meghișan and Nistor, 2016). Environmental commitment gained "in importance within organisations", "becoming part of organisational strategic agendas" (Keogh and Polonsky, 1998, p.38). Neumayer (2002) concludes that environmental commitment is also dependant on the level of democracy in a country, highlighting that the democratic countries are more interested in tackling environmental problems. Ling-Yee (2008) focuses on consumers who put a pressure on the companies to become greener. Other researchers choose to analyse environmental commitment for specific industries, such as the airline industry (Lynes and Dredge, 2010) and hotel industry (Rahman and Reynolds, 2016) or, for specific companies, such as small and medium enterprises (Roy and Therin, 2007). Lynes and Dredge (2010) also emphasize the role played by the organizational culture towards environmental commitment.

### 1.2. Hypotheses deduction and the research model development

In our research, four constructs were underlined, beginning from previous research: (1) Digitization; (2) Green performance; (3) Green production; (4) Environment commitment (figure no. 1). We used five items for the construct green performance: economic sources of energy; new IT equipment; practices for reducing water- waste; practices for reducing waste in general; practices for recycling.

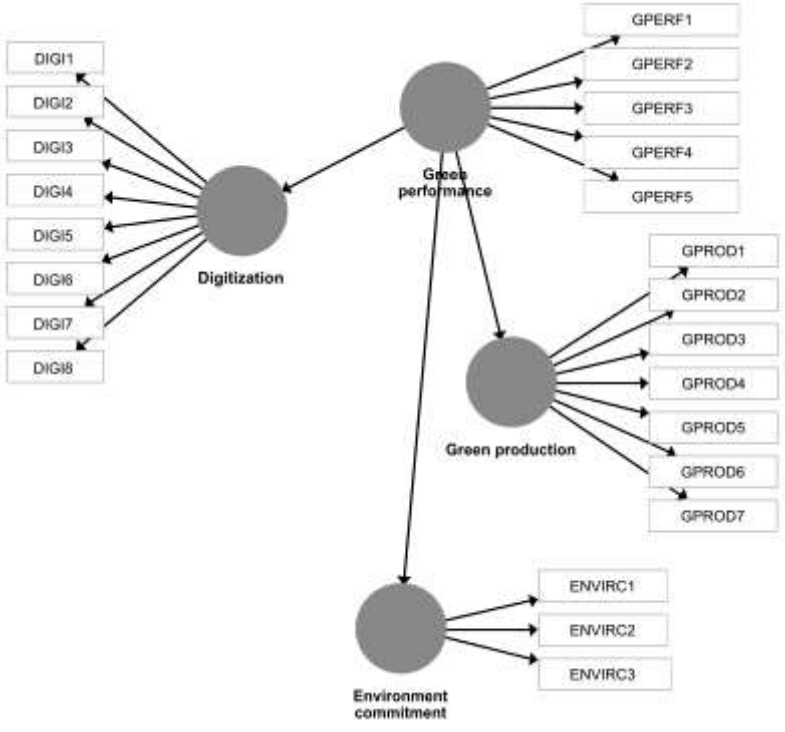


**Figure no. 1. Conceptual structural model**
*Source: Authors' own analysis using SmartPLS v3 software*

For the variable digitization, we developed eight items which we addressed in a questionnaire- based survey: self-configured workstations (Bag et al., 2021); online procedures for the employees' activity; use of artificial intelligence where possible; each employee working on a computer; big data for analysing information (Bag et al., 2021; Kumar and Bhatia, 2021); digital training for the employees; implementation of cybersecurity; cloud storage (Kumar and Bhatia, 2021). Thus, we developed the following hypothesis that links green performance to digitization, in Romanian companies:

*H1. Green performance has a positive impact on digitization in the companies from Romania.*

For the green production construct, we developed seven items which we addressed in in our study: materials used in the production are less pollutant; materials used in the production are energy-efficient; products are easy to recycle, reuse and decompose (Sharma et al., 2021); product design takes into consideration circular economy; product design takes into consideration end-of-life resource management; the company designs for environment (Bag et al., 2021); the company designs for remanufacturing (Bag et al., 2021). We developed a second hypothesis, which considers the impact of green performance on green production.

*H2. Green performance has a positive impact on green production in the companies from Romania*

For the variable environment commitment, we developed three items: employees' interest in environment commitment of the company; employees' interest for the environmental problems; employees' interest for the environmental efforts of the organization (Sharma et al., 2021). Thus, we developed a third hypothesis which considers the impact of green performance on environment commitment:

*H3. Green performance has a positive impact on environment commitment in the companies from Romania*

## 2. Research methodology

We considered the latest findings that cover: digitization, green performance, green production and environment commitment, in developing the hypotheses (table no. 1).

**Table no. 1. Constructs and items used in the model**

| Construct | Code | Item | Source |
|---|---|---|---|
| (1) Digitization | DIGI1 | In my company, self-configured workstation line is used | Bag et al., 2021 |
| | DIGI2 | In my company, online procedure for employees' activities is used | Authors' own contribution |
| | DIGI3 | In my company, every employee works on a computer | Authors' own contribution |
| | DIGI4 | In my company, artificial intelligence is used when possible | Authors' own contribution |
| | DIGI5 | In my company, big data is used to analyze the information | Kumar and Bhatia, 2021; Bag et al., 2021 |
| | DIGI6 | In my company, digital training is provided for each employee | Authors' own contribution |
| | DIGI7 | In my company, cybersecurity is implemented | Authors' own contribution |
| | DIGI8 | In my company, cloud is used to store information | Kumar and Bhatia, 2021 |
| (2) Green performance | GPERF1 | My company uses economic sources of energy (halogen lightening) | Authors' own contribution |
| | GPERF2 | My company uses new IT equipment (A+ class etc.) | Authors' own contribution |
| | GPERF3 | My company implements practices for diminishing water-waste (water sensors etc.) | Sharma et al., 2021 |
| | GPERF4 | My company implements practices for recycling (paper, glass etc.) | Sharma et al., 2021 |
| | GPERF5 | My company implements practices for waste reduction (reuse of papers etc.) | Sharma et al., 2021 |
| (3) Green production | GPROD1 | The enterprise uses materials with the least pollution during the process of product development, design or production | Sharma et al., 2021 |
| | GPROD2 | The enterprise uses the most energy-efficient materials during the process of product development, design or production | Sharma et al., 2021 |
| | GPROD3 | The enterprise examines whether products | Sharma et al., |

| Construct | Code | Item | Source |
|---|---|---|---|
| | | are easily recycled, reused and decomposed during the process of product development design or production | 2021 |
| | GPROD4 | The enterprise uses circular product design and production | Bag et al., 2021 |
| | GPROD5 | The company uses end-of-life resource management to protect the environment | Bag et al., 2021 |
| | GPROD6 | The company implements design for environment | Bag et al., 2021 |
| | GPROD7 | The company implements the concept of design for remanufacture | Bag et al., 2021 |
| (4) Environment commitment | ENVIRC1 | I care about the environmental concern of my organization | Sharma et al., 2021 |
| | ENVIRC2 | I feel as if my organization's environmental problems are my own | Sharma et al., 2021 |
| | ENVIRC3 | I would feel guilty about not supporting the environmental efforts of my organization | Sharma et al., 2021 |

*Source: Authors' own analysis using SmartPLS v3 software.*

The data was collected through a questionnaire-based survey, the items being measured through the 5-points Likert scale, where the response options were between "totally disagree = 1" and "totally agree = 5". Sample representatives were: managers, legal advisors, economists, accountants, assistant managers, computer operators, programmers, logistic coordinators, sales operations analysts, engineers, marketing specialists, customer relations managers, sales managers, office managers, junior managers, basic operators, brand managers, call center agents, area managers, so as to receive a wider approach on the organizations' level of digitalization, together with its approach on sustainable transformation. The questionnaire was sent online to more than 700 employees, while the valid questionnaires that were received, were 150. The collection of the data was done between 1st of July and 1st of September 2021. The respondents are aged between 19 years old and 58 years old, with a job experience from less than one year to 38 years (table no. 2).

**Table no. 2. Demographic summary**

| Metric | Years | Number of respondents | Percentage |
|---|---|---|---|
| Age (years old) | < 25 years old | 45 | 30.0 |
| | 25-34 years old | 59 | 39.4 |
| | 35-44 years old | 32 | 21.3 |
| | 45-54 years old | 12 | 8.0 |
| | 55-65 years old | 2 | 1.3 |
| | > 65 years old | | |
| Work experience (years) | < 5 years | 79 | 52.7 |
| | 5-10 years | 27 | 18.0 |
| | 11-20 years | 31 | 20.6 |
| | >20 years | 13 | 8.7 |

*Source: Authors' own analysis*

## 3. Results and discussion

Partial least square equation modelling (PLS-SEM) was applied with SmartPLS software. This method was used to analyse the connections between observed variables and latent

variables. Busu and Gyorgy (2021) use this method because it "enables complex models with many constructs, indicator variables and structural paths without imposing distributional assumptions on the data" (Hair, 2019).

### 3.1. Reliability and validity

Items' validity analysis imposes the rejection of three indicators from Digitization, whose loadings do not exceed 0.7: DIGI1, DIGI2, DIGI3. The variance inflation factor (VIF) should not exceed 5, so all the indicators that did not meet this criterion were eliminated (GPROD2, GPROD5, GPROD6, GPROD7). In order to confirm the convergent validity, all the values for Average Variance Extracted (AVE) are higher than 0.6. Also, the Cronbach's Alpha coefficients are above 0.7. Thus, the exogenous variables in our model are significant (table no. 3).

**Table no. 3. Reliability and validity**

| Construct | Cronbach's Alpha | Rho_A | Composite Reliability | Average Variance Extracted (AVE) |
|---|---|---|---|---|
| Digitization (DIGI) | 0.857 | 0.862 | 0.897 | 0.637 |
| Environment commitment (ENVIRC) | 0.895 | 0.900 | 0.935 | 0.827 |
| Green performance (GPERF) | 0.911 | 0.913 | 0.934 | 0.740 |
| Green production (GPROD) | 0.906 | 0.907 | 0.941 | 0.842 |

*Source: Authors' own analysis using SmartPLS v3 software*

For discriminant validity, the square roots of AVE, which are represented on the matrix' diagonal, are higher than the absolute correlations between constructs. For this test, we used Fornell-Larcker Criterion Analysis (table no. 4).

**Table no. 4. Fornell-Larcker Criterion Analysis for Discriminant Validity**

| Construct | Digitization (DIGI) | Environment commitment (ENVIRC) | Green performance (GPERF) | Green production (GPROD) |
|---|---|---|---|---|
| Digitization (DIGI) | **0.798** | | | |
| Environment commitment (ENVIRC) | 0.377 | **0.909** | | |
| Green performance (GPERF) | 0.602 | 0.499 | **0.860** | |
| Green production (GPROD) | 0.647 | 0.513 | 0.821 | **0.918** |

*Source: Authors' own analysis using SmartPLS v3 software*

Bootstrap *t*-statistics was analyzed. The model is significant at the level of 0.05, if *t*-statistics are higher than 1.96. All the path coefficients are statistically significant.

### 3.2. Structural model assessment

The model fit was assessed by standardized mean square root (SRMR). According to Hu and Benter (1999), the value of SRMR should be beneath 0.08 for a good fit of the model. The SRMR value in our model is 0.078. The Stone-Geisser's values ($Q^2$) are 0.223; 0.199 and 0.561, depicting medium and large predictive relevance of the PLS-path model (table no. 5).

**Table no. 5. Blindfolding**

| Construct | SSO | SSE | $Q^2$ |
|---|---|---|---|
| Digitization (DIGI) | 750.000 | 583.065 | 0.223 |
| Environment commitment (ENVIRC) | 450.000 | 360.259 | 0.199 |
| Green performance (GPERF) | 750.000 | 750.000 | 0.000 |
| Green production (GPROD) | 450.000 | 197.511 | 0.561 |

*Source: Authors' own analysis using SmartPLS v3 software*

The construct Green performance explains: 67.4% of the variance of the endogenous construct Green production ($R^2$= 0.674); 36.2% of the variance of the endogenous construct Digitization ($R^2$= 0.362); 24.9% of the variance of the endogenous construct Environment commitment ($R^2$= 0.249) (figure no. 2).

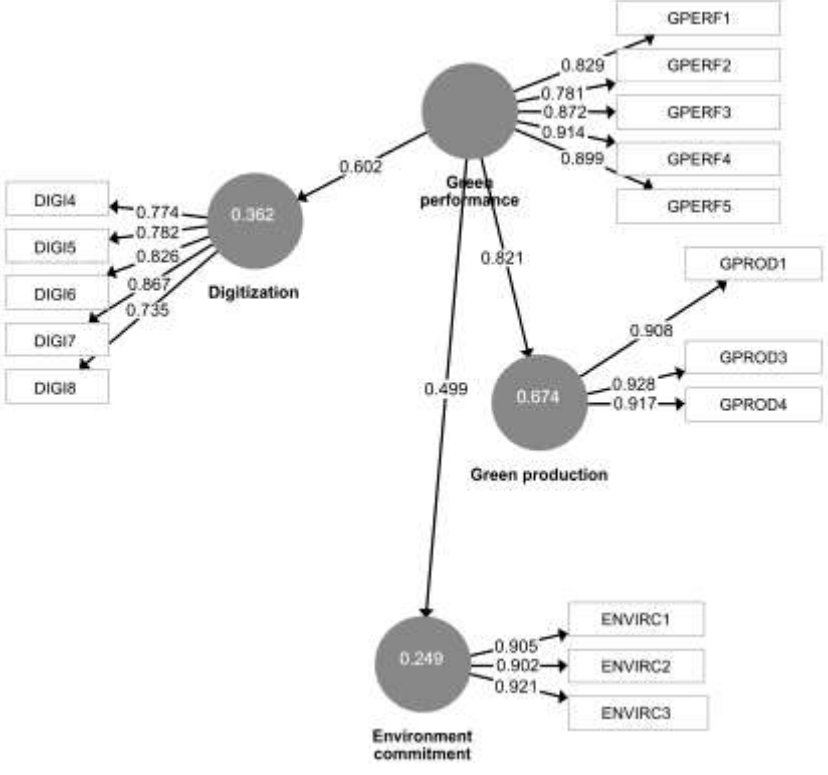


**Figure no. 2. PLS-SEM measurement model**

*Source: Authors' own analysis using SmartPLS v3 software*

All the hypothesized paths are statistically significant: *H1. Green performance has a positive impact on digitization in the companies from Romania*; *H2. Green performance has a positive impact on green production in the companies from Romania*; *H3. Green performance has a positive impact on environment commitment in the companies from Romania* (table no. 6).

**Table no. 6. Results of testing the statistical hypotheses (H1- H3)**

| Hypothesis | Path coefficients | Decision |
|---|---|---|
| H1: Green performance (GPERF) -> Digitization (DIGI) | 0,602 | Accepted |
| H2: Green performance (GPERF) -> Green production (GPROD) | 0,821 | Accepted |
| H3: Green performance (GPERF) -> Environment commitment (ENVIRC) | 0,499 | Accepted |

*Source: Authors' own analysis*

According to the data from table no. 7, the means of the retained indicators vary from 3.080 to 4.020.

**Table no. 7. Descriptive statistics of items**

| Code | Mean | Std. deviation | Loading |
|---|---|---|---|
| DIGI4 | 3.433 | 1.309 | 0.774 |
| DIGI5 | 3.880 | 1.216 | 0.782 |
| DIGI6 | 3.693 | 1.316 | 0.826 |
| DIGI7 | 3.940 | 1.261 | 0.867 |
| DIGI8 | 3.707 | 1.374 | 0.735 |
| ENVIRC1 | 4.020 | 0.990 | 0.905 |
| ENVIRC2 | 3.593 | 1.138 | 0.902 |
| ENVIRC3 | 3.820 | 1.065 | 0.921 |
| GPERF1 | 3.373 | 1.359 | 0.829 |
| GPERF2 | 3.767 | 1.202 | 0.781 |
| GPERF3 | 3.240 | 1.417 | 0.872 |
| GPERF4 | 3.627 | 1.364 | 0.914 |
| GPERF5 | 3.520 | 1.384 | 0.899 |
| GPROD1 | 3.240 | 1.215 | 0.908 |
| GPROD3 | 3.253 | 1.255 | 0.928 |
| GPROD4 | 3.080 | 1.129 | 0.917 |

*Source: Authors' own analysis using SmartPLS v3 software.*

### 3.3. Discussions

The results underline the fact that green performance has a direct impact on the level of digitization, green production and environment commitment, from the perspective of Romanian companies' representatives. Out of these three factors, green production is the most important (0.821), followed by digitization (0.602) and environment commitment (0.499). Thus, in terms of limited resources, the companies should emphasize mostly on green production and digitization in order to attain green performance. Green production is not a single- dimension factor, being represented by: the use of materials with the least pollution during the process of product development, design or production; examination of products to be easily recycled, reused and decomposed during the process of product development, design or production; use of circular product design and production. Digitization is represented by: use of artificial intelligence when possible; use of big data to analyse the information; digital training for each employee; implementation of cybersecurity; usage of cloud to store information. The positive relationship between green performance and digitization contributes to the creation of capabilities for companies, so that they can implement their operations efficiently, by improving the quality of their products and the speed of information transmission. (Li et al., 2020)

The results are consistent with those of the authors Kumar et al. (2021). The authors use the phrase "environmental dynamism", which influences industry 4.0. The authors also demonstrated the influence of Industry 4.0 on market performance, but also on environmental performance. Jayaram et al. (2014) point out the link between process innovation strategies and business performance. Green performance or the adoption of I4.0 technologies help drive innovation in the industry, along with improving the design and production of goods (Oberg and Graham, 2016). Moreover, Kumar et al. (2021) highlights other implications of the adoption of I4.0 technologies, with an emphasis on waste management, customized products, increased receptivity to changes within the turbulent environment, contribution to sustainability. Bag et al. (2021) introduces a new variable, demonstrating the link between I4.0 and the circular economy, part of the environment commitment.

**Conclusions**

This research is unique in that it emphasizes the link between green performance, digitization, green production and environmental engagement. Hypothesis H1 is validated. H1. Green performance has a positive impact on digitalization in Romanian companies. Hypothesis H2 is also validated. H2. Green performance has a positive impact on green production in Romanian companies. Hypothesis H3 is validated. H3. Green performance has a positive impact on the commitment to the environment in Romanian companies.

In terms of novelty for the business theory, it consists in putting together the four variables from the research theory: green performance, digitization, green production and environment commitment. This research has demonstrated a theoretical model that connects key resources from green performance, digitization, green production and commitment to the environment. This paper is an important contribution to the existing literature, because its results have identified the key elements that will help companies in the processes of digital transformation and sustainable development.

In terms of implications for business practice, the research article underlines valuable results in order to improve the green performance of a company, mainly based on digitization and green production. Thus, companies need to consider the use of I4.0 technologies in order to achieve the desired results, especially in terms of green performance. The relationship between green performance and commitment to the environment indicates the need for companies to adopt strategic changes in response to the environment specific. The link between green performance and green production underlines the need for a large number of innovations in a given industry, with an emphasis on highlighting the competitive advantage. Thus, the competitive advantage can be the result of both incremental innovations and radical innovations. Moreover, the paradigm of disruptive innovations is changing the approach of companies and it is placing more and more emphasis on environmental issues. Today, companies must no longer see profitability as the ultimate goal, but must integrate the sustainable development in all the actions taken.

The main limits of our study consist in the number of respondents to the survey, together with the subjective responses given. For the future research, these constraints could be overcome by increasing the number of respondents and also by adding trap questions in the questionnaire in order to verify the honesty of the responses. Also, the topic chosen for the analysis is current, which leads to the existence of a rather small volume of validated

results. This was a challenge for the authors, who interpreted the results in connection with the cultural and economic specific of the country in which the research was conducted. Regarding the future approach, the authors consider the analysis of the influence of other variables such as: human resources, economic development of the area, degree of rivalry between companies etc.

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# QUANTIFYING THE DIGITALISATION IMPACT ON THE EU ECONOMY. CASE STUDY: GERMANY AND SWEDEN VS. ROMANIA AND GREECE

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**Abstract**
The digital economy is an alternative to the traditional economy, an area of the future on which investment and R&D efforts are focused both by European forums and by Member States, which have understood the importance of the domain with the onset of the pandemic crisis. The aim of the research is to analyze and predict, on the one hand, the impact of digitalisation on EU Member States' economies by means of the three scenarios for the evolution of the digital component of the economy for the horizon 2025 (the baseline scenario, the high growth scenario and the challenge scenario), and, on the other hand, the Member States' ability to achieve the targets proposed by these scenarios. The analysis covers the period 2013-2025 and quantifies the dynamics of the digitalisation phenomena and processes based on dedicated statistical analyses (frequency series analysis, application of the unicriterion critical probability test, application of the Enter method, performing Pearson correlation tests) by means of the IBM-SPSS 25 software. The purpose of this research is the provision of relevant solutions to decision makers in the development of digitalisation. The study highlighted the placing of the results in favourable scenarios, the current trend regarding digital economy evolution, and presented the most likely scenario to be achieved in terms of knowing the provider offer and the needs of service users.
The topicality of the study targets a new approach on the foundations of financial allocations for the sustainable development of the digital economy needed in the current conditions of the global crisis and of the pandemic for the implementation of digital economy development policies. A novelty of this research is the conceptualization, validation and testing of an econometric model capable of quantifying the realism of the scenarios proposed by the European Union regarding the development of the digital economy.

**Keywords:** digitalisation; digitalisation indicators; digitalisation development scenarios: the baseline scenario, the high growth scenario and the challenge scenario; the econometric model of digitalisation development; digital market fragmentation: Germany, Sweden vs Romania, Greece.

**JEL Classification:** F63; O30; C40.

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## Introduction

In the current social and political context, digitalisation can be the engine of global economic growth, with developments being driven by the constraints of the COVID-19 pandemic and by the need to make progress in a sustainable manner. The European Commission is concerned with developing sustainable solutions that can enable the digital transformation of the European Union and, in order to achieve this goal, the European Commission has set three major objectives for the period 2020-2025: technologies to support the needs of citizens; the development of a fair and competitive economy; the achievement of an open, democratic and sustainable society (European Commission, 2020).

The European approach regarding digitalisation is built upon the democratic society, which relies on the welfare of European citizens. In the context of using digital solutions, economic excellence will be promoted and supported by specific "enforcement measures". The present and future objectives regarding digitalization must increase the population trust in the process of achieving a developed European economy and in obtaining the best possible international position. Both of them will increase the fairness at the global level and will ensure a better understanding of digital economy.

From the economic point of view, the EU digitalisation will define a new European single market for data and information. Table no. 1 shows the representative indicators for the digitalisation of the European market and their evolution, in the perspective of the three scenarios (the baseline scenario, the high growth scenario and the challenge scenario) proposed by the European Commission (2020).

**Table no. 1. EU digitalisation market's indicators**

| Representative indicators of digitalisation | Current indicator growth 2019/2018 | Forecasted growth wihin the baseline scenario | Forecasted growth within the high growth scenario | Forecasted growth within the challenge scenario |
|---|---|---|---|---|
| ***Highly specialized data professionals*** | Annual increase of the indicator by 6%; Data professionals account for 3.3% of the total workforce in the EU economy (6 million people, 2019) | Annual increase of the indicator by 25%; Data professionals account for 5% of the total workforce in the EU economy (9 million people, 2025) | Annual increase of the indicator by 30%; Data professionals account for 6% of the total workforce in the EU economy (11 million people, 2025) | Annual increase of the indicator by 23.5%; Data professionals account for 4.7% of the total workforce in the EU economy (8.5 million people, 2025) |

| Representative indicators of digitalisation | Current indicator growth 2019/2018 | Forecasted growth wihin the baseline scenario | Forecasted growth within the high growth scenario | Forecasted growth within the challenge scenario |
|---|---|---|---|---|
| ***Data professionals' skill gap*** Increasing differences between providers and users in the ability to connect/use the digital economy | Annual increase of the indicator by 24.5%; % of increasing differences between providers and users in the EU economy 6.2% (399,000 people, 2019) | Annual increase of the indicator by 31.7%; % of increasing differences between providers and users in the EU economy 8.2% (759,000 people, 2025) | Annual increase of the indicator by 46.5%; % of increasing differences between providers and users in the EU economy 10.5% (1.138 million people, 2025) | Annual increase of the indicator by 20.2%; % of increasing differences between providers and users in the EU economy 5.7% (484,000 people, 2025) |
| ***Data companies (data providers)*** | Annual increase of the indicator by 2.4%; % of increasing the representation of data economy suppliers in the total number of ICT and professional services suppliers 11.5% (149,000 data providers, 2019) | Annual increase of the indicator by 32.4%; % of increasing the representation of data economy suppliers in the total number of ICT and professional services suppliers 15% (290,000 data providers, 2025) | Annual increase of the indicator by 21.5%; % of increasing the representation of data economy suppliers in the total number of ICT and professional services suppliers 14% (193,000 data suppliers, 2025) | Annual increase of the indicator by 18.2%; % of increasing the representation of data economy suppliers in the total number of ICT and professional services suppliers 12.2% (163,000 data suppliers, 2025) |
| ***Data companies (data users)*** | Annual increase of the indicator by 2.4%; % of increasing the representation of digital service users in the total economy 5.9% (535,000 users, 2019) | Annual increase of the indicator by 18.2%; % of increasing the representation of digital service users in the total economy 6.3% (583,000 data users, 2025) | Annual increase of the indicator by 19.5%; % of increasing the representation of digital service users in the total economy 7% (627,000 data users, 2025) | Annual increase of the indicator by 17.5%; % of increasing the representation of digital service users in the total economy 6% (562,000 data users, 2025) |
| ***The value of the digital economy (% of GDP)*** | Annual increase of the indicator by 7.7%; % of EU GDP 2.6% (325 trillion euros, 2019) | Annual increase of the indicator by 28%; % of EU GDP 4% (550,000 bn. euro, 2025) | Annual increase of the indicator by 42.4%; % of EU GDP 6% (827,000 bn. euro, 2025) | Annual increase of the indicator by 22.1%; % of EU GDP 3.3% (432,000 bn. euro, 2025) |

*Source: Authors' contribution by using European Commission data (2020)*

Table no. 1 is an effective tool for quantifying the concrete possibilities for the evolution of digitalisation, as it takes into account different scenarios, including the one related to the impact of the current global crisis due to COVID-19.

In this context, the paper proposes an analysis on the capacity of EU Member States' national economies to sustainably develop the digital economy according to the taxonomy of this economy and the results regarding the capacity of national economies in terms of technology, innovation, attracting specialists, market growth and strengthening IT service providers and users by means of information and communication, taking into consideration the following most important objectives:

- **O1:** assessment of the current state of knowledge concerning the ability of users and information providers to make the transition to data economy;
- **O2:** Analysis of the dynamics of specific data economy indicators over the period 2013-2021 and their forecast by 2025;
- **O3:** Conceptualisation of the econometric model to quantify the realism of the scenarios proposed by the EU on data economy development;
- **O4:** Testing and validation of the proposed model;
- **O5:** Assessing the capacity of Member States to achieve the targets proposed by the EU through these scenarios.

The study continues with the analysis of the literature (in which we highlight the current approach to the issue of digitalisation in the opinion of international experts and models of digital economy development in the pre and post pandemic context), followed by the research methodology (in which we present the means and methods of research and the working hypotheses, we define, test and validate the proposed econometric model), discussions (in which we present the main results of the research and demonstrate the working hypotheses) and conclusions (in which we give prominence to the topicality, originality, implications for the digitalisation policy and the research limits).

## 1. Review of the scientific literature

The current socio-economic developments call for a focus on digitalisation and the increase in the associated economic performance. More and more researchers are currently studying this interesting topic. According to the Google Scholar scientific database, more than 125,000 scientific articles on this topic were published in the period 2020-2021 (Google Academics, 2021). According to the analysis conducted by Engels (2017), large databases have a significant impact on the global economy. The influence of factors with a negative impact can hinder economic development, on both innovative and economic grounds: ranking / level of data security; high costs; lack of / insufficient know-how in the field; lack of common standards; the absence of a common regulatory framework.

Bressanelli et al. (2018) bring into discussion digital technology as a growth engine for the economy, indicating the need for a conceptual framework aimed at improving the digital product and increasing the effectiveness of these products. It is recommended to quantify some specific indicators at the level of meta-analysis: product design improvement, customer engagement (both in the first product cycle), monitoring, technical support and maintenance

(in the second product cycle) and product upgrading and renewal (in the third product cycle). These components that contribute to better effectiveness of some IT products also require a specific dynamic of suppliers and users in the digital economy.

A complex analysis of the digital and circular economy by Lewandowski (2016) focuses on taxonomy (conceptual models), adaptation factors (evaluation models) and the methodology of change. The paper represents a bibliographic analysis of the literature, new modern technology development models being identified in the studied field, whose holistic approach covers the economic, environmental, social and consumption reduction characteristics. In the paper "Digital entrepreneurship: Innovative business models for the sharing economy", written by Richter et al. (2017), the authors build a business model from the investigation regarding the evolution of companies with reduced market experience. The findings of the paper show that a significant place in economic growth is played by the following components: Extended sharing of digital content, Customers as providers and consumers, Open mind set of entrepreneurs to innovative businesses, Changing living conditions, Urbanity, and Win-win situations in a business.

According to Farboodi and Veldkamp (2021), and Aytekin et al. (2021), the rise of information technologies and Big Data analytics have generated the new economy. The authors present a model in which firms accumulate data instead of capital. The model is based on three interesting research premises in the domain: computer data is a product of economic activity; data is information used as prediction; reducing uncertainty generates profitability. In the work of the authors Youssef et al. (2021), digitalisation is analyzed from the perspective specific to the entrepreneurial sector. They conduct a literature review showing that entrepreneurial intentions are becoming dominant in the digital marketplace, with programmes encouraging entrepreneurship as a career development alternative.

In some countries, the application for the digital economy is supported at the governmental level, and education and social adhesion to the digital economy of young people, together with digital technologies, can develop the concept of entrepreneurial performance in university education (Stanciu et al., 2019).

Tolstykh et al. (2018) propose an assessment of the potential for digitalisation of the regional economy through a model that relies on a stepwise methodology, starting from the identification of the digitilisation potential of the region on the Pospelowe scale, identification of characterisation indicators, evaluation of the effect of the indicators, quantification of BI1-BI5 ranks and characterisation of the digitalisation potential based on an impact G-factor.

Kravchenko et al. (2019) analyzes digitalisation as a global trend and growth factor of the modern economy. Germany, with a retail trade volume of about $ 73 billion, contributes 8.4% to global trade, ranking 5th after China, the United States, the United Kingdom and Japan. The authors propose an international hierarchy of the top 10 world economies by level of digitalisation, based on the indicators Digital Evolution, IMD Digital Competitiveness and Blumberg Innovation Index. Sweden ranks 2nd, Germany 4th and Romania ranks 9th in the DESI (EU) Index.

The Organization for Economic Co-operation and Development (OECD) proposes quantification indicators on a global scale regarding education, innovation, trade, digital policy, etc. in order to identify the global differences between areas in the development and progress of digital transformation (Organisation for Economic Co-operation and

Development, 2019). The study proposes 9 priority directions for action to better monitor the digital transformation: assessing the visibility of the digital economy in economic statistics, understanding the economic impact of digital transformation, encouraging the quantification of digital transformation effect and of its impact on social goods and welfare, a new conceptualization of interdisciplinary approaches in data collection, artificial and blockchain intelligence, improving data measurement and data flows, developing the skills needed for digital transformation, measuring confidence in the online environment by managing online consumer security and risk protection, and establishing the impact of the conceptual framework of government digitalisation.

The conceptualization of digital orientation is made by Quinton et al. (2018), who make a correlation between entrepreneurial orientation, market orientation and learning orientation. The factors that determine the digital orientation towards the three segments are significantly influenced by the nature of the innovation. The digital revolution is a field of great interest and profoundly beneficial to the education systems in the Member States. A correct strategy in the field of educational policies and their adaptation to the IT factor can be supported by developing the demand for educational services (Grosu et al., 2010; Cosmulese et al., 2019).

Measuring the GDP in the digital economy is analysed by Watanabe et al. (2018) as a way to argue for economic welfare and productivity. The authors appreciate that good information and technological communication can solve problems of economic stagnation and crisis, in the context of the digital economy. Social Media disseminates information with shaping effects on modern society. According to the research conducted by Pearson et al. (2016), social media contributes to the development of a sustainable society, and the use of social media technologies gives researchers and practitioners more effective means to improve research. Models for understanding consumer behaviour and models for predicting changes in consumer behaviour become easier to use with the help of criteria such as: social norms, knowledge, psychological orientations, knowledge, information, and ideology.

The study of the literature shows that digitalisation is a major concern of researchers in terms of the causes that generate it, holistic approaches thus being undertaken, but especially in terms of the effects on economy in general and on digital economy, in particular, with a short-, medium- and long-term impact.

## 2. Research methodology

Empirical and analytical methods were used in the research, including statistical tools in the critical analysis of the evolution indicators from the period 2013-2025, related to the digital economy, according to the recommendations of the European Commission. The study of the literature was used to assess the current state of knowledge regarding the ability of users and providers of information to join the digital economy, to quantitatively identify the dynamics of phenomena and processes related to digitalisation (by studying international databases), to critically analyse these data, respectively by queries, consolidations, classifications of quantitative data inputs and forecasts of research outputs. Statistical means and procedures focused on frequency series analysis, the application of the unicriterion critical probability test, the application of the Enter method, on performing Pearson correlation tests and on other relevant statistical tests performed with the help of the Statistical Product and Service Solutions program, version 25 (IBM- SPSS 25) in order to achieve the purpose of the

research, i.e. its usefulness for decision makers in the development of the digitalisation strategy at the level of local and national public administration.

The authors aim at analysing economic information through four categories of indicators, specific to digitalisation, recommended at European level: share of Data Market on Information and Communication Technology (sector J) Spending – DM%ICT), digishare data economy impact of GDP – DE%GDP, share of Data Suppliers on Total J and M Sectors – DS%JMS and share of Data Users on Total J and M Sectors – DU%JMS (Digital Europe, 2021).

In order to carry out the research, we used official Digital Europe data, on the basis of which we built a model to quantify the contribution of digitalisation to economic growth in the EU. We referred to the whole EU area and 4 Member States, namely Germany, Sweden, Romania and Greece. After analysing the latest Eurostat information on digitalisation indicators (European Commission, 2020), we have defined two antithetical poles, namely Germany and Sweden vs Romania and Greece. The sample took into account the level of digitalisation in the four economic entities, the implemented policies on digitalisation, as well as the level of adherence of national economic actors to digitalisation. Given the global concerns, at a scientific and administrative level, regarding the creation of specific models for the development of the digital economy, the research carried out in the paper proposes the development of a valid tool (the proposed econometric model) designed to quickly quantify the digital capacity development of economy through a study on the 4 selected European states. The proposed model from the paper is based on the premise that there is a direct correlation between the degree of digitisation and the economic performance of each Member State.

The research conducted at the level of The European Commission regarding the monitoring of the digital market shows that the rapid economic growth at a national level is directly influenced by the share of digital economy-specific indicators in the economic basket, with three development strategies being developed in this direction for the 2025 horizon. (Cattaneo et al., 2020). The research proposes the use of statistical / econometric arguments to test the reality of the scenarios using the four already mentioned indicators and the forecast of the European Commission, based on the information provided by Eurostat, the International Monetary Fund, the World Bank.

In order to observe the achievement of the objectives of our research, starting from the understanding of the scientific literature, we established the following hypotheses of the research:

**H1:** According to the literature (Engels, 2017; Richter et al., 2017; Watanabe et al., 2018; Organization for Economic Co-operation and Development, 2019), there is an opinion that transparency of information sources is directly related to economic growth. Thus, the first working hypothesis is: *an increase in information and the transparency of sources for digital service providers directly leads to GDP growth, with a threshold below which the growth function becomes reflexive*.

**H2:** In the literature (Bressanelli et al., 2018; Organization for Economic Co-operation and Development, 2019), the impact of data users' receptivity on economic growth has been studied. As a result, the second working hypothesis becomes*: the increase in user receptivity is directly proportional to the economic growth related to digitalisation, the degree of reflexivity of the growth function being much lower*.

**H3:** According to the authors (Pearson et al., 2016; Engels, 2017; Watanabe et al., 2018; Organization for Economic Cooperation and Development, 2019; Farboodi and Veldkamp, 2021, Ionescu et al., 2021), the digital sector is a factor of economic growth. Therefore, we may define the third working hypothesis as: *the growth of the digital sector through information and communication (sector J) is a favourable factor for economic growth, the premise of reflexivity also being present here, i.e. the point from which efforts do not generate significant effects*.

**H4:** The fourth working hypothesis considers the current situation of the economy during the pandemic period and is defined as follows: *the digital economy is less dependent on the pandemic shock than the classical economy and is a sustainable pillar of economic growth*.

To verify the research hypotheses, an econometric model, based on the least squares method, was developed, a model with a multiple linear regression function, which is defined as follows:

$$DE\%GDP=\alpha DM\%ICT+\beta DS\%JMS+\gamma DU\%JMS+\varepsilon \quad (1)$$

where:

DE%GDP – share data economy impact of GDP;

DM%ICT – Share of Data Market on Information and Communication Technology (sector J) Spending;

DS%JMS – Share of Data Suppliers on Total J and M Sectors;

DU%JMS – Share of Data Users on Total J and M Sectors;

$\alpha$, $\beta$, $\gamma$ – regression coefficients;

$\varepsilon$ – residual value.

The data were analysed with the help of the Statistical Product and Service Solutions software, version 25 (IBM-SPSS 25), and the results identified Pearson correlations. The Pearson correlation table, presented in table no. 2, reflects a better correlation of the dependent variable with the information and communication indicators, regarding outputs resulting from reduced user reluctance. Also, from the correlation table, it can be seen that the weakest correlation of the variables is between the result of increasing supplier information and data user reluctance reduction This demonstrates the different structure of digital service providers and users. The first category is very open to take up and use the news and opportunities offered by the digital market. The second category, depending on the age range of the users, is more or less open to digital opportunity assimilation.

**Table no. 2. Pearson Correlation**

| Indicators | **EU*DE%GDP** | **EU*DM%ICT** | **EU*DS%JMS** | **EU*DU%JMS** |
|---|---|---|---|---|
| EU*DE%GDP | 1.000 | 0.984 | 0.939 | 0.868 |
| EU*DM%ICT | 0.984 | 1.000 | 0.925 | 0.926 |
| EU*DS%JMS | 0.939 | 0.925 | 1.000 | 0.738 |
| EU*DU%JMS | 0.868 | 0.926 | 0.738 | 1.000 |

By applying the Enter methodology, regression variables were tested against the dependent variable to exclude data redundancy and autocorrelation, the result being valid, with all three regression variables accepted and no variable excluded.

The model summary, presented in table no. 3, indicates a statistical coefficient of determination of 97.8%, which means that the impact of the digital economy on GDP is influenced in a percentage of approximately 98% by the improvement of information and communication services, including the implementation of related technologies (one-unit increase in this indicator influences GDP growth by 0.7%). The other variables are inversely proportional to the increase in GDP with the mention that suppliers' information is less inversely proportional than users' (-0.05 compared to -0.3).

**Table no. 3. Model Summary**

| Model [a,b] | Correlation coefficient ® | Determination coefficient ($R^2$) | Adjusted determination coefficient (R2) | Std. Error of the Estimate | Change Statistics | |
|---|---|---|---|---|---|---|
| | | | | | $R^2$ Change | Changing the correlation factor (F) |
| The digitalisation development econometric model | 0.992[a] | 0.984 | 0.978 | 0.19097% | 0.984 | 147.986 |

| Change Statistics | | | |
|---|---|---|---|
| Regression degrees of freedom (df1) | Residual function degrees of freedom (df2) | The coefficient Sig. of the F correlation factor change | Durbin – Watson |
| 3 | 7 | 0.000 | 1.301 |

a. Predictors: (Constant), EU*DU%JMS, EU*DS%JMS, EU*DM%ICT
b. Dependent Variable: EU*DE%GDP

Following the ANOVA test, valid results of the general model were obtained. The value of the regression squares is significant in the total equation in a proportion of 98.5% of the obtained result and an F test of 147.99 and the Sig coefficient tending to 0, which demonstrates the homogeneity of the model (Table no. 4).

**Table no. 4. ANOVA test**

| Model [a,b] | | Sum of Squares | Degrees of freedom | Mean Square | Correlation factor (F) | Sig. coefficient. |
|---|---|---|---|---|---|---|
| The digitalisation development econometric model | Regression | 16.190 | 3 | 5.397 | 147.986 | 0.000[b] |
| | The residual component | 0.255 | 7 | 0.036 | | |
| | Total | 16.445 | 10 | | | |

a. Dependent Variable: EU*DE%GDP
b. Regresors: (Constant), EU*DU%JMS, EU*DS%JMS, EU*DM%ICT

The histogram distribution of the dependent variable respects the ordering under the Gaussian curve with inflection point on the ascending slope (median area of the slope) and on the descending slope (maximum area). For the analysed period, 2013-2025, the standard deviation is 0.837 (Figure no. 1).

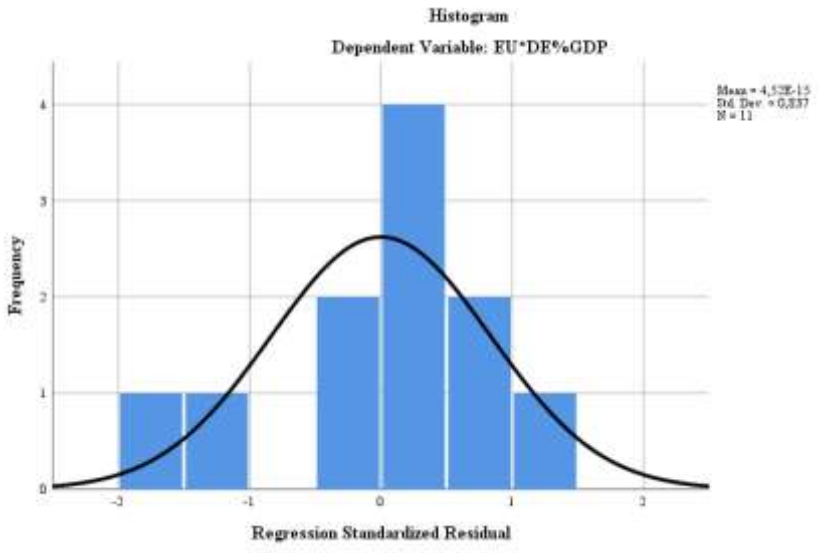


**Figure no. 1. Regression analysis of the dependent variable**

The proposed model was also tested for the 4 Member States based on the proposed model equation, obtaining statistical representativities of over 85% in all cases. This shows that economic growth based on the digitialisation component is strongly influenced by the promotion, information and communication of downstream and upstream users.

The distribution of the regional dependent variable calculated for Romania, Greece, Germany and Sweden reflects the fact that the economic achievements and growth achieved in the period 2014-2018 are aligned with a regressive trend curve, which predicts the onset of a crisis in the digital economy segment. The repositioning of the trend perceived by the market in 2020, with the onset of the Covid pandemic, creates the premises for the validation of scenario 3 (challenge) as having a higher probability of realization compared to the other two scenarios provided by the European Commission.

The econometric model of digitalisation development designed for the Community data series generated valid values that would confirm the correlations between the analysed indicators, both in terms of homogeneity and of statistical representativeness.

## 3. Discussions

According to the recommendations made by The European Data Market Monitoring (2015), financial analysts indicate the possibility of projecting at least three scenarios for the development of the European Data Economy (Cattaneo et al., 2020).

The first scenario, called the baseline scenario, which proposes a healthy growth of innovation, a moderate concentration of data owners and a wide distribution of information on the benefits of innovation in society. This scenario is regarde by specialists as most likely and achievable.

Scenario 2, the high growth scenario, is characterised by a high level of data innovation, a low concentration of data portals and high data sharing for the benefit of the pro-innovation information society. This scenario is proposed as a model for policy makers in the field of digital economy.

Scenario 3, challenge, is characterised by a low level of innovation, a high concentration of data power due to the fragmentation of the digital market and an uneven distribution of the benefits of innovation in society. It is the weakest digital development option in the European Union for 2025.

The proposed model critically analyses the data provided by the European Comission (2020) on the reality regarding the frequency distribution of the three scenarios. Within the research, the descriptive statistics presented in table no. 5 were calculated for the four selected European economic entities (Germany – GE, Sweden – SW, Romania – RO and Greece – GR).

**Table no. 5. Descriptive statistics of the regional frequency series analysed between 2013-2025**

| | Share data economy impact of GDP | Share of Data Market on Information and Communication Technology (sector J) Spending | Share of Data Suppliers on Total J and M Sectors | Share of Data Users on Total J and M Sectors |
|---|---|---|---|---|
| **EU Mean** | 2.9636% | 11.4182% | 15.8685% | 4.8000% |
| **EU Standard Deviation** | 1.28240% | 2.88715% | 4.59519% | 1.98997% |
| **GE Mean** | 4.3188% | 16.6394% | 23.1247% | 6.9949% |
| **GE Standard Deviation** | 1.86880% | 4.20736% | 6.69643% | 2.89993% |
| **SW Mean** | 4.1989% | 16.1772% | 22.4823% | 6.8006% |
| **SW Standard. Deviation** | 1.81689% | 4.09049% | 6.51042% | 2.81938% |
| **RO Mean** | 1.6795% | 6.4709% | 8.9929% | 2.7202% |
| **RO Standard Deviation** | 0.72676% | 1.63620% | 2.60417% | 1.12775% |
| **GR Mean** | 1.1997% | 4.6221% | 6.4235% | 1.9430% |
| **GR Standard Deviation** | 0.51911% | 1.16871% | 1.86012% | 0.80554% |

As far as the growth of the digital economy is concerned, onemay notice that the annual average of regional distribution is 3%, with significant differences of up to 400% between the growth rates of the digital economy in developed European countries (Germany and Sweden) as compared to those with emerging economies (Romania and Greece).

The calculated value of the standard deviation confirms this, namely that developed European countries with a strong digital economy (such as Sweden) have at least 50% higher volatility in economic growth as compared to countries whose traditional economies are infused with know-how and permanent investment support (Germany). In the case of emerging countries, the standard deviation of the economic growth indicator is smaller, maintaining a system inertia caused on the one hand by the lack of user information and on the other hand by the lack of infrastructure and investment in the digital economy.

The emerging economy countries (Romania and Greece) are characterised by the prevalence of transition to EU digital development programmes and the lack of support for projects by the national economy, fact which leads to business instability in the digital sector, an instability that is delimited by the monitoring horizon established at EU level (Figure no. 2).

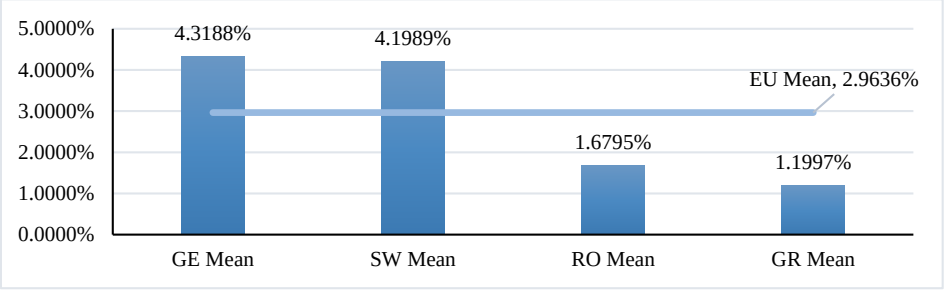


**Figure no. 2. Analysis of the average annual distributions of regional economic growth in the digital economy sector in the period 2013-2025 (% of GDP)**

Regarding the information and communication action to support the growth of the digital economy, although the European Union data show significant discrepancies between the average growth rates in the innovation benefit dissemination in society and the interest of users through information and communication methods in the digital sector (of up to 360%), it can be seen that, compared to the general dynamics of digital economic growth, there are fewer disproportions than in the case of the first analysed indicator.

It can be appreciated that this is a basic element in economic growth, developing advantages and disadvantages and enhancing the generating effect of economic growth (Figure no.3).

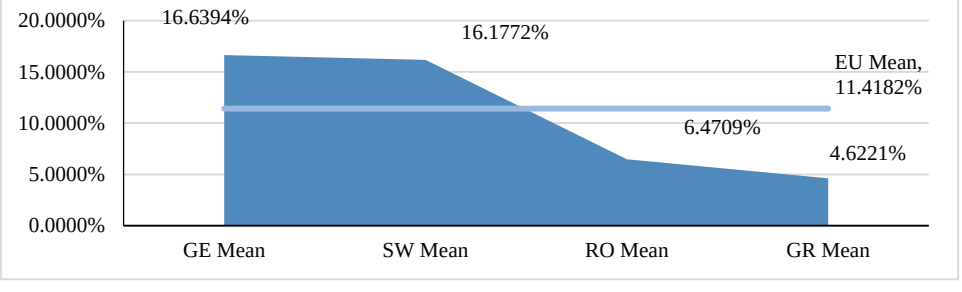


**Figure no. 3. Analysis of the average annual distributions of the information percentage on the data market and of the expenses related to the communication technology (Sector J) in the period 2013-2025**

The analysis of the last two indicators reflects the fact that, at the level of J sector users (Information and communication) and of M sector users (Professional scientific and technical activities), there is a negative gap in the degree of development of demand as compared to supply, of over 16% in developed countries and over 4% in emerging countries (Figure no. 4).

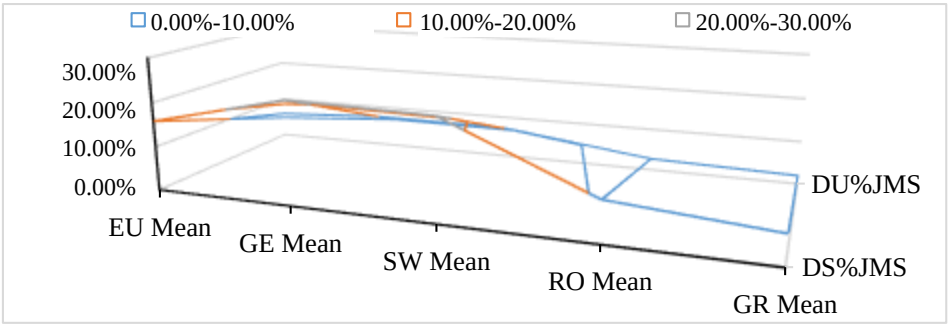


**Figure no. 4. Analysis of annual distributions of data providers and users by total J and M sectors in the period 2013-2015**

These aspects lead to the conclusion that the third scenario has a higher probability of realization, according to the model proposed by the authors (Figure no. 5).

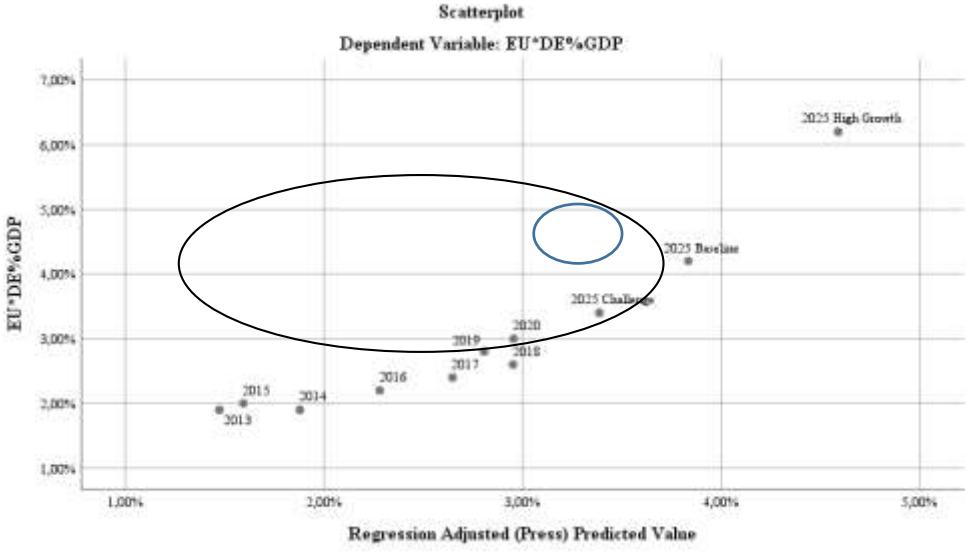


**Figure no. 5. Analysis of the average annual distributions according to the 3 scenarios using the proposed digital economic growth mode in the period 2013-2025**

This analysis quantified the impact of digitalisation on the EU Member States' economies as being low to medium, based on the fragmentation of the digital market and the unequal innovation benefit distribution in society.

Following the model validity testing, significant results were obtained at Community and regional level, leading to the rejection of the null hypothesis (the unicriterion critical probability test) and to the retention of the alternative hypothesis of the model, thus confirming the working hypotheses, namely:

- The economic development is favoured to a certain extent by digitisation, the difference in effort for growth above the reflexivity point being counterbalanced by the

technical rigidity of the market and the difficulty of adapting to the new. This confirms hypothesis **H1**: *Increasing information and source transparency for digital service providers directly drives GDP growth, with a threshold after which the growth function becomes reflexive.* (Table no. 2 and Table no. 3)

- The user is the least educated element in the market with the highest information cost attached to it, and reducing user reluctance is directly and immediately reflected in the economic growth. This confirms hypothesis **H2**: *The increase in user responsiveness is directly proportional to the economic growth associated with digitisation, as the degree of reflectivity of the growth function is much lower.* (Table no. 2 and Table no. 3)

- The communication efforts need to be carefully analysed before making the action plan because this segment leads to high costs and failure of the communication strategy can lead to economic crises. This confirms hypothesis **H3**: *The growth of the digital sector through Information and Communication (sector J) is an enabling factor for economic growth, and there is also the premise of reflexivity, i.e. the point from which efforts do not generate significant effects.* (Table no. 2 and Table no.3)

- The positive economic development in the period 2014-2018 was followed by the pandemic crisis, with strong socio-economic effects, that supported the validation of Scenario 3 (challenge), as more likely to be achieved than the other two scenarios proposed by the European Commission (see Figure no. 5). This proves hypothesis **H4**: *The digital economy is less dependent on pandemic shock than the traditional economy and is a sustainable pillar of economic growth.* (Table no. 2 and Table no.3)

**Conclusions**

The topicality of the study is based on the critical component regarding the foundations of financial allocations for the sustainable development of the data economy. The authors identify, by relying on the study of the literature and in accordance with the research results, the significant components that can generate consistent changes in the development policies of the data economy. An element of originality and novelty of this research is the conceptualization, validation and testing of the econometric model concerning the development of digitalisation, capable of quantifying the realism of the scenarios proposed by the European Union on the development of the data economy. This analysis took into account the three scenarios proposed by the European Union (the baseline scenario, the high growth scenario and the challenge scenario), the critical analysis being built upon data reported by Eurostat for the period 2013-2021, and the data forecast for the 2025 horizon.

The objectives of the study were fully achieved, with the authors assessing the current state of knowledge on the capabilities of users and providers of digital information to join the digital economy.

The testing of the scenarios was performed based on the analysis regarding the dynamics of the respective scenarios. The proposed econometric model of digitalisation development validated the third scenario as the most likely to be achieved, according to the indicator dynamics, the model being validated in specific statistical tests.

For the 4 states considered in conducting the research, anindividual assessment was made of their ability to achieve the targets proposed by these scenarios developed by the European Union.

The study was conducted on the basis of proven working hypotheses, being useful to government decision-makers in order to adjust the national digitalisation strategy. The results of the research lead to a proposal for a critical review of digital development models, based on reliable data, in line with current trends in the evolution of the digital market.

The limits of the study consist of the limited number of economic units analysed and of digitalisation indicators quantified by modeling. The authors intend to extend the research in a further study, both in terms of the number of economic entities analysed and in terms of the number of digitalisation indicators, considering that this can provide opportunities to improve scientific results with a theoretical and practical impact.

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# AVOIDING DIGITAL DIVIDE IN EUROPEAN UNION THROUGH EUROPEAN GREEN DEAL

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**Abstract**
The digital society is threatened by the existing divide that seems to be deepening between the population that has access to information technology and the population that for some reason does not. The phenomenon of digital divide has become a very important issue in the process of transformation of society and the authors relate it to European Green Deal, in order to identify the determinants and ways to reduce the negative effects that will be eliminated according to the proposed schedule. For this purpose, a narrative review of the literature was used as a research method, corroborated with a multidimensional analysis of the data regarding the Internet access in the households from the member countries of the European Union. As a result, eight determinants of the digital divide were identified, along with four examples of how they can be addressed. According to the authors, the Deal, which has committed all 27 member states to create new opportunities for innovation, investment, and jobs, can support the positive transformation of European society, even against a backdrop of enormous challenges and huge impacts that we can now imagine.

**Keywords:** European Union Green Deal; digital divide in European Union; digital literacy; digital inclusion; digital society.

**JEL classification:** I24, J16, J24, O15, O19

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## Introduction

The European Green Deal (EGD) generates new opportunities and challenges for all member states of European Union (EU), technologically and economically, socially, politically, and legislatively. From a technological perspective, the transfer to a green economy involves major changes (in areas such as energy, waste management, transportation, agriculture, construction, but also in many other fields) to address global climate change (Comisia Europeană, 2021).

From an economic point of view, these technological changes must enable the EU to remain globally competitive by identifying and using environmentally friendly resources in the shortest possible supply chains and in increasingly sophisticated operations (European Commission, 2021a). Thus, companies need to develop innovative business models based on clean and increasingly digital technologies to contribute to the sustainable transformation of the EU economy, and socially, the transformation of the economy and technologies must give citizens access to sustainable jobs, to education for the training of skills needed for this transition, but also to a better quality of life (through the use of products with a longer shelf life, living in renovated and energy-efficient buildings and the availability of healthy food at acceptable prices) (Comisia Europeană, 2021). From a political and legislative point of view, the EGD aims to achieve the goal of a single European market in all its components, including the labour market, in order to avoid a major divide in the knowledge, skills and abilities needed for an increasingly digitized forward-looking economy (European Commission, 2021a).

As EGD entails major changes across the EU, with the stated aim of "leaving no person or place behind" (Comisia Europeană, 2021), the aim of this paper was to conduct a thorough literature review regarding the factors responsible for the digital divide in the EU and how it can be mitigated to increase digital literacy and improve digital inclusion, which are necessary for the sustainable transformation of European society. The review of the current state of knowledge in the field was considered to identify the main factors that determine the digital divide. Thus, the analysis of the literature focused on issues such as: digital skills and literacy, the gaps caused by education, age, gender, and income, but also on the issue of digital natives and immigrants, (Prensky, 2001), and the content analysis examined documents, statistics, legislation, and policies recommended by the Commission and the European Parliament. The results obtained made it possible not only to identify the determining factors, but also to point out ways in which they can be counteracted in order to enable a sustainable transformation of European society into a digital one. The transition to an inclusive and sustainable European society is based on a holistic approach to the sustainable development goals formulated by the UN by integrating them into the provisions of the EGD, as part of the European Commission's strategy for 2019-2024 (European Commission, 2019). The authors consider that, through the proposed lines of action, both business and academia can contribute to the implementation of EGD provisions, as well as the objectives of sustainable development, aiming at quality education, decent work, and economic growth, but also reducing inequalities (United Nations, 2015).

The paper was structured in four sections: the review of the specialized literature, the research methodology, being followed by the presentation of the research results and the related discussions, and in the final part a series of conclusions is included.

## 1. Literature review

From an economic and social point of view, the digital society is threatened by the gap between the population that has access to information technology and the one that, for some reason, does not benefit from this opportunity. The digital divide represents the differences between people who have access to and use digital media and those who do not have these prerogatives, visible differences being both at the level of people and at the level of countries or areas of residence (urban / rural) (Van Dijk, 2020). The phenomenon of the digital divide is primarily related to the ability of citizens to use information technologies to increase the standard of living then to the Internet access (Plotichkina, Morozova and Miroshnichenko, 2020). The authors believe that this can be countered by the third point specified by European Commission (Comisia Europeană, 2021) in the EGD. A modern, competitive and resource-efficient EU economy "manages" to "leave no person and no place behind" ((Comisia Europeană, 2020). Based on this, the authors aim to promote the bridging of the digital divide between European citizens, a crucial condition for achieving the objectives of the EGD (Comisia Europeană, 2020), by identifying the determinants of the digital divide that have led to the existing significant gaps. The first aspect noted was the fact that the acceptance of technology is determined by the hope of achievement, habits, personality traits, but also by cultural factors (Chipeva et al., 2018). There are differences in behavioral patterns at the level of EU countries (due to uneven economic development), but also between different age groups, leading to inequalities between European citizens. (Rodriguez-Hevía, Navío-Marco and Ruiz-Gómez, 2020; Sala, Gaia and Cerati, 2020).

Another dimension highlighted is the performance of EU member states and the monitoring of their progress in digital competitiveness, achieved through the Digital Economy and Society Index (DESI), which includes five components: Connectivity, Human Capital, Internet Use, Digital Technology Integration and Digitisation of Public Services. DESI 2020, calculated on the basis of data provided by countries for 2019, shows that Finland, Sweden, Denmark and the Netherlands have the most developed digital economies in the EU, followed by Malta, Ireland and Estonia, and at the opposite pole are Bulgaria, Greece, Romania and Italy (European Commission, 2020).

Regarding the digital divide, the researchers appreciate that there are several stages of it. The first is the access to the Internet, the second by the ability to use it and the third, is to achieve tangible results using this technology (Scheerder, Deursen and Dijk, 2017). For those interested, it is important to understand the steps involved because it should be noted that the digital divide continues to deepen even after the first step. Even when access to the Internet is guaranteed, there are material differences between people (in terms of devices, software programs, etc.) (van Deursen and van Dijk, 2019), the dominance of English at the international level further exacerbating the digital divide, as most content on the web is written in this language (Dhungana, 2021).

Technological evolution make it necessary for digital literacy to correlate with the necessary skills that are now considered essential (van Deursen and van Dijk, 2011; Biezā, 2020;). Digital literacy can be defined as the ability to acquire and produce information using digital technology (Yildiz, 2020). Three perspectives on it have been proposed in the literature, namely the perspective of digital natives born in the so-called "internet age" for whom the acquisition of knowledge is automatic, digital literacy based on the acquisition of skills and competencies without which individuals cannot succeed in society, and literacy based on socio-cultural factors, i.e. participation and belonging to these communities

(List, 2019). The predominant contrast in an information society is due to the "digital natives" term, which has emerged as a consequence of the qualities of the new generations who are endowed with the gift of mastering technology, at the opposite pole being the term "digital immigrants", antithesis that outlines the generational gap (Dhungana, 2021). Digital literacy, considered the "catalyst for 21st century education", has accelerated the advancement of education, with skills in the field becoming the tools that students use to survive in the age of technology-enhanced learning (Reddy et al., 2020).

Beyond the aforementioned aspects, the literature points out that the digital divide threatens the process of e-inclusion. It refers to the implementation of policies so that all inhabitants of a country can participate in the information society through easy access to technology and the use of ICT tools and services, as well as the ability and skills of all people to use these tools (Eurostat, 2021a). With regard to the inclusive society from a digital point of view, the authors emphasize the scale of a major challenge: what will happen to the population that cannot integrate into a society in which access to information technology ensures an increase in the standard of living (Plotichkina, Morozova and Miroshnichenko, 2020)? The persistence of growing differences in the quality of data infrastructure between urban and rural areas links the issue of connectivity to the issue of digital inclusion. General policies in this area emphasize the paradox of rural communities, which are in great need of improved digital connectivity but are the weakest connected and virtually excluded from the information society. The adoption of personalized policies for these communities by governments would focus on a combined approach to the issues of connectivity and digital inclusion (Salemink, Strijker and Bosworth, 2017).

The importance of e-inclusion emerges from the analyses that give it the character of a dependent variable in the equation of the development of a modern economy. A society in which all people have access to information has a direct and positive impact on other areas where digital literacy and access to technology are required. For example, digital inclusion is closely linked to financial inclusion through the common denominator of "digital currency". Due to the existing digital divide and related inequalities, a potential central bank currency would be vulnerable. To close the gap, recently published studies even suggest offering free internet access in emerging economies to improve access to information (Noll et al., 2018).

## 2. Methodology

Based on the research question, which aimed to identify the determinants of the digital divide, the authors set out to contribute to the literature with a "summary" of primary sources about avoiding gaps in the EU. At the same time, narrative review of the literature was used as a method because of its "important scientific function" in facilitating the approach to a broader type of questions (Baumeister and Leary, 1997). The research methodology was fleshed out using the steps outlined below, which enabled the analysis of the literature (Snyder, 2019). Subsequently, the authors aimed to describe the situation of households in the EU in relation to home internet access, which led to the analysis of data for the period 2005-2020 (information available for different periods of time on the Eurostat website).

### 2.1. Designing the narrative literature review

Through the narrative review of the literature as a research method, it was possible to

connect the determinants of the digital divide to the solutions proposed in primary studies published in recent years. The aim of the paper is to promote measures to reduce the digital divide in the EU through EGD. Reconciling the priority of "leaving no person and no place behind" with a topical issue about the divide was possible through the use of this method, as it allowed the issue to be approached in a broader way, with the authors having the opportunity to "map and assess the relevant intellectual territory to specify a question that will further develop the knowledge base" (Tranfield, Denyer and Smart, 2003) – what are the determinants of the digital divide in the EU and how can they be addressed?

### 2.2. Information gathering

In order to solve the research problem as effectively as possible, the phase of documentation and collection of the necessary information for the analysis of the literature was carried out with the help of databases and electronic resources, which were centralized by the authors. For this purpose, 984 scientific resources were identified in the international databases Web of Science – Core collection, Google Academics and Science Direct Freedom Collection by searching the keywords "digital divide", "digital divide factors", "digital inclusion" and "digital literacy". At this stage, it was very important to identify complementary publications for the purpose. Thus, centralization was achieved by adopting the source, title and abstract so that authors can filter the relevant papers for the study in the next stage. To make it more efficient, the abstract of each publication was extracted and read, with the authors opting to study the full text of the selected works later.

### 2.3. Content analysis

Out of a total of 984 scientific resources, 57 were selected to be used in the research development process. The focus of the topic of the digital divide in the EU related to EGD with the priority that "no person or place should be left behind" led the authors to the current form of the analysis, which led to relevant results for the development of the analysed topic.

## 3. Results

In addition to the narrative literature review, an analysis of the internet connectivity situation of EU households was conducted. The data was imported in the form of Excel files, processed to obtain a consistent format, and then transferred to Tableau Public 2021 3.0 for analysis (Tableau Public, 2021). The EU countries were targeted, with data for the period 2005-2020, given that some analyses covered the period 2005-2019, others 2012-2019 and 2009-2020, depending on available statistics. To carry out the analysis, the dimensions of the multidimensional data cube were taken into account, and it is presented in Table no. 1.

**Table no. 1. Dimensions of the multidimensional analysis cube**

| Dimension | Explanation | Unit of measure |
|---|---|---|
| People who use their mobile devices to access the Internet on the move. | Individuals who use mobile devices to access the Internet on the move – Use of mobile devices via mobile or wireless connection: mobile phone (or smartphone), laptop (e.g. laptop, tablet, etc.), or another mobile device example, PDA, e-book reader) away from home or work. | The percentage of people. |

| Dimension | Explanation | Unit of measure |
|---|---|---|
| Level of Internet access – households | Percentage of households that have access to the Internet at home. All forms of internet use are included. The considered population is between 16 and 74 years old. | Percentage of households. |
| Reasons why there is no Internet access at home | Households without internet access at home because access costs are too high (telephone, etc.) | Percentage of households without internet access at home. |

*Source: data processed by the authors*

### 3.1. Factors that determine the digital divide and the access to technology

The preceding steps led to a number of results, which are presented in the following two subsections. The first contains the nomination of the factors identified in the literature, the second concrete solutions to improve Internet access and digital literacy. The two subsections contribute to address the research topic in a broad way and provide the opportunity to develop the discussions as suggested by the authors.

***Factors that determine the digital divide***

- *Access to technology: t*he distinction between the population that has access to technology and the population that does not has determined the appearance of the digital divide and can be classified according to criteria describing differences in terms of gender, age, income, education, social groups or geographical location (Eurostat, 2019). This topic has become very popular against the background of the pandemic COVID-19 (Aissaoui, 2021) because it counts access to technology and its use among the determinants of the digital divide that causes the development of the European information society. The fact that 20% of EU citizens have never used the internet and that only 18% of rural areas in the EU reach broadband speeds of 30 Mbps (European Commission, 2021b) compared to the European average of 76%, leads to an unequal distribution of access to internet-connected devices (Fox, 2019). Gaps in access and use of technology are a global concern, as evidenced by the fact that the United Nations General Assembly declared in 2016 that access to the Internet should be a basic human right (Sanders and Scanlon, 2021). In this way, everyone can belong to an information society, (Eurostat, 2019) where rural communities are connected regardless of distance and "no person or place being left behind".

- *Education:* differing socioeconomic conditions in countries have "slowed the incorporation of technology into education" in developing countries (Zalat, Hamed and Bolbol, 2021) with the United Nations International Children's Emergency Fund reporting that more than one billion children worldwide lack access to digital education during the pandemic COVID-19 (UNICEF, 2020). Exclusion from online education has now become an extremely important issue that has implications and negative consequences that impact not only the digital divide, but society. For example, it is extrapolated that "students who are not digitally connected during the learning process will not be able to acquire skills relevant to the labour market"(Molala and Makhubele, 2021), which has a negative impact on socio-economic development and implicitly on the labour market, to an extent that is difficult to imagine today.

- *Gender:* the issue of women's inclusion in the digital society brings to light obvious gaps, particularly in online cohorts of professionals, which have a strong impact on inclusion in the information society and influence global sustainable development (Kashyap and Verkroost, 2021). Given that the EU targets gender equality, the digital divide is still significant, and women still lag men due to education, lack of training and unemployment (Kerras et al., 2020).

- *Income:* experts appreciate that income and education favour the adoption of digital technologies, with poverty being one of the main causes of disparities (Mubarak, Suomi and Kantola, 2020). Higher-income men are more likely to have access to the Internet, but over time gender and education differences become less important, so that income and cognitive ability prevail (Huxhold, Hees and Webster, 2020).

- *The generation in which a person was born: r*egarding the effect of socio-demographic variables on the digital divide, it has been found that the generation in which a person was born is an important factor, and significant differences between generations X,Y,Z were identified (Dabija et al., 2017), but the level of education tends to be stronger than the effect of generation (Ertl, Csanadi and Tarnai, 2020). However, it cannot be ignored that the iGen (the first generation to reach adolescence after the proliferation of smartphones) is interacting less and less socially as digital media consumption increases. Students who started college in 2016 spent an hour less per day on social interactions. This has led to a sudden increase in feelings of loneliness among adolescents, an extremely important phenomenon to mention in the process of integration into an inclusive information society (Twenge, Spitzberg and Campbell, 2019).

- *Age and perception of age:* in addition to the above mentioned factors, interest in technology and marital status (Friemel, 2016) have a positive influence, but also the depreciation of cognitive, sensory and motor functions have a influence, but a negative one (Holgersson, Söderström and Rose, 2019). The digital divide leads to the formation of vulnerable groups, and at the EU level, such a group of older people with low levels of education and income has been identified as having negative attitudes towards digitalization and low internet use (Vasilescu et al., 2020). It is assumed that these people cannot take advantage of the digital society (Tavares, 2020). The stronger the negative perception of age, the less the Internet is used by older women compared to middle-aged women and men (Choi et al., 2020). Even if they have access to this technology, older people choose not to use it, especially due to prejudices such as "being too old to use it" (McDonough, 2020). To reduce the impact of this factor, studies show that the positive influence of the social context, encouragement from family and friends, but also professional training courses can contribute to positive long-term changes.

- *Social background, personal history and ability to use technology*: the lack of internet-enabled devices in low-income families limits children's development, especially those from rural areas. Family conditions and access to online education become determinants of the digital divide (Gu, 2021). Inequalities become more persistent as digital literacy increases, especially in light of the COVID-19 pandemic, which has led to a migration to the online environment even in areas with limited internet access (van Deursen and van Dijk, 2010; Molala and Makhubele, 2021). There are differences in the use of digital technologies and among school-age children based on social background, immigrant background and gender. However, immigrant boys with parents with higher education (who can provide educational resources) use digital technology more than girls born in EU

member states with less educated parents (Becker, 2021). The ability to use the Internet can improve academic performance, especially for students from families with low levels of education (Pagani et al., 2016; Surian and Sciandra, 2019), but the use of technology requires the possession of specific cognitive skills and knowledge that are essential for the use of ICT tools and services (Aissaoui, 2021), and their mastery is closely related to four categories of digital skills: operational, formal, informational and strategic (van Deursen and van Dijk, 2010).

- *People with disabilities:* is another vulnerable group that has emerged in the wake of technological development and require special attention in terms of education, support and improvement of legislation (Tomczyk et al., 2019) but not by treating them as a homogeneous group, but differentiated according to their diagnosis (Johansson, Gulliksen and Gustavsson, 2021). The same register includes people and places that are "left behind" in the process of "digital development" because they produce vulnerable groups that generate impacts with great influence on the developing information society.

***Analysis of EU households' access to technology***

At the level of the countries analysed, the most important factor associated with Internet access is its high cost. Figure no. 1 shows the map illustrating the average percentage of households without Internet access due to too high costs. The data analysed refer to the period 2005-2019 (Eurostat, 2021c).

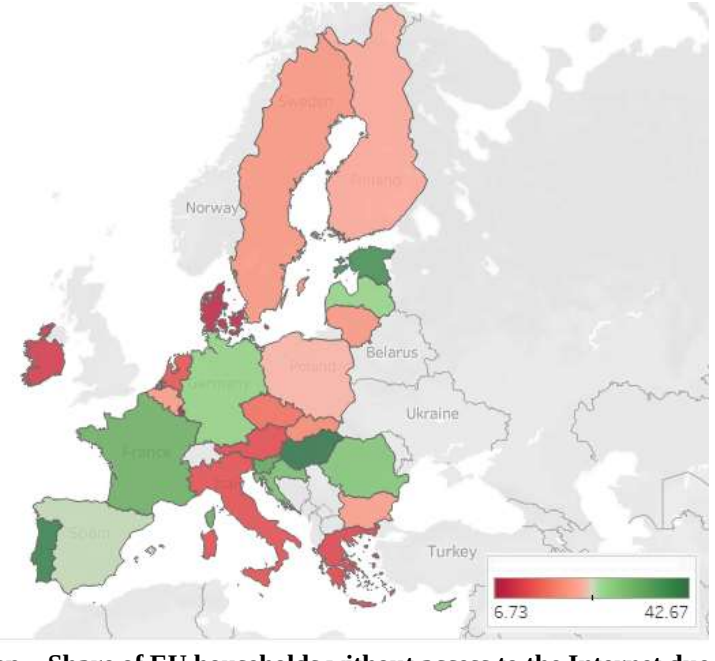


**Figure no. 1. Map – Share of EU households without access to the Internet due to high costs between 2005 and 2019 (%)**

The data collected between 2005 and 2019 allowed the construction of a graph showing, for the countries analysed, the evolution of the average proportion of households without Internet access due to excessive costs for all the countries analysed (Figure no. 2) (Eurostat, 2021c).

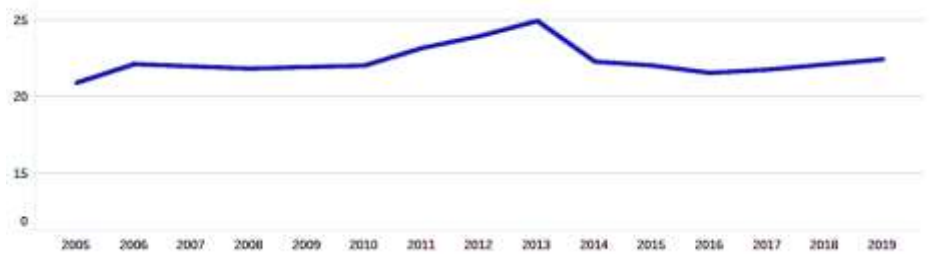


**Figure no. 2. Average share of countries analysed for households without Internet access, as access costs are too high between 2005 and 2019 (%)**

Figure no. 2 shows that the average at the level of the 27 countries analysed varies between 19% and 24% for households that do not have access to the home internet due to excessive access costs. There are countries like Romania where the indicator has dropped from 50% in 2011 to 18% in 2019. At the same time, there were significant increases in other countries, such as Finland, where the Internet access value increased from 15% in 2016 to 30% in 2019. or Portugal, which increased from 16% in 2010 to 53% in 2019 (see Figure no. 3) (Eurostat, 2021c).

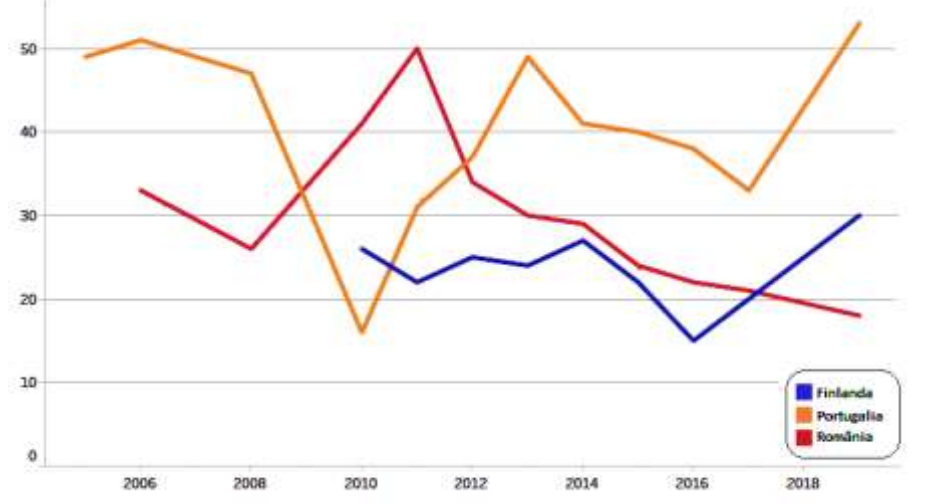


**Figure no. 3. Comparative evolution of the share of households without Internet access due to too high access costs between 2005 and 2019 (%)**

Regarding the people who use mobile devices to access the Internet on the move (Figure no. 4), a forecast was made based on the data collected in the period 2012-2019. Thus, forecasted value of 89.08% for 2022 and 93.71% for 2023 were obtained (Eurostat, 2021d). In order to generate a forecast, an annual non-seasonally adjusted time series was constructed using Tableau Public application based on data from 2012-2019 without ignoring periods, by taking into account the average share of people who use mobile devices to access the internet on the move. The forecast was generated for a period of 4 years (2020-2023).

| Initial 2020 | Change from initial 2020-2023 | Seasonality Effect High | Seasonality Effect Low | Contribution from Trend | Contribution from Seasonality | Quality |
|---|---|---|---|---|---|---|
| 79.83 ± 11.82 | 13.88 | None | | 100.0% | 0.0% | Ok |

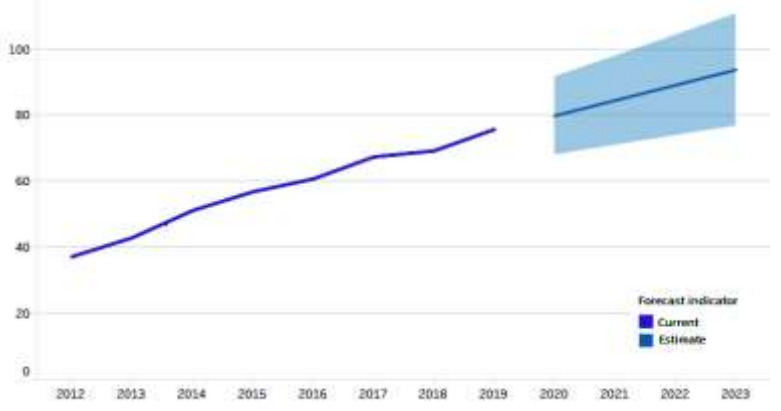


**Figure no. 4. Forecast – The share of people using mobile devices to access the Internet on the move between 2020 and 2023 (%)**

A forecast analysis for the level of Internet access – households (Figure no. 5), based on data collected between 2009 and 2020, made it possible to obtain a possible value of 93.96% for 2022 and 96.10% for 2023 (Eurostat, 2021e). To make the forecast, an annual, non-seasonally adjusted time series (2009-2020) was used in the Tableau Public application, based on data from 2009-2020 without ignoring periods, by taking into account the average share of Internet access of households, obtaining a forecast for 3 years period of time (2021- 2023).

| Initial 2021 | Change from Initial 2021-2023 | Seasonal Effect High | Seasonal Effect Low | Contribution Trend | Contribution Seasonality | Quality |
|---|---|---|---|---|---|---|
| 91.82 ± 5.56 | 4.28 | None | | 100.0% | 0.0% | Ok |

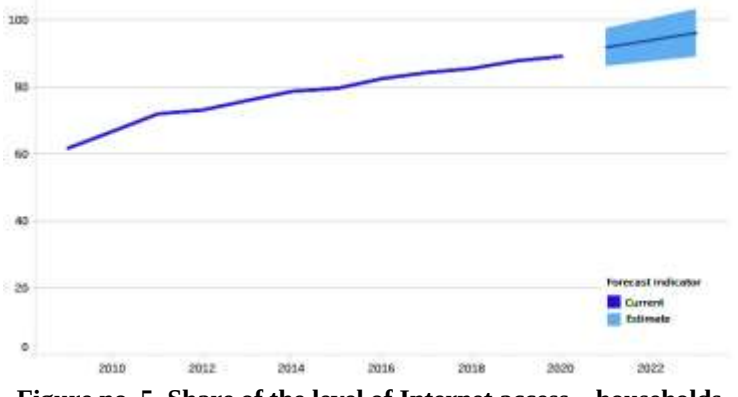


**Figure no. 5. Share of the level of Internet access – households between 2021 and 2023 (%)**

### 3.2. Solutions for digital divide mitigation

Linking concerns about narrowing the digital divide to EGD has led to the identification in the literature of appropriate examples of integration of digital immigrants and support for vulnerable groups that could threaten the development of the European information society, which are briefly presented in the next subsection.

***Kiwix Alternative Digital Library***

In the form of open-source software, Kiwix is a multiplatform that provides access to information for millions of users around the world. The project was launched in 2012 by Emmanuel Engelhart with the aim of digitally integrating developing countries. It currently runs on both Android, iOS, Windows, Mac OS and Linux and is designed to be used in remote areas without internet, with users accessing online web content via ZIM files. The functional mechanism of the platform is shown in Figure no. 6 (Kiwix, 2021).

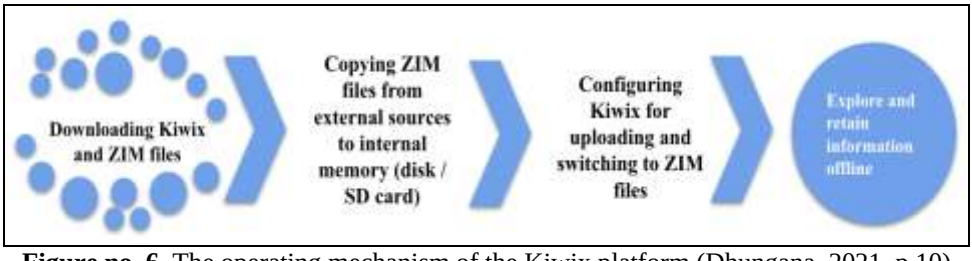


**Figure no. 6**. The operating mechanism of the Kiwix platform (Dhungana, 2021, p.10)

***Open Learning Exchange (OLE)***

As an organization founded to extend learning solutions through *open-access* tools, OLE has launched a portable solution that is accessible to all through a learning staff kit called Planet Learning. It works offline, but also on the Internet, and the Rasppberry Pi is often used as a server. It can be powered locally by batteries and solar panels and is designed for community use. Planet Learning integrates a free resource repository with open access for all Linux, Apple, OS X or Windows users (Open Leaning Exchange, 2021).

***Distribution of information via portable flash drives and radio waves***

Examples of success in improving digital literacy and reducing the gap between rural and urban students include the actions of REED – NEPAL (2020), which worked both to educate girls during the COVID-19 pandemic through the "Quick Impact Project" and to reduce the negative impact of the lack of ICT devices in schools and at home by transmitting information via radio waves (Annapurna Express, 2021). Another solution to promote digital literacy is MOLEAP, a modular e-learning and assessment platform provided online for students without internet access in rural areas accessed via a laptop or PC, being launched via a USB stick running the Ubuntu operating system, and giving each user individual access (Hillier, 2017).

***Web Accessibility Initiative for People with Disabilities***

Barriers for people with disabilities to use the Internet can be removed through platforms such as www.w3.org/WAi (WAI, 2021), which aim to help this vulnerable group access content specifically created with the help of professionals.

### 3.3. Discussion

The disparity in digital performance across EU countries revealed by the DESI index continues to raise concerns about the existing digital backwardness. The impact of inequalities between European citizens in this respect is so severe that action to mitigate the gap is urgently needed. Through a narrative review of published studies, the paper allows us to discover success storeys through which technology adoption, improving access to the internet and raising literacy levels are not impossible. Non-governmental organisations and agencies interested in enhancing the ability of rural communities to integrate into the information society by acquiring academic and life skills through radio education to close the gender gap (Annapurna Express, 2021) can promote their initiatives through the EGD calendar.

Avoiding the digital divide is a goal that must be considered in all its complexity, taking into account all three mentioned phases. The institutions involved in the mission to improve Internet access must not stand still but, on the contrary, contribute to the catalysis of 21st century education through digital literacy (Reddy et al., 2020), especially among digital immigrants (List, 2019). It is recommended to carry out a process of assimilation of digital knowledge synchronized with the generation in which a person/family was born (List, 2019). It is recommended to carry out a process of assimilation of digital knowledge synchronized with the generation in which a person/family was born (Ertl, Csanadi and Tarnai, 2020), socio-cultural factors, background and belonging to communities of information interest (Chipeva et al., 2018). In this way, all three perspectives of digital literacy are achieved, with individuals acquiring skills and competencies without which they cannot succeed in a changing society. The role of digital natives in the accelerated development of society is undeniable, but on the other hand, the differences between them and digital immigrants accentuate the challenges of the socio-digital revolution we are currently experiencing. The integration of the population that has not overcome the first stage to avoid the rupture, namely access to technology, is becoming more and more a controversial issue and EGD can be the solution to this challenge. Gender, education, income, social affiliation, and geographic disparities can be combated by governments adopting personalized policies for communities that produce vulnerable groups. They would promote the development of the information society with the phenomenon of digital literacy to prepare individuals for current and future jobs, thus facilitating living standards and the integration process.

If the different socio-economic conditions of countries have slowed down the incorporation of technology in education (Zalat, Hamed and Bolbol, 2021), ensuring quality data infrastructure between rural and urban areas would help to achieve both the goal of digital inclusion and avoid exclusion from online education and the difficult challenges that would be felt in the labour market in the long run (Molala and Makhubele, 2021). The lack of access to technology and the internet in homes and on the move further highlights the digital divide in the EU. Through the specific programs already mentioned, the initiatives proposed under the EGD would strengthen the EU's gender equality objectives, as from a digital perspective the gaps are still significant (Kerras, et al, 2020). Training, retraining, counselling and support for vulnerable women's communities would boost economic growth by creating jobs relevant to an information society, so that no female and low-income person would be “left behind”. This register may also include groups of people with disabilities, people with negative perceptions of old age, or people with a history where their social background and ability to use technology does not allow them to integrate. In light of the above challenges, the digital exclusion of these individuals is a real challenge

for the transformation of society. Therefore, the authors propose to combine the model of EGD – to which all 27 member states have committed themselves by creating new opportunities for innovation, investment and jobs, with the aim of digitally transforming European society – with the problem of avoiding digital disruption in the EU.

**Conclusions**

In terms of theoretical implications, the scientific novelty of the paper consists in reviewing the main determinants of the digital divide according to the literature in order to formulate solutions to avoid it in the context of EGD. The commitment of all EU member states to boost growth and ensure well-being gives the study a timely scientific contribution as well as the moral obligation of European citizens to respond to the EU initiative by actively contributing to the development of a transformative, digital and inclusive society.

Managerial contributions are not limited to the nomination of entities with which PVE priorities can be exercised and disseminated across the EU, but also seek to take into account the identified digital divide determinants in order to meet the challenges and take advantage of technological, economic, social, political, and legislative opportunities. These can be real opportunities for metropolitan agencies, businesses and, in particular, non-profit organizations to support vulnerable groups affected by the effects of digital exclusion. The aim is to benefit from an integration process by gaining access to the Internet and increasing digital literacy to meet the minimum employment standards relevant to an information society. On the other hand, universities and pre-university entities can be involved in the digital literacy process by improving the techniques and methods by which individuals' knowledge and skills can be acquired. Universities, schools, and educational centres can provide the infrastructure, curriculum, and environment conducive to digital inclusion of both the beneficiaries of the programs implemented and those already out of the educational process, by raising the standards for the development of digital immigrants.

A limit of this study is the method used, which is not direct research. The narrative nature of the literature review may highlight the subjectivity of the authors in conveying information to the readers. Another limit is the relatively small number of publications that went into the elaboration of the paper. Although the selected bibliography that formed the basis of the analysis lends relevance to the study, no care was taken to include works that depict the digital divide from its inception. Finally, the study is based on the authors' interpretation of the results obtained and requires completion through further quantitative research in order to increase the objectivity with which the research problem must be approached.

In the future, research directions should aim to conduct quantitative studies to analyse the attitudes and behaviour of people at risk of digital exclusion due to limited internet access. These can be complemented by an experimental study in which people considered at risk in the process of inclusion in an information society can benefit from a digital literacy program that allows tracking individuals and integrating them into the labour market to fill the appropriate positions in a digitally transformed society. Finally, starting from the results presented, a comparative study can be carried out to monitor the activity of natives and digital immigrants to ensure the transfer of information necessary for the integration process in a simple way in digital world.

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# DIGITAL TRANSFORMATION, FINANCIAL PERFORMANCE AND SUSTAINABILITY: EVIDENCE FOR EUROPEAN UNION LISTED COMPANIES

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**Abstract**
This paper aims to discuss the digitalization of European listed companies in the context of the European Green Deal. The digital transformation can support companies in the field of corporate social responsibility, particularly in terms of environmental protection. Companies' digitalization may have a beneficial impact by adopting 'smart' technologies that allow for the efficient use of natural resources and the reduction of pollution, enabling the transformation of business models into sustainable ones within the circular and digitized economy. Based on a large sample of companies listed on the main European Union financial markets, this paper aimed at analysing the extent to which digitalization efforts are part of the companies' general tendencies of becoming good corporate citizens, especially in regard to environmental protection. The study also showed that digitalization efforts are rewarded in financial markets, with investors providing more capital to companies that digitize their activities and are more socially responsible.

**Keywords:** digitalization of companies, digitalization index, Environmental, Social and Governance score, sustainable development, European Green Deal

**JEL Classification:** L86, M10, M15, M21, M49

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## Introduction

Digitalization is a characteristic phenomenon of the contemporary world that affects individuals, organizations, the global economy, and society as a whole. As an ongoing phenomenon, digitalization is perceived as a *megatrend* (Hossnofsky and Junge, 2019; Lichtenthaler, 2021) which influences, with different intensity, companies of all sizes and in all fields of activity. The concept of digitalization of companies is going through a structuring process and there is no commonly accepted definition. For some authors, the terms 'digitalization', 'digitization' and 'digital transformation' are often used interchangeably (Hossnofsky and Junge, 2019). Other authors note that there is a distinction between these terms: digitization is the process of changing from analogue to digital form; digitalization is the use of digital technologies to improve the performance and extend the scope of the business, and digital transformation is the adaptation to the requirements of the digital economy (Rachinger et al., 2018). Other studies (Verhoef et al., 2021) speak of three stages for digital transformation: digitization (e.g., automation of routine activities or conversion of analogue information into digital format), digitalization (e.g., the use of robots in production, the introduction of digital distribution and communication channels) and digital transformation (which consists of the introduction of new business models, such as the delivery of a 'product-as-service', digital platforms etc.). In this case, the digital transformation involves changing the way the company creates and appropriates value, using digital technology, the company's main business model becoming a digital one. From an evolutionary perspective, some authors have associated firms' digitalization with the 'Fourth Industrial Revolution' (or Industry 4.0) which is characterized by a "fusion of technologies that is blurring the lines between the physical, digital and biological spheres" (Schwab, 2016).

These approaches give us a dimension of the complexity of the digital transformation phenomenon that companies are going through, as well as of the difficulty of conceptualizing it. Given the conceptual inconsistency that persists in defining the phenomenon of firms' digitalization, we believe that corporate digital transformation is the phenomenon of change that companies undergo and propagate within the environment in which they operate by adopting digital technologies, with different intensity.

Digital transformation can support companies in the field of corporate social responsibility, in all its forms: responsibility to the environment, to society and to all stakeholders through good corporate governance. In terms of environmental responsibility, companies' digitalization has the potential to have a beneficial impact on the environment by adopting 'smart' technologies that enable the efficient use of natural resources, reduce pollution and other forms of negative environmental impact, enabling the transformation of business models into sustainable ones within the circular and digital economy. In this regard, the European Green Deal (European Commission, 2021) provides for the use of digital technologies to achieve the sustainable development goals in the European area, contributing to the substantial reduction of greenhouse gas emissions by 2030.

In this context, the present study aims to capture the extent to which the digitalization efforts of European listed companies are correlated with their policies in the field of environmental protection. Furthermore, this research intends to capture the degree in which investors reward these efforts by investing more in companies that have a higher level of digitization. The study considers companies included in the main index of the most important stock exchanges of all European Union (EU) countries, providing an overview of the digitalization

phenomenon of large listed European companies and the relationship between digitalization, sustainability, and financial performance at the EU level.

## 1. Firm digitalization: a megatrend with multiple implications in the context of the European Green Deal

As the speed, magnitude, and effects of companies' digitalization are not comparable to any of the previous technological changes, digitalization is associated with disruptive technologies (Matzler et al., 2018), being a *technological discontinuity* that reshapes companies' functionality both internally, and in relation to the external environment in which they operate. Digitalization transforms the firms' business model (Loebbecke and Picot, 2015; Rachinger et al., 2018) and affects both the companies and those interested in their operations – business partners, capital providers, workforce etc.

Ismail et al. (2017, p. 6) defined corporates' *digital transformation* as "the process through which companies converge multiple new digital technologies, enhanced with ubiquitous connectivity, with the intention of reaching superior performance and sustained competitive advantage". Therefore, it is estimated that digital technologies offer a high potential in terms of increasing companies' productivity (OECD, 2021) and performance. On the other hand, digitalization can lead to other benefits, such as environmental protection using intelligent machinery and equipment, increased opportunities for the efficient use of resources, waste reduction and sustainable development (Bonilla et al., 2018).

Digitalization is a priority of EU policies, also considering the gaps compared to the United States (USA). In the globalized digital economy, EU companies are less digitalized than those in the US. According to a study (European Investment Bank, 2021) conducted on a sample for 2020, 63% of EU companies had implemented at least one digital technology, in comparison with 73% of US companies. Furthermore, firm digitalization is done with a different intensity in the EU, varying by country. Thus, the most digitalized companies in the EU are companies from Belgium, Denmark, Finland, Ireland, the Netherlands, and Sweden and, at the lower limit, below the EU average, are the entities from the former socialist countries: Bulgaria, Hungary, Latvia, Poland, and Romania (European Commission, 2020; Brodny and Tutak, 2021). The fact that companies in the Scandinavian countries (Denmark, Finland and Sweden) are among the most digitalized in the EU is not surprising, as they have paved the way for digital development (Castells and Himanen, 2002).

EU's strategy is to create a digital single market ('Digital Single Market Strategy'). Through this, the European Commission seeks to boost the economy by eliminating the existing differences between the online and offline environments and removing existing barriers for cross-border online activities, but most of all to reduce the impact on the environment and improve the quality of life (European Commission, 2015). This trend is amplified by the adoption of the European Green Deal (European Commission, 2019) which includes the projection of sustainable development through a digital transformation of industries in the circular economy. The digitalization of industries is considered to be a key factor for attaining the sustainability goals of the European Green Deal, aiming that the use of digital technologies accelerates and maximizes the effects of policies dealing with climate change, environmental protection and optimizing the use of energy and natural resources (European Commission, 2019).

The EU policy of corporate digital transformation aims for 75% of European companies to use cloud computing, Big Data and artificial intelligence (European Commission, 2021) in the digital economy by 2030. Studies by McKinsey & Company (2020) estimate that the introduction of new digital technologies can contribute to a cumulative increase with 14.1% of the GDP in 2030 compared to 2017, representing 2.2 trillion euros (real 2017) at the EU level, an amount that will offset all investments needed for digitalization and will generate a positive return. A recent European Commission document reiterates the idea that the implementation of digital technologies and solutions by companies will ensure the achievement of the European Green Deal targets, contributing to the EU's proposed goal of reducing greenhouse gas emissions with at least 55% by 2030 (European Commission, 2021).

In the current context, European companies are going through a double transformation, in a conditioning relationship: a *digital transformation* that can facilitate another transformation – the adoption of *business models based on the circular economy*, with the aim of a sustainable development.

## 2. Literature review

Research to provide empirical evidence on the consequences of *digitalization* on firm *financial performance* is scarce and in the exploratory phase, primarily due to difficulties in measuring the phenomenon of digitalization at the companies' level. In addition, the reported findings are mixed. Research conducted by the European Investment Bank (2020) based on a questionnaire applied to 13,400 companies from 28 European countries and the US, having at least five employees, shows that the adoption of digital technologies is positively and significantly associated with firm *productivity*. According to OECD (2021), the gains from digitalization are not evenly distributed among entities. Companies with access to key technical, managerial and organizational skills benefit more than other entities, as they are registering an above average productivity, and digitalization contributes to increase their advantages. High productivity does not automatically translate into increased *performance* because investments in digitization entail high costs, thus having a negative effect on the firm's short-term *financial performance* (Chen and Srinivasan, 2020). Instead, Salvi et al. (2021) showed that the information companies disclose regarding digitalization has an impact on investors' expectations in respect of the estimated future cash flows for companies featuring a higher level of digitalization, the effects of digitalization being expected with a certain delay. Their expectations are justified by the ability of these entities to generate higher cash flows in close correlation with increased revenues and reduced costs. This perception of investors is based on a better understanding of customer needs and a reduction of the response time to requests received from customers among digital companies. At the same time, digitalized companies increase their revenues by using online commerce, and their costs are reduced by applying innovative business models, eliminating manually performed operations and optimizing resources (Salvi et al., 2021).

Indicators that measure firms' *market performance* incorporate the expectations of financial analysts and investors operating on the capital market regarding the future performance of companies, which are embedded in the share prices (Haslam et al., 2010). In this regard, empirical results show the existence of a positive relationship between the level of companies' *digitalization* and their *market performance* (Nwankpa and Roumani, 2016; Ricci et al., 2020; Salvi et al., 2021).

With respect to the relationship between *digital transformation* and the *sustainable development* of companies, most studies theorize a possible link between them, but empirical evidence is almost non-existent. Thus, a number of studies have questioned the extent to which digitalization can support the sustainable development of companies, given that some digital technologies are energy-intensive, have a high carbon footprint or have limited recycling opportunities (e.g., Kuntsman and Rattle, 2019; Beier et al., 2020). Instead, other authors (e.g., Tjoa and Tjoa, 2016; Vinuesa et al., 2020) consider that digitalization is a prerequisite for sustainable development, in terms of the *environmental* component of sustainability, the arguments being convergent with the goals of the European Green Deal.

In a very recent study, Camodeca and Almici (2021) provide empirical evidence for Italian listed companies, showing that there is a positive relationship between *digitalization* and *sustainable development.*

At the current stage, given the contradictory theoretical approaches in the literature and the lack of empirical results, the relationship between *digitalization* and *sustainable development* is unclear, and research is needed, especially quantitative, to document it. The present study aims to cover a gap in the literature, trying to analyse the extent to which there is a relationship between the digitalization of European listed companies and their sustainability, analysing the protection of the natural environment, considering the goals of the European Green Deal.

## 3. Research methodology

The sample consists of companies included in the benchmark indexes of the main stock exchanges located within the EU Member States: Austria (ATX), Belgium (BEL20), Bulgaria (SOFIX), Croatia (CROBEX), Cyprus (CSE), Czech Republic (PX), Denmark (OMXC25), Estonia (OMXTGI), Finland (OMXH25), France (CAC40), Germany (DAX), Greece (FTSEAthex20), Hungary (BUX), Ireland (ISEQ 20), Italy (FTSE MIB), Latvia (OMXRGI), Lithuania (OMXVGI), Luxembourg (LuxXIndex), Malta (MSE), the Netherlands (AEX), Poland (WIG), Portugal (PSI20), Romania (BETI), Slovakia (SAX), Slovenia (SBI), Spain (IBEX35), Sweden (OMXS30) and United Kingdom (FTSE100). As this paper aims at analysing the digitalization of listed companies in the context of the European Green Deal goals, out of the total 711 companies (Table no. 1), only companies that have an ESG (Environmental, Social and Corporate Governance) score calculated for the period 2018-2020 have been selected. ESG is a sustainability indicator provided by the Refinitiv Eikon database, which summarizes the behaviour of companies in terms of sustainable development, evaluating the impact of the companies' activities on the natural environment and society, as well as the quality of their corporate governance policies. The environmental pillar of ESG includes three categories: *i) emissions* (of $CO_2$, waste, biodiversity, environmental management systems); *ii) innovation* (product innovation, 'green' revenues, research and development and capital expenditure) and *iii) resource use* (water, energy, sustainable packaging and the impact of the supply chain on the natural environment).

In order to measure the digitalization of European listed companies, we conducted a quantitative textual analysis of their annual reports published during 2018-2020, using the linguistic software *Linguistic Inquiry Word Count* (LIWC), which identifies specific terms within a given text and calculates their percentage in the total of the words used.

The companies operating in the technology industry were removed from the sample, as, due to the characteristics of the sector, their annual reports feature a significant number of terms pertaining to the digitization realm. For the remaining companies (454 companies), the annual reports in English available in Thomson Eikon were downloaded for each year of the analysed period. Given the diversity of corporate reporting practices on the European markets, for comparability, from the annual reports we have extracted: the letters of the managers to the shareholders/stakeholders, the presentation of the entity, its strategy and its business model, following the methodology used by Chen and Srinivasan (2020) for companies listed on the American stock market, which have a more structured reporting model. The extracts from the annual reports were analysed on the basis of a dictionary of 91 terms describing digitization (shown in Annex no. 1). Out of the total 1,362 annual reports for the three years included in the analysis, after adjusting for cross-listings, a digitalization index (DI) was calculated for only 1,291 reports, as some reports were unavailable in the Thomson Eikon database.

To ensure comparability, financial data have been extracted from consolidated financial statements, which have the same basis for preparation. Missing financial data in Thomson Eikon further reduced the analysed sample to a total of 986 firm-year observations. The remaining sample contains 93.81% of companies listed on the EU developed markets, which is due to the importance of these markets in the total European stock exchanges, but also to the fact that the ESG indicator, relatively recently introduced, primarily considers large companies, likely to produce a significant impact on society, the environment and on all stakeholders. The structure of the sample by industry is shown in Table no. 1.

**Table no. 1. Sample structure**

| | |
|---|---|
| Companies included in the main European Stock Market indexes | 711 |
| Less companies missing ESG score | (224) |
| Less companies operating in the technology industry | (33) |
| Total companies | 454 |
| Firm-year observations (2018-2020) | 1,362 |
| Less missing management reports and cross-listings | (59) |
| Total firm-year observations with digitalization index | 1,291 |
| Less missing financial data | (305) |
| Total firm-year observations | 986 |
| Industry[a)] | % |
| Basic Materials | 11.46 |
| Consumer Discretionary | 17.55 |
| Consumer Staples | 8.62 |
| Energy | 6.80 |
| Financials | 5.78 |
| Health Care | 9.63 |
| Industrials | 23.02 |
| Real Estate | 5.38 |
| Telecommunications | 6.69 |
| Utilities | 5.07 |
| Markets[b)] | % |
| Developed Markets | 93.81 |
| Emerging and Frontier Markets | 6.19 |

*Note:* [a)] Industry Classification Benchmark (ICB) developed by FTSE Russel and Dow Jones; [b)] Classification by FTSE Russel.

The objective of this study is twofold. (1) On the one hand, this study aims at analysing the extent to which companies' digitalization efforts are in line with their general tendencies of being good corporate citizens, measured by their responsibility towards the environment, the society and all their stakeholders. (2) On the other hand, the purpose of this paper is to determine the extent to which companies' digitalization efforts are rewarded by financial markets, with investors providing more capital to companies that digitize their activities.

*Objective 1*: Investigation of the link between digitalization and social responsibility.

Within this objective, based on the theoretical arguments advanced in the literature and the goals of the European Green Deal, we formulate the following hypothesis:

*$H_1$: Digitalization efforts are more intense for more socially responsible companies.*

As indicated earlier, digitalization efforts are measured based on a digitalization index (DI) and corporate social responsibility is operationalized through the ESG score. Other control variables, which are likely to influence the digitization phenomenon, are also included in the model. Companies' digital transformation can be favoured by higher performance (ROA) or by the size of the companies (Size), as better performing or larger companies have the necessary resources for conducting these processes. On the other hand, digitalization efforts can be driven by financial distress, such as the lack of liquidity (Liquidity) or indebtedness (Leverage), as companies can construe automation and digitization as means to improve financial performance (e.g., implementing software for managing receivables, switch to online sales, etc.). Furthermore, companies with greater growth potential (Growth) can increase digitalization efforts to boost performance. Digitalization can also be determined by the industry in which companies operate, some industries being more suitable for these processes, or benefiting to a greater extent from this transformation. In addition, the digitalization efforts can also be amplified by the context generated by the COVID-19 pandemic, which is covered by the analysed period.

Accordingly, the first hypothesis is tested on the basis of the following regression model:

$$DI_{ij} = \alpha_0 + \alpha_1 x ESG_{ij} + \alpha_2 x ROA_{ij} + \alpha_3 x Size_{ij} + \alpha_4 x Growth_{ij} + \alpha_5 x Liquidity_{ij} + \alpha_6 x Leverage_{ij} + \alpha_7 x IndustryDummy_{ij} + \alpha_8 x YearDummy_{ij} + \alpha_9 x CountryDummy_{ij} + \varepsilon_{ij} \quad (1)$$

Where:

$DI_{ij}$ – Digitalization index of company *i* in year *j* calculated as a percentage of digitalization related terms in the total words used in the selected sections of the annual report describing the company's activity to its stakeholders.

$ESG_{ij}$ – Environment, Social and Governance score of company *i* in year *j*.

*Control variables:*

$ROA_{ij}$ – Return on assets of company *i* in year *j*, calculated as net profit divided by total assets;

$Size_{ij}$ – *Natural* logarithm of the market capitalization of company *i* in year *j;*

$Growth_{ij}$ – The increase in sales of company *i* in year *j* calculated as the ratio of the increase in revenues of the current year compared to the previous year divided by the previous year's revenues;

*Liquidity*$_{ij}$ – Current ratio of company *i* in year *j* calculated as the ratio of current assets and current liabilities;

*Leverage*$_{ij}$ – The degree of indebtedness of company *i* in year *j* calculated as debt to total assets;

*YearsDummy*$_i$, *CountryDummy*$_i$, *IndustryDummy*$_i$ are dummy variables used to control for fixed effects (FE) related to time, country, and industry. To avoid multicollinearity, countries are grouped into two categories according to the level of market development (developed markets and emerging and frontier markets).

*Objective 2*: Investigation of the relation between the financial performance, digitalization, and corporate social responsibility.

Based on the results reported so far in the literature (e.g., Chen and Srinivasan, 2020; Ricci et al., 2020), we posit that:

*$H_2$: Financial performance is higher for European listed companies that are making greater digitalization efforts.*

To measure financial performance, we use two market variables: i.e., *Tobin's Q*, and *Market to Book*. Accounting variables measuring performance have not been selected, as they depict companies' current performance (Haslam et al., 2010), and the literature shows that positive effects of digitalization are expected with a certain delay (Chen and Srinivasan, 2020). In contrast, market variables incorporate investors' expectations regarding companies' future performance, which are included in share prices (Haslam et al., 2010).

To capture the effect of digitalization on financial performance, other factors that can affect corporate performance are considered, such as the ESG score, as the markets tend to appreciate firms that are more socially responsible. The model also includes a number of financial indicators likely to be correlated with market performance, which control for growth, company size, leverage and company liquidity (e.g., Vafaei et al., 2015).

Consequently, for testing $H_2$, we formulate the following regression model:

$$Performance_{ij} = \alpha_0 + \alpha_1 xDI_{ij} + \alpha_2 xESG_{ij} + \alpha_3 xROA_{ij} + \alpha_4 xSize_{ij} + \alpha_5 xGrowth_{ij} + \alpha_6 xLiquidity_{ij} + \alpha_7 xLeverage_{ij} + \alpha_8 xIndustryDummy_{ij} + \alpha_9 xYearDummy_{ij} + \alpha_{10} xCountryDummy_{ij} + \varepsilon_{ij} \quad (2)$$

*Where:*

*Performance*$_{ij}$ – represents one of the market performance variables: $TQ_{ij}$ or $MTB_{ij}$.

*TQ*$_{ij}$ *– Tobin's Q* calculated as the sum of the market value of equity and the carrying amount of debt of company *i* in year *j* divided by the sum of their equity and debt carrying amount;

*MTB*$_{ij}$ *– Market to Book* value represents the ratio between the market value of equity and its carrying amount calculated for company *i* in year *j*.

## 4. Research results

The research results showed, in a first phase, an overview of the digitization phenomenon of large listed European companies. The digitalization index, calculated based on the quantitative analysis of 1,291 annual reports, depicts an important gap between the

companies listed on developed markets and those listed on emerging or frontier markets (Figure no. 1). Furthermore, an increase in the digitalization efforts can be observed in 2020, the year in which companies' activities have been severely affected by the COVID-19 pandemic, especially in the case of less developed markets, which, in an attempt to adapt to the new pandemic context, are bridging the gap to their more advanced counterparts.

Detailed results on the averages of the digitalization index by country, year and industry are presented in Table no. 2. High scores are recorded in the Northern countries (Finland, Sweden), but also in France, Spain, United Kingdom, the Netherlands, Belgium and Luxembourg, while in the less developed markets, the Czech Republic stands out. These scores are comparable to the EU reported results on companies' digitalization computed at a national level (European Commission, 2020), which supports the validity of the DI index.

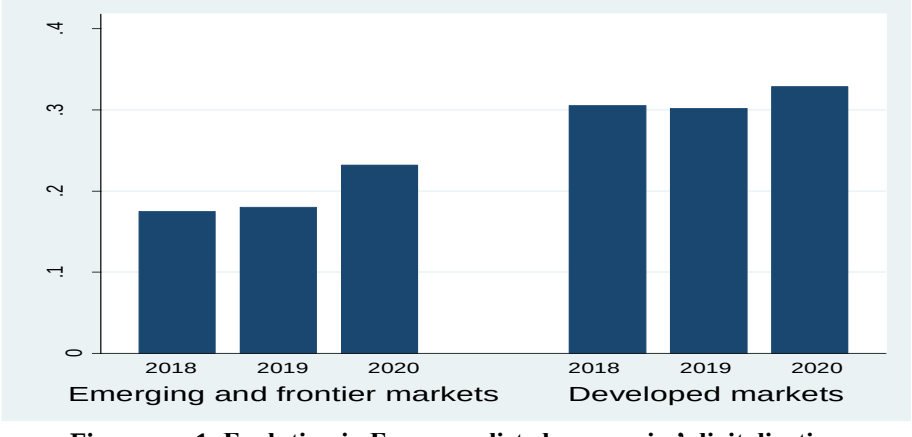


**Figure no. 1. Evolution in European listed companies' digitalization**

The averages computed for the two types of markets analysed, illustrate the gap between developed markets, with an average of the digitization index of 0.32 and a maximum of 2.09, and emerging and frontier markets, with an average of 0.2 and a maximum of 1.07. The annual averages per total sample confirm the increase in the digitization efforts in 2020 (0.32) compared to 2019 and 2018 (0.29).

**Tabel no. 2. Digitalization index across country, time and industry**

| Countries | Obs | Mean | Min | Max | Years | Obs | Mean | Min | Max |
|---|---|---|---|---|---|---|---|---|---|
| **Developed markets** | | | | | 2020 | 432 | 0.32 | 0 | 1.88 |
| Austria | 51 | 0.18 | 0 | 0.81 | 2019 | 431 | 0.29 | 0 | 2.09 |
| Belgium | 48 | 0.3 | 0 | 1.67 | 2018 | 428 | 0.29 | 0 | 2.05 |
| Denmark | 64 | 0.25 | 0 | 1.07 | **Industries** | **Obs** | **Mean** | **Min** | **Max** |
| Finland | 63 | 0.47 | 0 | 2.09 | Basic Materials | 113 | 0.14 | 0 | 0.73 |
| France | 101 | 0.42 | 0 | 1.75 | Consumer Discretionary | 184 | 0.4 | 0 | 1.41 |
| Germany | 79 | 0.26 | 0.01 | 1.38 | | | | | |
| Ireland | 39 | 0.2 | 0 | 0.77 | Consumer Staples | 102 | 0.31 | 0 | 1.55 |
| Italy | 115 | 0.24 | 0 | 0.98 | | | | | |
| Luxembourg | 6 | 0.57 | 0.08 | 1.22 | Energy | 72 | 0.12 | 0 | 0.84 |
| Netherlands | 73 | 0.34 | 0 | 1.28 | Financials | 264 | 0.3 | 0 | 1.09 |
| Poland | 46 | 0.3 | 0 | 1.01 | Health Care | 98 | 0.2 | 0 | 1.03 |
| Portugal | 45 | 0.18 | 0 | 0.64 | Industrials | 235 | 0.35 | 0 | 1.75 |
| Spain | 83 | 0.33 | 0 | 1.74 | Real Estate | 56 | 0.13 | 0 | 0.79 |

| Countries | Obs | Mean | Min | Max | Years | Obs | Mean | Min | Max |
|---|---|---|---|---|---|---|---|---|---|
| Sweden | 78 | 0.47 | 0.02 | 1.55 | Telecom | 69 | 0.8 | 0 | 2.09 |
| United Kingdom | 295 | 0.3 | 0 | 1.6 | Sector Utilities | 98 | 0.17 | 0 | 0.82 |
| **Total** | **1186** | **0.32** | **0** | **2.09** | | | | | |
| **Emerging and frontier markets** | | | | | | | | | |
| Cyprus | 3 | 0.12 | 0.04 | 0.21 | | | | | |
| Czech Republic | 12 | 0.42 | 0.02 | 0.9 | | | | | |
| Greece | 63 | 0.16 | 0 | 1.07 | | | | | |
| Hungary | 15 | 0.14 | 0 | 0.37 | | | | | |
| Romania | 9 | 0.27 | 0.03 | 0.54 | | | | | |
| Slovenia | 3 | 0.09 | 0.08 | 0.11 | | | | | |
| **Total** | **105** | **0.2** | **0** | **1.07** | | | | | |

Within industries, the telecommunications sector scores the highest value (0.8), as this industry is more prone to incorporating digital technologies, followed by non-essential consumer goods industry, i.e., consumer discretionary sector, (0.4), which also includes domains which are more likely to rely on digitization (production of electronic devices or cars, etc.), and have an important component of digitalization in the field of e-commerce.

Table no. 3 presents descriptive statistics for all variables, including financial ones, after eliminating missing data and winsorizing outliers. The companies included in the sample are large, with an average market capitalization (MK) of 14,400 mil. EUR and an average of total assets (TA) of 20,500 mil. EUR. The average ESG score is relatively high (67.28) and the mean digitalization index on the total sample is 0.29. The best-performing European listed companies have an average return on assets of 5%, an average annual growth of 3%, based on their annual turnover, and a relatively good liquidity with an average of 1.4. They also have a low indebtedness level with an average of 28% of total assets.

**Table no. 3. Descriptive statistics**

| Variables | Obs | Mean | Standard deviation | Min | Max |
|---|---|---|---|---|---|
| **DI** | 986 | 0.29 | 0.29 | 0.00 | 1.10 |
| **ESG** | 986 | 67.28 | 17.40 | 5.97 | 94.23 |
| **TQ** | 986 | 1.70 | 0.94 | 0.41 | 4.11 |
| **MTB** | 986 | 3.00 | 2.58 | 0.09 | 9.76 |
| **ROA** | 986 | 0.05 | 0.06 | -0.10 | 0.19 |
| **Liquidity** | 986 | 1.40 | 0.77 | 0.00 | 3.30 |
| **Growth** | 986 | 0.03 | 0.16 | -0.36 | 0.41 |
| **Leverage** | 986 | 0.28 | 0.16 | 0.00 | 0.88 |
| **MK (mil. EUR)** | 986 | 14,400.00 | 15,400.00 | 125,99 | 51,600.00 |
| **TA (mil. EUR)** | 986 | 20,500.00 | 24,300.00 | 70.87 | 81,000.00 |

The results of the first regression model, which analyses the relationship between the digitization of European listed companies and their corporate social behaviour, are presented in Table no. 4. They confirm the first hypothesis of the paper ($H_1$), i.e., the results indicate a significant positive correlation between digitalization efforts and corporate social responsibility, operationalized by the ESG score.

In order to understand the extent to which the digitization efforts are consistent with the corporate policies related to environmental protection, we focus on the environmental pillar

within the ESG score, and its constituents: *i) emissions; ii) innovation* and *iii) resource use*. Model 1.1 shows that digitalization is in line with the policies adopted by European listed companies in the field of environmental protection, as there is a significant direct relationship between the environmental component of ESG (E Pillar score) and the digitalization index.

A more detailed analysis (Models 1.2, 1.3 and 1.4 in Table no. 4) shows that two of the constituent categories of the environmental pillar (Emissions and Resource use) are significantly and positively correlated with the digitalization of companies, which suggests that digitalization is a prerequisite for reducing emissions and making better use of natural resources, in line with the goals of the European Green Deal.

Among the control variables, liquidity is negatively correlated with digitalization efforts, which confirms the initial assumptions, namely the fact that digitization efforts may be driven by financial difficulties, as companies may perceive digitalization as a means of increasing their performance. Within the same rationale, the digitization processes have increased significantly in 2020, as digitalization allowed companies to adapt to the new pandemic context (through e-commerce, teleworking, etc.).

Regression analysis confirms initial data showing that the digitalization index is significantly higher for companies operating in the telecommunications and consumer discretionary industries. Companies listed on developed EU markets also have a significant lead in the digitalization of their activities.

**Tabel no. 4. Regression results**

| **Variables** | ***Dependent:*** | | | | | | |
|---|---|---|---|---|---|---|---|
| ***Independent:*** | | | **DI** | | | **TQ** | **MTB** |
| | **Model 1** | **Model 1.1** | **Model 1.2** | **Model 1.3** | **Model 1.4** | **Model 2.1** | **Model 2.2** |
| **DI** | | | | | | **0.194*** *[2.05]* | **0.607*** *[2.20]* |
| **ESG** | **0.002***** *[4.30]* | | | | | **0.004*** *[2.46]* | **0.018***** *[3.81]* |
| **E Pillar:** | | **0.001**** *[3.16]* | | | | | |
| ***Emissions*** | | | **0.002***** *[5.22]* | | | | |
| ***Innovation*** | | | | **0.000** *[0.25]* | | | |
| ***Resource use*** | | | | | **0.001***** *[4.02]* | | |
| **ROA** | 0.062 *[0.48]* | 0.062 *[0.47]* | 0.030 *[0.23]* | 0.116 *[0.87]* | 0.035 *[0.26]* | 6.753***  *[9.42]* | 16.677***  *[9.28]* |
| **Size** | 0.001 *[0.09]* | 0.006 *[0.92]* | 0.004 *[0.63]* | 0.014* *[2.24]* | 0.006 *[1.07]* | -0.221***  *[-9.70]* | -0.707***  *[-11.27]* |
| **Growth** | 0.060 *[1.28]* | 0.054 *[1.15]* | 0.063 *[1.34]* | 0.027 *[0.57]* | 0.057 *[1.22]* | 0.306 *[1.56]* | 0.654 *[1.32]* |
| **Liquidity** | -0.041***  *[-3.75]* | -0.041***  *[-3.73]* | -0.039***  *[-3.51]* | -0.045***  *[-4.06]* | -0.039***  *[-3.52]* | 0.099* *[2.35]* | -0.091 *[-0.81]* |
| **Leverage** | -0.084 *[-1.39]* | -0.073 *[-1.18]* | -0.083 *[-1.35]* | -0.062 *[-1.00]* | -0.083 *[-1.36]* | -0.006 *[-0.03]* | 1.861***  *[3.55]* |
| **Non-essential goods** | 0.070* *[2.34]* | 0.068* *[2.25]* | 0.069* *[2.31]* | 0.059 *[1.92]* | 0.070* *[2.35]* | | |

| **Variables** | ***Dependent:*** | | | | | | |
|---|---|---|---|---|---|---|---|
| ***Independent:*** | **DI** | | | | | **TQ** | **MTB** |
| | **Model 1** | **Model 1.1** | **Model 1.2** | **Model 1.3** | **Model 1.4** | **Model 2.1** | **Model 2.2** |
| **Telecom sector** | 0.401*** *[10.04]* | 0.402*** *[10.14]* | 0.414*** *[10.56]* | 0.391*** *[9.80]* | 0.407*** *[10.32]* | | |
| **COVID-19** | 0.047* *[2.47]* | 0.048* *[2.52]* | 0.046* *[2.42]* | 0.048* *[2.52]* | 0.048* *[2.52]* | | |
| **Developed markets** | 0.120*** *[3.94]* | 0.121*** *[3.92]* | 0.114*** *[3.71]* | 0.134*** *[4.34]* | 0.114*** *[3.69]* | | |
| **Intercept** | 0.114 *[1.19]* | 0.109 *[1.12]* | 0.100 *[1.06]* | 0.058 *[0.61]* | 0.091 *[0.95]* | 3.529*** *[11.33]* | 9.273*** *[10.81]* |
| **Obs** | 986 | 986 | 986 | 986 | 986 | 986 | 986 |
| **F statistic** | 31.67*** | 30.96*** | 31.28*** | 29.66*** | 31.04*** | 49.50 | 39.12*** |
| **Adjusted $R^2$** | 0.332 | 0.326 | 0.336 | 0.320 | 0.343 | 0.476 | 0.415 |
| **FE** | Yes | Yes | Yes | Yes | Yes | Yes | Yes |

*Note:* significance levels: ***0.01, **0.05, *0.1. Dummy variables for years, industry and markets are included in the models to control for fixed effects. Only those with relevant economic significance are reported.

Table no. 4 reports regression results for the second model, which captures the impact of European companies' digitalization on their market performance. The regression analysis confirms the second hypothesis of the paper ($H_2$), both variables selected (TQ and MTB), which measure market performance, are significantly correlated with the variable DI, which measures digitization efforts. This shows that investors on the capital market appreciate the measures taken towards digitalization, which lead to more sustainable business models and have the potential to increase future performance of European listed companies. The digitalization index is significantly correlated with market variables, even when controlling for corporate social responsibility (operationalized through ESG).

Among the control variables, performance measured in terms of profitability (i.e., ROA) is positively and significantly correlated with market variables in both models, confirming previous results obtained in multiple markets characterized by different levels of development (Barth et al., 2011, Ionașcu et al., 2018), the information on the companies' profitability being relevant for the capital market and incorporated into the share prices. The size of the firm is negatively correlated with market performance which confirms previous results reported for some developed markets (e.g., Vafaei et al., 2015). In general, in emerging markets, larger companies perform better (e.g., Ionașcu and Ionașcu, 2018), but given the sample structure of this study, with a vast majority of companies listed on developed markets, the results are to be expected.

## Conclusions

This study aimed to analyse the digitalization efforts of companies listed on the main EU stock exchanges considering the European Green Deal's objectives, which proposes very ambitious targets in terms of environmental protection. The EU sees digitalization as a way to achieve its goals in the field of fighting pollution and climate change and promoting circular business models for resource efficiency and sustainable development.

In this context, this research aimed to analyse the extent to which digitization processes are consistent with the measures taken by companies in the area of corporate social responsibility and, especially, in the field of environmental protection. The study also observed whether financial markets appreciate digitalization efforts by rewarding companies that are more advanced in the digital transformation process.

Based on a computerized quantitative analysis of 1,291 annual reports of European listed companies published during 2018-2020, a digitalization index was calculated, which allowed observing the evolution in the degree of companies' digitization in different European financial markets and industries. Using regression analysis, the research has shown that digitalization processes are more advanced for more socially responsible companies, which confirms certain theoretical presuppositions (e.g., Tjoa and Tjoa, 2016; Vinuesa et al., 2020), but also some preliminary results reported in the literature (Camodeca and Almici, 2021). In terms of the objectives of the European Green Deal, the digitalization index is directly correlated with environmental indicators that measure corporate responsibility for harmful emissions and the use of natural resources. The study also confirmed previous results (e.g., Ricci et al., 2020; Chen and Srinivasan, 2020; Salvi et al., 2021), showing that the information on companies' digitalization presented in their annual reports is relevant for investors and analysts operating on the capital markets, with market values being higher for companies with more advanced digitization processes.

The research results are relevant for the EU regulatory bodies, which can implement policies to stimulate digitalization, with beneficial effects on the natural environment by promoting sustainable business models. The results also confirm management strategies of large European listed companies, based on digitalization and sustainable development, which can be extended to other types of entities.

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**Annex no. 1. Digitalization dictionary**

| | | | |
|---|---|---|---|
| App | Data lake | Emobility | Newsfeed |
| Artificial intelligence | Data mining | E-mobility | NLP |
| Artificial reality | Data monetisation | Eprocurement | Online |
| Augmented reality | Data monetization | E-procurement | Open source |
| Automation | Data processing system | Epublishing | Platform |
| Autonomous technology | Data science | E-publishing | Proprietary algorithm |
| Big data | Deep learning | Eservice | Robotics |
| Biometric | Devops | E-service | Robots |
| Biometrics | Digital | Etravel | Selfdriving car |
| Bitcoin | Digitalisation | E-travel | Sentiment analysis |
| Blockchain | Digitalization | Fintech | Sharing economy |
| Bots | Digitally | Hightech | Smart content |
| Business intelligence | Digitisation | High-tech | Smart devices |
| Click through rate | Digitization | Image recognition | Smart factory |
| Cloud | Ebusiness | Industry 4.0 | Smart home |
| Cognitive computing | E-business | Influencer | Smartphone |
| Connected car | Ecatalogue | Intelligent systems | Social media |
| Connectivity | E-catalogue | Internet | Software |
| Cryptocurrency | Ecommerce | IoT | Speech recognition |
| Data analytics | E-commerce | Machine learning | Trade in data |
| Data architecture | Edge computing | Natural language processing | Virtual reality |
| Data capturing | Elearning | Neural network | Web based |
| Data integration | E-learning | New economy | |

*Source: Adaptation based on Chen and Srinivasan (2020) and Hossnofsky and Junge (2019)*

# THE GREEN DEAL – DYNAMIZER OF DIGITALIZATION IN TOURISM: THE CASE OF CLUJ-NAPOCA SMART CITY

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**Abstract**
Global tourism activity reached high levels before the outbreak of the pandemic, but it was also one of the most affected economic sectors in 2020 when there was a real collapse of tourism activity. Tourism is an activity with a high degree of pollution, with many studies highlighting the fact that the hotel industry is a high-energy consumption and polluting sector. The Green Deal (GD), a bold project of the European Union, aims to make Europe carbon-neutral by 2050. Tourism is not an objective explicitly presented in the GD but because tourism is an activity with a high degree of pollution it must align to the new requirements. Targeting the hotel market of Cluj-Napoca, the article aims to analyse the activity of the hotels in terms of their adaptation to the new recommendations of the European Commission, implementing the GD, and moving to digitalization, as a new stage, for a cleaner environment. The research combines descriptive and inferential statistical methods to test the hypotheses formulated and to investigate the links between the variables studied, through unifactorial one-way ANOVA analysis. At the same time, the internal consistency of the 62 items of the questionnaire, filled in by the 38 hotels participating in the study, was analysed, obtaining a high Cronbach-Alpha score (0.88). The main conclusions drawn indicate a low degree of familiarity of hotel employees with the provisions of GD. In addition, especially in the case of internationally affiliated and of 4- and 5-star (*) hotels, the existence of a sustainable development policy is associated with a focus on local producers for both the supply of agri-food products and cosmetics and personal care products. The COVID-19 pandemic accelerated the digitization process of Cluj-Napoca hotels.

**Keywords:** Green Deal (GD), tourism, digitalization, smart city.

**JEL Classification:** Q20, Q30, Q53, Z30

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**Introduction**

The beginning of the 21st Century is marked by changes and transformations generated by the progress of society but also by adapting to new challenges. Among these challenges, climate change tends to become a priority, given that the world's population has reached 7.9 billion (The World Counts, 2021), population mobility has reached accelerating rates, and the National Centers for Environmental Information (NCEI, 2021) recorded July 2021 as the hottest month ever recorded on earth.

One of the activities that stand out because of the high mobility of the population is the tourist activity. Tourism has increased dramatically, reaching 1.5 billion tourists in 2019, before the COVID-19 pandemic. Global tourism activity reached high levels before the outbreak of the pandemic but was also one of the most affected economic sectors in 2020, when there was a real collapse of tourism activity, with a decrease of 74% compared to 2019 and only 381 million registered international tourists, continuing at a slower pace in 2021. It is difficult to say when it will be possible to return to the situation of 2019, which was a peak year for tourism (third place, after fuels and chemicals) in total exports, worth USD 1.7 trillion (UNWTO, 2021).

A major problem facing humanity is that of climate change, which is becoming more and more felt from day to day, and the fight against this phenomenon, must be a concerted effort of all actors around the world. Among the regional actors that are clearly involved in taking action to combat climate change, the European Union (EU) has taken the lead at the regional level by developing several documents to support this bold goal. The Green Deal (GD), a bold project that aims to make Europe carbon neutral by 2050, was launched in December 2019 (European Commission, 2019). This project has several directions for action, including the replacement of traditional energy systems. with modern systems, based on alternative energy, better-implemented waste management, increased attention to agricultural products but also faster digitalization, so as to reduce waste of water, food, energy, reduce carbon emissions, and be able to protect and preserve the environment.

As an integral part of the European Commission's strategy for implementing the 2030 UN Agenda and the Sustainable Development Goals (European Commission, 2020), the GD has set an ambitious agenda, based on the concept of green resilience. The GD pursues transformative goals, such as increasing the EU's climate ambitions for 2030 and 2050, providing clean, accessible, and secure energy, mobilizing industry for a clean and circular economy, building and renovating energy and resources efficiently, accelerating change toward sustainable and smart mobility, promoting a fair, healthy and ecological food system, conserving and restoring ecosystems and biodiversity, and achieving climate neutrality, with zero pollution, by 2050 (European Commission, 2019).

Tourism is not an objective explicitly presented in the GD, but, because tourism is an activity with a high degree of pollution (Ștefănică and Butnaru, 2019), which mainly concerns transport, food consumption, and accommodation, it must adapt to the new requirements. Many studies have approached tourism sustainability, including Dabija and Băbuț (2013), and have highlighted the fact that the hotel industry has high energy consumption and is a polluting sector (Ștefănică and Butnaru, 2019). Thus, tourism is not only vitally interested in most of the objectives of the GD but also has the potential to actively contribute to their implementation.

Scott and Gössling (2018) reveal that the energy used in tourism comes mostly from fossil fuels. It is estimated that three tourism sub-sectors account for 93% of total recorded greenhouse gas emissions from tourism, of which air transport has a 40% share, road transport 32%, and accommodation 21%. Therefore, accommodation is the component with the lowest emissions, and, at the same time, it is the component in which the easiest changes can be made, from adapting energy systems to purchasing products to reduce pollution and even to reducing energy consumption, water, and food losses. According to the Romanian National Tourism Master Plan for 2007-2026 (Guvernul României, 2006), tourism must develop in a sustainable manner. Among the most important objectives of sustainable tourism development are recycling, reuse, and energy efficiency, as well as water conservation and landscape preservation. In addition, supporting the digitalization process in tourism and promoting the implementation of energy efficiency measures are objectives of the Romanian Tourism Development Strategy (Guvernul României, 2018).

The city of Cluj-Napoca is one of the most important cities in Romania, the third largest city (INS, 2021), and the most important city in the North-West Development Region of the country; it has a rich tourist heritage, being an important cultural and university centre. The city of Cluj-Napoca is notable for being a modern city, a smart city, a genuine IT hub, which has many projects designed to support digitalization. It is the first city in the country to introduce electric buses, it has a smart street, and in 2021, it ranked first in the category of smart city development in Europe, according to Emerging Europe (2021). Smart tourism is closely linked to the smart city, which, according to the Dubai Smart City Destination model (Subramania, 2015) has a number of features, which are entirely met by the concerns and completed or ongoing projects of the municipality (Primăria Cluj-Napoca, 2021): waste management, e-governance, secure and fast financial services, buses and stations used at full capacity streamlining traffic, environmentally sustainable reporting, reducing aviation operating costs, and safety and security as priorities, efficient public lighting services, the importance of education and digitization, smart parking. In addition, the development of the Cluj IT sector benefits from the establishment of *Cluj IT Innovation Cluster*, one of the main local clusters, giving "the city a competitive advantage, since companies with foreign capital choose to develop branches in Cluj, which later offers the community expansion and investment resources in the field" (Bolog and Mathe, 2015). Furthermore, the strategic planning document of the city (Primăria Cluj-Napoca, 2021) points out that from the perspective of the local community, a positive aspect is that most of the capital in this sector is local, which diminishes withdrawals of profits.

By analysing the international literature, a series of studies have been identified that focus on the sustainable development of the hotel sector, its digitization and on adaptation strategies to the context caused by the COVID-19 pandemic (Hao, Xiao and Chon, 2020; Sigala, 2020; Garrido-Moreno, Garcia-Morales and Martin-Rojas, 2021). The impact of digitalisation on the sustainability of the hotel industry is a topical issue, still little researched, although of interest.

This study combines the provisions of the GD with digitization in the context of policies to adapt to the new conditions caused by the COVID-19 pandemic, similar studies not yet identified for the Romanian hotel market, in the context of the gap between the domestic and international hotel industry. The purpose of the article is to investigate how the objectives of GD in general and of digitization in particular are implemented, in the Romanian city of Cluj-Napoca, considered a European leader in terms of digitalization.

Throughout the coming sections, the paper includes a part dedicated to the review of the literature, followed by the one detailing the research methodology; the results and discussions are further presented, and finally, the main conclusions and recommendations are summarized; as well, the limits of the current research, respectively, the potential future research directions are pointed out.

## 1. Literature Review

Digitalization in tourism is dealt with from various angles. A more recent approach is related to the COVID-19 pandemic and the way it has influenced the acceleration of digitalization. António and Rita (2021) highlight that the COVID-19 pandemic accelerates the digital transformation in tourism and especially in the hospitality industry, highlighting the benefits of digitalization that can reduce costs by up to 90%. Also, digitalization can be efficient both in front- and back-office operations. Săseanu et al. (2020) address the aspects of digitalization in European countries in relation to green tourism, but also the preferences of tourists regarding ecological accommodation that can contribute to the sustainability of tourism. The transition from sustainability assessment to smart city goals, focused on modern and smart technologies, was achieved in the 21st century, with the general objective of improving sustainability with the help of technologies. In this regard, Ahvenniemi et al. (2017) recommends the use of the term "sustainable smart cities" instead of smart cities, because the first term is more precise.

Regarding the definition of smart city, experts have different views, but most definitions address mainly six dimensions: smart governance, smart people, smart housing, smart economy, smart mobility, and smart environment. Caragliu, Del Bo and Nijkamp (2011), Mosannenzadeh and Vettorato (2014), Neirotti et al. (2014) aimed at clarifying the definition of a smart city by developing their own definition and addressing smart cities in the 27 member states of the European Union. Allam and Newman (2018) provide a classification of articles that primarily address the main dimensions analysed in smart cities. They present a review of the literature on smart city using a table and circumscribe its main dimensions by the help of some definitions. Most definitions consider smart governance, smart people, smart environment, and smart economy (Dameri, 2012; Mosannenzadeh and Vettorato, 2014; Neirotti et al., 2014; Petrolo, Loscrì and Mitton, 2015), while dimensions such as smart education, safety, and culture are less frequently addressed (Washburn et al., 2010; Neirotti et al., 2014).

In Romania, the concept of a smart city is strongly linked to the improvement of infrastructure and sustainability at the national level (Ivan, Beu and van Hoof, 2020). A smart city is a connected city. In the case of the city of Cluj-Napoca, the advantageous geographical position that it occupies also contributes to its status as a smart city. Although progress in the development of smart cities is modest, recent trends highlight the acceleration of infrastructure development, smart economy, and smart governance. These transformations also occur against the background of the impact of deindustrialization (Ianoș et al., 2021).

Numerous arguments that support the city of Cluj-Napoca as a smart city highlight its image in terms of its dynamic economy that attracts many multinationals, but also cultural features. Due to the IT and software centres present in Cluj-Napoca and due to the companies desiring to invest in the area, an association with Silicon Valley was even made

(Androniceanu and Ivan, 2012). Digital infrastructure and national education programs can also be implemented through public policies to reduce digital gaps in Romania (Papuc and Andrei, 2018). Starting from the concept of smart city, some authors have extended this concept (Boes, Buhalis and Inversini, 2015) to a new notion of smart tourist destination, focusing largely on the importance of Information and Communication Technology (ICT) within the destination. The skilful way in which technology is used supports the hospitality industry, as it is an industry with an extremely interconnected network, generating a new term, that of smart hospitality (Buhalis and Leung, 2018).

By imposing social distancing, the COVID-19 pandemic has hit the hospitality industry in its very essence that of generating unique experiences, often based on the interaction between tourists and staff. Thus, in the hotel industry, it has become compulsory to rethink processes and operations by implementing contactless procedures (Sigala, 2020; Garrido-Moreno, Garcia-Morales and Martin-Rojas, 2021).

A complex study of the international literature dedicated to the hotel industry and tourism in the context of the COVID-19 pandemic and beyond indicates the change in the behaviour of tourists, respectively, six basic pillars of tourism in the new normality: (1) sustainability; (2) interest in local development; (3) technology and smart cities; (4) luxury services; (5) hygiene protocols; as well as (6) emotions. From a managerial point of view, the impact of COVID-19 on tourism and implicitly on the hotel industry translates into the implementation of new strategies; hygiene protocols; proposing new values; tourist platforms; and new employee relationships (Casado-Aranda, Sánchez-Fernández and Bastidas-Manzanoc, 2021). In the same line, Jiang and Wen (2020) recommend that the hotel industry include artificial intelligence, cleanliness, and hygiene in their future strategies (Casado-Aranda, Sánchez-Fernández and Bastidas-Manzanoc, 2021). Sigala (2020) discusses the need for cooperation between the business environment of the tourism industry and hospitality with academia to research and maximize the transformative potential of the pandemic, by identifying and implementing reactive and proactive solutions to recover responsibly, sustainably, smart, and for the well-being of this sector.

## 2. Research Methodology

The current study focuses on investigating the digitalization of hotels and their attitude towards the implementation of GD. To achieve these two goals, the entire population of hotels and aparthotels, active on the market of the Romanian city of Cluj-Napoca, considered a leader in Europe in the field of digitalization, was targeted. Thus, given the provisions of the GD, three research hypotheses were derived from studies dedicated to the digitalization of the hotel industry or focused on issues of its sustainability in the context of the COVID-19 pandemic situation (Buhalis and Leung, 2018; Carlisle, Ivanov and Dijkmanas, 2020; Jiang and Wen, 2020; OECD, 2020; Sigala, 2020; Casado-Aranda, Sánchez-Fernández and Bastidas-Manzanoc, 2021; Garrido-Moreno, Garcia-Morales and Martin-Rojas, 2021).

*Hypothesis 1 (H1)*: The employees of most hotels in Cluj-Napoca have heard of GD.

*Hypothesis 2 (H2)*: Hotels in Cluj have adopted measures to implement GD to reduce energy consumption and better waste management.

*Hypothesis 3 (H3)*: Digitization has been accelerated by the COVID-19 pandemic, through measures imposed by social distancing and reduced physical contact between employees and tourists.

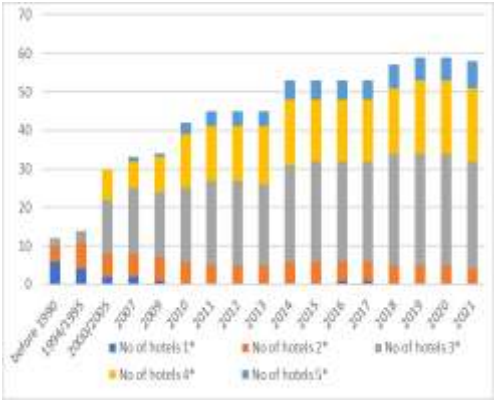
To test these hypotheses, a three-part questionnaire was designed consisting of 12 questions that address the two directions of the investigation, plus 6 identification questions. Five questions were multiple-choice questions with a single valid answer; two questions involved the possibility to pick more than one answer and to also add other options; the remaining five questions were evaluation questions based on Likert scales.

In the first part, the objective was to learn whether hotel staff is aware of the GD and its content; the second part focused on how hotels have implemented or are going to implement the recommendations of the GD on reducing carbon emissions and waste; and the third part deals with digitalization and accelerated digitalization in the context of pandemic. To facilitate the collection of responses, the survey was designed so that both reception desk personnel and front office managers could provide the answers. The research took place between August 1st and September 27th, 2021.

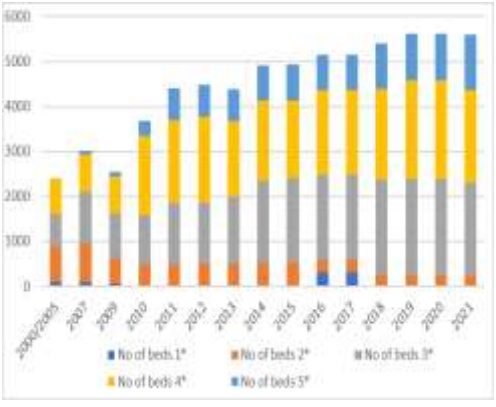
The research combines several methods of statistical analysis aimed at tourist demand and supply. Therefore, descriptive methods are used for the analysis of the evolution of the number of hotels and number of beds in two-, three-, four-, and five-star (*) hotels in Cluj-Napoca; the second stage analyses the results obtained based on the questionnaire, as well as to illustrate the way in which the hotels in Cluj-Napoca relate to the GD provisions. Inferential methods are used to investigate the results obtained based on the questionnaire. Given the small size of the sample, it was decided to calculate simple regressions (one-way ANOVA) at the level of variables relevant to the present approach. The use of these methods is common in studies dedicated to the hospitality and tourism industry (Carlisle, Ivanov and Dijkmanas, 2020; Liu, 2020).

For a better understanding of the hotel market of Cluj-Napoca, an analysis of the development of hotels and apart-hotels on the local market of Cluj-Napoca has been carried covering the entire timespan since the fall of communism in December 1989 until today. Some hotels located in the metropolitan area of Cluj-Napoca have been included in this analysis, as their activity is closely related to the city and is influenced by it; it is the case of the West City hotel from Florești, the two Sungarden Resort hotels from Baciu, and the Premier Resort Vâlcele and Premier Garden hotels from Feleacu. Sunny Hill (formerly, Tulip Inn Sunny Hill) was initially also located in the outskirts of Cluj-Napoca, in the Făget area, which has in the meantime become a residential area of the city.

A first step was that of investigating the changes that have occurred on the market. Thus, relying on the official catalogue of OJT Cluj (1982) and on the databases of officially ranked accommodation units issued by the MT/ANT (2021) in 2005, 2007, 2009, sixty-seven hotels have been identified as having been active on the local market during the analysed timeframe. Of these, twelve were hotels established before the Romanian Revolution of December 1989 (some dating back at least to the 18th and 19th Centuries).




**1a. Number of Hotels by Ranking-Level**




**1b. Number of Beds by Ranking-Level**

**Figures no. 1a. and 1b. The Development of the Hotel Market of Cluj-Napoca**

*Source: Authors' determination based on MT/ANT data (2000-2021).*

Over the past more than three decades, hotels have increased 4.83 times, while their lodging capacity has more than doubled since 2000/2005, both rooms and beds registering a growth rate of 2.33 (Figures no. 1a and 1b). Furthermore, the qualitative shift is also visible, as over the analysed timeframe investors have oriented towards increasing capacity of the midscale (2.99 times), upper midscale (2.54 times), and luxury lodgings (13.76 times). The first aparthotel registered as such appeared in 2013 (Cabrio, 4*), and was followed five years later by Platinia Luxury Suites (5*) and a year afterwards by UBA Accommodation (4*). The international affiliation to hotel chains and the penetration of international hotel brands positively influenced the qualitative level of the local lodging service. Thus, the first brand was Best Western (currently absent from the local market), followed by Golden Tulip, Wyndham, Select Hotels, and Hilton. Radisson Blue, Marriott, and Sheraton are expected to enter the market soon.

According to the most recent database of Romanian lodgings (MT/ANT, 2021), 58 lodgings are ranked as hotels and aparthotels on the local market; the hotels that have already closed are still included in the database. To establish the real supply of lodgings in Cluj-Napoca this number was reduced to 51 hotels (accounting for 2,635 rooms and 5,082 beds), after having excluded the seven hotels that are permanently closed (Cristian 2*, Gala 3*, Melody Central 3*, Norm Hill 3*, Granata 4*, Opal 4*, and Opera Plaza 5*). In three cases, the same family owns or operates two or three hotels, and in another case two hotels are located at the same address and are promoted via a single website. After discussions with the owners/managers of these units, the number of hotels was further diminished with 5 units, by treating these hotels as a single unit (Capitolina Chic Hotel 3* and Lol et Lola 3*, operated by Bon Ton Hotels SRL; Premier 4*, Premier Resort Vâlcele 3*, and Premier Garden Vâlcele 3*, operated by Real Hospitality SRL and Premier Garden SRL, both enterprises belonging to the same family; Onix I 4* and Onix II 3*, located at the same address and operated by AB Onix Hotel SRL; and the two Sungarden Resort 5*, located at the same address and operated by Sunset Tour Inn SRL and Sungarden Resort). Thus established, the total population of hotels operating on the local market includes 46 hotels (three 2* hotels, 6.5%; 21 3* hotels, 47.5%; 17 4* hotels, 37%; and five 5* hotels, 10.9%).

After the hotels were contacted in eight rounds (four times via e-mail, once via their Facebook pages, once in person at their reception desk, once via phone, and once via WhatsApp), by the date of closing the study, only 38 hotels have accepted to respond. The remainder explicitly refused to participate in our study and consequently have been removed from the sample. The total population includes all the internationally branded hotels active on the local market. The structure of the investigated sample, in fact the entire population, is: one 2* hotel (2.6%, covering 33.3% of all 2* hotels); seventeen 3* hotels (44.7%, accounting for 81% of all 3* hotels); fifteen 4* hotels (39.5%, representing 88.2% of the total 4* hotels); and five 5* hotels (13.2%, covering 100% of the 5* hotels).

Given that the hotels ranking in the upper-scale and luxury segments are more likely to develop sustainability policies and invest in their digitalization, we consider that the participants in the study are representative of their peers and that the results are not distorted. In addition, to determine the internal consistency of the responses received, the Cronbach's Alpha coefficient was computed; it has a value of 0.88 for the answers provided by the 38 respondents in the case of the 62 items considered. The score being high, it indicates a good to very good internal consistency of the items of the questionnaire. The studied sample also presents the following features: it includes a percentage of 13.2% of internationally affiliated hotels; most hotels (44.7%) report a percentage of international tourist arrivals between 0 and 25%, respectively 36.8% for foreign tourists between 26 and 50%, followed by a generous percentage (15.8%) of arrivals of foreign nationals of more than 50% and no more than 75%, as well as arrivals of more than 76% to 100% for 3% of respondents. Based on the main reason for travel, the profile of the destination Cluj-Napoca was determined. Therefore, most hotels declare business tourism as the main reason for the arrival of Romanian tourists (78.9%) and foreign ones (55.3%); followed by event tourism with a share of 10.5% for both Romanians and foreigners; leisure and city break tourism appear with equal quotas in the case of foreigners (15.8%) but are not of no interest to Romanians (2.6%). Transit tourism is present in a higher proportion for Romanians (5.3%) and in a lower proportion for foreigners (2.6%). Medical tourism does not appear to be the main reason for accommodation in any of the hotels in Cluj.

## 3. Results and Discussion

Given the importance of the GD, the first investigated aspect regarded the familiarization of the hotels with the GD, respectively, their orientation towards sustainable development. The study revealed that 57.9% of the respondents are not familiar with GD but, at the same time, over 65% of hotels consider themselves to be environmentally friendly (10.5% to a very large extent, 55.3% to a large extent, while the remaining 34.2% are environmentally friendly only to a low extent). The results are similar to those shared by Musavengane (2019), which showed that most of the hotels studied had fragmented sustainable development policies, the implementation of which has not been verified.

A somewhat higher percentage is registered in the case of the existence of a sustainable development policy, with 68.4% of the respondents admitting the existence of a sustainable development policy for their hotel. At the same time, if any, the implementation of the policy is carried out to a very large extent by only 7.9%, respectively, to a large extent by 50% of the hotels, and to a small extent among 23.7% of the respondents; at the same time, the policy is not implemented in the case of 18.4% of hotels, while internationally it has

been observed that some managers have understood that the sustainable development of hotels is conditioned by the adherence to environmental policies (Erdogan and Baris, 2007), and Schaper (2002) indicated the need for education in this regard.

When asked whether the hotels invest in training their staff for acquiring and applying the hotel's own sustainable development policy, the results are surprising, as only 37% of the respondents (here included three of the five internationally branded hotels) confirm such training. Furthermore, 42% (with two internationally affiliated hotels) neither admit nor deny the provision of such training, and a fifth of then denying the fact that they benefit from such training sessions. This situation is paradoxical, as Schaper (2002) showed that the decision to implement environmental policies belongs to the management and combined hotel-level education with its sustainable development, nearly 20 years ago.

It seems that hotels focus more on educating their tourists about sustainable development, rather than increasing the awareness of their employees in this regard. Thus, 50% of the respondents (all internationally branded hotels included) agree that they have developed and implemented procedures to ensure the education of the tourist/client in the spirit of sustainable development; further, 34% neither admit nor deny the existence of such procedures, while only 16% deny the existence of such procedures. Unlike foreign tourists (61% in general and 80% for branded hotels), Romanian tourists show to be less educated on the adoption of sustainable development policies for hotels (32% in general and 60% of branded hotels). In the same line, the respondents neither agree nor disagree with the fact that Romanian tourists are open to the adoption of sustainable hotels policies (45%); the percentage drops to 26% for international visitors.

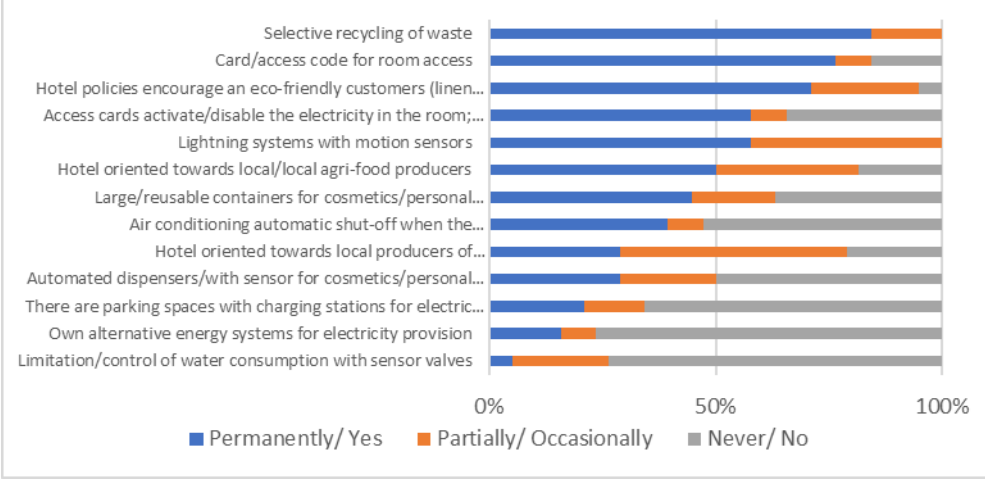



**Figure no. 2. Sustainability practices adopted by hotels**

*Source: Authors' determination based on research results.*

Several remarks ought to be made regarding the sustainability practices adopted by the hotels (Figure no. 2). A positive aspect is that almost 85% of hotels recycle their waste in a selective manner. Still, it is quite surprising to notice that two of the internationally branded hotels, respectively, two 5* hotels, three 4* hotels, and one 3* hotel select waste only occasionally, despite this activity being law-enforced.

The use of access cards is important both for tourist security and energy saving purposes; therefore, the fact that 76% of hotels have implemented access cards on a regular basis and that nearly 10% use them occasionally is another positive fact; this situation occurs only mainly in 3* hotels. Still, only around 60% of hotels use access cards, mainly permanently, to control and limit electricity consumption. Furthermore, only less than half of hotels use such cards to save energy by turning off air conditioning systems when windows and/or doors are open, with 39% (all internationally affiliated hotels included in the study) of hotels doing so permanently and 8%, occasionally.

To save energy, all hotels have implemented motion sensors to control the lighting system in all public spaces (58%) or certain areas (42%). Almost three-fourths of the hotels have a policy to always encourage customers to adopt an eco-friendly attitude regarding the change of linen and towels, while a quarter opt to do so occasionally. In spite of having and implementing a sustainable development policy, one of the 5* internationally branded hotels opts not to encourage their customers to accept using linen and towels for more than the legally established number of days (2 days for 4* and 5* hotels).

Supporting local agro-food producers is a rather common practice of the mid-scale, upper-scale, and some luxury hotels from Cluj-Napoca, as half of them regularly address local suppliers, while another third of them occasionally buy certain local products. Only one 5* internationally affiliated hotel never buys local agricultural products. Likewise, in the case of cosmetics and personal hygiene and care products, a fifth of the local hotels, including two of the branded ones, never opt for local products, while half of the respondents occasionally turn towards local producers of such products, and a third of them have permanent collaborations in this respect.

More than a third of the respondents (37%, including three internationally affiliated hotels) do not consider using large containers to provide their customers with cosmetics and personal care and hygiene products, but nearly half of the respondents (45%) always do so, and a little less than a fifth (the remaining two branded hotels included in the study) provide some of the products in large and/or reusable containers, thus acknowledging the importance of reducing plastic waste. Only half of the respondents proved to be aware of the need to reduce water pollution, by limiting the quantities used and by reducing the waste of soap, shower gel and shampoo through the permanent (25%) or partial (25%) implementation of automated dispensers of such products.

Approximately a third of the respondents provide parking spots with charging stations for electric cars. A relatively low quota of the respondents, namely some 25%, indicated the generation of some of the needed electric energy via their own alternative energy systems (16%, permanently/regularly and 8% partially). Despite the fact that at the global level many areas face life-threatening problems related to accessing water resources and that hotels have the reputation of consuming significant volumes of water, the control of water consumption does not seem to be a priority of the hotels in Cluj-Napoca, where only about a quarter of the players on the market have considered investing in automatized and sensor-based taps (5% have invested in all areas, while 21%, including three internationally branded hotels, have covered some spaces).

Very few of the respondents mentioned other measures adopted for their hotel's sustainable development. Worth to mention in this respect are the following ones: the replacement of plastic single-use products with eco-friendly and recyclable products, materials and

supplies in their restaurants or on their terraces (such as straws, cups, napkins, etc.); the diminishing of individually wrapped food products available during breakfast; the use of water tanks for employees and customers instead of bottled water and their encouragement of using reusable and refillable bottles; selective waste processing for paper and cardboard; the care towards water consumption; as well as also the installation of flood and fire/smoke sensors, respectively of open-window sensors.

An encouraging aspect results from the fact that 55% of the hotels use classic heating systems combined with alternative energy; furthermore, a small but important percentage of the hotels (3%) rely only on alternative energy sources, while 42% of the hotels still use fossil fuels for their heating and for providing hot running water.

As table no.1 further reveals, nearly half of the respondents indicate their hotel's intention to invest in alternative sources of energy (21% of those that still rely on fossil fuels and 24% of those who have already begun to use alternative sources of energy combined with classic ones). Given the rather high costs associated to such investments, the percentage of 47% of hotels that have not yet decided whether to invest or not, is reasonable and understandable.

A positive aspect is related to the fact that only 8% of the respondents clearly know that they do not plan to switch to alternative sources of energy. Moreover, 20% of internationally affiliated hotels use only alternative sources of energy, while 60% have already opted for combining classic with alternative sources, and only 20% still entirely rely on fossil fuels.

**Table no. 1. Hotels' behaviour and intentions relative to energy consumption**

| | Intend to invest in alternative systems | Do not know if they will invest in alternative systems | No intention to change | Total |
|---|---|---|---|---|
| Fossil fuels | 21% | 18% | 3% | 42% |
| Classic systems combined with alternative sources of energy | 24% | 26% | 5% | 55% |
| Alternative sources of energy | 0% | 3% | 0% | 3% |
| Total | 45% | 47% | 8% | 100% |

*Source: Authors' determination based on research results.*

Regarding hotel adaptation to the digital age, most respondents (63% and 80% of the branded hotels) agree that their hotels embrace digital innovations quickly, while only one hotel (the remaining branded hotel) considers itself not to be a quick adopter of digital technologies. Once again, when it comes to requesting digitized services (e-payment, smart rooms, electronic menus, self-check-in/electronic check-in, etc.), Romanian tourists (34%) score significantly lower when compared to international ones (58%).

An analysis of the responses received from the hotels in Cluj-Napoca (Figure no. 3) reveals that in terms of digitalization, by far the most frequently implemented systems are linked to the electronic payment systems, with three fourths of the hotels permanently implementing such systems, and the remainder, who have opted for a partial implementation of these, selecting certain features and departments for this purpose.

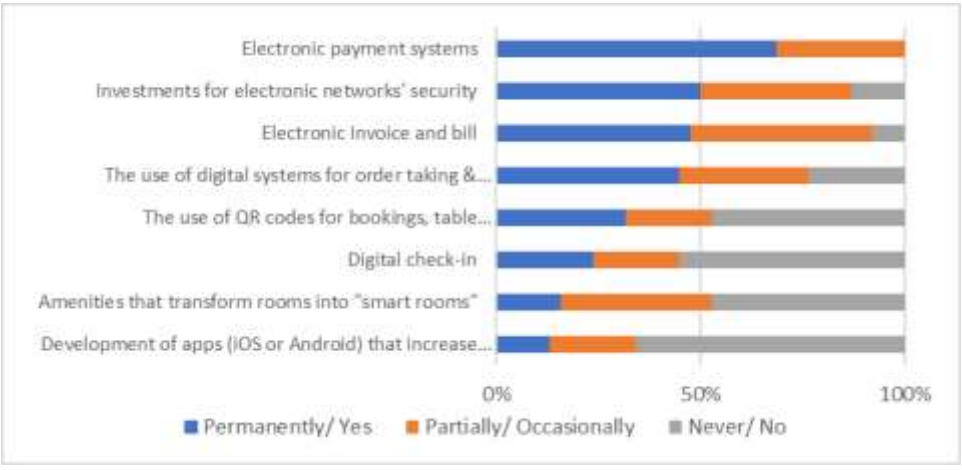



**Figure no. 3. Digitalization as implemented by hotels**

*Source: Authors' determination based on research results.*

A major concern of businesses relying on the online environment is related to network security; logically, most of the respondents (87%) have allotted budgets for this purpose, half of the hotels consider this a permanent investment (50%), while the other more than a third (37%) occasionally budget such investments. The attitude of the remaining 13% of hotels of not investing in network security but of investing in electronic payment systems and in electronic invoicing and billing is rather odd (47% on a regular basis, 45% occasionally, and 8% never). Almost 80% of hotels have implemented IT&C solutions for order taking and processing and for restaurant inventory management (45% always and 32% occasionally), while nearly a quarter (24%) have not yet adopted such solutions. These last two aspects contradict the initial statement regarding the hotels' statute of early adopters of digital technologies. QR codes are relatively popular tools, used regularly by a third of the hotels (including 40% of the ones internationally affiliated) and occasionally by another fifth of them (of which 40% are branded ones), in one or more of their services (bookings, table reservations, menu accessing & order placement for restaurant/bar/room service). At the same time, there is a significant percentage of hotels (47%, including 20% of the internationally affiliated hotels) that do not use them. Digital check-in is a regular procedure in the case of around a quarter of the respondents, while another fifth implement it as an occasional practice.

Even though customers are increasingly orienting towards digitalized services, most enterprises (55%) do not provide their customers with the possibility of electronic check-in. Facilities and amenities at room level tend to be rather common, as only a little more than 15% of the respondents indicate the fact that they regularly try to endow hotel rooms with smart facilities and amenities, while 37% admit that their hotels invest in this area only occasionally. Nearly half of the hotels seem not to be familiar with the concept of smart rooms, and consequently not to direct financial resources in this area. The development of iOS and Android applications is not a priority for any of the hotels under scrutiny, not even for the internationally affiliated brands. Only a single hotel specified that its facility invests in the implementation of Building Management Systems (BMS) dedicated to the control of lights by means of a dedicated app. There is a significant gap in relation to the international hotel markets; In China, for example,

as a measure to reduce social contact in the context of the pandemic, various solutions have been implemented such as: contactless smart services, including personal check-in or remote check-in, facial scanning, voice control for room service, robotic room service and check-out in zero seconds. Similar measures have been taken since April 2020 by more than 100,000 hotels in 351 cities (Hao, Xiao and Chon, 2020).

When it comes to communication with their customers, it turns out that most of the hotels use online booking platforms (97%), equally their own website and social media (92%). Obviously, these are part of a complex mix that also involves other communication strategies. Thus, nearly half of the hotels have implemented group or private loyalty programs (47%); organize events (42%). Some have developed their own apps or use those of the international brands they have joined (13%) and 5% seem to consider implementing virtual and augmented reality solutions. Close to a quarter still use one or more of the classic advertising media: leaflets (24%), flyers (21%), banners (18%), road signs (13%), and/or catalogues (5%).

Perhaps more than any other sector, hospitality is the most affected by the COVID-19 pandemic. In this context, their activities were influenced by behavioural changes such as an increasing demand for room service, as an alternative to the services offered by the restaurant (in case of accommodated customers) was registered by nearly two thirds of the respondents (61%); it has boosted the digitalization process for half of the respondents (50%); their purchasing departments have turned towards local producers (45%). These changes led to adaptation strategies. Between a fourth and a fifth of the hotels have developed new activities, such as delivering food in a catering system (24%), purchasing organic products (21%), and/or have invested in IT&C solutions for the digitalization of the accommodation sector (18%). Around a quarter of the analysed hotels have also invested in IT&C solutions for digitization in the food/restaurant area (16%), promotion and loyalty programs, and for the financial and accounting departments (13%, each). Only 5% of the respondents invested in the development of the COVID-19 pandemic health safety and security protocols and have purchased robots for cleaning services, while only 3% have invested in the development of apps (for iOS and/or Android, etc.) to increase the degree of independence of their tourists/customers.

Next, the investigation of the influence determined by certain variables upon the behaviour of the studied hotels was considered. In this sense, the authors opted for the unifactorial one-way analysis of variance (ANOVA), with a 95% confidence level. As most hotels rather indicated a business profile, it was decided to only research the influence of the classification level, respectively, the international affiliation on hotel practices. International affiliation is weakly associated with the level of familiarity of employees with the provisions of GD ($p=0.015$, adjusted $R^2=0.1374$), while the classification level is not related to this aspect.

In the case of environmentally friendly hotels, there is a strong orientation both towards local/local producers of agri-food products ($p=0$, adjusted $R^2=0.7649$, link) and towards those of cosmetics and hygiene products ($p=0$, adjusted $R^2=0.6262$). The same trends appear in relation to the classification level: the orientation towards local agricultural producers ($p=0$, adjusted $R^2=0.7407$) and personal care products ($p=0$, adjusted $R^2=0.6943$), respectively, towards the encouragement of customers to have an eco-friendly attitude towards the environment in relation to changing bed sheets and towels ($p=0$, adjusted $R^2=0.8506$), with high intensities. Furthermore, the association of the classification

level with the orientation towards local producers in general is confirmed by a moderate intensity (p=0, adjusted $R^2$=0.4146) but also by the purchase of organic products (p=0.004, adjusted $R^2$=0.1858) and by the provision of catering services (p=0, adjusted $R^2$=0.4066), with low or moderate intensities.

In the context of the COVID-19 pandemic, the existence of a sustainable development policy is directly but weakly associated with the orientation towards local producers in general (p=0, adjusted $R^2$=0.3657), respectively with an average intensity towards local farmers (p=0, adjusted $R^2$=0.5875) and to local cosmetics manufacturers (p=0, adjusted $R^2$=0.5003), as well as with the stimulation of the ecological behaviour of tourists, through an intense connection (p=0, adjusted $R^2$=0.7188), slightly with the implementation of electronic check-in (p=0, adjusted $R^2$=0.2638), but more intense with the issuance of electronic invoices (p=0, adjusted $R^2$=0.6139), and with the implementation of electronic payment systems (p=0, adjusted $R^2$=0.6625).

**Conclusions**

Sustainability is most often approached as a theoretical concept, while digitalization tends to be approached mainly from a practical perspective. The concretization of the theoretical connotations, with which sustainability is usually associated, by identifying the benefits on sustainability derived from digitalization in the hotel industry is the main contribution of this study.

After analysing the research results, it can be concluded that out of the three working hypotheses, only two are being verified. Thus, hypothesis one shows that more than half of the respondents did not hear anything about the GD, which means that this hypothesis is not confirmed. Instead, the second hypothesis is confirmed, more than half of the respondents apply the principles of sustainable development and environmentally friendly policies; the level of classification is the most important triggering factor of this orientation. The third hypothesis has the highest percentage of positive answers, which confirms that the pandemic has accelerated the digitalization process that implicitly contributes to the development of smart cities. Although the presence of the IT sector brings the city of Cluj-Napoca to the forefront, the solutions related to digitalization in the hotel industry are poorly represented. In addition, they are not linked to the implementation of sustainable development in the hotel industry. The study highlights the importance of involving the IT sector not only in the development of digitalization solutions adapted to the current pandemic context (COVID-19), but also in considering their contribution to the sustainable development of the hotel units for which they are created, as well as to sustainable development, in general.

Lodgings have not demonstrated an increased capacity to integrate solutions related to digitalization or sustainability, even if the current context has amplified the need to emphasize the first aspect, and also highlighted the strong human impact generated by unsustainable behaviours. However, only fast digital solutions were sought that would address the problems posed by the pandemic, which were not correlated with sustainability, neither in general nor in particular (with the independent or affiliated hotel policy). We consider that one of the directions that the study highlights is related to the implementation of digital solutions, correlated with policies regarding sustainability, whether they are

simple or complex, and regardless of the level of decision or type of activities involved, based on the principle of local action in the context of global thinking.

According to the opinions expressed by the leaders of the professional and entrepreneurial associations of the Romanian hotel industry, meeting the goals of the GD and having the ability to adapt under the conditions of the pandemic situation are two crucial challenges for the Romanian hospitality sector. Their opinions confirm the main conclusions of our study. Therefore, from a managerial perspective, one of the most important aspects that hotels must consider is to improve their communication process with both their employees and their customers and to increase their awareness of the sustainable development goals they have as businesses. Both the responses received, and the investigation activity have led to the conclusion that hotels need to increase the awareness of their employees about their policies and procedures in general, not only those related to the job descriptions of employees. Other areas that lack awareness among both employees and tourists are the waste management policies of hotels and their implementation, respectively, the digitized services of hotels.

From the perspective of their community involvement, hotels should better cooperate with local producers of both agricultural products and cosmetics and personal care and hygiene products. Furthermore, hotels should reconsider the way they provide toiletries so that they diminish their no recyclable waste. In the same line, the implementation of automatized lightning systems and of water supply systems is also an area to carefully regard by the respondents. For this to be implemented successfully, the state's support intervention is crucial, as in the case of the hotel's orientation towards green energy sources. Additionally, hotel owners and managers must focus on the adoption and implementation of the most appropriate IT&C solutions. Other suggestions can regard the provision of sustainable services, such as: introducing independently or with the support of the city hall of electric shuttles that would connect the lodging facility to the city centre/railway station/airport, etc. The establishment for parks of electric bicycles, scooters, etc. is another environmentally friendly measure to adopt.

The limitations of the current research include several aspects. First, the concrete involvement of the Cluj-Napoca IT sector in the solutions developed for the local hotel industry and for the hotel industry, in general, was not pointed out. An in-depth analysis of the responses received suggests that the respondents' reluctance to participate in research, in general, to some extent limits the correlation of the implications of studies in practice and vice versa. At this stage, there is no certainty that the results obtained in Cluj-Napoca can be extrapolated to other large cities in Romania.

The research enhances not only the extension of the study to the level of other major cities in Romania, but also the drawing of an overview of the domestic hotel market in terms of adaptation to current events, but also its future development. Such a study will lead to the identification of the most sustainable strategic directions that the Romanian hotel industry can adopt.

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# VEGETABLES CONSUMERS' PROFILE IN THE CONTEXT OF DIGITALIZATION: EVIDENCE FROM ROMANIA

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**Abstract**
The objectives of the European Green Deal are closely related to digitalization as a key factor in achieving them. Accordingly, this study aims at analysing the differences among the profiles of consumers from Romania regarding the method of payment used in online purchasing of fresh vegetables from local producers. Using Multiple Correspondence Analysis and Logistic Regression, main results showed similarity in consumers' profiles using debit card and bank transfer, where individuals with ages between 19-49, with an income in the household equal to at least 6,000 RON (1,213 EUR), having at least a Master's Degree and a high frequency of buying products online, are mostly included while, in the case of cash payment, the following characteristics were observed: age between 50-64, income between 3,000-4,499 RON (606-909 EUR), mainly Bachelor's Degree, and a low frequency of buying products online. Our results revealed that local vegetable producers should be prepared to adapt themselves to digitalization. People seem to be open to it and, for responding to such digital needs, the farmers must get out their comfort zone and become aware that this adaptation becomes a mandatory requirement on the actual market.

**Keywords:** digitalization, local vegetable producers, consumers' profile, on-line purchase, method of payment, short supply chains, Romania

**JEL Classification:** D01, D12, O14, Q13

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**Introduction**

The European Green Deal (EGD) has been intended as a strategic and legislative plan with a significant impact on the European economy and society (Pîrvu, 2020), setting an ambitious target: Europe to become the first climate-neutral continent by 2050 (Pîrvu, 2020; Zlaugotne et al., 2020). It covers all sectors of economy (Pîrvu, 2020), including numerous strategies and plans, inclusively a "farm to fork" sustainable agriculture strategy (Siddi, 2020).

Going further and referring to the strategy related to agriculture, the Farm-to-Fork Strategy needs to move towards more sustainable and resilient food systems. Among the six principal objectives of this strategy – which feed into and are in turn influenced by other strategic objectives of the European Green Deal (Matthews, 2020), the ones regarding (1) encouragement of sustainable food consumption; (2) promotion of affordable and healthy food for all; (3) improvement of farmers' position in the value chain – are the objectives followed up in the present study. A key factor in achieving the EGD objectives is the fact that the European Union should make the most of the potential of digital transformation. Accordingly, our paper mainly aims at analysing the profiles of the consumers of vegetables produced by local farmers that turn to digitalization in the process of promotion and distribution of their fresh products and that directly deliver them to customers' doors within short supply chains. In detail, our focus was laid on observing the differences among consumers as a function of their most frequently method of payment, i.e. cash or helped by the bank as an intermediate, through bank card or bank transfer, and also on the preferred ways of obtaining offers and placing orders, i.e. online platform, web page, Facebook, e-mail, phone or others. Focus on the digitalization of vegetable producers comes to respond to the care for better informing consumers about the food they buy, gaining customers' trust and loyalty, inclusively through digital means, as pointed out in the Farm-to-Fork Strategy of the European Green Deal (European Commission, 2019).

The "local" has been frequently associated with sustainable and healthy production and consumption patterns (DuPuis and Goodman, 2005), fostering the growth of niche products and allowing "weak" actors in the system – in particular, farmers – to challenge "big food" with alternative principles, values, organizational patterns, and business models (Morgan, 2010; Brunori et al., 2016). Consequently, while also following the special indications of the European Green Deal, our endeavour could represent a useful guide for local vegetable producer's vs their relationship with customers, thus encouraging the consumption of sustainable food, while also improving farmers' position in the value chain.

This is not an easy concern to answer, however our study aimed at capturing the indicative lines that delineate reality, although it will not provide ultimate general figures in this regard. Still, it could shape some specific peculiarities regarding the frequency of ordering, the preference for making a standing order, age, education, income, number of persons in household and other important elements capable of enriching the knowledge regarding the profiles of vegetable consumers as a function of their preferred method of payment. Accordingly, our findings could ultimately respond to the question regarding the way vegetable producers should manage the digitalization of their promotion and distribution processes for a more efficient orientation as to customers' needs, preferences, and requirements.

This paper is structured in four parts. After the Introduction, section 1 deals with the scientific literature, and section 2 contains a description of the data and methodology used. The results are presented and discussed in section 3. The paper ends with the conclusions in section 4.

## 1. Review of the scientific literature

Digitalization has been identified as one of the major trends within a society, affecting both people's life and business environment (Parviainen et al., 2017). In this way, the adaptation and utilization of digital technologies are imposed by the actual fast-changing context (Annarelli et al., 2021). Across the literature, the many positive effects of digitalization within an organization are pointed out, such as: improving work efficiency, innovation, and quality of management decisions, reducing costs, increasing company visibility and communication, putting the customer in the centre of activities (Parviainen et al., 2017; Baber, Ojala and Martinez, 2019; Stoyanova, 2020; Brumă et al., 2021). In addition, awareness on this potential goes closely together with understanding and accepting the inevitable transition (Stoyanova, 2020).

Moving on and pointing out a more punctual aspect, as Baber, Ojala and Martinez (2019, p. 4997) mentioned, digitalization of delivery channels and its impact on firms' business models represent relatively new phenomena. In this respect, the first aspect to be pointed out is, as also mentioned by Krasyuk et al. (2020), that the changes registered in the behavior of the consumer, who has to be perceived "as a full participant in the business ecosystem", should determine changes in the manner in which the distribution channels are designed and coordinated, from the perspective of digital connectivity and transition to a more complex system (Krasyuk et al., 2020). In detail, it is generally accepted that a deep understanding of consumer's behavior is of great importance for all companies (Kotler and Keller, 2006; Ulman and Dobay, 2016; Krasyuk et al., 2020). Accordingly, the facets of the buying process should also be taken into consideration (Mihart, 2012), this perspective potentially guiding the companies to direct their marketing communications and actions, distribution (and the related range of activities) included, starting from consumer needs and interests (Kitchen et al., 2004).

In this respect, the interaction between buyers and sellers, assured through digital means (Baber, Ojala and Martinez, 2019) like online platforms, Facebook, web pages, etc., have a critical role to firms, providing content and related services (Cortimiglia et al., 2011; Diba and Wagner, 2015) and helping them easily and quickly reach many potential customers (Cortimiglia, Ghezzi and Renga, 2011; Diba and Wagner, 2015). The use of an integrated approach to Internet marketing (Achtenhagen, Melin and Naldi, 2013), which confidently leads to good results (increasing the number of incoming addresses, i.e., calls, orders; increasing sales, increasing market share, etc.) could bring about advantages, inclusively for agribusiness enterprises, over competitors. Before choosing the most effective tools for product promotion, it is very important to determine the main groups of future consumers and the product promotion and/or distribution strategy for each target group, based on detailed research, as Popova et al. (2020) also pointed out.

Unfortunately, most enterprises in the field of agriculture are still fundamentally far from what modern interactive media could offer (Popova et al., 2020), especially in the countries – Romania included – having not yet reached the last stage of development, i.e. the innovation-based economies (Brumă et al., 2021). It is on the last place out of 27 EU Member States in the 2021 edition of the Digital Economy and Society Index (DESI, 2021, p. 3). In terms of connectivity, progress continued in 2020, but the adoption of services has been slower. Connectivity, human capital, e-government, digital public services and local digital ecosystems, digitalisation of enterprises, investments in digital capabilities and the implementation of advanced technologies, as areas of digital policy, are included in the

National Recovery and Resilience Plan (DESI, 2021). In the context of digital economy development, BTL market solutions and tools for the integrated Internet marketing, are of interest, the technologies proposed by Internet for agricultural and processing enterprises involving especially contextual advertising, promotion in social networks, creation of an online store, etc. (Popova et al., 2020).

Even though the importance of digitalization is well-known, companies are often struggling hard to attain its potential impact and benefits, meeting many obstacles in the process. On one hand, this requires a major change/ paradigm shift in habits and ways of working, based on collaboration and intensive interactions (Parviainen et al., 2017), in the context in which the problems that farmers are facing are diverse, ranging from lack of access to information related to inputs and markets, financing difficulties, up to lack of ability to analyse market data and forecast proper production, etc. (Vlachopoulou et al., 2021).

On the other hand, a recent study (Brumă et al., 2021) emphasized that, in a punctual case, a community of consumers interested in a distribution system best adapted to the digital transformation of the contemporary society does exist. Moreover, when searching for information and placing orders, consumers declared themselves interested in having access to additional information about the purchased products, as also confirmed by Annunziata et al. (2016). These findings emphasized the real need for digital transformation, aimed at developing media channels for the presentation of product offering and for order management, inclusively in terms of implementing the necessary measures for card payments and bank transfer, if 47% of the respondents declared they prefer such a system (Brumă et al., 2021). Our study appears as an ongoing endeavour for completing these results and offering a more general perspective, while extending the initial findings to a larger number of consumers, from a larger geographical area, and delineating the profiles of vegetable consumers as a function of the method of payment selected with empirical tools.

## 2. Research methodology

The *aim of the present study* is to determine consumer's profile *vs* the payment method used in online purchasing of fresh vegetables from local producers.

The *objectives of the research* are related to:

- Identifying the reasons for orientation towards socialization channels;
- Determining consumer profiles for each payment method;
- Investigate the link between socio-demographic variables and payment methods used.

We start from the following *hypotheses*:

*H1*. In the case of vegetable consumers, there is a high openness in turning on modern social channels for obtaining information and offers and placing orders.

*H2*. Consumer profiles for each payment method (debit card, cash payment and bank transfer) differ depending on various socio-demographic variables.

*H3*. The payment method that is used by the vegetable consumers is significantly influenced by socio-demographic aspects such as age, gender, level of education, and income.

To this end, in the period between 10 April and 15 May 2020, the Rural Development Research Platform developed a questionnaire which was applied nationwide.

The respondents were contacted *via* social media networks (mainly Facebook, since it is the most accessed social media platform in Romania), e-mail and telephone, as well. In the process of collecting the data, for ensuring the respondents' anonymity, no personal identification data were requested. They were informed about their free participation, ensuring the withdrawing at any time from the study, without repercussions.

Respondents were grouped into three categories, based on their responses regarding the method of payment used: debit card, cash payment and bank transfer. Each of the respondents had to answer some questions about frequency of ordering, quantity of products ordered, price that they are willing to pay and socio-demographic data. We mention that the relationship between the payment method chosen by the client and other socio-demographic variables has not been extensively analysed across the literature. However, there are several studies that addressed the issue (Mascarenhas and Phad, 2021; Sowmya and Hebbar, 2021), highlighting especially factors related to age, educational level, and gender. Moreover, elements such as the agreed method of payment, the frequency of purchases, the interest for a subscription, etc. are variables that address the relationship between producer and consumer, meeting the objectives set out in this study. Table no. 1 listed the variables used in constructing the three consumer's profiles. The variables reflect the questions from the questionnaire and their possible answers. Thus, no transformations were performed on the variables before their use in the study.

**Table no. 1. Description of variables**

| Variable | Description | Reference category |
|---|---|---|
| Payment_ Method | The payment method agreed by the respondent for the products ordered online (1 = Debit card, 2 = Cash payment, 3 = Bank transfer). | None |
| Frequency | Frequency of purchasing fresh vegetables (0 = Low, 1 = High). | 0 |
| Subscription | Interest for the delivery of products ordered online based on a monthly subscription (0 = No, 1 = Yes). | 0 |
| Quantity | Quantity of products the respondent is interested in ordering online from local producers (0 = Small (maximum 5 kg), 1 = Large (at least 5 kg)). | 0 |
| Price | Minimum price that the respondent would be willing to pay for direct delivery from local producers (0 = Low (maximum 100 RON, approx. 20 EUR), 1 = High (minimum 100 RON, approx. 20 EUR)). | 0 |
| Age | Respondent's age (1 = 19-34, 2 = 35-49, 3 = 50-64, 4 = 65+). | 1 |
| Education | Respondent's level of education (1 = Middle School – UNESCO (2011), levels 1 and 2, 2 = High School – UNESCO (2011), level 3, 3 = Bachelor's Degree – UNESCO (2011), level 6, 4 = Master's Degree – UNESCO (2011), level 7, 5 = PhD – UNESCO (2011), level 8) | 1 |
| Gender | Gender of respondent (0 = Male, 1 = Female) | 0 |
| No_Persons | Number of people living in the household, including the respondent (codes from 1 to 6) | 1 |
| Income | Income at household level (1 = <3,000 RON, approx. 606 EUR, 2 = 3,000-4,499 RON, approx. 606-909 EUR, 3 = 4,500-5,999 RON, approx. 910-1,212 EUR, 4 = 6,000-7,499 RON, approx. 1,213-1,515 EUR, 5 = 7,500-8,999 RON, approx. 1,516-1,818 EUR, 6 = 9,000-10,499 RON, approx. 1,819-2,121 EUR, 7 = 10,500 + RON, approx. 2,122+ EUR) | 1 |

For determining consumers' profiles, the following three steps were established: (1) running a descriptive analysis of the respondents, considering their socio-demographic characteristics (i.e., gender, age, and educational level) and aspects regarding the communication with local producers; (2) applying the Multiple Correspondence Analysis (MCA) to identify the associations between the variables considered; (3) applying Logistic Regression models in order to determine which factors have significant impact on the probability of using a certain method of payment.

MCA aims at identifying a group of respondents with a similar profile of their answers to the questions of the survey, and also the associations among the categorical variables (Abdi and Valentin, 2007). Regarding Logistic Regression, it is a process of modelling the probability of a discrete outcome given several input variables. This type of regression is an extremely robust and complex method for the prediction of dichotomous classification, representing a method used for classification when the aim is to identify if the statistical units belong to a specific category or another (Edgar and Manz, 2017).

## 3. Results and discussion

### 3.1. Descriptive analysis

The sample size comprised 1,788 respondents from urban areas. The number of valid answers is higher than the estimated sample size (1,068) in the case of Romanian population, while considering the 95% confidence level and the 3% margin of error. Figure no. 1 shows the structure of the sample according to the socio-demographic variables considered.

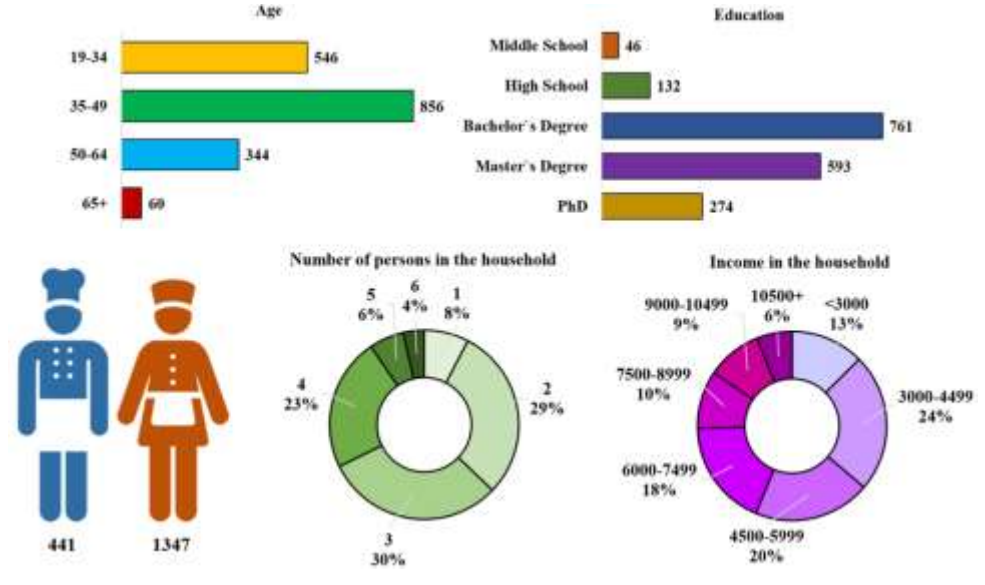


**Figure no. 1. Sample structure by age, education, gender, number of persons in the household, and income in the household**

*Source: Authors' contribution using Tableau Public 10.3*

In terms of gender, our respondents are represented by 441 males and 1,347 females with ages ranging between 19-34 years (546 respondents) - 35-49 years (856 respondents) - 50-64 years (344 respondents) to 65+ years (60 respondents). The largest group occurs in the 35-49 age range, representing 47.39% of all respondents. The last age group (65+ years) registered the lowest frequency (3.32%). In terms of educational level, 90.14% of the respondents have higher education, levels 6-8 according to UNESCO (2021), and 48.01% of them also have master's or PhD studies, levels 7-8 according to UNESCO (2021). The number of persons in the household is another important indicator in our investigation, an unequal distribution being observed in this regard, namely: 50% respondents with 3 (30%) or less than 3 persons in their household (37%), 23% of them coming from households with 4 persons, while the rest of the persons interviewed have larger families. Regarding the monthly income, it also varies from less than 3,000 RON, approx. 606 EUR (13% of the respondents) to more than 10,500 RON, approx. 2,122 EUR (6%), the higher part of them (44%) earning between 3,000 and 5,999 RON, approx. 606-1,212 EUR (Figure no. 1).

In terms of ways of obtaining offers and payment methods used, it can be observed that: 1) the persons preferring to pay with a debit card have an approximately similar preference for obtaining offers from online platforms (29.20%), sites (30.82%) and Facebook (28.55%); 2) the same situation of equilibrium could be observed for the persons that prefer the bank transfer as way of payment for their vegetable orders (25.1%; 27.8%, and 33.59%, respectively); 3) on the contrary, when cash is used, the tendency seems to prefer especially Facebook (38.22%), but also sites or online platforms, even if in lower percentages (23.76% and 23.55%, respectively); 4) a low tendency to prefer e-mail or other ways of obtaining offers (like phone messages or direct calls) (Figure no. 2). These results confirm hypothesis H1.

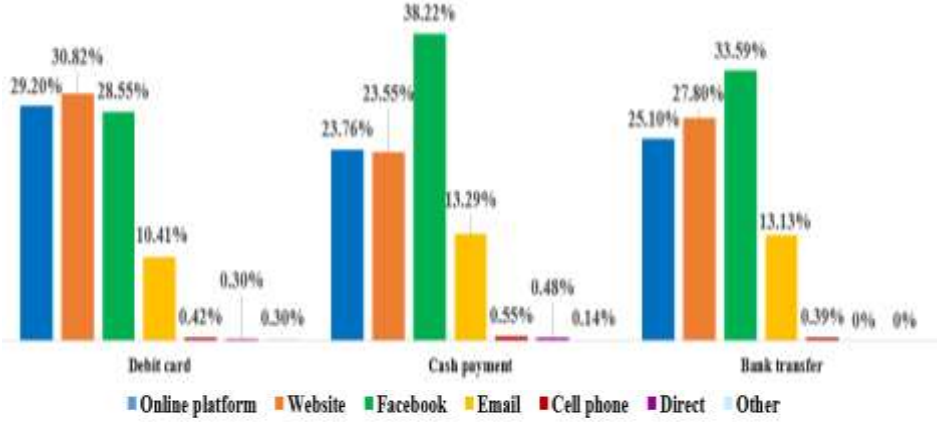


**Figure no. 2. Modalities of obtaining offers and payment methods used**
*Source: Authors' contribution using Tableau Public 10.3*

Analysis in terms of placing offers and payment methods used shows that: 1) the persons preferring to pay with a debit card have an approximately similar preference for placing offers on online platforms (33.92%), online order form (26.49%), message on Facebook (15.26%), e-mail (10.94%) or phone (13.39%); 2) an almost similar situation could be met for the persons that prefer bank transfer as way of payment for their vegetable orders (20.43%, 24.17%, 21.1%, 11.81%, and 22.48%, respectively); 3) in the same manner, when cash is used, the tendency seems oriented towards online platform (26.75%) or order form

(26.42%), but also Facebook or phone, in approximately similar percentages (17.39% and 16.72%, respectively), while e-mail seems to be the least preferred means (12.71%); 4) in the case of placing orders, the more traditional methods, like phone or e-mail, are still among the main preferences of vegetable customers, unlike the case of offers obtaining (Figure no. 3). These results confirm the hypothesis H1.

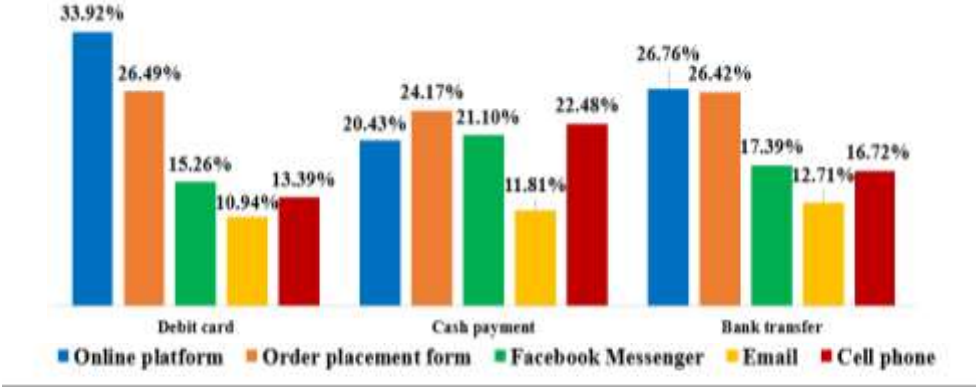


**Figure no. 3. Modalities of placing offers and payment methods used**
*Source: Authors' contribution using Tableau Public 10.3*

As shown in Figure no. 4, when analysing the way customers prefer to buy in terms of products and quantities, in general, vegetable consumers prefer to choose the products and quantities they bought each time. In this way, the basket with pre-set products and quantities seems not the best option, whether it's those who buy with debit card, cash, or bank transfer, in the case in which only 8.58% of the respondents have chosen it.


**Figure no. 4. Preference for placing offers and payment methods used**
*Source: Authors' contribution using Tableau Public 10.3*

In detail, (1) the persons who buy with debit card and prefer a pre-set shopping basket represent only 8.28% of the total respondents using this method of payment, (2) the ones that use cash and choose the pre-set basket are 8.5%, while (3) the ones using online transfer and preferring a shopping basket with pre-set products and quantities represent 10.95% of the respondents using such payment method. In this way, it can be assumed that most respondents, whichever their preferred method of payment, prefer to choose each time the type of products and specific quantities bought.

### 3.2. Multiple Correspondence Analysis

The results of the Multiple Correspondence Analysis (MCA) reveal consumers' profile regarding the analysed variables as a function of each of the payment methods used (i.e., debit card, cash payment and bank transfer). In Figure no. 5, the three consumer's profiles are represented as follows: red area for debit card, green area for cash payment and blue area for bank transfer.

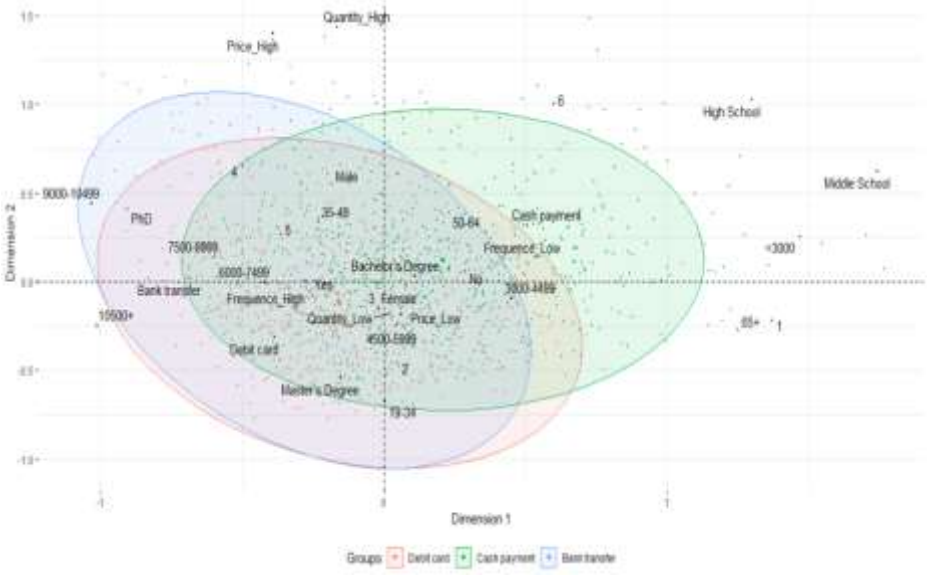


**Figure no. 5. Associations among variables by the payment method**
*Source: Authors' contribution using R 4.1.1*

When using debit card and bank transfer as payment methods, consumer's profiles are similar, mostly including individuals with ages between 19 and 49 years, that have an income in the household varying within the 6,000-10,500 RON, approx. 1,213-2,122 EUR, interval and higher, and having at least a master's degree, level 7 according to UNESCO (2021). Also, these respondents are characterized by a high frequency of buying products online. In the case of the cash payment method, consumer's profile has the following characteristics: ages between 50-64 years, household income between 3,000-4,499 RON, approx. 606-909 EUR, mainly bachelor's degree, and a low frequency of buying products online. The results confirm the hypothesis H2.

Few extreme cases regarding some categories of age (i.e., 65+ years), income in the household (i.e., <3,000 RON, approx. <606 EUR), education (i.e., Middle and High School), price (i.e., high) and quantity (i.e., high) were identified. As the number of respondents with these characteristics was very low, they were not included in any consumer's profile. In addition, no significant differences were observed in terms of gender and intention of subscription.

### 3.3. Logistic Regression

To determine the significant factors influencing the probability of choosing a specific payment method, logistic regression was applied. Table no. 2 presents the results obtained

for each of the estimated models, taking into consideration the payment method frequently used by the respondents when they buy products online.

The results obtained in the model estimated for the respondents who mentioned debit card as the payment method used reveal that age, education, number of persons living in the household and income in the household represent significant factors for choosing it (Table no. 2). The influence of age and number of persons living in the household is a negative one, an increased level of each of these two variables determining a decrease in terms of the probability to use debit card as a payment method (Coef = -0.183, Prob = 0.01 for Age and Coef = -0.191, Prob = 0.01 for No_persons). The results also indicate that education and income in the household have a positive influence on the dependent variable. In this way, an increase in their level determines an increase in the probability of using debit card as a payment method, as well (Coef = 0.356, Prob = 0.01 for Education and Coef = 0.163, Prob = 0.01 for Income).

**Table no. 2. Econometric modelling results**

| ***Variable*** | ***Debit card*** | | ***Cash payment*** | | ***Bank transfer*** | |
|---|---|---|---|---|---|---|
| | Coefficient (Std. error) | Exp(B) [Wald] | Coefficient (Std. error.) | Exp(B) [Wald] | Coefficient (Std. error.) | Exp(B) [Wald] |
| Frequency | 0.127 (0.115) | 1.136 [1.233] | -0.017 (0.116) | 0.983 [0.022] | -0.377* (0.210) | 0.686 [3.252] |
| Subscription | 0.119 (0.110) | 1.126 [1.162] | 0.059 (0.112) | 1.061 [0.279] | -0.652*** (0.216) | 0.521 [9.134] |
| Quantity | -0.109 (0.178) | 0.896 [0.378] | 0.065 (0.179) | 1.067 [0.132] | 0.159 (0.305) | 1.172 [0.266] |
| Price | -0.040 (0.158) | 0.961 [0.064] | -0.137 (0.160) | 0.872 [0.737] | 0.515** (0.254) | 1.673 [4.085] |
| Gender | -0.143 (0.126) | 0.867 [1.281] | 0.107 (0.128) | 1.113 [0.700] | 0.128 (0.242) | 1.136 [0.277] |
| Age | -0.183*** (0.070) | 0.833 [6.732] | 0.244*** (0.071) | 1.277 [11.741] | -0.217 (0.135) | 0.805 [2.575] |
| No_Persons | -0.191*** (0.048) | 0.827 [15.855] | 0.207*** (0.048) | 1.230 [18.552] | -0.040 (0.088) | 0.961 [0.175] |
| Education | 0.356*** (0.062) | 1.428 [32.912] | -0.392*** (0.063) | 0.676 [38.778] | 0.120 (0.115) | 1.128 [1.094] |
| Income | 0.163*** (0.034) | 1.177 [23.684] | -0.206*** (0.035) | 0.814 [35.293] | 0.115* (0.060) | 1.122 [3.737] |
| Constant | -0.982* (0.536) | 0.375 [3.359] | -0.632 (0.543) | 1.882 [1.354] | -2.336** (0.968) | 0.097 [5.822] |
| Hosmer and Lemeshow Test | 9.478 [0.304] [(a)] | | 3.108 [0.927] | | 8.327 [0.402] | |
| Omnibus Test | 127.491 [0.000] | | 166.326 [0.000] | | 42.531 [0.008] | |

*Notes:* *, ** and *** show the statistical significance of the regression coefficient at 10%, 5%, and 1% level, respectively; [(a)] the values in [ ] brackets represent P-values corresponding to Chi-square from Hosmer and Lemeshow Test and Omnibus Test.

*Source: Results obtained using R 4.1.1*

In the model in which the dependent variable stands for the probability to use cash payment as the payment method, the results contradict those obtained in the previous model: variables age and number of people living in the household have a positive impact on the probability of

using cash payment (Coef = 0.244, Prob = 0.001 for Age and Coef = 0.207, Prob = 0.01 for No_persons), while education and income in the household have a negative impact (Coef = -0.392, Prob = 0.01 for Education and Coef = -0.206, Prob = 0.01 for Income).

Table no. 2 also lists the results obtained for the respondents that frequently use bank transfer as a payment method. In this case, the increasing frequency of online use for placing offers or making a subscription reduces the probability of using bank transfer (Coef = -0.377, Prob = 0.10 for Frequency and Coef = -0.652, Prob = 0.01 for Subscription). Moreover, any increase in income in the household or in price has a positive effect on the probability of using this method of payment (Coef = 0.115, Prob = 0.10 for Income and Coef = 0.515, Prob = 0.01 for Price).

In more detail, several results may be mentioned regarding the differences between the reference category of a variable and the rest of categories. For instance, in all models, significant differences do exist among: 2 the reference category of Income (i.e., <3,000 RON, approx. <606 EUR) and the other ones, more precisely, an increase in the level of this variable positively predicts the probability of using debit card or bank transfer, and negatively predicts the probability of using cash payment. The same situation can be observed for the differences among the reference category of Education (i.e., Middle School, levels 1-2 according to UNESCO (2021)) and the other three categories, when the increase in the level of education determines an increase in the probability of using debit card and a decrease in the probability of using cash payment. Contrary to variables Income and Education, in the case of Age, an increase of its level beyond the reference category (i.e., 19-34 years) determines a decrease in the probability of using debit card as payment and an increase in the probability of using cash payment. Table no. 2 also indicates the goodness-of-fit-statistics for each of the models estimated. The high P-values of the Hosmer and Lemeshow test indicate that the models are well-fitted. In addition, the Omnibus tests of model coefficients give significant values ($P< 0.05$), confirming the causal relationship between the proposed logit models and acceptance of the hypothesis that $\beta$ coefficients are different from zero. The results obtained confirm the hypothesis H3.

All these empirical results show that, in the case of younger customers, a better adaptation to the general digitalization process within societies is observed, while the most appropriate way of payment for this category of public seems to be the debit card. The eldest (65+ years) seem to remain more loyal to the classical cash manner of payment, although they adapted themselves to online orders. In addition, another explanation could be that they are more attentive to their income and spending, because, on one hand, of their locking into a routine followed along their entire life, marked by the indigence of the communist period or, on the other, because of their actual life material conditions, once known that the Romanian retired persons are not especially an advantage group within the society from the perspective of income and/or social protection. The cautionary specificity of spending could be also observed when the influence of the number of persons from the household is analysed in relation to the method of payment. As the family grows, the avoidance of risks assumed in the case of transfers intermediated by banks, especially when discussing perishable products like vegetables, seems to be more pronounced, while the probability to pay with cash is higher in this case. In addition, this cautionary behaviour is confirmed by other results of the present analysis, in the case of the income variable, that is shown to negatively influence the probability of paying with cash. This means that, as the income decreases, the option for paying with cash in the case of vegetable purchasing is more frequent.

Consequently, as shown by our results, local vegetable producers should be prepared for adaptation to digitalization if they intend to have a durable, efficient, resilient, and profitable business. People seem to be open to online promotion, prepared for placing orders through digital channels, and also, especially in the case of younger persons, to pay their orders by debit cards or even by bank transfers. For responding to these digital customers' needs, the farmers have to get out of their comfort zone and work for the digitalization of their activity, reconfirming, in this way, the results of other studies (Abid and Jie, 2021; Gautam, Bhimavarapu and Rastogi, 2021; Popescu and Popescu, 2021; Prause et al., 2021). Once the orientation to the profiles of consumers is a must in the marketing theory, they have to understand that, even in the societies that have not yet reached the last stage of development and do not have innovation-based economies, this adaptation becomes a compulsory requirement which will allow vulnerable actors in the system – in particular, farmers – to actively and efficiently participate in the process of challenging "big food".

Our study concretes into a shy initiative (but considered necessary by us) for observing the vegetable consumers profiles in function of their preferred method of payment in a certain context. Among the limits of this paper, we mention: (1) the sample structure that is applied on the urban areas, (2) the limited number of variables considered to be main important factors for contouring the profiles of the respondents, and (3) the impossibility to place the study in a specific international context.

## Conclusions

Digitization is an essential condition for the resilience of local vegetable producers in the years to come, and the COVID-19 Pandemic has created a good premise for this entrepreneurial digitization to start a little earlier than we would have expected, especially in the agri-food sector. The principle regarding the hegemony of the markets is reconfirmed, the Romanian consumer seeming to be prepared for making the transition to digitalization, in this case materialized through online orders and the use of dedicated platforms. Accordingly, producers have to respond to this need for digitalization, social media channels, especially Facebook groups, being the perfect link between consumers and agri-food producers. These appear to be the most accessible and resilient ones, outlining the bases for the digitization of the Romanian agri-food chains, both short and conventional ones. The present study highlights some specific peculiarities regarding age, education, income, number of persons in household, frequency of ordering, and preference for making a standing order, and other important elements, thus permitting understanding of the profiles of vegetable consumers as a function of their preferred method of payment.

A general low tendency to prefer e-mail or other ways of obtaining offers (like phone messages or direct calls) was observed, comparatively to online platforms, sites and Facebook, whichever the method of payment chosen. In this way, it can be concluded that consumers tend to orient more and more to modern social media channels for self-informing and obtaining offers while, in the case of placing orders, the (more) traditional methods, like phone or e-mail, are still among the main preferences of vegetable customers. Also observed was that the majority of respondents, whichever their preferred method of payment, opt for choosing each time the type of products and specific quantities, appearing as unprepared to a shopping basket with pre-set products and quantities, like the customers from other more developed markets.

Considering the main objective of the study – that of delineating consumers' profiles as a function of their preferred method of payment – it was found out that the profiles of customers using debit card and bank transfer were approximately similar, mostly including individuals with ages between 19-49, with an income in the household varying between 6,000-10,500 RON, approx. 1,213-2,122 EUR and higher, having at least a Master's Degree and a high frequency of buying products online. In the case of cash payment, consumers' profile is especially characterized by: age between 50 and 64, income in household between 3,000-4,499 RON, approx. 606-909 EUR, mainly Bachelor's Degree, and a low frequency of buying products online.

In addition, these findings showed that: (1) the eldest (65+) seem to remain more loyal to the classical cash manner of payment, although they adapted themselves to online orders; (2) as income decreases, the option for paying with cash for vegetable purchasing is more frequent; (3) as the family grows, the avoidance of risks assumed by transfers intermediated by banks, when discussing about perishable products like vegetables, seems to be more pronounced.

In this way, some general guidelines were established in terms of customers' responses and needs, in close relation with the digitalization of vegetable farmers. The obtained results showed the general orientation towards different channels of promotion and distribution, as a function of the method of payment chosen and also of the main determining factors about the probability of paying by debit card, cash or bank transfer. This represents the main contribution of this study, especially in the context in which we were not able to find specific studies that punctually analyse the same investigated problematic across the literature. Consequently, some clear digital customers' needs have been outlined, to which the farmers have to properly respond by getting out of their comfort zone and by working for a better integration of digitalization within their daily activity. Accordingly, these findings seemed to respond to the question regarding the manner in which vegetable producers should generally manage the digitalization of their promotion and distribution processes for a better adaptation to customers' needs, preferences and requirements that change over time.

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# EXAMINING THE CORRELATIONS BETWEEN INDUSTRY 4.0 ASSETS, EXTERNAL AND INTERNAL RISK FACTORS AND BUSINESS PERFORMANCE AMONG HUNGARIAN FOOD COMPANIES

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**Abstract**
The current maturity of enterprises has a significant development potential for the introduction of new technologies, and requires significant physical, mental and material resources. In this research, we examined the impact of the risk factors of Hungarian food production companies, Industry 4.0 tools, and the supporting and hindering factors affecting the companies, and how they affect changes in business performance. The questionnaire survey took place between 2019 and 2020, during which time we collected data from 276 food companies. The data were then analysed using a number of statistical methods: Cronbach's alpha index, factor analysis, PLS pathway analysis, indicator reliability index, composition reliability index, mean explained variance index, Fornell-Larcker criterion, heterotrait-monotrait ratio, magnitude of effect, fit goodness, predictive relevance, and road model coefficients. In this study we formulated three hypotheses related to Industry 4.0 tools, external and internal risk factors, and business performance, which we were able to accept during the study. By analysing the risk factors, we try to identify the types of external and internal risks that are most characteristic of companies, so that they can react to them as efficiently and quickly as possible, thus making the company effective and efficient at the same time.

**Keywords:** risk factors, Industry 4.0 assets, business performance

**JEL Classification:** F23, G32, L26, M16

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## Introduction

Newer technologies also carry risk factors that influence the decisions of company executives. It does not matter whether companies have an influence on the factors that cause the risks, or whether the risks affect the companies. In this sense, we can distinguish between internal and external hazards. We speak of external risk when the company has little, if any, influence over the factors that trigger the risk, which is why it is important for the company to develop a strategic plan to manage such risks. Examples of such are a unfavorable changes in demand, changes in the regulatory environment of the industry, and unexpected moves by competitors. Interior (internal) risk is when the company can influence various risk factors within its competence, such as obsolescence of equipment and technologies, lack of maintenance, lack of interior (internal) procedures and regulations, and the use of unskilled labor. In the research we pay attention to the analysis of both external and interior (internal) risks, and we also examine the risk factors that food service providers may face as a result of technological changes.

The goal is to assess the strategies, developments and new technologies of the Hungarian food production companies, which may have an impact on the business performance of the companies and on changes in risk factors.

In section 1 we present in detail the characteristics of Industry 4.0 technology tools, external and internal risk factors, and the factors most influencing business performance examined in the research. In section 2 we present in detail the territorial location of the Hungarian food production companies studied, as well as a detailed description of the methods used in the analysis.

In section 3 the results, namely the direct and indirect effects included in the model were investigated and the regression equations written by using the PLS-SEM method. With the help of the path model set up based on the bootstrapping result, we determined the direction and strength of the relationship between the variables. The hypotheses formulated in the introduction were confirmed in the results section.

In section 4 we compare the results with the results of other researchers and literature sources, and finally in the last section we discuss the conclusions.

## 1. Literature review

### 1.1. Risk grouping in the food industry

According to Nolden and Feeney (2020) risk means that we do not know the future. In terms of the expected effects, the risk can be divided into two major groups: we speak of simple or pure risk in the case of risks threatening damage or loss. There are only two possible outputs here: either loss, damage, or the status quo. We talk about speculative risk when there are three possible outcomes: a loss occurs, the current state remains unchanged, and the result is a profit.

The economic consequences of damages can be twofold: either they cause additional cost or they reduce revenue. The costs of risk management consist of the costs of risk management activities and measures. The most important rule of risk management is that risk management expenditures must always be in proportion to potential losses (Moschini and Henessy, 2001).

In the food industry, risk management methods can be divided into 3 main groups (production, finance and market) according to which area of farming they are related to. Methods also include asset protection and insurance underwriting, which are generally accepted risk management methods (Tomchuk et al., 2018).

Moktadir et al. (2021) divides the risks into two parts. Systematic risk is the part of the risk that affects all companies and the company-specific risk that can only be eliminated by individual companies and diversification. The main components of risk, more specifically financial risk, are transactional and operational risk. The other two parts of transaction risk are price risk and credit risk. Operational risk arises from the activities of the company.

In addition, we can even talk about liquidity risk, which is related to the liquidity of the company. According to another division, we can mention value risk, currency risk and interest rate risk (Vlahos, 2001), which are actually part of the divisions according to Nagy et al. (2018). Again, in addition to the risks mentioned above, other sources also refer to country risk (Just, 2003), including political and economic policy risk (Oláh et al., 2017).

Even a separate investment risk can also be listed, as all the risk factors of companies also appear as a component of an investment risk. The number of factors influencing risk can be very large per area, including those that cannot be directly quantified. How many of these and which ones we select to prepare a decision is to some degree arbitrary and may also depend on the development of our knowledge and individual agreements (Pocol et al., 2021).

In particular, the main sources of risk for food businesses are (Colacito et al., 2018): Production risk, Market risk, Financial risk, Obsolescence risk, Accidental loss risk, Legal risk and Human risk factors.

Nagy et al. (2018) identifies another possible grouping, namely strategic and operational risks. Operational risk in the traditional sense is business and financial risk. Business risk is usually identified with the inherent uncertainty of financial performance. The main sources of risk in all product cycles are the following: price, costs, productivity, production uncertainty.

Risk sources can be very diverse, although all risk sources cannot be incorporate into our decisions, we must strive to take into account risk factors whose probability of occurrence is not negligible in our risk calculations (Oláh et al., 2019).

### 1.2. The relationship between corporate performance and innovation

Published foreign studies present the positive effects of risk management on information quality, risk-influenced decision-making, increasing corporate value, ensuring competitiveness, and achieving and preventing continuous improvements to ensure the smooth operation of the business (Kovács, 2017).

The market is constantly changing. Adaptation is essential for service providers and industrial companies to maintain or improve their current market positions. The market position of a company largely depends on its efficiency, competitiveness, customer focus, and flexibility and its role in the supply network (Takács and Toyserkani, 2014).

Maintaining a lasting competitive advantage is closely linked to the internal operation of the company. The basis of a company's success depends on its essential abilities, i.e. the abilities of the company based on the experience gained over the years, which its competitors cannot adapt to, or can only do so by working for many years (Vasa et al., 2020).

As defined by Slusarczyk et al. (2020), performance measurement is the process of measuring the efficiency and economy of an activity. The definition illustrates the two main dimensions of performance: Efficiency or effectiveness, which refers to meeting business objectives (or, according to others, meeting consumer needs); and economy, which means the economics of using the resources associated with achieving the goals.

Research into the relationship between corporate performance and innovation has examined the impact of R&D spending, and researchers have in most cases found a positive correlation between the two variables. Hasnan and Yusoff (2018) analysed data from American companies and found that increasing R&D expenditures could increase firm productivity.

An international survey based on the "Oslo Manual" allows the analysis of the relationship between company performance and innovation. In Hungary, Halpern and Muraközy (2010) investigated innovation activities and their impact, using the CIS (Community Innovation Survey) database.

Judgments about the productivity of new technologies are influenced by firm-level calculations that show that Industry 4.0 investment has significantly increased investor productivity (Bughin, 2016). It is worth considering the finding that performing the study at different times may skew the conclusions drawn from the results. In 2010, the majority of investors were companies with high capital and productivity, meaning that these observations are not generalizable and are not suitable for macro-level forecasts, either. In addition, the researchers performed calculations at the level of the national economy, including a study of 17 countries by Graetz and Michaels (2015), which clearly showed the impact of the use of industrial robots on economic and productivity growth. Using IT investments, companies are introducing new tools to increase production and thereby achieve revenue and profit as well as higher quality and performance (Popp et al., 2018).

### 1.3. Risks of digitization of food companies

According to expert data, 80% of the problems of food companies could be solved with the help of Industry 4.0 technologies, but most of the players in the industry are not even aware of the new tools and the developers are not aware of the problems in the sector (Bai et al., 2020).

An important challenge is to learn about new technologies as quickly as possible and to renew training. Society reacts significantly more slowly and adapts to the changes brought about by digitalisation (Corallo et al., 2018).

In the case of food companies, do not ignore safety issues either. The importance of data security is growing as companies produce huge amounts of data due to digital operation, which, if properly analyzed, can lead to better decisions. However, some of this information is sensitive data, so it is important to protect it (Javaid et al., 2020).

Digitization and artificial intelligence offer great opportunities and risks as well. Of course, the competition that can be characterized by the digital transformation can not only be a winner but also a loser at all levels: individuals, professions, companies, sectors, countries and societies. Managing challenges and risks is a shared responsibility of all stakeholders (Goti et al., 2022).

As a result of digitalisation, the following sources of risk for food companies can be distinguished (Santos et al., 2020):

- Data Management and Encryption: From a security perspective, it is key for companies to be aware of how sensitive their data is and how to properly encrypt and protect it.
- Zero trust: The essence of this method is that users only have access to sensitive data if they have verified their identity, which is a prerequisite for companies to use identity and access management systems that can handle both biometric identifiers and tokens.
- Vision of the entire environment: With the introduction of an intelligent, centralized corporate governance system, it is necessary to monitor events and filter out suspicious activities.
- Analytics and automation: Automation can be used to eliminate human error, but care must be taken to ensure that individual processes can be modified to perform malicious activities.

## 2. Material and methodology

### 2.1. Presentation of the research work and delimitation of the research area

The collection of secondary information was based on international literature sources. Industry 4.0 technologies, risk factors, and business performance literature and research address only specific areas of the topic. In the course of the literature search, we compared the statements formulated in international sources.

During the research we examined the following hypotheses:

**H1:** External and internal risk factors affecting the food company directly affect the use of Industry 4.0 technology tools.

**H2:** Industry 4.0 devices clearly have a positive, direct impact on business performance. The more Industry 4.0 tools a company uses, the more its business performance will increase.

**H3:** The extent of Industry 4.0 developments is negatively and significantly affected by the high cost of technologies, a lack of its own resources and a lack of skilled labour.

During the primary data collection, we conducted interviews at Hungarian food industry companies. The questionnaire survey was typically conducted between 2019 and 2020 at online professional events, as well as by personal and telephone inquiries.

Some of the topics and structure of the questionnaire, as well as the relationships between the topics are illustrated in figure no. 1, which is also the initial model of PLS road analysis.

The structure and composition of the questions were structured based on the literature read and collected during the research and prior consultation with five company executives in the food industry; thus, it was possible to draw attention to the less studied factors. As a result, we assessed the factors hindering and supporting the development of companies, the strategic goals of companies, the willingness of Industry 4.0 to use assets, external and internal risk factors, and the expected business performance and efficiency of companies in their development.

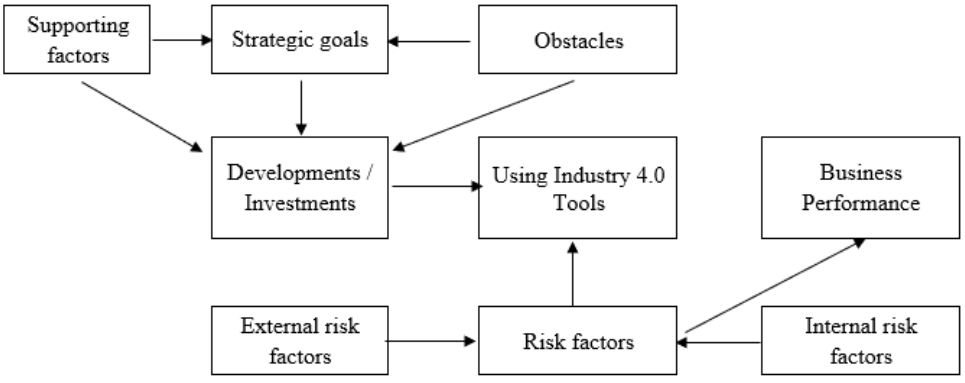



**Figure no. 1. Theoretical framework of the questionnaire and initial model of the PLS path analysis**

In Hungary, there are only a total of 1,157 companies categorised as food companies, of which 276 filled in the questionnaire after the survey; this number was reduced to 259 during the data cleaning. For the seven main topics of the questionnaire (barriers, supporting factors, strategic goals, developments, use of Industry 4.0 tools, risk factors, and business performance), we assigned statements, the consistency of which was established by a reliability test. Of the 97 statements made, two had to be removed from the model because the Cronbach's alpha value was too low to reduce the alpha value of the entire area.

The Cronbach's alpha values of the examined factors in the research are above 0.7 in all cases, therefore their reliability based on internal consistency is adequate for further research.

### 2.2. Methods used in the research

Statistical methods were used to process the collected data, as shown in figure no. 2. Reliability tests were performed to determine the internal consistency of the questionnaire. Cronbach's alpha is a measure of internal consistency. This metric divides the scale items into two possible ways and calculates a correlation between the two parts each time. The Chronbach's alpha index is the average of all correlation values thus obtained. This is the most commonly used indicator of internal consistency, which should reach a minimum of 0.6 (Cronbach, 1990).

When using PLS regression, the latent variable scores and the coefficients (parameters) associated with the latent variables are calculated in an iterative process. In the first step, latent variables can be created as a linear combination of (standardized) manifest variables.

During the first iteration, weights can be determined in a pseudo-random way for the manifest variables, which represent unit values, respectively. In the second step, the road coefficients are estimated for the internal model. in the third step, the latent variables can be estimated with internal weight coefficients (calculated in the second step), and in the fourth, the path coefficients are estimated for the external (measurement) model, thereby modifying the initial weights and restarting the whole process. PLS path analysis can also be applied to relatively small number of samples (Nagy et al., 2018; Aranyossy and Kulcsár, 2020).

Standardized factor weights (> 0.5), average variance extracted (AVE)> 0.5, and composition reliability (CR)> 0.7 can be used to check convergence validity (Hair et al., 2020).

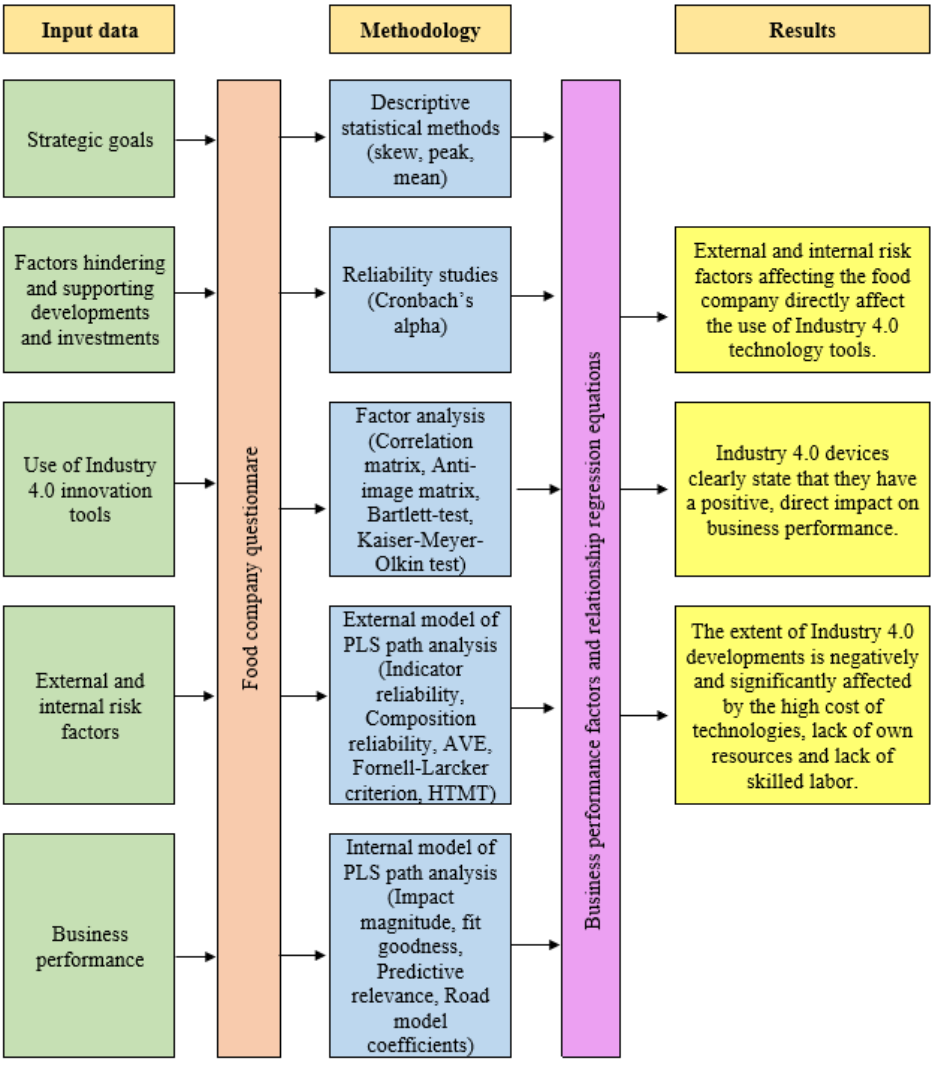



**Figure no. 2. Summary diagram of the applied methods**

The discriminative validity of the study constructs was tested by the method of Fornell and Larcker (1981), according to which the external, reflective model is valid in a discriminatory sense if the AVE square root of each construct exceeds the correlation between the elements and all other elements. The HTMT correlation ratio (heterotrait-monotrait) shows the quotient of the average of the pairwise correlation coefficients between the manifest variables associated with two latent variables and the average of the pairwise correlation coefficients between the manifest variables associated with the same latent variable. Henseler et al. (2015), it is sufficient to assume discriminant validity if the values of the HTMT indices are below 0.9.

The Goodness of Fit (GoF) index can be calculated as the mean of the mean explained variance and the mean R2. Previous research by Fornell and Lacker (1981) showed that the

Goodness of Fit index should be around 0.10 for a small sample, 0.25 for a medium sample, and 0.36 for a large sample. When testing predictive relevance (Q2), the Q2 value should always be greater than zero Chin (1988).

In the PLS-SEM, the path model coefficients can be used to determine the extent to which the target variable is affected by each variable. The estimated values of the latent variable can even have different signs for each sample. If the value of p for the path model coefficients for bootstrap sampling is less than 0.05, then the regression line is acceptable, i.e., the explanatory variables actually affect the target variable. The recommended number of bootstrap samples to be generated is 5000 (Hair et al., 2020).

The goal of Importance Performance Matrix Analysis (IPMA) is to identify historical variables that are relatively important for target constructs, but also relatively low-performing.

## 3. Results

### 3.1. Demographic and sectoral characteristics of food companies

Using the EMIS database, it can be said that most food companies are based in Budapest and Pest County. In the second place is Bács-Kiskun county, followed by Szabolcs-Szatmár-Bereg county, then Hajdú-Bihar county. Based on the data, it can be stated that in 2020 there were companies engaged in food production in every county in Hungary. More than 30% of food companies are engaged in the production of bakery products and pasta, and nearly 25% are engaged in meat processing, preservation and production. A total of two companies are engaged in fish processing and preservation in Hungary, and 11 companies are active in the production of vegetable and animal oils.

More than 70% of the respondents came from Central Hungary and the Northern Great Plain region. The fewest responses came from Central Western and Southern Transdanubia (Figure no. 3).

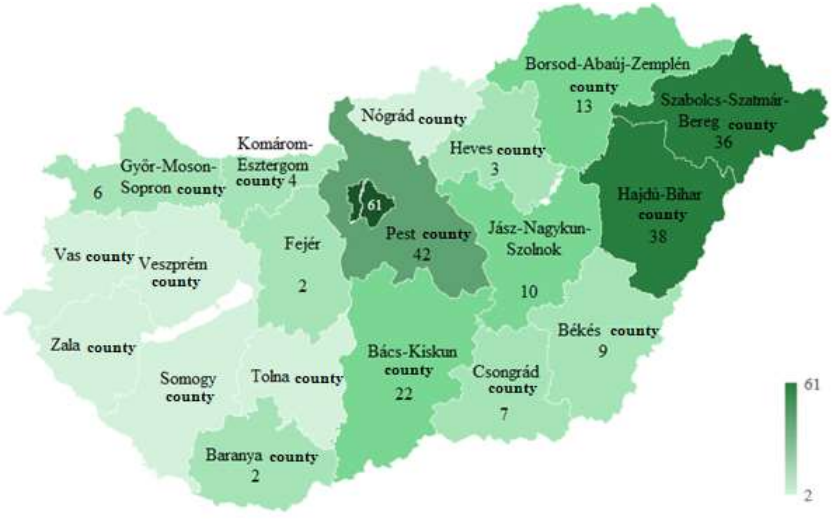
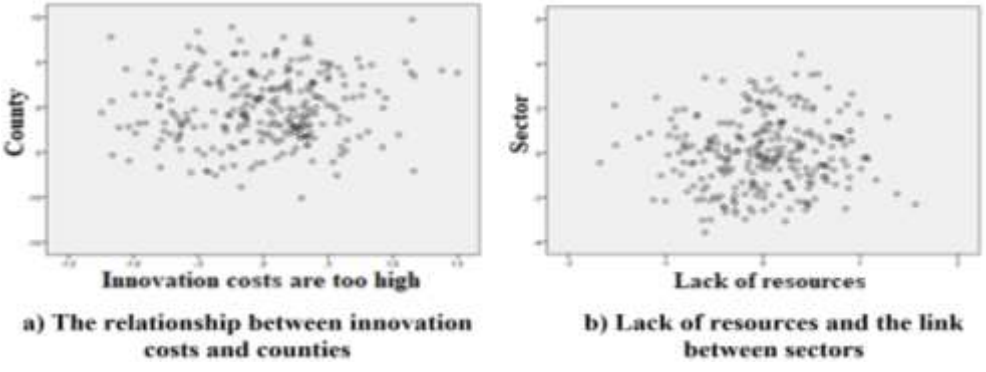



**Figure no. 3. Distribution of the number of respondents by county**

Most responses came from meat processing and canning companies (97), followed by bakery and pasta companies (60) and then from fruit and vegetable processing and preservation companies (46). The fewest responses came from companies involved in fish processing and preservation, as well as in the production of vegetable and animal oil, which is due to the fact that very few companies in Hungary carry out their main activities in this field.

### 3.2. Analysis of factors of food production companies, and results

In accordance with the interest of validating the indicators included in the questionnaire, we performed a factor analysis on the data. The validity of the principal components was analyzed with the latest available version of IBM SPSS Statistics 23. Indicators with low values in the model included in the questions were removed after performing the factor analysis. It is important for the study to know what distribution the variables follow. For each variable, we expected the discovery of a normal distribution, the graphical representation of which is shown in figure no. 4.




a) The relationship between innovation costs and counties

b) Lack of resources and the link between sectors

**Figure no. 4. Relationships and distributions between variables**

Figure no. 4.a shows the classification by county and the relationship between counties and innovation costs. Based on this, it can be said that the cost of innovation to respondents varies widely by county. Figure no. 4.b shows that each sector has a completely different view of the financial risks of Industry 4.0 technologies. In the case of financial risk, we highlight the risk of a lack of funds, to which there have been several extreme responses, i.e. the company is either not at all, or alternatively, very afraid of a lack of funds. The lack of funds is related to the existence of the current cash position and the annual net sales of the company.

### 3.3. Evaluation of external and internal models of PLS-SEM results

Using the PLS algorithm, we calculated the Composite Reliability Index (CR), which also takes into account the factor weight values assigned to the variables, so its value already needs to exceed 0.7. In the model, these expected values are met, i.e., for all factors, the composite reliability index is higher than the Cronbach's alpha index.

Based on the results of the Fornell-Larcker criterion, it can be said that financial risk was given the highest value among the risk factors (0.672), which means that the main obstacle can be identified most closely. factor. Furthermore, the results also show that the AVE square roots of the model are higher in all cases than the correlation of all reflective constructs, thus meeting the criterion of discriminant validity. The result shows that the value of all HTMT indices is below 0.9, which means that the validity of the discrimination is fulfilled.

Exogenous variables range from 1.163 to 2.792, which means that there is no multicollinearity between the factors.

To evaluate the magnitude of the effect, we used the 5000 subsample bootstrap sampling, thanks to which we determined the small, medium, and large effects of the variables on the target variable. Based on this, it can be said that there is a strong relationship between supporting factors and strategic goals, between risk factors and Industry 4.0 assets, and between Industry 4.0 assets and business performance. The results of the direct effect of bootstrapping are summarized in table no. 1.

**Table no. 1. Internal model bootstrapping results: direct effect**

| | Routes | Direct and indirect effect | Sample mean | t statistic value | p-value |
|---|---|---|---|---|---|
| Direct effect | Obstacles → Developments / investments | -0.145 | -0.144 | 2.009 | 0.045 |
| | Obstacles → Strategic goals | 0.033 | 0.038 | 0.556 | 0.579 |
| | Developments / investments → Industry 4.0 assets | 0.112 | 0.109 | 2.036 | 0.042 |
| | Industry 4.0 Tools → Business Performance | 0.187 | 0.190 | 2.054 | 0.040 |
| | Industry 4.0 Risk Factors → Industry 4.0 assets | 0.184 | 0.185 | 2.960 | 0.003 |
| | Strategic goals → Developments / investments | 0.156 | 0.158 | 1.898 | 0.058 |
| | Supporting factors → Developments / investments | 0.032 | 0.038 | 0.379 | 0.705 |
| | Supporting factors → Strategic goals | 0.545 | 0.560 | 10.501 | 0.000 |
| Indirect effect | Supporting factors → Strategic goals → Developments / investments | 0.094 | 0.097 | 2.486 | 0.013 |
| | Risk → Industry 4.0 Tools → Business Performance | 0.034 | 0.037 | 1.597 | 0.111 |

Based on the analyses, it can be established what affects the Industry 4.0 devices in the model, and what affects business performance, and how it does so:

*Strategic goals = 0.545 x Supporting factors*

The results of mediation analysis show that there is a significant, indirect relationship between the constructs examined. The supporting factors affect the strategic goals, and the strategic goals have a positive effect on the developments and investments made. The supporting factors do not directly (p = 0.705), but only indirectly, affect development and investments through the strategic goals.

*Development and investments = -0.145 x Obstacles + 0.156 x Strategic goals*

The opposite sign of the obstacles suggests that they have an effect on developments and investments, but the effect is negative (-0.145). The more barriers there are, the less companies will invest in new technology tools. Obstacles directly affect developments, but

do not affect the development of strategic goals (p = 0.579). Developments and investments are also influenced by the company's strategic goals.

*Industry 4.0 Assets = 0.112 x Development Developments + 0.184 x Risk Factors*

**H1:** External and internal risk factors affecting the food company directly affect the use of Industry 4.0 technology tools.

As the direct impact coefficient is 0.112, it can be stated that developments and investments have a direct impact on the use of Industry 4.0 tools, which means that if a food company thinks about developing its individual areas, there is a significant chance that one of the Industry 4.0 tools will receive investment. Risk factors affect new technological assets.

*Business Performance = 0.187 x Industry 4.0 Assets*

Industry 4.0 devices clearly have a positive, direct impact on business performance. The more Industry 4.0 tools a company uses, the more its business performance will increase.

**H2:** Industry 4.0 devices clearly have a positive, direct impact on business performance. The more Industry 4.0 tools a company uses, the more its business performance will increase.

Examining the nine main risk factors, we concluded that these factors directly affect the use of Industry 4.0 tools. Interestingly, risk factors only affect business performance through Industry 4.0 tools, not directly.

In the final model, directly or indirectly, five factors explain the factor related to the use of Industry 4.0 assets, and six factors explain the corporate business performance factor: supporting factors, impediments, strategic goals, developments/investments, Industry 4.0 assets, and risk factors.

### 3.4. Interpretation of the model results

The factors in the model and the direct and indirect effects between the factors are shown in figure no. 5.

It can be stated that the supporting factors significantly influence the strategic goals and indirectly influence the development of the company and investments. Obstacles affecting the company have a negative effect on developments, meaning that the more obstacles a company faces, the less development it undertakes. Among the obstacles are the lack of own resources and the high costs for companies following investing in innovation tools. However, if a company has sufficient own resources to invest in innovation tools, they may be less bothered by the high costs involved. Among other obstacles, the lack of a skilled workforce should be mentioned, as this factor also has a significant impact on investment.

**H3:** The extent of Industry 4.0 developments is negatively and significantly affected by the high cost of technologies, a lack of its own resources and a lack of skilled labour.

This result is consistent with the finding of Bughin's (2016) research that new technologies and Industry 4.0 investments clearly increase investor productivity.

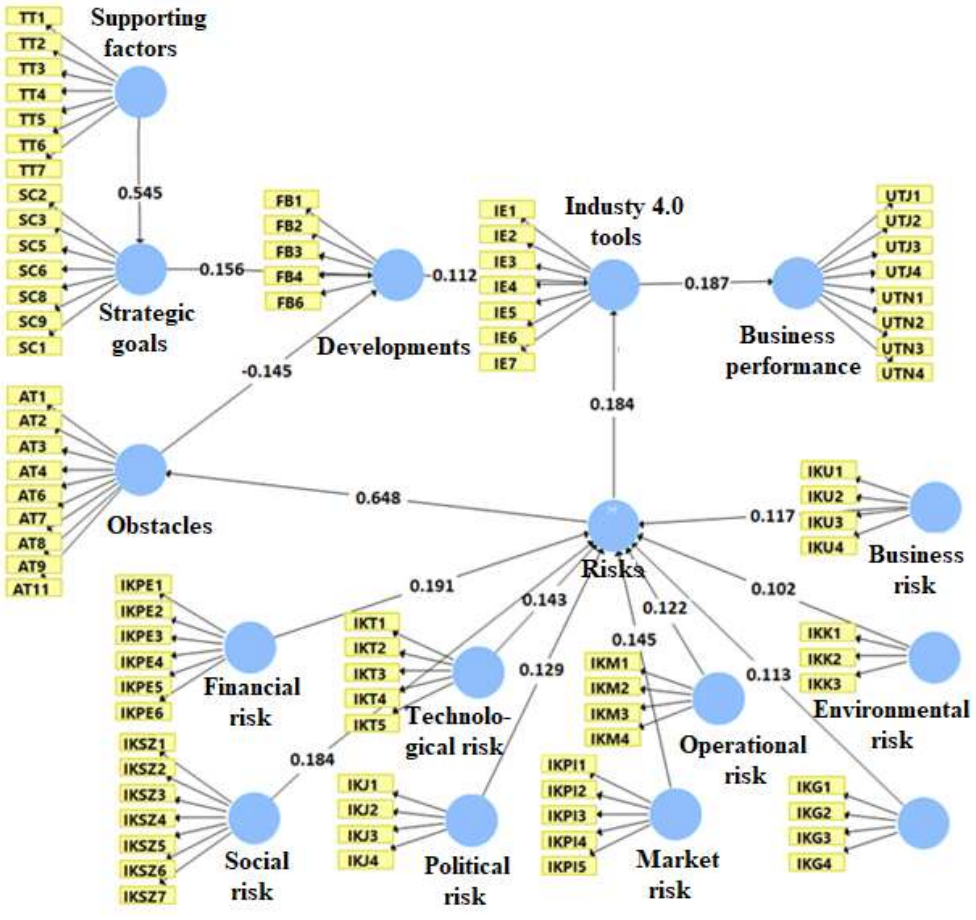



**Figure no. 5. Direct and indirect effects in the model**

## 4. Discussion

Some international studies have shown a positive effect of process and product innovations on productivity. It is believed that IT tools improve the efficiency of mechanisms as well as the quality of service, which is related to the size of service providers (Freagán et al., 2018). This was also supported by our research, as we found that the companies that use the new technological devices the most have been engaged in food production for more than 5 years. Another segment of the study addresses the disadvantages of improvements; service providers believe that the introduction of new tools will increase the invisible costs incurred, and system protection and data security will become even more important in the future (Nagy et al., 2018).

We continued the literature search on the relationship between corporate business performance as well as innovation, as one of the main objectives of the study was to examine the relationship between these two factors. Several authors describe in their paper that the

market position of firms is significantly influenced by the endowments and capabilities of the firm that it accumulates over many years over time based on experience (Bughin, 2016). Studies on the relationship between corporate performance and innovation have mostly shown a positive relationship between the two variables (Moraes et al., 2020).

Our results include the statement that the extent of Industry 4.0 developments is negatively impacted by high technology costs, companies' lack of resources and the lack of skilled manpower. Other researchers include unexpected high costs, insufficient demand, a lack of skilled labour or knowledge, and the introduction of tax laws and regulations that negatively affect the company (Hashi and Stojcic, 2013; Ferraris et al., 2020).

Based on the results, we can formulate a number of practical suggestions that can be used to improve the business performance of food companies. In conclusion, after reviewing all these studies, the long-term threats and opportunities associated with implementing Industry 4.0 are still uncertain, and the technologies involved have not yet been fully explored by researchers.

We found that nine sources of risk are worth examining and including in the questionnaire, namely: economic, financial, operational, technological, social, political and legal, environmental, market, and business risks. In the case of food companies, the consideration, analysis and appropriate level of risk management are of paramount importance. In the course of the study, we sought the opinions of and data from Hungarian food industry companies. The data collection was carried out with the help of a questionnaire; we received 276 completed questionnaires, a number which was reduced to 259 during the data cleaning.

The results of the mediation analysis show that supportive factors indirectly influence developments through strategic goals. Industry 4.0 risk factors influence the use of Industry 4.0 innovation tools through barriers as well as developments / investments. Risk factors influence the development of business performance through Industry 4.0 tools. In the final model, six factors directly or indirectly explain corporate business performance: barriers, supporting factors, strategic objectives, developments / investments, Industry 4.0 assets, in addition to Industry 4.0 risk factors.

The hypotheses formulated in the introduction were proved in the research results section.

## Conclusions

The main objective of the research was how the following indicators directly and indirectly affect business performance: supporting factors, obstacles, implementation of strategic goals, use of Industry 4.0 tools and risk factors.

We found that 9 sources of risk are worth examining and including in the questionnaire: financial, technological, operational, economic, social, political and legal, environmental, market, business risk. In the case of food companies, the consideration, analysis and appropriate level of risk management are of paramount importance.

The results suggest that Industry 4.0 risk factors directly affect the use of Industry 4.0 assets, but also indirectly through barriers and developments / investments. This relationship is a negative one, as the higher the risk and disincentives, the less the company invests in Industry 4.0 assets.

The aim is to expand domestic and international publications and research related to the topic, as well as to learn about the methods and results used in several scientific journals and to utilize them in our further research. Authors intend to continue the research, another goal is to further improve the business performance of the Hungarian food companies, as well as to examine the practical possibilities of the technological development of food companies and the Industry 5.0 technologies.

The hypotheses formulated in the introduction have been confirmed in the results section. As not all Hungarian food companies completed the questionnaire, the results are not suitable for generalization.

The activity of publications in recent years shows that innovation and efficiency will continue to be a key issue in the production of companies, and various publications and debates will contribute to the further development of theoretical and practical developments in these areas.

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# URBAN AGRICULTURE DIGITAL PLANNING FOR THE EUROPEAN UNION'S GREEN DEAL

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**Abstract**
Urban agriculture is a nature-based solution recommended for the regeneration and adaptation of urban areas to climate change, in consonance with the European Green Deal. Nevertheless, for the development of urban agriculture, the availability, access and usability of cultivable land in urban areas is of particular concern. This study aimed to use the digital agricultural data geographic information system AGRO-GIS to calculate and predict potential urban agriculture from abandoned horticultural lands and greenhouses in urban areas. In doing so, the variation of agrarian land in urban areas was calculated. A binary logistic regression modelled abandoned horticultural land and greenhouses in urban areas to obtain the determinant factors for potential urban agriculture. Then, an analysis of variance (ANOVA) was used to obtain significant differences in the variation of the agrarian land among urban areas. Results show that an average of 97.85 ha of abandoned horticultural land and greenhouses can provide potential urban cultivable land in cities. The variation of non-irrigated lands and grasslands-shrublands are determinant for potential urban agriculture. A hectare decrease in non-irrigated lands is associated with an 87.98% increase in the odds of potential urban agriculture. An increase of a hectare of grasslands-shrublands increases the likelihood of potential urban agriculture by 67.59%. Furthermore, it is concluded that differentiated planning and management of urban agriculture by urban areas is needed. This study can help urban planners to manage, plan and predict cultivable land for urban agriculture.

**Keywords:** Potential urban agriculture, land use, binary logistic regression, citizens' well-being, city climate change adaptation, societal demand.
**JEL Classification:** R11, R14, R52

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## Introduction

Urban Agriculture (UA) is defined as horticultural, agricultural and farming activities carried out in and around urban areas. UA is recommended for the regeneration and adaptation of urban areas to climate change and contributes to food security providing social, economic and environmental benefits, in consonance with the European Green Deal. Therefore, the demand for UA in urban areas is increasing worldwide. However, one of the most significant challenges of UA is the access to cultivable land in urban areas. Thus, it is necessary to address issues associated with use, availability, access and usability of cultivable land in urban areas. Furthermore, there is a need to integrate agriculture in the sustainability agenda frame as a main component in future city planning and, in doing so, manage and predict potential agrarian lands in urban areas. Authors have demonstrated that land management digital tools can be a suitable tool for attaining these objectives. Nevertheless, up to date, no previous research work explored agricultural data geographic information system AGRO-GIS to calculate and forecast potential land for UA in urban areas. This study aimed to explore the digital agricultural data geographic information system AGRO-GIS to plan, manage and predict potential UA for the recovery of abandoned agricultural lands and their application to urban areas. This paper is structured as follows. The first part revises the literature on the subject. The second part describes the material and methods of the exploratory analysis of the digital agricultural data geographic information system AGRO-GIS to plan, manage and predict potential UA, including the sampling, fieldwork and the data analysis. In the third part, the results are presented, and the theoretical and managerial implications of the findings are discussed. Finally, the conclusions, practical implications and future research lines are delineated.

## 1. Literature review

The European Union's Green Deal aims to protect, conserve and enhance the EU's natural capital and protect the health and well-being of citizens from environment-related risks and impacts (European Commission, 2019). In this context, urban agriculture (UA) is a nature-based solution recommended for adaptation to climate change and the regeneration of urban areas (Frantzeskaki, 2019), in consonance with the European Green Deal. In this line, UA preserves and restores the ecosystems and biodiversity in urban areas (von der Leyen, 2019), decreases the urban heat island intensity, improves the air quality, regulates water run-off, offers habitat networks through cities, preserves agricultural knowledge in urban populations, offers increased human health and well-being and contributes to food security providing social, economic and environmental benefits (Speak et al., 2015; Gittleman et al., 2016; Wynne et al., 2020; Puppim de Oliveira and Ahmed, 2021).

Moreover, Artmann and Sartiso (2018) demonstrated that UA contributes to key societal challenges of urbanization such as biodiversity and ecosystem services, agricultural intensification, resource efficiency, urban renewal and regeneration, land management, public health, social cohesion and economic growth. Many gardeners, especially those from urban areas, cultivate to have contact with nature and feel a connection to the land (Park et al., 2019). Community gardens activate the sense of belonging to the community and contact with other neighbours, favouring the creation and strengthening of social networks (Camps-Calvet et al., 2016). Urban community gardens improve social relations and favour reciprocity, mutual trust, common decision-making, civic commitment and community

building, all of which favour both individual and community health (Barriuso and Urbano, 2021). These relationships are also vital to promote healthy lifestyles and strengthened neighbourhoods (Langemeyer et al., 2021). Gardening offers an activity that liberates urban dwellers from an otherwise sedentary lifestyle and from the stress of the city. Community gardens are also leisure spaces, and citizens use these recreational spaces, which protects the health and well-being of citizens (Yu et al., 2019).

Additionally, one of the objectives of the European Union's Green Deal is to propose transformative policies to design a fair, healthy and environmentally friendly food system, from 'Farm to Fork', to which UA contributes. In this line, Wynne et al. (2020) showed that UA is considered as a solution to inadequate food access in cities and provides a source of healthy food. Some families cultivate urban gardens to know what they eat and to avoid the transport and transaction costs of large-scale food distribution. They are moved to reverse the system by consuming products produced locally and by themselves. In this sense, UA contributes to food security by both the quantity and quality of food availability in urban areas (Barriuso and Urbano, 2020). Specifically, UA has been shown to improve the quantity and quality of food available to low-income urban households. Therefore, UA can contribute to an improvement in food security and a reduced reliance on food from rural areas (Nigussie et al., 2021).

The demand for UA in urban areas is increasing worldwide in consonance to its benefits. In London, it has increased fourfold since 2006, and provision would need to increase by 77% in order to address the current length of waiting lists (Fletcher and Collins, 2020). Nevertheless, authors have pointed out that the development of UA must overcome several challenges. For instance, it is required new technologies integrating the Internet of Things (IoT) (Atitallah et al., 2020). Innovations in food production are required which can offer citizens sustainable alternatives that simultaneously address local food security and green infrastructure needs (O'Hara et al., 2021). New business' models supporting both social and technological innovations in UA are needed (Sanyé-Mengual et al., 2019).

Additionally, the authors indicated that the most significant challenges of UA are the regulatory framework and access to suitable lands (Halloran and Magid, 2013; Sarker et al., 2019). For instance, in Southern United States, Fricano and Davis (2019) concluded that land conversion and the lack of economic sustainability are the main barriers to UA. In African cities, Puppim de Oliveira and Ahmed (2021) also showed that problems with UA could be solved by removing perverse incentives, conflicting regulations and unfair land management decision-making systems, along with providing more secure land tenure. Therefore, there is a need to address issues associated with land use, availability, access and usability (Sarker et al., 2019). In this same line, Marat-Mendes et al. (2021) regret that UA has been largely absent of formal recognition in the urban planning policies. Although agriculture has always been a relevant element of city sustainability, it took 55 years to emerge urban planning practices that fully integrate agriculture in cities (Jansma and Wertheim-Heck, 2021). Therefore, there is a need to integrate agriculture in the sustainability agenda frame as a main component in future city planning (Wynne et al., 2020). In doing so, there is a need to manage and predict potential agrarian lands in urban areas among their urban planning. Authors have demonstrated that land management digital tools can be a suitable tool for attaining these objectives. Nigussie et al. (2021) used overlay analysis with multiple criteria in ArcGIS software to search for appropriate locations for UA. They demonstrated that of the bare-lands can be categorized as highly suitable for UA in

Ethiopia 57.2%. Saha and Eckelman (2017) used GIS and remote sensing data to estimate the potential of UA in Boston, screening ground parcels and rooftop areas for UA, despite this, not all ground parcels and rooftops are adequate for agriculture. Dupuy et al. (2020) used landscape zoning based on multisource satellite data to identify agri-urban functional areas in the city and demonstrated its suitability for mapping agriculture and urban land cover. Nduati et al. (2019) used Landsat images and their Normalized Difference Vegetation Index to map and continuously monitor UA in the Tokyo Metropolis. Gottero et al. (2021) used map-based indices to characterize the peri-urban landscape of Turin in Italy, and generated maps of spatial and functional classification at the landscape unit level, obtaining a map of critical areas to improve UA. In all these cases, authors used and combined existing land management digital tools, to plan, manage and predict potential UA. Nevertheless, up to date, no previous research work explored agricultural data geographic information system AGRO-GIS to calculate and forecast potential UA. The agricultural data geographic information system AGRO-GIS is a tool included in the Spatial Data Infrastructure (IDE) of the Spanish Ministry of Agriculture that integrates the data, metadata, services and information of a geographical nature that are the competence of the Ministry, following the specifications of the Open Geospatial Consortium (OGC, 2021). Then, to integrate agriculture in urban planning Sanz Sanz et al. (2017) proposed a methodology to map, characterize and represent homogenous peri-urban agriculture spatial units (USAPU) combining geographical descriptions and agricultural and urban data with statistical analysis, to define a systemic and generic methodology for planning and public action at inter-municipal level. In this line, Sarker et al. (2019) examined current practices and identified existing opportunities and constraints and developed an integration framework of urban agriculture for Australian cities that allow improve sustainability of cities by bringing together the advantages of growing food within a greener urban environment. Furthermore, Contesse et al. (2017) indicated that urban agriculture is an opportunity for urban greening, although in the case of Santiago changes are needed in how green areas are planned and conceived. UA should not be understood as a substitute for parks but as a complementary form of green space provision with a distinctive value.

## 2. Research methodology

The research questions of this exploratory analysis are the following:

- RQ1: How the agricultural data geographic information system AGRO-GIS can be used to calculate and predict potential urban agriculture?
- RQ2: What are the determinant factors for potential urban agriculture?
- RQ3: Why is digital differentiated planning and management of urban agriculture recommended?

The agricultural data geographic information system AGRO-GIS was used to calculate and predict potential UA. AGRO-GIS is a tool that offers cartographic and alphanumeric information (MAPA, 2021). AGRO-GIS integrates the data, metadata, services and information of a geographical nature that are the competence of the Spanish Ministry of Agriculture Ministry aligning with the objectives of the European directive (INSPIRE, 2014) and the Spatial Data Infrastructure of Spain (IDEE). The agricultural data geographic information system AGRO-GIS offers, i) general cartography, ii) thematic maps on

agroclimatic variables, iii) reports on municipalities and meteorological stations, iv) map of crops and uses of Spain, at 1/50,000 scale and v) reports on 50,000 sheets and municipalities. These public services operate the interoperability of the geographical information of the ministry, its effective inclusion in the IDEE and comply with the provisions of Directive 2007/2 / EC of the European Parliament of the Council called INSPIRE and the Law on infrastructures and geographic information services in Spain (14/2010 of July 5), called LISIGE.

In order to plan, manage and predict UA using AGRO-GIS, a sample of the urban areas in the Castilla y Leon region of Spain was analysed. To select the sample of the urban areas of the region, the classification of urban areas by the Spanish Ministry of Development (2018) was used. The classification characterized forty-seven urban areas in the region. Castilla y Leon is Spain's largest region and the third largest region in Europe, with a territory of 94,225 km$^2$. The land use in the region is 31.36% forested land, 36.77% arable lands and permanent crops, 17.81% pastures and mosaics, and 14.06% other lands. It represents over 5% of the country's population (2,418.556 inhabitants in 2018) (Eurostat, 2019). The unemployment rate in Castilla y Leon has continued to decrease from 2013 (when it was at 21.8%), and it was 12.1% in 2018 (Eurostat, 2019). This value is below the national average (15.3%) but above the EU average (6.9%). Furthermore, the regional production sector is widely scattered, with small family firms dominating the market. The main activities in the region in terms of percentage of GDP are tourism and culture (11.8%), construction (8.4%), transport (6.3%) and agriculture (5.1%). The sociodemographic characteristics of the urban areas of the Castilla y Leon region are presented (table no.1).

**Table no. 1. Socio-demographic characteristics of the urban areas of the region expressed as minimum, maximum and Mean, Standard Deviation (S.D.) values**

| Variable | Minimum | Maximum | Mean (S.D.) |
|---|---|---|---|
| **Population** | 1165.0 | 299715.0 | 27377.8 (55737.4) |
| **Population over 65 years** | 91.0 | 59737.0 | 6518.9 (14662.2) |
| **Percentage of population over 65 years** | 1.9 | 27.8 | 19.8 (39.5) |
| **Surface (km$^2$)** | 943.3 | 27167.5 | 5873.5 (6029.8) |
| **Density of population (pop./km$^2$)** | 21.0 | 3671.0 | 482.9 (759.3) |

The digital agricultural data geographic information system AGRO-GIS of the Spanish Ministry of Agriculture (MAPA, 2021) was used to calculate the variation of the agrarian land uses in the urban areas of the Castilla y Leon region. The maps and data of agrarian land uses from 1980-1990 and 2000-2010 were analysed. The agrarian lands were classified into agricultural, livestock and forestry lands. Then, the variation of these lands was calculated. The correlation between the variation of the agricultural land use, other land uses and the sociodemographic characteristic of the urban areas was calculated using the Pearson correlation ($p < 0.05$).

A principal component analysis (PCA) was then used to reduce the variables and eliminate possible multicollinearity among variables (Rahayu et al., 2017). From each component of the PCA, the highest loads of the eigenvectors were selected as predictors. A binary logistic regression was used to model abandoned horticultural lands and greenhouses in the cities, obtaining the determinant factors for potential UA. In the binary logistic regression the log odds of the outcome were modelled as a linear combination of the descriptors. For the data set we deployed a binary response (outcome, dependent) variable called 'potential UA',

which is equal to 1 if the horticultural land and greenhouses have decreased (negative value), and 0 otherwise. Binary logistic regression was used to predict the odds of potential UA, based on the values of the predictors. Regression coefficients were estimated using maximum likelihood estimation and were presented with Wald $\chi^2$-statistics and as odds ratios, by using the Wald forward stepwise method. The models revealed the most important predictors of potential UA and predicted potential UA.

Finally, an ANOVA analysed the significant differences in the variation of the agrarian land uses among urban areas of the Castilla y Leon region, to determine whether similar or differentiated urban planning of UA by urban regions is required. The statistically significant differences between urban areas' means were determined (F and p-value). The significance ($p < 0.05$) was obtained using Levene's test. SPSS v.26 software was used.

## 3. Results and discussion

Results show that the major decrease in agricultural lands was in non-irrigated lands, with an average of 504.14 ha, followed by horticultural land and greenhouses (97.85 ha) and irrigated lands (73.32 ha). It is noteworthy that in the region an average of 202.37 ha was abandoned and has become unproductive lands. The livestock lands showing a major decrease were grasslands-shrublands, with an average of 55.36 ha. Moreover, forested lands in which conifers predominate decreased by 286.92 ha (table no. 2).

**Table no. 2. Variation of the agrarian land in the urban areas of the region, Mean, Standard Deviation (S.D.) expressed in hectares classified in agricultural, livestock and forestry uses**

| Agricultural use | Mean (S.D.) |
|---|---|
| Non irrigated lands | -504.1(1132.1) |
| Horticultural land and greenhouses | -97.8 (311.7) |
| Irrigated lands | -73.3 (453.3) |
| Non irrigated vineyards | -30.9 (78.6) |
| Irrigated orchards | -1.0 (4.7) |
| Non irrigated orchards | -1.0 (8.5) |
| Irrigated vineyards | 5.7 (21.5) |
| Unproductive | 202.4 (244.3) |
| **Livestock use** | |
| Grasslands associated with hardwoods | -55.4 (255.6) |
| Grasslands | 159.6 (522.9) |
| Grasslands- shrublands | 221.3 (773.3) |
| **Forestry use** | |
| Conifers | -286.9 (1042.5) |
| Shrublands | -76.9 (683.8) |
| Poplars | -46.4 (403.8) |
| Hardwood forests | -41.3 (236.7) |
| Shrublands associated with conifers | 29.4 (48.5) |
| Shrublands associated with hardwoods | 30.2 (154.7) |
| Shrublands associated conifers and hardwoods | 34.6 (95.6) |
| Water (water bodies, ponds, etc.) | 59.4 (122.9) |
| Other hardwoods | 181.0 (423.0) |
| Conifers associated with hardwoods | 312.6 (1081.0) |

Results show that the decrease of agricultural lands in urban areas point to the recommendation that vacant lands be recovered as suitable for UA. Abandoned horticultural land and greenhouses, averaging 97.85 ha, can provide urban cultivable land in cities. A negative Pearson correlation was found between the variation of horticultural land and greenhouse crops and unproductive lands amounting to -0.439 ($p < 0.01$). The variation of horticultural land and greenhouses is negatively correlated with the variation of forestry and scrub lands associated with conifers ($r = -0.338$; $p < 0.05$) and scrublands associated with hardwoods ($r = -0.389$; $p < 0.01$).

Table no. 2 answers the first research question that this study sought to address:

- RQ1: How the agricultural data geographic information system AGRO-GIS can be used to calculate and predict potential urban agriculture?

Table no. 2 demonstrates that the agricultural data geographic information system AGRO-GIS allows calculate the variation of agricultural vacant lands suitable for UA to be recovered.

Pearson correlation with the sociodemographic variables showed a negative correlation between the decrease of horticultural lands and greenhouses and the population ($r = -0.574$; $p < 0.01$), and the population older than 65 years ($r = -0.417$; $p < 0.01$). The higher the population that is over 65 years, the lower the decrease of horticultural lands and greenhouses. This result is consonant with municipal occupational programmes that promote UA among elders, and these programmes are consonant with the Silver Economy policy of the European Union that investigates the well-being of older citizens, considering that in Europe, a quarter of the population will be aged 65 and over by 2050 (Grundy and Murphy, 2017). In this sense, the World Health Organization (2015), in its World Report on Aging and Health, defined the concept of healthy ageing to the process of promoting and maintaining functional capacity that allows well-being in old age. The WHO argued that EC Silver Economy policies should consider the active ageing of older people in situations of social vulnerability; knowledge and opportunities for personal, cognitive, biological and physical development and social participation; promoting and balancing personal responsibility; intergenerational encounters and solidarity; and the creation of favourable environments, which provide quality of life and delay levels of dependency. In this line, it has been proved that the physical activity necessitated by UA can contribute to active ageing (Barriuso and Urbano, 2021, Camps-Calvet et al., 2016). Moreover, UA allows the elderly to share time with younger people and communicate with others, combating isolation and providing for the development of social relationships (Freeman et al., 2012). Therefore, elder can benefit from UA with general wellbeing impacts, nutritional health impacts, economic interests, and socialization motivations (Kirby et al., 2021).

The PCA reduction of the variables revealed nine new components that eliminate the possible multicollinearity among variables (table no. 3). From each component of the PCA, the highest loads of the eigenvectors were selected as predictors.

**Table no. 3. Loading weights of the principal component analysis of the variables land use and socio-demographic characteristics**

| Agricultural use | Component number | Weights |
|---|---|---|
| Non-irrigated orchards | 2 | -0.504 |
| Non-irrigated lands | 2 | -0.715 |
| Irrigated lands | 3 | 0.608 |
| Unproductive | 3 | 0.775 |
| Irrigated orchards | 5 | 0.557 |
| Irrigated vineyards | 6 | -0.588 |
| Non-irrigated vineyards | 6 | 0.796 |
| **Livestock use** | | |
| Grasslands associated with hardwoods | 3 | -0.609 |
| Grasslands | 5 | 0.517 |
| Grasslands- shrublands | 8 | 0.732 |
| **Forestry use** | | |
| Conifers | 1 | -0.706 |
| Conifers associated with hardwoods | 1 | 0.718 |
| Water (water bodies, ponds, etc.) | 1 | 0.866 |
| Shrublands associated with conifers and hardwoods | 1 | 0.686 |
| Shrublands associated with conifers | 1 | 0.548 |
| Other hardwoods | 1 | 0.512 |
| Shrublands | 4 | -0.503 |
| Hardwood forests | 5 | 0.505 |
| Shrublands associated with hardwoods | 5 | 0.478 |
| Poplar | 9 | -0.554 |
| **Socio-demographic characteristics** | | |
| Surface ($km^2$) | 1 | 0.931 |
| Population over 65 years | 2 | 0.659 |
| Density of population ($pop./km^2$) | 2 | 0.640 |
| Population | 2 | 0.708 |
| Percentage of population over 65 years | 7 | 0.689 |

Rotated components using varimax.

Then, a binary logistic regression modelled the abandoned horticultural lands and greenhouses as potential UA lands, obtaining the determinant factors for potential UA. Table no. 4 presents the results of the binary logistic regression model with the estimated logistic regression coefficients (β), their respective standard errors (S.E.), Wald $\chi^2$-statistics, significance levels, odds ratios (Exp(β)) and goodness-of-fit statistics.

**Table no. 4. Coefficient estimates and diagnostics from binary logistic regression explaining potential UA**

| Descriptors | β | S.E. | Wald | Sig. | Exp (β) |
|---|---|---|---|---|---|
| **Non-irrigated lands** | -2.751 | 1.163 | 5.595 | 0.018 | 15.664 |
| **Grasslands-shrublands** | 1.643 | 0.773 | 4.52 | 0.034 | 5.172 |
| **Constant** | -3.255 | 1.175 | 7.678 | 0.006 | 0.039 |

The model of potential UA obtained is this:

ln (p/(1-p)) = -3.255 + 2.751 x Non-irrigated lands + 1.643 x Grasslands- shrublands

The variation in non-irrigated lands and grasslands-shrublands was found to have significant effects on potential UA. The estimated coefficient of the predictor of non-irrigated lands was 2.751, and the exponentiated value was 15.664. Considering an initial probability (p) of 0.5 (i.e., 50% probability of potential UA against 50% probability of no potential UA) at a certain value for non-irrigated lands, the corresponding odds of 1 for the UA[O(UA)] would be $O(UA) = p / (1 - p)$ for that subject. Since the odds ratio for non-irrigated lands was 15.664 for urban areas, probability of UA against no UA would be 15.6 times higher if the non-irrigated lands decrease by a unit value. Thus, the probability of the potential UA will be 0.9399, which is 87.98% higher than the initial 0.5 probability (Mathew et al., 2009). A one-ha decrease in non-irrigated lands is associated with an 87.98% increase in the odds of potential UA. Operating similarly, an increase of one ha of grasslands-shrublands increases the likelihood of potential UA by 67.59%.

On the one hand, the decrease of non-irrigated lands, which accounts for 85.20% of the farmlands of the region, might mean an increase of UA. The Regional Council reports a decrease of farmers in the region of 27.5% since 2005. Consequently, this decrease of farmers might be translated into potential urban farmers who leave large non-irrigated farms for small subsistence urban gardens during their retirement. Cabo et al. (2014) demonstrated that many urban gardeners in the region come from the migration from rural areas to the city. The migration from rural to urban areas during retirement produces in the cities a large proportion of people who were born and raised in rural areas and feel a nostalgic connection with the land and the wish to cultivate it.

On the other hand, the increase of grasslands-shrublands shows a potential for UA, which can mean an increase of urban livestock farms.

Table no. 4 answers the second research question that this study sought to address:

- RQ2: What are the determinant factors for potential urban agriculture?

Table no. 4 demonstrates that the variation in non-irrigated lands and grasslands-shrublands are determinant on potential UA.

The analysis of variance (ANOVA) of the variation of the agrarian land in the urban areas of the region revealed statistically significant differences between the urban areas of the region in the variation of the horticultural land and greenhouses, grasslands-shrublands, poplars, shrublands associated with conifers and hardwoods, and shrublands associated with conifers (table no. 5). Levene test demonstrated the equality of variances. This result leads to a recommendation for differentiated management (Cabo et al., 2014) of the lands for UA by urban areas of the Castilla y Leon region. Therefore, further research and specific planning for UA in the region is recommended in order to manage and predict the most suitable solution for each urban area (Tapia et al., 2021). This study represents an initial proposal of planning and management, although it shows that further research is required to explore the ways in which urban planning practices emerge in particular urban settings.

**Table no. 5. Analysis of variance ANOVA of the agrarian land uses. F and p-value<0.05 indicates the significant differences for each variable among urban areas**

| Variation of agrarian land use | F | p |
|---|---|---|
| **Poplars** | 1078.523 | 0.024 |
| **Horticultural land and greenhouses** | 1909.034 | 0.018 |
| **Shrublands associated conifers and hardwoods** | 540.990 | 0.034 |
| **Shrublands associated with conifers** | 1896369.436 | 0.001 |
| **Grasslands- shrublands** | 4255.431 | 0.012 |

These results can help urban planners to develop policies to promote the formal management of UA and government responsibility for UA (Marat-Mendes et al., 2021). This approach can also help urban planners to assist urban farmers in accessing or using land in urban areas. In this sense, Camps-Calvet et al. (2016) indicated that planners can use other, less formal, means to influence change, to forge alliances between different groups, and to facilitate opportunities for urban farmers to overcome land-related hurdles.

Table no. 5 answers the third research question that this study sought to address:

- RQ3: Why is digital differentiated planning and management of urban agriculture recommended?

Table no. 5 demonstrates variation of the agrarian land revealed statistically significant differences between the urban areas of the region, in the variation of the horticultural land and greenhouses, grasslands-shrublands, poplars, shrublands associated with conifers and hardwoods, and shrublands associated with conifers, recommending a differentiated planning and management of UA by urban areas of the region.

## Conclusions

This study aimed to use the digital agricultural data geographic information system AGRO-GIS to plan, manage and predict potential UA recovery of abandoned agrarian lands, and its application to the urban areas of the Castilla y Leon region in Spain. Results show that the major decrease in agricultural land in the region was non-irrigated lands, with an average of 504.14 hectares, followed by horticultural land and greenhouses, with an average decrease of 97.85 ha. It is concluded that those abandoned horticultural lands and greenhouses can provide urban cultivable land for UA. Results demonstrated that the higher the population over 65 years, the lower the decrease in horticultural lands and greenhouses, which is consonant with municipal occupational programmes that promote UA among elders, and also in line with the Silver Economy policy of the European Union. It is demonstrated that the variation of non-irrigated lands and grasslands-shrublands is determinant on potential urban agriculture. A one-ha decrease in non-irrigated lands is associated with an 87.98% increase of potential urban agriculture. Therefore, the retired farmers of non-irrigated lands farms, representing a 27.5% increase since 2005, can become potential urban farmers of small subsistence gardens. An increase of one ha of grasslands-shrubland increases the likelihood of potential UA by 67.59%, indicating the potential development of urban livestock. It is concluded that the agricultural data geographic information system AGRO-GIS can be used to calculate, map and model the abandoned horticultural lands and greenhouses as potential UA lands, obtaining the determinant factors for potential UA and

predicting potential UA. Finally, it is concluded that in the Castilla y Leon region, specific planning for UA is recommended in order to predict and manage the most suitable solution of UA for each urban area.

This study provides specific digital tools for policymakers to set their strategies on UA. The application of this analysis to urban areas is insightful since it provides a pointer for the design of policies which could strengthen UA. It contributes to providing guidance to solve societal challenges using digital tools, and in doing so to fulfil the growing societal demand for UA. Finally, the study contributes to knowledge about the planning of UA in line with the European Union's Green Deal.

This paper has several limitations, one being the difficulty of generalizing the results. The digital tool chosen for investigation is rather specific in relation to many urban areas. However, the study is a first attempt to integrate digital tools in UA planning, and the study enhances the understanding of the role of UA in developing urban planning strategy, despite the fact that there is still a long road for its expansion.

There is a need for future research to validate our findings through additional case studies in other urban areas. It would also be important to conduct more in-depth assessments with regards to the impact of UA, so as to provide further guidance to policymakers. Furthermore, it would be important to examine mechanisms to implement UA. This would be highly important in order to strengthen social and environmental innovation. Future work should also explore the expansion of UA and the creation of a database registering UA lands in cities and regions.

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# Contents

## Economic Interferences

# OWNERS VS. MANAGERS. DISPARITIES OF ATTITUDES ON THE BUSINESS RISK IN SME SEGMENT

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**Abstract**
The article aims to identify disparities in the perception of business risks between the owners and managers of small and medium-sized enterprises (SMEs) in the V4 countries. The statements of strategic, market, personnel, legal and operational risks are the research's subject. Disparities of attitudes on the business risks were verified on the sample of 1585 SMEs by the mathematic method with the non-parametric approach – the Kruskal-Wallis test. The most significant disparities are in the perception of the adequacy of the market risk's level in the case of SMEs. The owners are significantly more optimistic in their market risk assessment than the managers of SMEs. On the other hand, the managers compared to the owners present a more pessimistic assessment concerning the statement that the business environment in their field of doing business is over-regulated. The respondents presented the same attitudes in the cases of the operational and personnel risk statements. Continuity of views and the perception of the business risks are critical factors for the growth of SMEs' business performance. Implications and consequences are generally valid for all SMEs, not only the ones from the V4 countries.

**Keywords:** SMEs, manager, business owner, business risks, case study, central European countries.

**JEL Classification: M21, G32, L26**

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**Introduction**

Competitiveness has been increasing in every business field at a rapid pace in the last few years. To be well-positioned in the market, firms must adequately react to these challenges and try to find ways to meet customers' requirements and keep a good position in the market (Lima et al., 2020). Effective risk management (RM) can help SMEs to gain a competitive position in the market (Dvorsky et al., 2020a).

SMEs are considered to be the backbone of European economics and growth. They have specific features (family-owned in most cases, limited restatements, more flexible, less diversified in economic activities), which predetermine them to use different tools and methods than large companies (Kim Vonortas, 2014; Pisar and Bilkova, 2019; Lima et al., 2020; Belas et al., 2020b). Furthermore, the management process in SMEs, compared to larger companies, is often neglected and has a narrower scope, contributing to the emergence of numerous threats. RM is one of the most critical internal processes in SMEs (Ślusarczyk and Grondys, 2019; Liang et al., 2021).

In contrast, Hamdan and Alheet (2020) support a generally accepted idea that SMEs tend to take much more risks in uncertain conditions than larger enterprises to take advantage of available opportunities in individual markets. Similarly, Naude and Chiweshe (2017) state that the gap between SMEs and large businesses performing RM assessment is quite significant.

The decision if a founder (owner) will be the firm's manager at the same time is considered essential for its future existence. The differences can be seen in personal motivation to manage the firm, attitude to risk, and limited expertise (Kulchina, 2016). There exists an information asymmetry between owners and managers. Business owners, bearing the main business risk of the company, usually delegate the management to the hired managers and do not have control over the day-to-day operation of their businesses. However, managers do not have to take the owners' interests into account and act in their favor. For example, they can avoid implementing the new approaches and facing new business risks, even though they would increase the firm's profits. They can also reduce the firm's goals, and tolerate unnecessary costs (Wasserman, 2016). The choice of whether to manage a firm in person or to hire a manager is even more challenging for foreign entrepreneurs who found ventures outside of their native countries. They have to consider the liabilities of being a foreigner next to general issues common to all entrepreneurs (Kulchina, 2016).

The Visegrad Group (also known as the "Visegrad Four" or simply "V4") reflects the efforts of the countries of the Central European region to work together in several fields of common interest within the all-European integration. Czechia, Hungary, Poland, and Slovakia have always been a part of a single civilization sharing cultural and intellectual values and common roots in diverse religious traditions, which they wish to preserve and further strengthen (visegradgroup.eu). The financial systems and the business environment in each country are highly heterogeneous, accompanied by external influences from the national and international eco-nomic environment (Bilan et al., 2017).

The article aims to identify disparities in the perception of business risks between the owners and managers of SMEs in the V4 countries. The paper is structured as follows. The literature review part presents the theoretical background focused on SMEs' characteristics and their position in the V4 economies and the characteristics of business risks, especially on financial,

operational, personnel, and legal risks. The following section is devoted to the description of data and methodology. Further, the main results are presented. The final part discusses the results and limitations of the research in comparison with other authors.

## 1. Literature review

Verbano and Venturini (2013) emphasize the need to adopt RM strategy and methodology to identify, assess and treat risks for SMEs much more than for larger firms due to resource limitations. Virglerova et al. (2020a) add that firms' internal systems are more vulnerable without the potential risk analysis and implementation of proper risk management. Especially for SMEs, functional RM can be a crucial aspect of their business in times of crisis.

In general, the risk is a kind of reflection of the negative aspects of the firm's development. It arises as an uncertainty in the fulfillment of objectives (Roper and Tapinos, 2016; Sira et al., 2016); when business is in a position where unexpected events disrupt normal operations, resulting in financial loss and damage to reputation (Naude and Chiweshe, 2017). Havierniková and Kordoš (2019) consider two perspectives of risks: the existence of an external threat (external risks) and risk associated with a firm's activities (internal risks). Core directions to investigate external risks in changing business environment are still those connected with financial factors influence (Kalusova and Badura, 2020). Appropriate measures to mitigate these risks lead to increase possibilities in competitive environment, particularly, due to advantages of diversification (Mura and Kljucnikov, 2018).

The features of the current business environment, such as dynamic changes, global economic crisis arising from consequences of Covid-19, many failures and bankruptcies, have increased the importance of the implementation of RM in firms. Effective RM is a way to increase performance efficiency or achieve cost savings (Florio and Leoni, 2017; Dvorsky et al., 2020b; Crovini et al., 2021). Due to the influencing factors Gatzert and Martin (2015) found that such factors as the assets' opacity and growth opportunities are not significantly related to the development of an “enterprise RM” (ERM) system, but the company size and the level of institutional ownership positively influence the implementation of ERM system.

Based on opinions of e.g. Lima et al. (2020), Virglerova et al. (2020a), Crovini et al. (2021) we can state that the ERM sets the general framework and methodology for how a company manages risks and is integrated with all other aspects of the business. It can help to identify many dependencies or interrelationships among risks that might otherwise go unnoticed. Quick integration of risk information in a consistent format across the organization can help a company gain an overall picture of its general risk profile. Kiseľáková et al. (2015) noticed that ERMs can be used in managerial practice for effective risk management in order to minimize, diversify and predict risks on global markets and to streamline enterprise performance. Based on Tonello (2012), ERM can encompass a wide range of risks that any organization faces. Some risks may reflect exposures that will not threaten the overall health of an organization or its ability to meet its business objectives ultimately. ERM also means an opportunity recognition and allows innovative business solutions. On the other hand, ERM can be a substantial cost factor for SMEs and consequently cause financial problems due to limited financial resources. Sira et al. (2016), in their research of Slovak SMEs, showed that onerous access to finance is one of the main reasons for risk situations' occurrence in the case of 25% of small businesses and 23% of medium enterprises.

Concluded, the impact of ERM on SME performance does not seem to be straightforward (Glowka et al., 2020). Their findings regarding ERM in family SMEs showed that the implementation costs of ERM seem to contribute to an insignificant overall effect of ERM on the financial performance of family SMEs and confirmed the importance of firm size as a determinant of ERM effectiveness.

Similarly, Soin and Collier (2013), Britzelmaier et al. (2015), Brustbauer (2016) emphasize that firms do not have sufficient and working RM. Moreover, this system is not connected with the firm's strategy. It faces problems of defining the contents, taking responsibilities for the risks, and the risk tolerance, the insufficient orientation on identifying the root causes of the risks. In some enterprises, RM is only a part of emergencies and unexpected events. Hanggraeni et al. (2018) indicate that most entrepreneurs try to identify risks without relation to their business process to manage them.

Many practitioners argue that it is easier to meet the RM requirements than to talk about risk culture. Both practitioners and academics argue that a company's risk culture is much more critical (Gorzeń-Mitka, 2018). The authors argue that the perception of markers of risk culture in a company depends on company size in the case of four areas: risk leadership, risk governance, risk transparency, and risk competence. Risk culture means the values, beliefs, knowledge, and risk understanding shared by a group of people with a common intended purpose, particularly the leadership and employees of an organization (Mura and Kajzar, 2019).

Strategic RM (SRM) is a vital part of global RM. SRM focuses on those most substantial and significant risks to shareholder value, an area that merits the time and attention of executive management and the board of directors. SRM should reflect an organization's individual needs and culture. If the SRM process is not embedded and owned by management as an integral part of the business processes, the RM process will lose its impact and will not meet its expectations (Tonello, 2012).

Generally, risk identification is the first step in the RM process. It needs systematic identification of all potential internal and external risks. The identification of business risk is related to risk categorization, consequently followed by risk assessment and monitoring (Naude and Chiweshe, 2017). It is important to properly evaluate, compare and examine the impacts of multiple alternatives on business processes in the company both in the short and long term (Belas et al., 2018; Polishchuk et al., 2019).

Lima et al. (2020) categorize risks into financial, operational, strategic, and hazard risks; Ekwere (2016) and Chłapek (2017) differentiate market, credit, operational, legal, liquidity risk, and others. Loosemore et al. (2018) distinguish the following categories: financial risk, legal, management, market, social, political, and technical risk. Naude and Chiweshe (2017) differentiate operational, market, technical, and financial risks. Many studies note that little attention is devoted to the few new emerging risks (Meyer at al., 2017; Gavurova et al., 2020; Kotaskova et al., 2020a; Lima et al., 2020).

Kassi et al. (2019) evaluate the market risk (a systematic risk that investors cannot eliminate through a diversified portfolio) as the most crucial. Market risk is one of the critical components of financial risk (Kim and Vonortas, 2014; Dankiewicz et al., 2020). According to Olah et al. (2019), financial risk is one of the main threats to a business. It arises from difficulties in business financing due to lack of equity and the necessity of replenishing

financial resources using debt (Yang, 2017; Bosma et al., 2018). Olah et al. (2019) assess financial risk as a risk that manifests itself in the form of capital risk, investment risk, interest risk, market risk, currency risk, and credit risk. It may manifest an inability to obtain the required amount of funds at a given time. Belas et al. (2020a) define financial risk as a possibility that a business's cash flow does not suffice to pay creditors and fulfill other financial responsibilities. Kim and Vonortas (2014), Ślusarczyk and Grondys (2019), Yin et al. (2020) see the main problem in accessing funding in SMEs in the information asymmetries between investors and entrepreneurs. Ključnikov et al. (2016) found that Czech SMEs perceive intensively restricted access to financial resources and intensive influence of market risk. Kramoliš and Dobeš (2020) revealed that Czech SMEs do not consider debt a critical factor of business risk and do not associate it directly with the significant risk of business failure. SMEs consider the risk of indebtedness as relatively insignificant. Their attitude to indebtedness is generally passive, and they will always manage in some way to solve it through insurance, risk avoidance, and the creation of financial reserves.

The sources of operational risk in the business activities arise from the company's people, systems, and processes. Generally, it refers to the internal organization and management of own operations (Kim and Vonortas, 2014; Karwanski and Grzybowska, 2018, Lima et al., 2020) or the risk of loss as a direct consequence of inadequate or failed processes (Naude and Chiweshe, 2017). Dumitrescu and Deselnicu (2018) consider human resources in the sense of their availability, qualification, injuries, and embezzlement as a part of operational risk. Human resource risk management (HRM) is not less important than other ones (Babikova and Bucek, 2019; Dvorsky et al., 2020b). In this regard Bilan et al. (2020) study factors of risks in business environment through the external threats and internal weaknesses in HRM practices. Becker and Schmidt (2016) note that an effective HRM needs a suitable risk assessment phase, adopting prevention and protection actions followed by implementing a severe "safety audit" phase. However, these phases are not given much attention in practice. Kotaskova et al. (2020a) defined personnel risk as a lack of qualified employees and a negative impact on an enterprise's human factor. They found personnel risk to be the most significant business risk in the research of Czech and Slovak SMEs.

Legal risk is also a part of operational risk. It includes the risk of financial or reputational loss resulting from any legal issue, a lack of awareness, or a misunderstanding of how laws and regulations apply to a business (Virglerova et al., 2020b).

Strategic risks are primarily defined as the risks that enable or threaten to achieve a firm's strategic goals and disrupt the fulfillment of a firm's strategy. These risks are unique compared to other ones due to their relation to future and firm's new opportunity to innovate its products, technology, gain new markets (Lima et al., 2020). Concerning the roles of owners and managers, generally, the owners are the company's investors, and the managers are the company's employees. In some cases, both roles can be played by the same people, usually in family businesses. The manager's role should be held by professional employees with adequate education and competencies (Garciá-Vidal et al., 2019). Entrepreneurs are generally considered to be risk-takers (Block et al., 2015).

Khan et al. (2019) consider "sensemaking of risks" as a critical factor influencing the difference between entrepreneurs and small business owners. They suggest the growth stage and organizational filters as critical determinants of the owner/managers' understanding of business risks. Gropp and Köhler (2013) found that owners prefer more risk compared to

managers. The ability to control management empirically seems to be more important than the risk-reducing effect of lack of diversification. Similarly, Kerr et al. (2019) revealed that entrepreneurs are more risk-tolerant than managers. Salehi et al. (2020) suggest that the Chief Executive Officer's narcissism at the board of directors positively and significantly affect corporate risk-taking. Risk-taking is also positively and significantly related to managers' overconfidence.

## 2. Aim, methodology and data

The article aims to identify disparities in the perception of business risks (BRs) between owners and managers of small and medium-sized enterprises in the V4 countries. Our respondents are the business owners or top managers in the SME in the business environment of V4 countries. The work position of the respondent is a criterion of the case study of SMEs.

### 2.1 Research design

The data collection was performed in Hungary (H), Poland (PL), Czechia (CR), and Slovak Republic (SR) from September 2019 to March 2020. The data were collected using an online questionnaire with seven demographics questions and 24 business risk statements (BRSs). Information about SMEs (e.g., number of employees, e-mail address, and telephone number) was collected from the database of Chambers of Commerce and Industry in Budapest (H), from the CRIBIS database (CR, SR), and the database of the Central Statistical Office of Poland (PL).

The process of SMEs sample file creation had the following steps (separately for each region in V4 countries): i. definition of the basic set of SMEs (criterion: companies up to 249 employees); ii. assignment of a serial number; iii. random numbers generated using the mathematical function "Randbetween"; iv. assignment of SMEs to randomly generated numbers; v. finding contacts and addressing SMEs by e-mail with a request to fill in an online questionnaire. SMEs were also contacted by telephone with a request to complete a questionnaire.

### 2.2 Business risk

The questionnaires were created in the national languages of the selected countries. The first part includes the demographics questions. The second part conducts randomly assigned statements about the BRSs . The questionnaire contained a control question (preventing the questionnaire from being filled out automatically by computer; verified the consistent attitudes). The average return rate of the questionnaires was more than 5% (in V4 countries). The respondent had to evaluate each BRS by the use of five types of answers: completely agree (1), ..., completely disagree (5). The BRSs are as follows:

**Strategic risk statements (SR):** SR1: Strategic management in a company is an integral part of corporate governance. SR2: Strategic management is implemented in the everyday life of our company and is done through action plans and programs. SR3: Proper strategic management improves the competitive ability of our company and its stability in domestic and foreign markets. SR4: Our company regularly monitors, evaluates, and manages strategic risks. **Market risk statements (MR):** MR1: I rate the market risk (potential lack of sales for my company) as adequate. MR2: Business competition motivates us to perform better. MR3: Selling products and services on the market is challenging. However, our company has

adequate sales volume. MR4: Our company uses innovative ways to win new markets and retain existing customers. **Financial risk statements (FR):** FR1: I consider financial risk as part of everyday business. FR2: I evaluate the financial performance of our (my) company positively. FR3: I understand the most crucial aspect of financial risk. FR4: I can adequately manage the financial risk in my (our) company. **Personnel risk statements (PER):** PER1: Personnel risk in the company is considered adequate and does not harm my business. PER2: Employee turnover is low and has no negative impact on my (our) business. PER3: The error rate of employees is low and has no negative impact on my (our) business. PER4: Our employees strive to improve their performance, competition among them prevails. **Legal risk statements (LEG):** LEG1: I consider the legal risk as appropriate; it does not harm our (my) business. LEG2: Business is affected by frequent legislative changes, but it has no negative impact on our (my) business. LEG3: I do not consider the business environment to be 'over-regulated. LEG4: I understand the essential legal aspects of doing business. **Operational risk statements (OPE):** OPE1: We use company capacities at a sufficient level. OPE2: We place great emphasis on the innovation of our products and services, and it is positively reflected in the stability and performance of the company. OPE3: The number of possible requests for specific products/services has a downward trend. OPE4: Our company is not dependent on a limited number of suppliers.

### 2.3 Formulation of statistical hypothesis and methods

The following statistical hypotheses ($H_{ij}$; i (type of BR) = 1, …, 6; i =1 - SR; i =2 - MR; i = 3 - FR; i = 4 - PER; i = 5 - LEG; i = 6 - OPE; j - BRS; j = 1, …, 4) were formulated to fulfill the aim of the article:

$H_{ij}$: There are statistically significant differences in the overall structure of attitudes on the BRSs (i = 1,…, 6; j = 1, …, 4) between respondents according to the work position in the SME segment in V4 countries.

$HPP_{ij}$: There are statistically significant differences in positive attitudes on the BRSs (i = 1,…, 6; j = 1, …, 4) between respondents according to the work position in the SME segment in V4 countries.

The validity and reliability of the questionnaire were verified according to the following characteristics (e.g. Byrne, 2009 – also see limits of acceptability): factor loading (FL); Cronbach alpha (CA); composite reliability (CR); average variance extracted (AVE). The results are shown in table no. 1. The pivot tables (from table no. 2 to no. 7) contain absolute and relative values of respondents according to the type of answer and the work position in SME. The statistically significant differences in the overall structure of attitudes on the BRSs between selected groups of respondents (according to the work position in SME) were verified by using the Chi-square test (Rao and Scott, 1981). The basic value of the level of significance (α) was 0.05. If the p-value was more than α then the hypothesis was rejected (Goodman, 1970). The measure of association between two nominal variables (type of answer and the work position of respondent in SME) was calculated and interpreted (strong association (SA) > 0.15; moderate association (MA) > 0.10) by Cramer's V (Akoglu, 2018). The results were also verified by the non-parametric approach of the Kruskal-Wallis test. The Z-Score verified the hypotheses population proportions (HPPij) for two population proportions.

### 2.4 Structure of respondents

The structure of respondents (N = 1585 SMEs) was as follows: company's country of operation: CR 454 (28.6%), SR 368 (23.2%), PL 364 (23.0), H 399 (25.2); size of SME: micro-enterprise (up to 9 employees) 976 (61.6%), small enterprise (from 10 to 49 employees) 371 (23.4%), medium-sized enterprise (from 50 to 249 employees) 238 (15.0%); length of operating the business: 536 (33.8%) less than or equal to 10 years, and 1049 (66.2%) for over 10 years; type of entity in business: limited liability company 479 (30.2%); sole trader 898 (56.7%); join-stock company 95 (6.0%); another form of business 113 (7.1%); gender: male 1081 (68.2%); female 504 (31.8%); age: less than 35 years 312 (19.7%), from 36 to 45 years 475 (30.0%), from 46 to 55 years 452 (28.5%), more than 56 years 346 (21.8%); the highest level of education: comprehensive college and high school graduate 673 (42.5%); Bachelor´s, Master´s and Doctoral degree 912 (57.5%).

## 3. Empirical results

The aim criterion of this case study is respondents' work position in SME: business owner (O) 422 (26.6%), top manager (M) 1163 (73.4%). Section 3.1 presents the results of validity and reliability analysis. The following sections (from 3.2 to 3.7) present the comparison of attitudes on the BRSs between these two groups of respondents.

### 3.1 Reliability and validity analysis

Table no. 1 shows that CAs and CRs of BRs are greater than 0.70 (the minimum criterion). The composite reliabilities were fulfilled. The results further exhibited (see table 1) that FLs of all the types of BR are in the range of 0.591 to 0.852, meeting the discriminant validity. The value of AVE is more significant than 0.50 for each type of BR, which meets the constructs' convergent validity criterion.

**Table no. 1. The results of reliability and validity analysis**

| Type of BR | ST | FL | CA | CR | AVE | Type of BR | ST | FL | CA | CR | AVE |
|---|---|---|---|---|---|---|---|---|---|---|---|
| SR | SR1 | 0.772 | 0.819 | 0.882 | 0.651 | PER | PER1 | 0.719 | 0.762 | 0.848 | 0.585 |
| | SR2 | 0.852 | | | | | PER2 | 0.832 | | | |
| | SR3 | 0.839 | | | | | PER3 | 0.820 | | | |
| | SR4 | 0.761 | | | | | PER4 | 0.676 | | | |
| MR | MR1 | 0.643 | 0.760 | 0.798 | 0.503 | LEG | LEG1 | 0.803 | 0.782 | 0.811 | 0.521 |
| | MR2 | 0.729 | | | | | LEG2 | 0.773 | | | |
| | MR3 | 0.760 | | | | | LEG3 | 0.689 | | | |
| | MR4 | 0.685 | | | | | LEG4 | 0.606 | | | |
| FR | FR1 | 0.591 | 0.732 | 0.838 | 0.568 | OPE | OPE1 | 0.803 | 0.724 | 0.851 | 0.588 |
| | FR2 | 0.709 | | | | | OPE2 | 0.773 | | | |
| | FR3 | 0.836 | | | | | OPE3 | 0.689 | | | |
| | FR4 | 0.849 | | | | | OPE4 | 0.798 | | | |

*Notes:* ST – Statement; BR – Business risk; SR – Strategic risk; MR – Market risk; FR – Financial risk; PER – Personnel risk; LEG – Legal risk; OPE – Operational risk

### 3.2 Strategic risk

Structure of respondents according to the type of answer (T.A.; e.g. T.A. (1) - (SR1+SR2+SR3+SR4)/ (4*N) in %): (1) - 23.5% respondents; (2) - 38.4% respondents; (3) - respondents 25.6%; (4) - 8.9% respondents; (5) - 3.6% respondents. Comparison of respondents' attitudes on the strategic risk statements according to the work position in the SME presents table no. 2.

**Table no. 2. Evaluation of the strategic risk statements**

| T.A. | SR1 | | SR2 | | SR3 | | SR4 | | DS | Kruskal-Wallis test | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | O | M | O | M | O | M | O | M | | SR1 | | SR2 | |
| (1) | 164 | 407 | 89 | 183 | 123 | 291 | 79 | 155 | | O | M | O | M |
| | 38.9% | 35.0% | 21.1% | 15.7% | 29.1% | 25.0% | 18.7% | 13.3% | N | 422 | 1163 | 422 | 1163 |
| (2) | 186 | 477 | 158 | 430 | 172 | 460 | 159 | 390 | Me | 2.000 | | 2.000 | |
| | 44.1% | 41.0% | 37.4% | 37.0% | 40.8% | 39.6% | 37.7% | 33.5% | >Me | 72 | 279 | 175 | 550 |
| (3) | 49 | 208 | 121 | 378 | 96 | 289 | 119 | 360 | <=Me | 350 | 884 | 247 | 613 |
| | 11.6% | 17.9% | 28.7% | 32.5% | 22.7% | 24.8% | 28.2% | 31.0% | K-W | ***8.620**** | | ***4.229**** | |
| (4) | 14 | 51 | 43 | 118 | 23 | 90 | 46 | 178 | DS | SR3 | | SR4 | |
| | 3.3% | 4.4% | 10.2% | 10.1% | 5.5% | 7.7% | 10.9% | 15.3% | | O | M | O | M |
| (5) | 9 | 20 | 11 | 54 | 8 | 33 | 19 | 80 | N | 422 | 1163 | 422 | 1163 |
| | 2.1% | 1.7% | 2.6% | 4.6% | 1.9% | 2.8% | 4.5% | 6.9% | Me | 2.000 | | 3.000 | |
| C.S. | ***10.644**** | | ***9.766**** | | 6.029 | | ***15.463***** | | >Me | 127 | 412 | 65 | 258 |
| Z-S. | SR1: (1)+(2) | | SR2: (1)+(2) | | SR3: (1)+(2) | | SR4: (1)+(2) | | <=Me | 295 | 751 | 245 | 905 |
| | ***2.936***** | | ***2.056**** | | ***1.980**** | | ***3.356***** | | K-W | 3.021 | | ***8.775***** | |

*Notes:* C.S – Chi-Square test; K-W – Kruskal-Wallis test; Z-S – Z-Score; O – Business owner; M – Manager; T.A. – Type of answer; N – Total number of respondents; Me – Median; * $\alpha = 0.05$; ** $\alpha = 0.01$

The results of Chi-square tests (see table no. 2) confirmed, that owners more positively evaluate strategic risk statements SR1 (p-value = 0.031; Cramer's V = 0.082 - MA), SR2 (p-value = 0.045; Cramer's V = 0.078 - MA), and SR4 (p-value = 0.004; Cramer's V = 0.099 - MA) than managers. Disparities between owners and managers in the overall structure of attitudes are significant in evaluating SR1, SR2, and SR4. The impact of the work position of the respondent is not statistically significant on the evaluation of SR3 (p-value = 0.197). Hypotheses $H_{11}$; $H_{12}$ and $H_{14}$ were confirmed. Hypothesis $H_{13}$ was rejected. Disparities between owners and managers in positive attitudes (see table no. 2: Z.S. results) are significant by evaluating each SR statement. Hypotheses $HPP_{11}$; $HPP_{12}$; $HPP_{13}$, and $HPP_{14}$ were confirmed.

### 3.3 Market risk

Structure of respondents according to the type of answer (T.A.; e.g. T.A. (1) - (MR1+MR2+MR3+MR4)/ (4*N) in %): (1) - 18.3% respondents; (2) - 41.3% respondents;

(3) - respondents 25.5%; (4) - 8.9% respondents; (5) - 3.4% respondents. Comparison of respondents' attitudes on the market risk statements according to the work position in the SME presents table no. 3.

**Table no. 3. Evaluation of the market risk statements**

| T.A. | MR1 | | MR2 | | MR3 | | MR4 | | DS | Kruskal-Wallis test | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | O | M | O | M | O | M | O | M | | MR1 | | MR2 | |
| (1) | 41 | 145 | 110 | 366 | 70 | 197 | 53 | 180 | | O | M | O | M |
| | 9.7% | 12.5% | 26.1% | 31.5% | 16.6% | 16.9% | 12.6% | 15.5% | N | 422 | 1163 | 422 | 1163 |
| (2) | 204 | 441 | 205 | 450 | 210 | 545 | 155 | 408 | Me | 2.000 | | 2.000 | |
| | 48.3% | 37.9% | 48.6% | 38.7% | 49.8% | 46.9% | 36.7% | 35.1% | >Me | 177 | 577 | 107 | 347 |
| (3) | 122 | 383 | 65 | 212 | 90 | 285 | 130 | 327 | <=Me | 245 | 586 | 315 | 816 |
| | 28.9% | 32.9% | 15.4% | 18.2% | 21.3% | 24.5% | 30.8% | 28.1% | K-W | ***7.304**** | | ***3.547**** | |
| (4) | 50 | 140 | 34 | 92 | 45 | 107 | 63 | 198 | DS | MR3 | | MR4 | |
| | 11.8% | 12.0% | 8.1% | 7.9% | 10.7% | 9.2% | 14.9% | 17.0% | | O | M | O | M |
| (5) | 5 | 54 | 8 | 43 | 7 | 29 | 21 | 50 | N | 422 | 1163 | 422 | 1163 |
| | 1.2% | 4.6% | 1.9% | 3.7% | 1.7% | 2.5% | 5.0% | 4.3% | Me | 2.000 | | 2.000 | |
| C.S. | ***21.794****** | | ***14.880**** | | 3.533 | | 3.950 | | >Me | 142 | 421 | 214 | 575 |
| *Z-S.* | **MR1: (1)+(2)** | | **MR2: (1)+(2)** | | **MR3: (1)+(2)** | | **MR4: (1)+(2)** | | <=Me | 280 | 742 | 208 | 588 |
| | ***2.703**** | | 1.744 | | 0.938 | | 0.447 | | K-W | 0.879 | | 0.200 | |

*Notes:* C.S – Chi-Square test; K-W – Kruskal-Wallis test; Z-S – Z-Score; O – Business owner; M – Manager; T.A. – Type of answer; N – Total number of respondents; Me – Median; * $\alpha = 0.05$; ** $\alpha = 0.01$; *** $\alpha = 0.001$

The results of Chi-square tests (see table no. 3) confirmed, that owners more positively evaluate market risk statements MR1 (p-value = 0.000; Cramer's V = 0.117 - SA) and MR2 (p-value = 0.005; Cramer's V = 0.097 - MA) than managers. Disparities between owners and managers in the overall structure of attitudes are significant in evaluating MR1 and M2. The respondent's work position impact is not statistically significant in the case of MR3 (p-value = 0.473) and MR4 (p-value = 0.413) evaluation. Hypotheses $H_{21}$ and $H_{22}$ were confirmed. Hypotheses $H_{23}$ and $H_{24}$ were rejected. Disparities between owners and managers in positive attitudes (see table no. 3: Z.S. results) are significant in the case of MR1 statement. Hypothesis $HPP_{21}$ was confirmed. Hypotheses $HPP_{22;}$ $HPP_{23}$ and $HPP_{24}$ were rejected.

### 3.4 Financial risk

Structure of respondents according to the type of answer (T.A.; e.g. T.A. (1) - (FR1+FR2+FR3+FR4)/ (4*N) in %): (1) - 24.1% respondents; (2) - 48.1% respondents; (3) - respondents 19.4%; (4) - 6.5% respondents; (5) - 1.9% respondents. Comparison of respondents' attitudes on the financial risk statements according to the work position in the SME presents table no. 4.

**Table no. 4. Evaluation of the financial risk statements**

| T.A. | FR1 | | FR2 | | FR3 | | FR4 | | DS | Kruskal-Wallis test | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | O | M | O | M | O | M | O | M | | FR1 | | FR2 | |
| (1) | 97 | 345 | 91 | 243 | 104 | 317 | 67 | 264 | | O | M | O | M |
| | 23.0% | 29.7% | 21.6% | 20.9% | 24.6% | 27.3% | 15.9% | 22.7% | N | 422 | 1163 | 422 | 1163 |
| (2) | 218 | 524 | 183 | 546 | 224 | 563 | 229 | 565 | Me | 2.000 | | 2.000 | |
| | 51.7% | 45.1% | 43.4% | 46.9% | 53.1% | 48.4% | 54.3% | 48.6% | >Me | 107 | 294 | 148 | 374 |
| (3) | 76 | 196 | 92 | 234 | 70 | 219 | 90 | 251 | <=Me | 315 | 869 | 274 | 789 |
| | 18.0% | 16.9% | 21.8% | 20.1% | 16.6% | 18.8% | 21.3% | 21.6% | K-W | ***6.351***** | | 1.189 | |
| (4) | 22 | 80 | 41 | 109 | 15 | 48 | 31 | 63 | DS | FR3 | | FR4 | |
| | 5.2% | 6.9% | 9.7% | 9.4% | 3.6% | 4.1% | 7.3% | 5.4% | | O | M | O | M |
| (5) | 9 | 18 | 15 | 31 | 9 | 16 | 5 | 20 | N | 422 | 1163 | 422 | 1163 |
| | 2.1% | 1.5% | 3.6% | 2.7% | 2.1% | 1.4% | 1.2% | 1.7% | Me | 2.000 | | 2.000 | |
| C.S. | ***10.035**** | | 2.237 | | 4.391 | | ***11.414**** | | >Me | 94 | 283 | 126 | 334 |
| *Z-S.* | FR1: (1)+(2) | | FR2: (1)+(2) | | FR3: (1)+(2) | | FR4: (1)+(2) | | <=Me | 328 | 880 | 296 | 829 |
| | 0.031 | | 1.091 | | 0.851 | | 0.442 | | K-W | 0.724 | | ***4.195**** | |

*Notes:* C.S – Chi-Square test; K-W – Kruskal-Wallis test; Z-S – Z-Score; O – Business owner; M – Manager; T.A. – Type of answer; N – Total number of respondents; Me – Median; ** $\alpha = 0.01$; *** $\alpha = 0.001$

The results of Chi-square tests (see table no. 4) confirmed, that owners more positively evaluate financial risk statements FR1 (p-value = 0.040; Cramer's V = 0.080 - MA) and FR4 (p-value = 0.022; Cramer's V = 0.085 - MA) than managers. Disparities between owners and managers in the overall structure of attitudes are significant concerning FR1 and FR4. The impact of work position of the respondent is not statistically significant concerning FR2 (p-value = 0.692) and FR3 (p-value = 0.356). Hypotheses $H_{31}$ and $H_{34}$ were confirmed. Hypotheses $H_{32}$ and $H_{33}$ were rejected. Disparities between owners and managers in positive attitudes (see Table 4: Z.S. results) are not significant concerning FR statement. Hypotheses $HPP_{31}$; $HPP_{32}$; $HPP_{33}$ and $HPP_{34}$ were rejected.

### 3.5 Personnel risk

Structure of respondents according to the type of answer (T.A.; e.g. T.A. (1) - (PER1+PER2+PER3+PER4)/ (4*N) in %): (1) - 17.9% respondents; (2) - 35.1% respondents; (3) - respondents 26.0%; (4) - 15.3% respondents; (5) - 5.7% respondents. Comparison of respondents' attitudes on the personnel risk statements according to the work position in the SME presents table no. 5.

**Table no. 5. Evaluation of the personnel risk statements**

| T.A. | PER1 | | PER2 | | PER3 | | PER4 | | DS | Kruskal-Wallis test | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | O | M | O | M | O | M | O | M | | PER1 | | PER2 | |
| (1) | 41 | 173 | 86 | 309 | 78 | 232 | 54 | 160 | | O | M | O | M |
| | 9.7% | 14.9% | 20.4% | 26.6% | 18.5% | 19.9% | 12.8% | 13.8% | N | 422 | 1163 | 422 | 1163 |
| (2) | 169 | 443 | 126 | 367 | 155 | 449 | 141 | 374 | Me | 2.000 | | 2.000 | |
| | 40.0% | 38.1% | 29.9% | 31.6% | 36.7% | 38.6% | 33.4% | 32.2% | >Me | 212 | 547 | 210 | 487 |
| (3) | 120 | 312 | 92 | 248 | 97 | 259 | 144 | 377 | <=Me | 210 | 616 | 212 | 676 |
| | 28.4% | 26.8% | 21.8% | 21.3% | 23.0% | 22.3% | 34.1% | 32.4% | K-W | 1.273 | | ***7.821**** | |
| (4) | 68 | 181 | 77 | 154 | 75 | 159 | 69 | 188 | DS | PER3 | | PER4 | |
| | 16.1% | 15.6% | 18.2% | 13.2% | 17.8% | 13.7% | 16.4% | 16.2% | | O | M | O | M |
| (5) | 24 | 54 | 41 | 85 | 17 | 64 | 14 | 64 | N | 422 | 1163 | 422 | 1163 |
| | 5.7% | 4.6% | 9.7% | 7.3% | 4.0% | 5.5% | 3.3% | 5.5% | Me | 2.000 | | 3.000 | |
| C.S. | 7.452 | | ***12.659**** | | 5.542 | | 3.648 | | >Me | 189 | 482 | 83 | 252 |
| *Z-S.* | PER1:(1)+(2) | | PER2:(1)+(2) | | PER3:(1)+(2) | | PER4:(1)+(2) | | <=Me | 233 | 681 | 339 | 911 |
| | 1.128 | | ***2.797**** | | 1.190 | | 0.103 | | K-W | 1.417 | | 0.743 | |

*Note:* C.S – Chi-Square test; K-W – Kruskal-Wallis test; Z-S – Z-Score; O – Business owner; M – Manager; T.A. – Type of answer; N – Total number of respondents; Me – Median; ** $\alpha = 0.01$; *** $\alpha = 0.001$

The results of Chi-square tests (see table no. 5) confirmed, that managers more positively evaluate personnel risk statement PER2 (p-value = 0.013; Cramer's V = 0.089 - MA) than owners. Disparities between owners and managers in the overall structure of attitudes are significant in the case of PER2. The impact of the work position of the respondent is not statistically significant concerning PER1 (p-value = 0.114). PER3 (p-value = 0.236) and PER4 (p-value = 0.456). Hypothesis $H_{42}$ was confirmed. Hypotheses $H_{41;}$ $H_{43}$ and $H_{43}$ were rejected. Disparities between owners and managers in positive attitudes (see table no. 5: Z.S. results) are significant by concerning PER2 statement. Hypothesis $HPP_{42}$ was confirmed. Hypotheses $HPP_{41;}$ $HPP_{43}$ and $HPP_{43}$ were rejected.

### 3.6 Legal risk

Structure of respondents according to the type of answer (T.A.; e.g. T.A. (1) - (LEG1+LEG2+LEG3+LEG4)/ (4*N) in %): (1) - 15.9% respondents; (2) - 32.0% respondents; (3) - respondents 24.5%; (4) - 17.3% respondents; (5) - 10.3% respondents. Comparison of respondents´ attitudes on the legal risk statements according to the work position in the SME presents table no. 6.

**Table no. 6. Evaluation of the legal risk statements**

| T.A. | LEG1 | | LEG2 | | LEG3 | | LEG4 | | DS | Kruskal-Wallis test | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | O | M | O | M | O | M | O | M | | LEG1 | | LEG2 | |
| (1) | 61 | 122 | 51 | 137 | 39 | 103 | 118 | 380 | | O | M | O | M |
| | 14.5% | 10.5% | 12.1% | 11.8% | 9.2% | 8.9% | 28.0% | 32.7% | N | 422 | 1163 | 422 | 1163 |
| (2) | 143 | 376 | 130 | 282 | 99 | 226 | 226 | 545 | Me | 3.000 | | 3.000 | |
| | 33.9% | 32.3% | 30.8% | 24.2% | 23.5% | 19.4% | 53.6% | 46.9% | >Me | 107 | 339 | 129 | 419 |
| (3) | 111 | 326 | 112 | 325 | 134 | 300 | 58 | 189 | <=Me | 315 | 824 | 293 | 744 |
| | 26.3% | 28.0% | 26.5% | 27.9% | 31.8% | 25.8% | 13.7% | 16.3% | K-W | *4.203** | | *4.079** | |
| (4) | 82 | 225 | 86 | 249 | 104 | 305 | 16 | 31 | DS | LEG3 | | LEG4 | |
| | 19.4% | 19.3% | 20.4% | 21.4% | 24.6% | 26.2% | 3.8% | 2.7% | | O | M | O | M |
| (5) | 25 | 114 | 43 | 170 | 46 | 229 | 4 | 18 | N | 422 | 1163 | 422 | 1163 |
| | 5.9% | 9.8% | 10.2% | 14.6% | 10.9% | 19.7% | 0.9% | 1.5% | Me | 3.000 | | 2.000 | |
| C.S. | *10.091** | | *10.042** | | *20.604*** | | 8.415 | | >Me | 150 | 534 | 78 | 238 |
| Z-S. | LEG1:(1)+(2) | | LEG2:(1)+(2) | | LEG3:(1)+(2) | | LEG4:(1)+(2) | | <=Me | 272 | 629 | 344 | 925 |
| | *1.962** | | *2.490** | | 1.703 | | 0.873 | | K-W | *13.576**** | | 0.761 | |

*Notes:* C.S – Chi-Square test; K-W – Kruskal-Wallis test; Z-S – Z-Score; O – Business owner; M – Manager; T.A. – Type of answer; N – Total number of respondents; Me - Median; ** $\alpha = 0.01$; *** $\alpha = 0.001$

The results of Chi-square tests (see table no. 6) confirmed, that owners more positively evaluate legal risk statements LEG1 (p-value = 0.039; Cramer's V = 0.080 - MA), LEG2 (p-value = 0.040; Cramer's V = 0.080 - MA) and LEG3 (p-value = 0.000; Cramer's V = 0.114 - SA) than managers. Disparities between owners and managers in the overall structure of attitudes are significant concerning LEG1, LEG2, and LEG3. The impact of the work position of the respondent is not statistically significant concerning LEG4 (p-value = 0.078). Hypotheses $H_{51;}$ $H_{52,}$ and $H_{53}$ were confirmed. Hypothesis $H_{54}$ was rejected. Disparities between owners and managers in positive attitudes (see table no. 6: Z.S. results) are significant in relation to LEG1 and LEG2 statements. Hypotheses $HPP_{51}$ and $HPP_{52}$ were confirmed. Hypotheses $HPP_{53}$ and $HPP_{54}$ were rejected.

### 3.7 Operational risk

Structure of respondents according to the type of answer (T.A.; e.g. T.A. (1) - (OPE1+OPE2+OPE3+OPE4)/ (4*N) in %): (1) - 22.3% respondents; (2) - 37.2% respondents; (3) - respondents 24.1%; (4) - 11.8% respondents; (5) - 4.6% respondents. Comparison of respondents´ attitudes on the operational risk statements according to the work position in the SME presents table no. 7.

**Table no. 7. Evaluation of the operational risk statements**

| T.A. | OPE1 | | OPE2 | | OPE3 | | OPE4 | | DS | Kruskal-Wallis test | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | O | M | O | M | O | M | O | M | | OPE1 | | OPE2 | |
| (1) | 72 | 218 | 74 | 279 | 72 | 218 | 74 | 279 | | O | M | O | M |
| | 17.1% | 18.7% | 17.5% | 24.0% | 17.1% | 18.7% | 17.5% | 24.0% | N | 422 | 1163 | 422 | 1163 |
| (2) | 202 | 574 | 186 | 470 | 202 | 574 | 186 | 470 | Me | 2.000 | | 2.000 | |
| | 47.9% | 49.4% | 44.1% | 40.4% | 47.9% | 49.4% | 44.1% | 40.4% | >Me | 148 | 371 | 162 | 414 |
| (3) | 96 | 268 | 114 | 309 | 96 | 268 | 114 | 309 | <=Me | 274 | 792 | 260 | 749 |
| | 22.7% | 23.0% | 27.0% | 26.6% | 22.7% | 23.0% | 27.0% | 26.6% | K-W | 1.414 | | 1.043 | |
| (4) | 44 | 89 | 36 | 80 | 44 | 89 | 36 | 80 | DS | OPE3 | | OPE4 | |
| | 10.4% | 7.7% | 8.5% | 6.9% | 10.4% | 7.7% | 8.5% | 6.9% | | O | M | O | M |
| (5) | 8 | 14 | 12 | 25 | 8 | 14 | 12 | 25 | N | 422 | 1163 | 422 | 1163 |
| | 1.9% | 1.2% | 2.8% | 2.1% | 1.9% | 1.2% | 2.8% | 2.1% | Me | 2.000 | | 2.000 | |
| C.S. | 4.539 | | 8.612 | | ***12.764**** | | 5.884 | | >Me | 215 | 510 | 213 | 536 |
| *Z-S.* | LEG1:(1)+(2) | | LEG2:(1)+(2) | | LEG3:(1)+(2) | | LEG4:(1)+(2) | | <=Me | 207 | 653 | 209 | 627 |
| | 1.189 | | 1.021 | | ***2.506**** | | 1.546 | | K-W | ***6.282**** | | 2.390 | |

*Notes:* C.S – Chi-Square test; K-W – Kruskal-Wallis test; Z-S – Z-Score; O – Business owner; M – Manager; T.A. – Type of answer; N – Total number of respondents; Me - Median; ** $\alpha = 0.01$; *** $\alpha = 0.001$.

The results of Chi-square tests (see table no. 7) confirmed, that managers more positively evaluate operational risk statement OPE3 (p-value = 0.012; Cramer´s V = 0.090) than owners. Disparities between owners and managers in the overall structure of attitudes are significant concerning OPE3. The impact of the work position of the respondent is not statistically significant concerning OPE1 (p-value = 0.338), OPE2 (p-value = 0.072) and OPE4 (p-value = 0.208). Hypothesis $H_{63}$ was confirmed. Hypotheses $H_{61,}$ $H_{62,}$ and $H_{64}$ were rejected. Disparities between owners and managers in positive attitudes (see table no. 7: Z.S. results) are significant concerning OPE3 statement. Hypothesis $HPP_{63}$ was confirmed. Hypotheses $HPP_{61;}$ $HPP_{62}$ and $HPP_{64}$ were rejected.

All empirical results (Chi-square tests) were also verified according to the non-parametric approach (Kruskal-Wallis tests; see tables from no. 2 to no. 7) with the same interpretations.

## 4. Discussion

Starting a business involves risk and, thus, requires a risk- taking attitude (Block et al., 2015). Risk and corporate earnings are in a positive correlation (Caliendo et al., 2010). The higher the income, the higher the risk (Kotaskova et al., 2020b). Dankiewicz et al. (2020) showed that the larger the SME enterprise is, the more complex is the risk management of all risks, including market, financial (exogenous risks), and endogenous risks. Caliendo et al. (2010) studied and confirmed the relationship between an entrepreneur's risk attitude and entrepreneurial survival. They revealed that persons with particularly low or particularly high risk attitudes survive as entrepreneurs less often than persons with a medium-level risk

attitude. Khan et al. (2020) consider lack of management skills, insufficient flexibility in decision-making, poor interpersonal relationships, poor quality of planning, insufficient support of strategic thinking as the sources of the business risks.

The results of the paper bring exciting findings. Owners have more positive attitudes than managers on evaluating strategic risk statements. For example, 56.4% of owners think that the company regularly monitors, evaluates, and manages strategic risks versus 46.9% of managers. Due to lower strategic risk tolerance, it is possible to assume that managers pay much attention to strategic decisions a do not minimize strategic risks, which corresponds with their importance (Tonello, 2012). Managers have more negative attitudes than owners on evaluating legal risk statements. For example, 35.5% of managers consider the business environment to be over-regulated versus 45.9% of owners. The results confirm the prevailing view of entrepreneurs' greater propensity to take risks than managers (Block et al., 2015; Gropp and Köhler, 2013; Kerr et al., 2019). On the contrary, managers (58.1%) have more positive attitudes than owners (50.2%) to assess that employee turnover is low and has no negative impact on my business. Market and financial risk statements are evaluated similarly, except for one market statement - MR1. 58.1% of owners think that the market risk rate (potential lack of sales for my company) is adequate versus 50.4% of managers. This fact confirms the awareness of market risk to be the crucial one in RM and confirms findings of Kim and Vonortas (2014); Kassi et al. (2019); Danikewicz (2020). Both groups of respondents have the same perception of the statement that the error rate of employees is low and has no negative impact on my (our) business (owner/manager: 55.2%/58.6). Since most of the owners and managers (more than 50%) were able to evaluate the statetements related to personnel risks, we can assume they are aware of their importance in business and the necessity of their effective managing, which corresponds with Kotaskova et al. (2020a); Becker and Schmidt (2016). In general, operational risk statements are evaluated similarly, except for OPE2. 56.1% of managers compared to 49.1% of owners believe that their company emphasizes its products and services innovation, which positively reflects in its stability and performance. The assessment of managers is more optimistic than the owners.

Regarding the positive evaluation of managers and entrepreneurs regarding the sufficient emphasis on innovation, it is necessary to realize a new kind of risks as a new field of research named "New and Emerging Risks management (NERs)" in SMEs. NERs are related to the development of society that creates new kinds of risks whose medium- and long-term effects are unknown (Marchand et al., 2016). NERs relate to new dangers, exposures, behaviors, or a recent legal or collective awareness and are linked to modernity and new technologies. Cantonnet et al. (2019) found that SMEs tend to identify NERs to a lesser extent than large ones and confirmed the size to be one of the crucial factors influencing the management of NERs, especially HRM. Cañamares et al. (2017) add that straightforward communication with the productive workers and including safety measures in RM system is vital for minimizing the risk of accidents.

The paper's results support the existence of primarily different risk attitudes of managers and owners (Kulchina, 2016; Wasserman, 2016) except for the findings on similar appreciation of operational and personnel risk. Kulchina (2016) emphasizes different motives of managers and owners and the principle of trust and good faith of owners towards managers. Based on these findings, it is necessary to pay attention to both the appropriate motivation of managers concerning short-term material form, but above all, for the sustainable development of the

company and control of their activities in the interest of the company. It confirms findings of Salehi et al. (2020) associated with owners' overconfidence of managers.

Risk management is still underestimated in SMEs (Crovini et al., 2021). They pay little attention to risk identification, assessment, and monitoring due to the lack of risk mindfulness and knowledge, and its essence can be seen in the managers' and owners' risk attitudes. Due to negative consequences, it is important to understand the risk of non-implementation of risk procedures and find a way to raise awareness of the potential benefits of an effective risk management strategy. Based on Cantonnet et al. (2019) it is essential to realize that firms' different size requires different communication approaches regarding the security risks.

## Conclusions

The dynamics of the business environment cause the firms to face several risks. It is necessary to systematically identify, assess and monitor to reduce possible future losses.

The article aimed to identify disparities in the perception of business risks between owners and managers of small and medium-sized enterprises in the V4 countries.

The most significant disparities between the business owners and the managers of SMEs are in the cases of the strategic and legal risk statements. On the other hand, similar attitudes are in the cases of the operational and personnel risk statements. The perception of financial and market risk statements has either similar or also different signs. The relationship between business owners and managers is most important for good cooperation and management in SMEs. The article enriches research about disparities of subjective perception of the business risks between owners and managers in the SMEs segment.

The presented case study has some limitations. Findings are interpreted based on the subjective attitudes of 1585 SMEs in V4 countries. The data collection was realized before the pandemic of COVID-19. As a subject of the research, the disparities between only two groups of respondents responsible for risk management in SMEs is another limitation. The authors consider it reasonable to focus on examining disparities of attitudes to i. Risk management; ii. Corporate social responsibility; iii. Marketing and social media; iv. Internationalization of the company. Comparison between middle European countries and, for instance, Scandinavian countries can bring other exciting findings for academic staff, organizations supporting the business environment, or for individual leaders of small and medium-sized enterprises.

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# COMPARISON OF THE ENVIRONMENT OF EU COUNTRIES FOR SHARING ECONOMY STATE BY MODERN MULTIPLE CRITERIA METHODS

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**Abstract**
The rapid growth of the sharing economy attracts attention from scientists, businesses, and governments. The European Commission acknowledges the benefits of the sharing economy and emphasises that European countries should be open to the new opportunities that the sharing economy brings. The sharing economy makes an essential contribution to job creation and growth in the European Union. The sharing economy creates new markets and expands existing ones. It makes the use of resources more efficient due to the extensive sharing of assets. Sharing improves resource conservation and efficiency of use, reformats consumption patterns, raises the spirit of entrepreneurship and responsibility of every capital owner, and improves social trust among people worldwide. Despite the focus of researchers on the sharing economy, there is still a lack of research on conditions that stimulate the sharing economy's growth. The article lays the foundation for creating a more comprehensive methodology for assessing the growth of the sharing economy. The authors apply multi-criterion decision-making methods for research purposes, such as EDAS and PROMETHEE II, and recently developed CILOS and IDOCRIW for criteria weight calculation. A hierarchy structure of criteria for evaluating sharing economy growth was created and presented in the paper. The resulting weights of criteria of performance of sharing economy growth were obtained. The prominent features of hierarchy structures and the methodology for calculating ultimate weights are described and demonstrated. The results reveal that the environment is more favourable for sharing economy growth in the Netherlands, Germany, and Sweden among the chosen European countries.

**Keywords:** sharing economy, multicriteria evaluation, environment, factors, EDAS, PROMETHEE

**JEL Classification:** O30, O44, L26

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**Introduction**

According to Bloomberg, the turnover of the global sharing economy could reach $335 billion by 2025 (Bloomberg, 2020). Sharing improves resource conservation and efficiency, reshapes consumption patterns, and makes the spirit of capital owners more flexible and entrepreneurial while considerably increasing their responsibility and social trust among people. The USA and China are leaders in generating revenue of sharing, and they are noted in sustaining high rates of increase. The sharing phenomenon is not new, but the financial crisis of 2008-2009 boosted the growth of the sharing economy as it forced people to seek new ways of consumption and it made companies look for new business opportunities. The phenomenon considerably endangered traditional industries, such as hotels and accommodation vendors, the car and equipment rental, online media, book rental, and invented new industries, such as shared mobility, streaming media or on-demand staffing. Sharing is continuously expanding in every industry and is creating new sharing platforms: large companies-platforms such as Uber, Airbnb, Twitter, and Lime, which were established in the USA and Asia; Ola in India; Didi Chuxing in China, while the largest companies-platforms in Europe are Bolt (Estonia); Tubber, Bargo (The Netherlands); Cabify (Spain); and Grover (Germany) to name a few. According to World Bank estimates, China is the world leader in the sharing economy, with a turnover of more than 230 billion US dollars that makes 1.67% of its GDP (Daxueconsulting, 2020). In the EU, the largest sharing economy markets are in seven countries: France, the UK, Poland, Spain, Germany, Italy, and Denmark; in 2016, they comprised approximately 80% of the total collaborative revenues of the EU-28 member countries. At the same time, the level of development of the sharing economy in the EU varies significantly. In Estonia, Poland, Latvia, Luxembourg, the Czech Republic and Sweden, the collaborative economy makes a significant share of the total economy with its turnover above the average within the EU-28 (EC, 2018).

The name of sharing economy differs by various authors: collaborative consumption (Owyang et al., 2013), collaborative economy (European Commission, 2016), peer-to-peer e-commerce (Hawlitschek et al., 2018), on-demand economy (Cockayne, 2016). The Oxford English Dictionary covered a sharing economy as an economic system in which assets or services are shared between private individuals, either free or for a fee when transactions are typically performed via the Internet. The European Commission (2016) describes the collaborative/sharing economy as a new business model in which activities are facilitated by collaborative platforms and stresses that goods are not "sold" via digital platforms but that temporary access to them is allowed. According to Rinne (2019), the sharing economy focuses on sharing underutilised assets, monetised or not, in ways that improve efficiency, sustainability, and life. The sharing economy is an umbrella term for many organisational models that transform marketplaces and even cityscapes so that the goods and services, skills and spaces are shared, exchanged, rented, or leased (Mont et al., 2020). To summarise, it is an economy that involves individuals and businesses that are sharing the real estate, goods, services, transportation options, space, money, knowledge or skills (Mladenović and Krajina 2020), time, wi-fi network and similar by renting, lending, trading, bartering, or swapping through a shared marketplace (Grybaitė and Stankevičienė, 2016). The sharing economy involves the following participants: service providers, owners of underutilised physical assets or labour; customers who are willing to use the offered assets and services for a particular fee; providers of digital platforms (website or a mobile application). In this paper, the authors are inclined to adhere to the

following description of the sharing economy: it is the set of multi-sided digital platforms that supply various services and products to the open market and act as intermediaries between users and service providers for individuals and businesses.

This article aims to present and use the quantitative methodology to evaluate different countries in terms of their attractiveness for doing the sharing business. The methodology implies choosing a set of indicators that characterise particular conditions that make peer-to-peer services successful and ensure the sharing economy's future growth. The paper presents grounding for the chosen criteria. The authors used several multiple criteria methods in the proposed methodology as the most fitting for the quantitative evaluation of various multi-facet phenomena (Palevicius et al., 2016, 2018; Jakimavicius, 2016; Bielinskas et al., 2018), such as conditions for the sharing economy. The methods imply eliciting weights of criteria as well. The results of several multiple criteria methods and methods for eliciting weights were combined in order to increase precision. Several European countries were chosen from each sub-region to derive a snapshot of the current situation in the EU for further analysis.

The structure of the article is as follows: the literature review and grounding of the choice of criteria are provided in Section 1. Section 2 presents the research methodology and empirical results of the analysis. Finally, conclusions are provided in the last section.

## 1. Literature review

As the sharing economy has a considerable impact on society's welfare, it became essential to perform a comparative evaluation (Ginevicius et al., 2012) of countries in terms of their attractiveness for doing the sharing business there. The analysis of factors that influence the environment for the sharing economy in the literature usually consists of the following aspects: economic, political-legal, technological, socio-demographical, environmental, and international. The authors did not account for the international factor as the sharing economy became global: in the paper, we limit ourselves to large firms that can choose countries for their business. Contemporary technology allows online intermediation services across countries, even making cultural particularities or language unimportant. On the other hand, platform providers are registered in a particular country. As taxes are paid to a specific country's budget, the countries should be competing for a favourable environment for the sharing businesses.

Various researchers, e.g. Dervojeda et al., (2013), Demailly and Novel (2014), Daunorienė et al., (2015), Molenaar (2015), Hamari et al., (2016), Selloni (2017), Dabbous and Tarhini (2019), highlight rapid technological development as the most significant factor that influences the growth of the sharing economy. Baller et al., (2016) emphasise the importance of international trade centres, aligned with creating and sustaining connectivity between vendors, in making a sharing business accessible to a broader range of consumers. Huckle et al. (2016) point out the benefits of the Internet of Things with blockchain technology, as it opens opportunities for creating peer-to-peer secure automatic payment mechanisms and foreign exchange platforms (CIO review, 2016). Sundararajan (2016) emphasises wireless broadband, mass-market smartphones, and digitalised social networks while Owyang (2013) social networking technologies, mobile technologies and payment systems; and Baller et al. (2016), Stremousova and Buchinskaia (2019) the Internet as the most critical technology in the world. Criteria that represent the technological environment

are outlined in table no 1. First, they represent communication ability (Internet availability, infrastructure reliability, connection costs) and technological literacy. Second, they reveal how citizens use such technologies by such aspects as the Internet usage level, computers, tabs, and smartphones. Third, special technological features are also included in the list, such as digitalised social networking technologies, a number of sharing economy platforms, blockchain, secure automatic payments, and software quality.

**Table no. 1. List of indicators that refer to the technological factors**

| Group of technological criteria | Criterion | Source | Ratios of the criteria |
|---|---|---|---|
| Infrastructure | Level of internet access. | Owyang et al., 2013; Baller et al., 2016; Huckle et al., 2016; Rowe, 2017; Apte and Davis, 2019. | Level of internet access (percentage of households). |
| Technological literacy | Individuals using the Internet; Computers, tabs and smartphones. | Owyang, 2013; Owyang et al., 2013; Rowe, 2017; Apte and Davis, 2019. | Availability of computers (% of households; Fixed broadband subscriptions (per 100 people); Number of smartphone users; Individuals using the Internet (% of population); Mobile-cellular subscriptions per 100 inhabitants. |
| Smartness of technologies | Digitalised social networking technologies; Blockchain, secure automatic payment; Quality and secure of information at various software. | Owyang, 2013; Huckle et al., 2016; Apte and Davis, 2019; Huckle et al., 2016; Hong and Lee, 2018; Dabbous and Tarhini, 2019. | Individuals using the Internet for selling goods or services (% of individuals); Sharing economy platforms (number). |

*Source: Created by authors using databases: Eurostat, International Telecommunication Union, Statista, The World Bank*

Socio-demographical factors are essential, but it is difficult to gauge them as they are related to the level of trust, the particularities of culture, the level of sharing mentality, and the prevailing entrepreneurial spirit. Debarshi (2015) highlighted the development of sharing mentality, entrepreneurial spirit, aspiration, and other particularities of culture, induced by sharing. The level of trust among unacquainted people is essential in the sharing economy and trust in the information provided by different platforms (Trivett and Staf, 2013; Botsman, 2015; Debarshi, 2015; Dabbous and Tarhini, 2019). Furthermore, it is essential to note that consumers in the sharing economy have access to their peers' resources instead of being related to businesses. Consequently, Eckhardt and Bardhi (2020) define the sharing economy as "access-based consumption" because market-mediated transactions mostly occur without ownership change. That makes socio-demographic factors even more important as such type of access cannot be entirely regulated by the law.

Such factors could be gauged more easily: knowledge level of new IT services, population density; consumption habits of each generation; and intensity of participation in social

networks, such as Facebook. Furthermore, social networks allow some security checks on customers; thus, they deepen trust-building with unacquainted customers (Trivett and Staf, 2013) and consequently help to share idle assets with others by advertising and by promoting the attitude of customers who believe that products and services can be provided only by regular businesses.

Tussyadiah and Pesonen (2016) confirm that authentic experiences (enjoyment, social belongingness, perceived usefulness, and meaningful interactions with locals) are the most substantial factors that influence an individual's choice to stay at the P2P accommodation (Barnes and Mattsson, 2016). The authors indicate that an average guest who uses the P2P accommodation is educated and, as a result, may not prioritise cost as a deciding factor for making the accommodation choice. The authors noticed that technological knowledge influences trust and positively affects the choice of services and products of the sharing economy (Dabbous and Tarhini, 2019). The possibilities provided by the sharing economy allow individuals to enter the market for the first time and compete almost immediately with large, well-established companies on an equal basis (Apte and Davis, 2019).

To make the quantitative analysis, we had to choose such socio-demographic factors that can be gauged (table no. 2). First, general indicators of population growth and population density influence the style of consumption (Diamantopoulos et al., 2003; Owyang 2013; Hellwig et al., 2015; Dabbous and Tarhini, 2019). Second, sustainability, value-driven, and minimalistic mindset contain several positive drivers that positively affect the sharing economy. It intrinsically supports the feeling that the planet is for everyone and promotes sharing, trust, and the increasing entrepreneurial spirit; market participants with a sustainability mindset understand the importance of sharing economy's development. In addition, people spend more time on various social networks; thus, they actively participate in economic and social life. On the other hand, sharing can be viewed as a considerable augmentation to the capitalist market economy and even a protest against consumerism.

**Table no. 2. List of indicators referring to the socio-demographical factors**

| **Group \| of socio-demographical criteria** | **Criteria** | **Authors/year** | **Ratios referring the criteria** |
|---|---|---|---|
| Population structure | Population density;<br>The number of women (Women are keener to share). | Diamantopoulos et al., 2003; Owyang, 2013; Hellwig et al., 2015; Dabbous and Tarhini 2019. | Population density (people per sq. km of land area);<br>Number of women; (Women per 100 men). |
| Sustainability mindset | The generational shift in consumption habits: sustainability mindset – value-driven and minimalist;<br>Trust factors;<br>Entrepreneurial spirit and aspiration;<br>An independent lifestyle. | Owyang, 2013; Debarshi, 2015; Botsman, 2015; Sundararajan, 2016; Böcker and Meelen, 2017; Ravenelle, 2017;<br>Apte and Davis, 2019. | Ratio of young people in the total population on 1 January by sex and age (from 15 to 29) %;<br>Entrepreneurial intention index;<br>Motivational index;<br>Cultural and Social Norms Index. |

| **Group \| of socio-demographical criteria** | **Criteria** | **Authors/year** | **Ratios referring the criteria** |
|---|---|---|---|
| Dependence on technology | Knowledge level; Participation in social networks; enjoyable communication | Trivett and Staf, 2013; Barnes and Mattsson, 2016; Dabbous and Tarhini, 2019. | Individuals using the Internet for participating in social networks% of individuals. |

*Source: Created by authors using databases: Eurostat, The World Bank, Global entrepreneurship monitor (GEM)*

Inclusion of the economic criteria category into the list of criteria of evaluation is obvious as they are considered uniformly among human beings in making economic decisions. For example, Guttentag (2015), Weng et al. (2020) find that low cost is one of the main reasons to stay at Airbnb. Interestingly, the very emergence of the sharing economy could be related to the financial and economic crisis (Dervojeda et al., 2013; Goudin, 2016; Rowe, 2017). The severe consequences of the crisis can be seen in the coherent rise of unemployment and the decline in consumer purchasing power. That leads to substantial changes in buyers' consumption behaviour: households faced a strong demand to find ways to save or earn money and shift to peer-to-peer business models. Financial sources for investment in sharing economy business became more accessible (Dervojeda et al., 2013); this helped the rapid development of sharing economy's platforms. Apte and Davis (2019), Parente et al. (2018) highlighted other drivers of sharing economy growth: lower transaction costs and extensive venture capital funding that the industry has received in the last decade, both interrelated factors. Thus, we created two categories of economic criteria to simplify the process of choosing: uncertainty of performance of country's economy; and new opportunities in the market for the development of the sharing economy.

Bounding ourselves to the first group of criteria (uncertainty of performance of country's economy), we note that the 2008 financial crisis was the major impetus fostering a change of economic life of a large part of households. The solutions proposed by sharing economy platforms became attractive for many consumers who had the motivation to reduce expenditures. Furthermore, the rising unemployment rate forced many people to offer their underutilised assets or services to the market. The lower GDP and the higher unemployment rate created economic uncertainty and a stimulus for market participants to find new ways to conduct their economic lives (Dervojeda et al., 2013; Goudin, 2016; Apte and Davis, 2019).

The second group of economic criteria (new opportunities in the market for the development of the sharing economy) is related to the sharp improvement in the IT business while making the sharing economy more attractive to smaller entrepreneurs. In addition, lower transaction and IT services costs and increasing dominance of the IT industry have boosted investment in sharing economy businesses. Therefore, opportunities for the sharing economy are better in a country with high R&D expenditures, significant investment rates, development and expansion of the IT sector. The economic criteria are presented in table no 3.

**Table no. 3. List of indicators that refer to the economic factors**

| Group of economic criteria | Criteria | Authors/year | Ratios referring the criteria |
|---|---|---|---|
| Uncertainty of performance of country's economy | GDP per capita; Total unemployment rate. | Dervojeda et al., 2013; Goudin, 2016; Rowe, 2017. | GDP per capita, PPP; GDP per capita of IT industry; Total unemployment rate (% of the total population); Annual net earnings, Euro (per person); Labour costs (wages and salaries total); Productivity (GDP per hour worked). |
| | | Apte and Davis, 2019. | |
| New opportunities | Lower transaction costs. | Parente et al., 2018; Apte and Davis, 2019. | R&D expenditure (% of GDP); Intramural R&D expenditure (GERD) by sectors of performance (all sectors); Rate of GDP growth (%). |
| | Investment into sharing economy business (R&D expenditure). | Sundararajan, 2016; Apte and Davis, 2019. | |
| | Economic benefit. | Guttentag, 2015; Dabbous and Tarhini, 2019; Weng et al., 2020. | |

*Source: Created by authors using databases: Eurostat, The World Bank, Organization for Economic Co-operation and Development (OECD)*

Such regulatory, political, and legal factors that ensure the stable performance of businesses also naturally affect the growth of the sharing economy. Political stability, protected property rights, and ease of starting and operating a business are essential factors for any economic activity, including the sharing economy. It should be noted that the further development of the sharing economy largely depends on the 'government's approach. As Ohlhausen (2015) states, "misguided government regulation can be the barrier to innovation that never falls". Vitkovic (2016) acknowledges the need for an "effective regulatory framework for the sharing economy". The sharing economy serves as an excellent example of the internationalisation of business, allowing even novices to enter markets and compete almost immediately as equals with larger and well-established companies (Apte and Davis, 2019). The chosen political and legal factors are presented in table no. 4; the factors are placed in two categories: *regulatory environment* with five essential criteria and the *level of freedom* category with two indices of business and investment freedom. The latter category is especially attractive to the sharing small businesses because high freedom levels allow them to deal with shared assets.

The literature suggests that all factors impact the phenomenon of sharing economy, and at the same time, these factors are interrelated. Despite that, the task of empirical research is to clarify the most significant ones. The analysed literature, economic logic, and availability of statistical information summarise the particular list of variables chosen for a further stage of analysis (table no. 5).

**Table no. 4. List of indicators referring to the political-legal factors**

| Group of political-legal criteria | Criteria | Authors/year | Ratios referring the criteria |
|---|---|---|---|
| Regulation environment | Rule of law;<br>Regulatory quality;<br>Government effectiveness;<br>Property rights. | Vitkovic, 2016;<br>Hong and Lee, 2018. | Rule of law index;<br>Regulatory quality index;<br>Government effectiveness index;<br>Property rights index;<br>Tax burden index. |
| Level of freedom | The waves of democratisation. | Apte and Davis, 2019;<br>Gurău and Ranchhod, 2020. | Business freedom index;<br>Investment freedom index. |

*Source: Created by authors using databases: The Heritage Foundation, Worldwide Governance Indicators*

## 2. Methodology

As described above, the literature analysis allowed us to identify four categories of factors: technological, socio-demographical, economic and political-legal, in which the most critical indicators were gathered up. Due to limitations related to finding quality data and MCDM methods, the authors used thirteen indicators for further empirical investigation. Such categorisation makes searching for criteria much more effective, especially in complicated problems (Amiria et al., 2021). The imposing structured approach to reach a better trade-off between the comprehensiveness of the set of criteria and limitations of MCDM methods on the number of criteria to be relatively small to enable their processing by experts to be relatively small. In addition, the goal of comprehensiveness is achieved more efficiently by limiting the search of criteria to each particular category at a time. There are no formal methods to build a hierarchy structure (Brauers et al., 2012); the authors used the most popular literature analysis approach that provided an exhaustive set of categories. The most important criteria for evaluating the conditions for the sharing economy were identified. Several stages of reviewing the set of criteria resulted in the following set of criteria, as is presented in table no 5.

**Table no. 5. Factors and criteria of evaluation of conditions for sharing**

| Category | Criterion | Ratio |
|---|---|---|
| Technological | Level of internet access | percentage of households |
| | Individuals using the Internet | percentage of population |
| | Individuals using the Internet for selling goods or services | percentage of individuals |
| Socio-demographical | Population density | people per sq. km of land area |
| Economic | GDP per capita, PPP | current international $ |
| | R&D expenditure | % of GDP |
| | Total unemployment rate | percentage of the total population |
| Political | Rule of law | index |
| | Regulatory quality | index |
| | Government effectiveness | index |
| | Property rights | index |
| | Business freedom | index |
| | Investment freedom | index |

Weights of the importance of criteria of evaluation that reflect conditions for the sharing economy are not found in the literature; the paper attempts to fill this gap. Grounding of the choice of criteria was provided in the literature review section (table no 1-4); weights were calculated using recently developed methods of objective allocation of weights that reflect the particularities of the data: CILOS, entropy, and the integrating method IDOCRIW. In the paper, we will use MCDM methods of evaluation; they integrate weights with normalised values of criteria.

The values of criteria are initially placed into the so-called decision matrix R:

$$R = \|r_{ij}\| \tag{1}$$

where $i$ ($i = 1, \dots, m$) is the index of criteria while $j$ ($i = 1, \dots, n$) is the index of alternatives to be evaluated, in our case countries.

The values of criteria are normalised depending on the method used. The ways of normalisation will be described in appropriate sections in the description of MCDM methods. For example, the EDAS method uses the normalisation that divides values by the maximal value, while PROMETHEE uses the chosen preference function. Normalised values are coupled with the weights to obtain the cumulative criterion of each method that represents the level of attractiveness of each alternative in quantitative terms.

*Description of the CILOS method of objective allocation of weights*

The CILOS method is a relatively new original method that belongs to the realm of objective methods of establishing weights brought to be ready-to-use by Zavadskas and Podvezko (2016). The method uses losses of impact by each criterion measured by distances to its best value. The following steps form the integral model of the method.

Step 1. The values of all minimising criteria are transformed to become the maximising ones. The following inverse transformation function can be used:

$$\bar{r}_{ij} = \frac{\min_j r_{ij}}{r_{ij}} \tag{2}$$

After the transformation, we denote the decision matrix where all criteria are maximising, as
$X = \|x_{ij}\|$.

Step 2. Maximal values are found in each row of the matrix. Such maximal values are denoted as $x_i$.

Step 3. The matrix $A = \|a_{ij}\|$ is formed from the columns where maximal values were found for each criterion. Naturally, the matrix is square, of the size *m* x *m*, where *m* is the number of criteria; maximal values for each criterion are now found on the main diagonal of the matrix.

Step 4. Relative losses are found for each entry of matrix A as follows:

$$p_{ij} = \frac{x_i - a_{ij}}{x_i} \quad (p_{ii} = 0; i, j = 1,2, \dots, m) \tag{3}$$

Step 5. The vector of weights $q$ of the CILOS method is found by solving the following system of equations and by further normalisation:

$$F \cdot q = 0 \tag{4}$$

The matrix $F$ has the sums of relative losses embedded to its main diagonal:

$$F = \begin{pmatrix} -\sum_{i=1}^{m} p_{i1} & p_{12} & \cdots & p_{1m} \\ p_{21} & -\sum_{i=1}^{m} p_{i1} & \cdots & p_{2m} \\ \vdots & \vdots & \ddots & \vdots \\ p_{m1} & p_{m2} & \cdots & -\sum_{i=1}^{m} p_{im} \end{pmatrix}. \tag{5}$$

Description of the entropy method of objective allocation of weights

The entropy method of the objective allocation of weights, and the CILOS method, reflects the structure of the data. The steps of finding weights using this method are as follows.

Step 1. Normalisation of criteria is carried out using the following formula:

$$\tilde{r}_{ij} = \frac{r_{ij}}{\sum_{j=1}^{n} r_{ij}} \tag{6}$$

Step 2. Calculation of the entropy level is carried out at this step as follows:

$$E_i = -\frac{1}{\ln n} \sum_{j=1}^{n} \tilde{r}_{ij} \cdot \ln \tilde{r}_{ij}, (i = 1,2, \dots, m; 0 \leq E_i \leq 1). \tag{7}$$

Step 3. Now, the variation level is calculated:

$$d_i = 1 - E_i, \tag{8}$$

Step 4. Finally, weights by normalisation are calculated:

$$\omega_i = \frac{d_i}{\sum_{i=1}^{m} d_i} \tag{9}$$

*Description of the IDOCRIW method of integration of objective methods*

The above objective methods have different logics. Integration of the two methods, the CILOS and the entropy, mitigates the shortcomings of each method (Zavadskas and Podvezko, 2016). The integration is created using the following formula:

$$\omega_i = \frac{q_i W_i}{\sum_{j=1}^{m} q_j W_j} \tag{10}$$

Based on the above idea of integration, the method is called Integrated Determination of Objective Criteria Weights (IDOCRIW).

*Description of the EDAS method of MCDM evaluation*

MCDM methods integrate the vector of weights with normalised values of the criteria. Normalisation in this method is a proprietary one. The method uses distances to the average solution; the method's name descends from this idea as the abbreviation of the method is "Evaluation Based on Distance from Average Solution". The following are the steps of the method.

Step 1. The average solution is calculated for each criterion $i$:

$$AV_i = \sum_{j=1}^{n} \frac{r_{ij}}{n} \tag{11}$$

Step 2. Both positive and negative distances (namely, PD and ND) to the average solutions are found for each criterion and alternative:

$$PD_{ij} = \frac{\max\left(0,(r_{ij} - AV_i)\right)}{AV_i}, \tag{12}$$

$$ND_{ij} = \frac{\max\left(0,(AV_i - r_{ij})\right)}{AV_i}. \tag{13}$$

The above formulae are used for the maximising criteria. For the minimising criteria, the following formulae are used:

$$PD_{ij} = \frac{\max\left(0,(AV_i - r_{ij})\right)}{AV_i}, \tag{14}$$

$$ND_{ij} = \frac{\max\left(0,(r_{ij} - AV_i)\right)}{AV_i}, \tag{15}$$

Formulae 12-15 fulfil the function of normalisation.

Step 3. At this step, the weights $\omega_j$ are coupled with the normalised values using the following formulae for the positive and negative distances separately:

$$SP_j = \sum_{i=1}^{m} \omega_i \cdot PD_{ij}, \tag{16}$$

$$SN_j = \sum_{i=1}^{m} \omega_i \cdot ND_{ij}, \tag{17}$$

Step 4. At this step, the resulting sums are normalised for each alternative by dividing them by the maximal value found among all alternatives:

$$NSP_j = \frac{SP_j}{\max\limits_j SP_j}, \tag{18}$$

$$NSN_j = 1 - \frac{SN_j}{\max\limits_j SN_j}. \tag{19}$$

Step 5. The average between normalised positive and negative normalised solutions is believed to represent the cumulative representative criterion of the EDAS method that reflects the attractiveness of each alternative *j*.

$$AS_j = \frac{1}{2}\left(NSP_j + NSN_j\right), \tag{20}$$

Obviously, $0 \leq \mathrm{AS}_i \leq 1$.

*Description of the PROMETHEE II method of MCDM evaluation*

The group of PROMETHEE methods belongs to the category of MCDM methods with a pairwise comparison of alternatives. Comparison is carried out for all pairs of alternatives with respect to all criteria involved in the evaluation. Preference functions serve the purpose of creating a normalisation, an essential part of the MCDM evaluation. Preference functions are chosen among the set of proposed functions in the original method or in subsequent studies (Brans and Mareschal, 2005; Podviezko et al., 2019). The function of linear preference (with indifferences) was chosen for all criteria as this function proportionally reflects differences between values of criteria for each pair of alternatives and also mitigates irregularities of data. The parameters of the function are found after the calculation of the minimal distance $\left|\min_{1\leq j,k\leq n} d_i\left(A_j, A_k\right)\right|$ and, correspondingly, the maximal distance $\left|\max_{1\leq j,k\leq n} d_i\left(A_j, A_k\right)\right|$. Then the algorithm of finding such parameters that are laid out in Podvezko and Podviezko (2010) is used. The sizes of the areas of indifference are determined by taking the 5% size of the largest difference within the set of all differences of values, among all pairs of alternatives, for each particular criterion. This is an increment of the indifference threshold from both sides.

For all pairs of alternatives ($A_j$, $A_k$) and, respectively, ($A_k$, $A_j$,), inward and backward aggregated preference indices are calculated. For the *j*-th alternative formulae of finding the indices will be the following:

$$\pi\left(A_j, A_k\right) = \sum_{i=1}^{m} \omega_i p_t \left(d_i\left(A_j, A_k\right)\right) \tag{21}$$

$$\pi\left(A_k, A_j\right) = \sum_{i=1}^{m} \omega_i p_t \left(d_i\left(A_k, A_j\right)\right) \tag{22}$$

Inward and backward aggregated preference indices are calculated:

$$F_j^+ = \sum_{k=1}^{n} \pi\left(A_j, A_k\right) (j = 1,2, \dots, n) \tag{23}$$

$$F_j^- = \sum_{k=1}^{n} \pi\left(A_k, A_j\right) (j = 1,2, \dots, n) \tag{24}$$

The cumulative criterion is found by taking the difference between the positive and the negative flows:

$$F_j = F_j^+ - F_j^- \tag{25}$$

*Empirical analysis*

For our analysis, we chose 12 representative countries, three from each EU region determined by the EuroVoc geographical classification as shown in table no. 6.

**Table no. 6. List of countries**

| | Region | Country |
|---|---|---|
| 1. | Northern Europe | Sweden |
| 2. | | Lithuania |
| 3. | | Estonia |
| 4. | Western Europe | Germany |
| 5. | | France |
| 6. | | The Netherlands |
| 7. | Central and Eastern Europe | Poland |
| 8. | | Hungary |
| 9. | | Czech Republic |
| 10. | Southern Europe | Spain |
| 11. | | Italy |
| 12. | | Portugal |

Data were obtained from various databases: Eurostat, The World Bank, The Heritage Foundation, Worldwide Governance Indicators.

To apply the PROMETHEE method, values of the thresholds and parameters of the preference functions were calculated using the algorithm described in (Podvezko and Podviezko, 2010) and applying 5% of the size of the most significant difference within the set of all differences of values, among all pairs of alternatives, for each particular criterion. The 5% increments, and the parameters of the indifference *q* and *s*, are provided in table no. 7.

**Table no. 7. The 5% increments along with the parameters of the indifference q and s**

| | 2011 | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 |
| 5% | 1.80 | 1.92 | 1189 | 0.06 | 0.08 | 2.00 | 1.68 | 1.75 | 23.60 | 1.30 | 1189 | 0.13 | 0.54 |
| *q* | 1.80 | 2.78 | 1215 | 0.07 | 0.10 | 2.00 | 1.78 | 1.75 | 27.67 | 1.30 | 1215 | 0.15 | 0.54 |
| *s* | 34.2 | 36.5 | 22586 | 1.21 | 1.51 | 38 | 31.9 | 33.3 | 448 | 25 | 22586 | 2.4 | 10.2 |
| | | | | | | | | | | | | | |
| | 2014 | | | | | | | | | | | | |
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 |
| 5% | 1.55 | 1.84 | 1181 | 0.06 | 0.07 | 2.00 | 1.05 | 1.00 | 24 | 1.25 | 1181 | 0.11 | 0.63 |
| *q* | 1.55 | 2.34 | 1189 | 0.06 | 0.07 | 2.00 | 1.05 | 1.00 | 27 | 1.25 | 1189 | 0.12 | 0.63 |
| *s* | 29.5 | 35.0 | 22447 | 1.11 | 1.37 | 38.0 | 20.0 | 19.0 | 453 | 23.8 | 22447 | 2.10 | 12.0 |
| | | | | | | | | | | | | | |
| | 2017 | | | | | | | | | | | | |
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 |
| 5% | 1.15 | 1.62 | 1267 | 0.07 | 0.07 | 1.43 | 1.34 | 1.00 | 24 | 1.50 | 1267 | 0.12 | 0.47 |
| *q* | 1.15 | 1.83 | 1444 | 0.07 | 0.08 | 1.73 | 1.54 | 1.00 | 26 | 1.50 | 1444 | 0.13 | 0.47 |
| *s* | 22 | 31 | 24077 | 1.33 | 1.28 | 27 | 25 | 19 | 460 | 29 | 24077 | 2.30 | 8.84 |

The results obtained using different MCDM methods are presented in table no 9. As was mentioned in the methodological part, weights form the essential part of the MCDM evaluation; weights obtained by the CILOS, entropy and IDOCRIW methods are presented in table no. 8.

**Table no. 8. Weights of criteria**

| | Criteria, 2011 | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 |
| Entropia | 0.013 | 0.014 | 0.073 | 0.052 | 0.096 | 0.016 | 0.006 | 0.009 | 0.297 | 0.209 | 0.035 | 0.089 | 0.090 |
| CILOS | 0.039 | 0.092 | 0.041 | 0.051 | 0.032 | 0.298 | 0.044 | 0.329 | 0.003 | 0.020 | 0.027 | 0.016 | 0.007 |
| IROCRIW | 0.020 | 0.050 | 0.112 | 0.101 | 0.115 | 0.180 | 0.009 | 0.112 | 0.033 | 0.154 | 0.036 | 0.053 | 0.025 |
| | **Criteria, 2014** | | | | | | | | | | | | |
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 |
| Entropia | 0.007 | 0.011 | 0.104 | 0.070 | 0.090 | 0.019 | 0.004 | 0.005 | 0.322 | 0.150 | 0.029 | 0.080 | 0.107 |
| CILOS | 0.021 | 0.150 | 0.086 | 0.054 | 0.038 | 0.270 | 0.152 | 0.135 | 0.002 | 0.044 | 0.025 | 0.016 | 0.006 |
| IROCRIW | 0.005 | 0.047 | 0.261 | 0.110 | 0.099 | 0.152 | 0.018 | 0.020 | 0.016 | 0.193 | 0.021 | 0.038 | 0.020 |
| | **Criteria, 2017** | | | | | | | | | | | | |
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 |
| Entropia | 0.003 | 0.006 | 0.112 | 0.069 | 0.087 | 0.008 | 0.007 | 0.004 | 0.321 | 0.147 | 0.024 | 0.089 | 0.124 |
| CILOS | 0.087 | 0.142 | 0.051 | 0.029 | 0.040 | 0.159 | 0.051 | 0.336 | 0.006 | 0.011 | 0.038 | 0.016 | 0.033 |
| IROCRIW | 0.011 | 0.033 | 0.227 | 0.079 | 0.138 | 0.051 | 0.014 | 0.058 | 0.070 | 0.063 | 0.036 | 0.058 | 0.160 |

Finally, in table no. 9, the results of MCDM evaluation by the EDAS and PROMETHEE II methods are presented. The final results of each year's evaluation are found as averages of the ranks obtained using the EDAS and PROMETHEE II methods, while the final ranks for the three-year period are calculated as the weighted average of the ranks. The weights are proportional to the power of 2 placing greater emphasis on the later years. The weight for 2011 is 0.14 that is proportional to 2 of 14; for 2014, it is 0.29 that is proportional to 4 of 14; and for 2017 it is 0.57 that is proportional to 8 of 14; 14 is the sum of the corresponding powers. In table no 9, the values of the cumulative criteria of the MCDM methods EDAS and PROMETHEE II are presented, as well as the integral results obtained by taking averages of the ranks and the final ranking.

**Table no. 9. Results of MCDM evaluation by the EDAS and PROMETHEE II methods**

| | Sweden | Lithuania | Estonia | Germany | France | The Netherlands | Poland | Czech Rep | Hungary | Spain | Italy | Portugal |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | **2011** | | | | | | | | | | | |
| EDAS | 0.870 | 0.026 | 0.505 | 0.917 | 0.655 | 1.0 | 0.103 | 0.364 | 0.248 | 0.283 | 0.024 | 0.130 |
| EDAS | 3 | 11 | 5 | 2 | 4 | 1 | 10 | 6 | 8 | 7 | 12 | 9 |
| PROMETHEE $F+$ | 0.456 | 0.033 | 0.230 | 0.410 | 0.231 | 0.483 | 0.048 | 0.073 | 0.052 | 0.083 | 0.037 | 0.046 |
| PROMETHEE $F-$ | 0.022 | 0.308 | 0.095 | 0.021 | 0.137 | 0.008 | 0.300 | 0.197 | 0.234 | 0.196 | 0.381 | 0.283 |
| PROMETHEE $F$ | 0.434 | -0.275 | 0.135 | 0.390 | 0.094 | 0.476 | -0.252 | -0.124 | -0.182 | -0.114 | -0.345 | -0.237 |
| PROMETHEE | 2 | 11 | 4 | 3 | 5 | 1 | 10 | 7 | 8 | 6 | 12 | 9 |
| Final rank, 2011 | 2 | 11 | 4 | 2 | 4 | 1 | 10 | 6 | 8 | 6 | 12 | 9 |
| | **2014** | | | | | | | | | | | |
| EDAS | 0.805 | 0.193 | 0.664 | 0.942 | 0.725 | 1.0 | 0.244 | 0.433 | 0.199 | 0.253 | 0.008 | 0.257 |
| EDAS | 3 | 11 | 5 | 2 | 4 | 1 | 9 | 6 | 10 | 8 | 12 | 7 |
| PROMETHEE $F+$ | 0.426 | 0.055 | 0.284 | 0.466 | 0.281 | 0.503 | 0.042 | 0.103 | 0.053 | 0.061 | 0.020 | 0.060 |

| | Sweden | Lithuania | Estonia | Germany | France | The Netherlands | Poland | Czech Rep | Hungary | Spain | Italy | Portugal |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| PROMETHEE $F-$ | 0.045 | 0.305 | 0.075 | 0.004 | 0.085 | 0.004 | 0.298 | 0.184 | 0.344 | 0.260 | 0.475 | 0.274 |
| PROMETHEE $F$ | 0.381 | -0.250 | 0.209 | 0.462 | 0.196 | 0.499 | -0.256 | -0.081 | -0.291 | -0.199 | -0.456 | -0.214 |
| PROMETHEE | 3 | 9 | 4 | 2 | 5 | 1 | 10 | 6 | 11 | 7 | 12 | 8 |
| Final rank, 2014 | 3 | 10 | 4 | 2 | 4 | 1 | 9 | 6 | 11 | 7 | 12 | 7 |
| | **2017** | | | | | | | | | | | |
| EDAS | 0.730 | 0.254 | 0.473 | 0.850 | 0.535 | 1.0 | 0.185 | 0.507 | 0.153 | 0.062 | 0.028 | 0.331 |
| EDAS | 3 | 8 | 6 | 2 | 4 | 1 | 9 | 5 | 10 | 11 | 12 | 7 |
| PROMETHEE $F+$ | 0.446 | 0.0613 | 0.1976 | 0.3939 | 0.2406 | 0.5307 | 0.0303 | 0.0846 | 0.0147 | 0.0713 | 0.0316 | 0.0802 |
| PROMETHEE $F-$ | 0.0226 | 0.2295 | 0.0926 | 0.022 | 0.078 | 0.0053 | 0.3588 | 0.1831 | 0.3948 | 0.2077 | 0.3805 | 0.208 |
| PROMETHEE $F$ | 0.4235 | -0.1682 | 0.105 | 0.3719 | 0.1626 | 0.5254 | -0.3286 | -0.0985 | -0.38 | -0.1364 | -0.3489 | -0.1278 |
| PROMETHEE | 2 | 9 | 5 | 3 | 4 | 1 | 10 | 6 | 12 | 8 | 11 | 7 |
| Final rank, 2017 | 2 | 8 | 5 | 2 | 4 | 1 | 9 | 5 | 11 | 9 | 12 | 7 |
| | | | | | | | | | | | | |
| FINAL | 3 | 9 | 5 | 2 | 4 | 1 | 10 | 6 | 11 | 8 | 12 | 7 |

Graphically, the dynamics of ranks of countries can be observed in figure no. 1. It becomes clear that the countries did not experience considerable fluctuations in rank over the period.

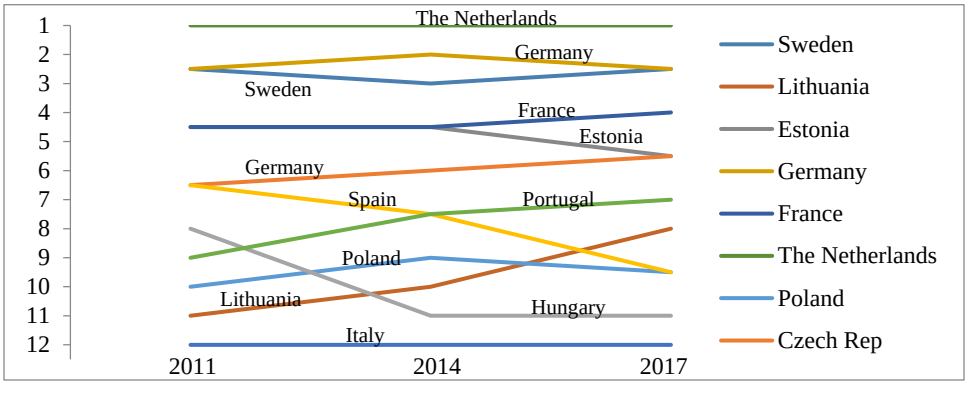


**Figure no. 1. Dynamics of ranks of countries**

The Netherlands, Germany, Sweden, France and Estonia are at the top of the proposed list. These countries are well-developed with a high level of Internet connectivity, rapid adoption of new technologies, and a high GDP. Generally, countries with mature Internet infrastructure and tourism fuelled economies have more significant proportions of the sharing economy. Therefore, according to the criteria chosen for the research, countries that achieved high ranks based on the values of such criteria should have high rates of sharing economy growth in the future.

**Conclusions**

Sharing economy is the ability to match the supply and demand of capital available for the sharing between different market players to increase the efficiency of its utilisation and thus expand free-market possibilities. An effective connection between suppliers and consumers can only be possible when tremendous digital networks' progress occurs while the social trust climate is favourable. The sharing economy is changing people's attitudes towards ownership. It emphasises that using rather than just owning, sharing economy can be related to liberalisation adjustment of regulations. However, on the other hand, it brings chaos and risk to the market.

The authors selected the main criteria that influence the growth of the sharing economy to create an instrument to monitor and control the progress of this phenomenon. Based on analysis of the literature, four categories of criteria were found: technological, socio-demographical, economic, and political.

From the initial observation of the sum of all final ranks in each of the four regions, it becomes clear that the leading region is Western Europe (with the sum equal to 21). The second region by attractiveness is Northern Europe (the sum of ranks equals 49), and the remaining two regions, Central and Eastern and Southern Europe, are similar and are least attractive (the sum of ranks being 75 and 81, respectively). Looking at the values of criteria, we can analyse both causes of success and failure. Three leading countries, The Netherlands, Germany, and Sweden, have excellent relative positions in terms of all criteria in all three years with the following exceptions. The Netherlands has a non-inspiring R&D expenditure, while Sweden has the lowest population density. Germany also has only half of the Netherlands' population density, even if it is found in the second-best position in terms of this criterion. France (rank 4) has most of the criteria above average even if it never reaches the best market position in 2017 by all criteria. However, it has the worst position in terms of investment freedom among selected countries. Estonia (rank 5) has especially good property rights and investment freedom but low population density. GDP per capita and R&D expenditure are lagging compared to the majority of other countries. The Czech Republic (rank 6) has an especially low level of unemployment, but especially low and even decreasing business freedom; low use of internet shops; and a relatively low population density. Portugal (rank 7) has a mediocre but increasing level of internet access; a relatively small part of the population uses Internet shops, and regulatory quality gradually increasing but still uninspiring. GDP per capita is low and even decreasing insignificantly, and investment freedom became the lowest among the set of chosen countries. On the other hand, variables such as business freedom, the rule of law, government effectiveness, property rights, and the unemployment rate create quite favourable conditions for the sharing economy. Spain (rank 8) has the highest unemployment rate permanently; relatively low population density, R&D expenditure, regulatory quality, increasing but still a mediocre level of Internet access, and the level of business freedom. On the other hand, favourable conditions are created by more influential positions in investment freedom, the percentage of the population that uses the Internet, property rights, fluctuating at a rather good level of government effectiveness. Lithuania (rank 9) has an uninspiring percentage of the population using the Internet for selling goods and services, R&D expenditure, population density, and sharply increasing but still a relatively low GDP per capita, slowly increasing the quality of property rights. On the other hand, good positions in business freedom, unemployment rates, and investment freedom improve conditions for sharing economy. Poland (rank 10) is lagging in areas such as GDP

per capita, R&D expenditure, business freedom, property rights, and investment freedom; while it has a low unemployment rate, a high percentage of individuals and households use the Internet, decreasing regulatory quality. Hungary (rank 11) has low positions in GDP per capita, government effectiveness, rule of law, regulatory quality, and population density. In contrast, Italy (rank 12) has low positions in the percentage of individuals and households using the Internet, the rule of law, government effectiveness, regulatory quality, property rights.

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# GOVERNMENT-ENTERPRISE RELATION, FINANCING PLIGHT AND ENTERPRISE GROWTH: EMPIRICAL EVIDENCE FROM WORLD BANK ON CHINESE FIRMS

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**Abstract**
Theoretically, the influence of government-enterprise relation on enterprise growth is divided into lubricating effect and friction effect. However, the government-enterprise relation has been discussed in only a few studies from the perspectives of enterprise financing and willingness. No unified conclusions have been formed regarding the influential consequences of government-enterprise relation. To investigate the influence mechanism of government-enterprise relation on enterprise growth, World Bank Survey of Chinese Enterprises data in 2012 was used in this study to empirically verify how the government-enterprise relation influenced enterprise growth, the mediating effect of financing plight via mediating effect models. The differentiated influences of government-enterprise relation on enterprise growth were explored through the grouping test of corporate ownership and scale. Moreover, the causal relation between government-enterprise relation and enterprise growth (the former facilitated the latter) was further tested and recognized through the instrumental variable method. Results show that the government-enterprise relation is capable of boosting enterprise growth by mitigating the financing plight faced by enterprises, thus proving the lubricating effect of government-enterprise relation. The findings still hold after the endogeneity problem is weakened by using the instrumental variable method and after the robustness test. In the grouping test, a good government-enterprise relation can promote the growth of private enterprises and small-sized enterprises by remitting the financing plight they face. The conclusions obtained from this study can provide a beneficial reference for expanding enterprise financing channels and constructing a complete financial system, and lay a theoretical foundation for probing the influences of government-enterprise relation.

**Keywords:** government-enterprise relation, financing plight, enterprise growth, mediating effect model.

**JEL Classification:** G38, O17, D22

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**Introduction**

Small and medium-sized enterprises play an important role in the economy of China. An important government duty lies in creating a benign enterprise growth environment and in abating the institutional barrier and constraint faced in enterprise development. The current institutional construction matching China's market economy is imperfect, and government intervention in resource allocation forces numerous enterprises to take an active part in politics. To acquire the resources necessary for their development, enterprises need to establish a stable and close cooperative relation with the government. In many countries, enterprises strive for and hope to establish a solid long-term relationship with the government (Faccio, 2006). The unique Chinese characteristics in creating relations can answer why China's economy maintains rapid growth over the years (Allen et al., 2005). Putting the high-speed economic development aside, the deep problems created in the establishment of government-enterprise relation need to be urgently solved for the development and reform of China's economic system.

When enterprises make contact with the government and support their growth using government rights (Faccio et al., 2006; Goldman et al., 2009), the lubricating effect of government-enterprise relation is demonstrated. By contrast, the friction effect occurs when enterprises spend excessive costs in handling the government-enterprise relation, and these efforts go against enterprise growth (Fan et al., 2007; Boubakri et al., 2008). In addition, scholars believe that the government-enterprise relation is not simply positively or negatively correlated with enterprise growth.

According to the literature, enterprises seek to establish relations with the government to acquire government orders, fiscal support, as well as efficient government review, approval, and credit aid (Luo and Tang, 2009; Pan et al., 2013; Agudelo et al., 2019). Therefore, the government-enterprise relation is of enormous significance for the operation and growth of Chinese enterprises. The financing plight faced in enterprise growth can be effectively mitigated by a complete financial system and stable bank credit sources (Eisenhardt, 1990; Beck et al., 2006). According to traditional economics, the financing constraints of enterprises are caused by information asymmetry; but under the current situation, they are rooted in the national development strategies and institutional arrangement (Zhu et al., 2015). On the one hand, the allocation of key credit resources is still controlled by the government, and bank credit is also dominated by the government (Sapienza, 2004). Given the discrimination in bank credits, financial institutions within the *system* are affected by the government, and they will *rationally* reduce the loans granted to small and medium-sized private enterprises, which are always faced with intense external financing barriers (Zhang, 2000). On the other hand, relative to state-owned enterprises, other enterprises, especially small and medium-sized private enterprises, have limited resources. Bank loans can hardly support their growth because of few fixed assets and mortgages and small scale; hence, private enterprises are stuck in prominent financing plights. The capital market presents a policy inclination to large state-owned enterprises, which are given special treatment in listing review and approval procedures and bear fewer bond issuing limitations. By contrast, heavy barriers are imposed on the financing of small and medium-sized private enterprises in the capital market, thus bringing about financing difficulties to enterprise growth. On this basis, enterprises have intense motive to establish political connections (Morck and Yeung, 2004; Li et al., 2006) to acquire resources and overcome financing difficulties, and one of the important strategic decisions for them is to

build a good government-enterprise relation (Zhang and Zhang, 2005). A good government-enterprise relation, which is a scarce resource, can serve as an informal institution that evades the adverse effects caused by the imperfect market mechanism to enterprise development (Chen et al., 2011a). More importantly, the government-enterprise relation is a form of *signaling*, which embodies the external reputation of an enterprise (Luo and Zhen, 2008). If the market mechanism is not completely established in an economic entity, then bank credit agencies will usually take the enterprise quality signal transmitted by a good government-enterprise relation as an important instrument for risk identification. Therefore, in a transitional economic entity, enterprises that enjoy a good government-enterprise relation can win good graces from credit agencies, and they are less probable to face financing plights.

On this basis, under the current institutional environment, a good government-enterprise relation can relieve financing plights faced in enterprise growth. However, theoretical hypotheses in existing research have been scarcely explained through empirical analyses. Based on the World Bank Survey of Chinese Enterprises data in 2012, how the government-enterprise relation influenced enterprise growth was empirically verified by using a mediating effect model. Our empirical analysis results showed that enterprise growth could be positively influenced by good government-enterprise relation. The subsequent mechanism verification manifested that government-enterprise relation could facilitate enterprise growth by relieving enterprises' financing difficulties. Moreover, the above conclusion remained prominent after the endogeneity problem was weakened by the instrumental variable method and the robustness test was carried out. Research on individual samples discovered that private enterprises, foreign-owned enterprises, and small enterprises gained growth by establishing relations with the government, and a proper government-enterprise relation could boost the growth of these enterprises by remitting their financing plights.

The main contributions of this study are as follows: (1) government-enterprise relation, financing plight, and enterprise growth have not been incorporated into a unified framework for analysis in most of the extant research. However, a core viewpoint held in this research is that measures can be taken to break through enterprise growth bottlenecks only when the action mechanisms of the three are clarified. On this basis, the influencing mechanisms of government-enterprise relation, financing plight, and enterprise growth are comprehensively explored, in an effort to provide new evidence for probing the corporate governance problem. (2) The mean value of government-enterprise relations established by enterprises of the same type has been mostly used as an instrumental variable to relieve the endogeneity problem. Unlike in the existing literature, the number of times that enterprises had been inspected or visited by government officials in the previous year is taken as an instrumental variable in this study to remit the endogeneity problem. (3) Whether any senior manager in the board of directors has taken any post in government sectors has been mostly used to measure government-enterprise relation in extant literature. In this study, government-enterprise relation is measured by the time spent by senior managers in handling rules and regulations according to the data structure of World Bank. In addition, the index is substituted to perform the robustness test.

The rest of this study is structured as follows: Section 1 is the literature review and research hypotheses. Section 2 is the research design, introduces the mediating effect models and variable selection, and presents the descriptive statistics. Section 3 shows the regression

results. Section 4 expounds on the handling of the endogeneity problem and the robustness test. Section 5 presents the research conclusions.

## 1. Literature Review and Research Hypotheses

### 1.1. Government-enterprise relation and enterprise financing

Enterprises can win government resources by establishing relations with the government (Fisman, 2001; Xu and Liu, 2020). Good government-enterprise relation can influence enterprise financing directly and indirectly. The government is capable of directly providing financial support for enterprises and regulating their tax rate, thus influencing the financing. Using the panel data of 900 enterprises with and without relations with the government in 35 countries during 1997–2002, Faccio et al. (2006) deem that enterprises with political background influenced the possibility of government subsidies and the subsidy level, and companies could acquire government assistance and thus eliminate financial plights by the good government-enterprise relation under extreme cases. Taking private enterprises listed in China from 1993 to 2008 as the sample, Chen et al. (2011b) found that a good government-enterprise relation could help enterprises gain government financial aids, especially in regions with low economic marketization degree where the government had a powerful autonomous right in allocating economic resources. Moreover, they found that the rent-seeking behavior of government officials forced private enterprises to establish a relation with the government and maintain their interests. Kamasak et al. (2019) found that corporate social responsibility (CSR) and corporate political activities are complementary, and the coordinated management of corporate social responsibility and corporate political activities may lead to better firm performance.

Literature focusing on Chinese enterprise indicates that a good government-enterprise relation endows enterprises with diversified financial resources. Using Chinese private enterprises during 2002–2007 as the research samples, Yu et al. (2010) tested whether the government could give full play to the social effect, enterprise effect, and economic effect of fiscal subsidies if enterprises sought government-enterprise relation. The results showed that enterprises managing a good government-enterprise relation gained more access to fiscal subsidies, with obviously improved social benefits and enterprise benefits. Furthermore, this effect of acquiring fiscal subsidies was stronger in regions featured by low marketization degree, low level of rule by law, poor property rights protection, and many government-dominated resources. Further research has been carried out to discuss the influences of government-enterprise relation by taking companies in financial distress as the samples. For instance, Pan et al. (2009) sampled companies listed in Shanghai and Shenzhen during 2002–2007, which were suffering from abnormal financial status and operating status. They verified that companies in financial difficulties could acquire more government subsidies by building good government-enterprise relations. Moreover, private enterprises make more efforts to build a stable long-term relation with the government so that they can gain financial support from the government when financial plights arise. However, this effect is not significant among state-owned enterprise samples. Further analysis shows that government-enterprise relation can bring more resources to private enterprises only when they are located in regions with abundant local financial resources.

Besides, a good government-enterprise relation can lower the tax rate and relieve tax burdens on enterprises. In a research specific to Malaysia, Adhikari et al. (2006) analyzed

how the government-enterprise relation influenced the effective tax rate of enterprises using the data of local listed companies during 1990-1999. They found that the actual tax rate of enterprises striving to establish a relation with the government was significantly lower than that of other samples in the research. By surveying over 500 listed private companies in China during 19992004, Wu et al. (2009) found that a favourable government-enterprise relation could bring tax preferences to enterprises in provinces that impose heavy tax burdens. Shen and Zou (2017) used the survey data of the World Bank on the investment environment of Chinese enterprises to explore how the government-enterprise relation influenced the tax rate of enterprises. They discovered that a good government-enterprise relation usually existed in large-scale enterprises, and it could bring preferences to enterprises in actual tax rate only at the local tax level but not at the national tax level.

The indirect influence of government-enterprise relation on enterprise financing is discussed mainly from the perspectives of enterprises acquiring bank loans and solving the information asymmetry between enterprises and government. From the theoretical level, the establishment of government-enterprise relation means that the government provides an implicit guarantee for external financing of enterprises. Financial institutions or other investors deem that the risk of lending or investing on these enterprises is low; hence, the financing convenience or financing availability of enterprises striving for relations with the government is enhanced (Johnson and Mitton, 2003; Claessens et al., 2008). In empirical research, enterprises enjoying such government-enterprise relation need fewer guarantees but more government-endorsed letters of credit for borrowing compared with other enterprises (Charumilind et al., 2006). Yu and Pan (2008) explored whether the loan effect of government-enterprise relation established by listed private companies would vary significantly with the institutional environment. They found that when seeking relations with the government, private enterprises could obtain the credit resources necessary for their development by relying upon the influence of government officials on state-owned banks. Moreover, they could reduce or overcome the *ownership discrimination* problem of credits. A good government-enterprise relation exerts a more significant loan effect in regions with low financial development level, low level of rule by law, and severe infringement upon property rights. Enterprises hoping to occupy a dominant information position are also pleased to establish relations with the government. Unlike individual enterprises, the government can master the development status, credit supply, and use of funds of enterprises within the industry, acquire the information that cannot be mastered by enterprises from the macroscopic level (Lin et al., 2010), and guide the decisions of individual enterprises and judge their investment opportunities. Many scholars think that enterprises that have established government-enterprise relations can increase their debt ratio according to the acquired government support (Faccio et al., 2006). Furthermore, they can obtain loans from banks, with lower interest expenses and financial expenses (He, 2011). In the end, they gain access to more short-term debt financing from the aspect of loan structure (Li et al., 2016). On this basis, the following hypothesis is proposed:

- Hypothesis 1: Enterprises that strive for government-enterprise relations have stronger financing abilities than enterprises without government-enterprise relations.

Private enterprises can keep and continuously arouse the vitality of the market economy. However, the "ownership discrimination" imposed by financial institutions on the credit financing of enterprises is a common phenomenon in China. On the one hand, state-owned enterprises are under a dominant position in the market by support and protection of

government administrative power (Zhang, 2007). In the form of invisible subsidies for state-owned enterprises, the government will lend bank credits to state-owned enterprises at an interest rate lower than that in the market (Liu, 2007). On the other hand, private enterprises are exposed to financing difficulties due to the relatively backward legal system and property rights protection. With the unsound creditor's interest protection mechanism, creditors are forced to protect their interests through other channels. Failing to establish a natural relation with the government, state-owned enterprises firmly believe that the debt financing of state-owned enterprises can win additional government guarantees out of the trust in the government; hence, creditors like banks or other financial institutions grant more loans to state-owned enterprises (Pan et al., 2013). However, creditors may begrudge loans to private enterprises with small scale and high risks, as they are worried about the possible failure to recover the loans.

A primary reason for the prominent financing plight of private enterprises is their congenital advantages in enterprise financing (Luo and Zhen, 2008). Hence, more private enterprises expect to enhance their financing abilities by forming sound government-enterprise relations (Yu et al., 2012). Taking the top 100 private enterprises in Zhejiang Province in 2004 as the research samples, Hu (2006) discussed the relation between political identity of private entrepreneurs and financing convenience of private enterprises, and found that the political signal transmitted by private entrepreneurs increased the possibility for financial institutions to select private enterprises as their clients. This effect was remarkable under the institutional background of an imperfect judicial system. Accordingly, the following research hypothesis is raised:

- Hypothesis 2: Government-enterprise relation exerts a more significant effect on the financing ability of private enterprises relative to state-owned enterprises.

### 1.2. Government-enterprise relation and enterprise growth

Enterprises come into contact with the government and support their growth owing to the government power (Faccio et al., 2006; Goldman et al., 2009). Faccio et al. (2006) thought that enterprises could increase their value and boost their growth by establishing political relations, and this effect was evident in countries or regions with weak property rights protection. Furthermore, enterprise decisions are significantly affected by the legal system, judicial operation efficiency, property rights protection, and financial system in a country or region (Yuan et al., 2015), and corporate reputation, resource commitment also affect enterprise decisions (Hesari et al., 2021). The political resource is also one of the important company resources (Boubakri et al., 2008). On the one hand, government-enterprise relations can support enterprises to expand their credit channels and increase government subsidies (Johnson and Milton, 2003; Claessens et al., 2008). On the other hand, a good government-enterprise relation can reduce the equity financing and credit financing costs needed for enterprise growth (Boubakri et al., 2012; Liu et al., 2013). Further analysis shows that a good government-enterprise relation can facilitate enterprises to master social capitals and exert the effect of relation capital (Li and Huang, 2010). After identifying the relations among society, government, and property rights, Tian and Zhang (2013) used the data of listed companies during 2001-2008, proposed hypotheses from three aspects – society, government, and property rights – and carried out an empirical test. Their results showed that the long-term development of Chinese listed companies could be boosted by government-enterprise relations.

According to scholars, enterprises spend excessive costs in handling government-enterprise relations, which is beneficial for enterprise growth (Fan et al., 2007; Boubakri et al., 2008). First, resource allocation is a focus in the market economy. When establishing the government-enterprise relation out of their interests, enterprises will reduce the resource allocation efficiency and enterprise investment efficiency (Asiedu and Freeman, 2009). Second, if the government-enterprise relation is inappropriately handled, an actual corruptive behavior may arise, which will be followed by other market subjects, thus aggravating social corruption (Liu and Peng, 2012).

Of course, scholars deem that the government-enterprise relation does not simply have a positive or negative correlation with enterprise growth. They support a view that government-enterprise relation presents a nonlinear relation with enterprise growth or the two are not correlated. Park and Luo (2001) indicated that the government-enterprise relation does not always influence enterprise growth. In developed Western economies, the marketization mechanism could effectively inhibit government rent-seeking and corruption and weaken the loan effect of government-enterprise relation. Taking China in the transitional period as the research object, Zhang (2013) pointed out the "Janus bipolar" in China, investigated the motives of enterprises with different scales and ownership patterns in seeking for the government-enterprise relation and the effect differences. The results showed that the age and scale of private enterprises had a nonlinear relation with government-enterprise relation, and only medium-sized and middle-aged private enterprises enjoyed faster growth through frequent interaction with the government. A possible reason is that the government has development intention and rent-seeking motive. By comparison, enterprises have two objectives: a good government-enterprise relation can prevent government rent-seeking and lower business operation costs and risks, and enterprises can acquire more preferential resources and policies through government relations.

In this study, the government-enterprise relation in China differs from what is expounded in Western literature. Therefore, the definition and measurement of government-enterprise relation need to be localized. In developed Western economies, enterprises generally influence government decisions by institutional means through political action committee, donations to political campaigns, and lobbying (Keim and Zeithaml, 1986). However, in emerging economies with imperfect capital market and loopholes in legal norms, enterprises will choose to acquire resources and opportunities by keeping good relations with the government (Khanna et al., 2005). Chinese enterprises, which have prominent performance in political behaviors, directly establish relations with government officials but not by means of influencing public policies, to acquire preferences in policies and regulations (Zhang and Zhang, 2005). Therefore, the Chinese characteristics should be considered in the empirical research on the promoting effect of government-enterprise relation on enterprise growth. Hence, hypothesis 3 is proposed:

- Hypothesis 3: Compared with enterprises without government-enterprise relations, those striving for a good government-enterprise relation can facilitate their growth, and this effect is more significant among small and medium-sized private enterprises.

## 2. Methodology

### 2.1. Sample selection and data sources

The data used in this study is World Bank Survey of Chinese Enterprises, including 25 Chinese cities 2,848 enterprises in 2012, which came from 7 service sectors and 11 manufacturing sectors. Compared with the survey data of World Bank on Chinese enterprises in previous years, this survey data is recent and more novel and unique for measuring the government-enterprise relation. The GDP and urban population size are derived from *China City Statistical Yearbook*.

### 2.2. Definitions of main variables

*Enterprise growth* (*Growth*). Developing potential of enterprise can be an index used to measure enterprise growth. In the existing literature, the measurement indexes for enterprise growth include gross sales level, profit level, and growth rate of employees, among others. As enterprise employees are influenced by the growth of labor productivity and replacement of labor with machine, the measurement of enterprise growth by the number of employees is deficient (Zhang et al., 2016). In many empirical researches, enterprise growth is measured by sales volume and sales growth rate (Chrisman et al., 2005; Zhao et al., 2012), as well as profit growth rate (Zahra et al., 2002). According to the data structure, enterprise growth was measured in this study by selecting the natural logarithm of gross sales in the previous year.

*Government-enterprise relation* (*Relation*). In many studies, government-enterprise relation takes into consideration that senior executives of a company take posts or once took posts in government sectors or NPC and may have served as CPPCC representatives (Khwaja and Mian, 2005; Du et al., 2009). However, this index cannot effectively measure government-enterprise interaction, and quantifying the time and money spent by enterprises in maintaining government relations is difficult. In this study, government-enterprise relation was measured using the natural logarithm of the time spent by a company's senior managers in handling government rules and regulations. If the senior managers of an enterprise can spend time in reading and studying the rules and regulations of different departments and interact with the government accordingly, then this enterprise makes effort to establish relations with the government.

*Financing plight* (*Finance*). On the basis of the research methods of Drakos and Giannakopoulos (2011) and Gou and Huang (2014), the loan information of enterprises was investigated from two dimensions: loan demand and actual loan acquisition, to discriminate whether an enterprise was faced with any financing plight. If an enterprise applying for loans failed to obtain approval from the credit department, it was faced with a financing plight; otherwise, it was not. Enterprises not applying for any loan had enough cash flow and broad financing channels; hence, they were free of financing plights. By contrast, enterprises that did not apply for any loan due to more mortgages required by the credit department and high interest rates were also faced with such financing plights. In the end, the samples were divided into enterprises facing financing plights and those that are not according to the two loan measurement dimensions. Enterprises without financing plights had stronger financing abilities. This variable was taken as 1; otherwise, it was 0.

*Enterprise age* (*Age*). The relation between enterprise age and enterprise growth is unclear due to the differences in the resources owned and the level of creativity between mature

and young enterprises. In this study, enterprise age was measured by taking the natural logarithm after 2011 was deducted from the year of enterprise registration.

*Experience of senior manager* (*Exper*). Enterprise growth is closely related to the operation and management of senior managers. The talents of senior managers, the leading figures of an enterprise, play a significant role in enterprise development. In general, the more the working years of senior managers, the stronger their management abilities, and the better they can boost enterprise growth. In this study, the experience of senior managers was measured by taking the natural logarithm of the number of years they have worked at their posts.

*Enterprise export* (*ExpDum*). Enterprises expand their market scope and broaden their marketing channels through exports (Batra et al., 2003; Du and Guo, 2012), which can increase their main business income and facilitate their growth. In this study, this index was measured according to whether the export value of an enterprise was greater than 0; if yes, the variable value was 1, otherwise it was 0.

*Industry competition* (*Competition*). A fierce competitive environment will increase the credit needs of enterprises. Under unchanged capital supply, the above circumstance is a disadvantage in enterprise growth. Here, enterprise competition was measured by the quantity of enterprise competitors in the industry. In the questionnaire survey, if the observed value of this variable was greater than 0, then enterprise competition existed, and it was taken as 1; otherwise it was 0.

*Per capita gross domestic product* (*GdpPop*). Enterprise growth is not only related to an enterprise's financial status but is also influenced by the economic development level of the city where the enterprise is located. Under a high urban economic development level and a complete financial system, an enterprise can acquire more resources to boost its growth. In this study, the per capita GDP was measured by dividing the urban GDP by the urban population.

### 2.3. Models

The following mediating effect models were set to explore how the government-enterprise relation influenced enterprise growth:

$$Growth_i = \alpha_0 + \beta Relation_i + \gamma Control_i + \varepsilon_1 \quad (1)$$

$$Finance_i = \alpha_1 + \beta_1 Relation_i + \gamma_1 Control_i + \varepsilon_2 \quad (2)$$

$$Growth_i = \alpha_2 + \alpha_3 Finance_i + \beta_2 Relation_i + \gamma_2 Control_i + \varepsilon_3 \quad (3)$$

Where:

$Growth_i$ – enterprise *i* growth;

$Relation_i$ – enterprise *i* government-enterprise relation;

$Finance_i$ – mediating variable enterprise *i* financing plight;

$Control_i$ – control variable;

$\varepsilon_1$, $\varepsilon_2$, $\varepsilon_3$ – random error terms.

In Equation (1), coefficient $\beta$ can be regarded as the total effect of enterprise growth, coefficient $\beta_2$ in Equation (3) represents the direct effect, and coefficient $\alpha_3$ in Equation (2) represents the mediating effect of the mediating variable.

## 3. Result Analysis

### 3.1. Descriptive statistics

Table no. 1 presents the descriptive statistics of the main variables. The mean value and median of government-enterprise relation were 0.507 and 0, respectively. Averagely, senior managers of enterprises spend 0.66% of their total time handling government rules and regulations. The median and minimum values of the variable measuring government-enterprise relation were 0, and the data were left-skewed, indicating that most enterprise samples have not established government-enterprise relation. The mean value of Finance was 0.692, whereas the median and maximum values were 1, presenting a right-skewed form. This result showed that most enterprise samples were troubled by a few financing plights; nonetheless, they had good financing abilities.

**Table no. 1. Descriptive Statistical Table of the Main Variables (Sample Size: 2,848)**

| Variable | Mean | S.D. | Minimum | Median | Maximum |
|---|---|---|---|---|---|
| **Growth** | 16.71 | 1.759 | 4.605 | 16.56 | 24.41 |
| **Relation** | 0.507 | 0.681 | 0 | 0 | 4.615 |
| **Finance** | 0.692 | 0.462 | 0 | 1 | 1 |
| **Age** | 2.429 | 0.522 | 0 | 2.398 | 4.89 |
| **Exper** | 2.691 | 0.491 | 0 | 2.708 | 4.007 |
| **ExpDum** | 0.235 | 0.424 | 0 | 0 | 1 |
| **Competition** | 0.993 | 0.083 | 0 | 1 | 1 |
| **GdpPop** | 9.842 | 7.71 | 4.094 | 8.186 | 42.95 |

*Source: Authors' calculations.*

Table no. 2 displays the correlation coefficients of the main variables. Government-enterprise relation was positively correlated with enterprise growth, and the correlation coefficient passed the significance test at the 1% level. This result indicated that enterprises enjoying a good government-enterprise relation had a high growth level. The correlation coefficient between financing ability and enterprise growth was significantly positive at the 1% level, and this result showed that better financing ability facilitated faster enterprise growth. The correlation coefficients of enterprise age, experience of senior managers, enterprise competition, and urban per capita GDP with enterprise growth were positive at least at the 5% significance level.

**Table no. 2. Correlation Coefficients of the Main Variables**

| | A | B | C | D | E | F | J | H |
|---|---|---|---|---|---|---|---|---|
| **A: Growth** | 1 | | | | | | | |
| **B: Relation** | 0.098*** | 1 | | | | | | |
| **C: Finance** | 0.171*** | 0.068*** | 1 | | | | | |
| **D: Age** | 0.200*** | 0.03 | 0.060*** | 1 | | | | |
| **E: Exper** | 0.224*** | 0.013 | 0.038** | 0.382*** | 1 | | | |
| **F: ExpDum** | 0.227*** | 0.193*** | 0.104*** | 0.034* | 0.087*** | 1 | | |
| **G:Competition** | −0.021 | 0.037 | 0.014 | −0.013 | 0.005 | 0.028 | 1 | |
| **H: GdpPop** | 0.044** | 0.063*** | −0.043** | −0.059*** | −0.124*** | 0.116*** | 0.044* | 1 |

*Source: Authors' calculations.*

### 3.2. Regression results

Regression was performed by using the least-squares method according to Equations (1) - (3). The result was corrected by using the robust standard company clustering error to solve the heteroscedasticity problem. Table no.3 lists the regression results.

**Table no. 3. Baseline Regression Results**

| | (1) *Growth* | (2) *Finance* | (3) *Growth* |
|---|---|---|---|
| **Relation** | 0.284*** (3.758) | 0.032* (1.825) | 0.228*** (3.01) |
| **Finance** | | | 0.546*** (5.514) |
| **Age** | 0.247*** (2.784) | 0.009 (0.448) | 0.288*** (3.329) |
| **Exper** | 0.715*** (6.673) | 0.043* (1.707) | 0.670*** (6.306) |
| **ExpDum** | 0.640*** (5.072) | 0.062** (2.063) | 0.629*** (4.990) |
| **Competition** | −0.287 (−0.568) | 0.225 (1.355) | −0.181 (−0.343) |
| **GdpPop** | 0.002 (0.029) | 0.074*** (2.987) | −0.022 (−0.290) |
| **Constant** | 14.295*** (13.928) | −0.627** (−1.984) | 14.339*** (14.348) |
| **City FE** | Yes | Yes | Yes |
| **Industry FE** | Yes | Yes | Yes |
| **N** | 1,543 | 1,487 | 1,479 |
| **Adj.$R^2$** | 0.226 | 0.233 | 0.243 |

Note: ***, **, and * represent the significance levels of 1%, 5%, and 10%, respectively; the estimated coefficient values obtained through the regression are displayed in the above table, and the values in brackets are the standard clustering errors corrected based on the company clustering effect; Constant denotes the constant term, and N is the sample number.

In Column (1) of Table no. 3, the regression coefficient of government-enterprise relation for enterprise growth was significantly positive at the 1% level, proving that enterprises could achieve their growth by establishing a relation with the government. Their business income could be increased by 0.32% if they spent additional 1% of their total time studying government rules and regulations and the policy interaction with the government. Enterprises could acquire government resources to promote their growth by establishing a good government-enterprise relation. Therefore, Hypothesis 3 was verified.

In Column (2), the regression coefficient of government-enterprise relation for financing ability was significantly positive at the 10% level. Thus, a good government-enterprise relation remitted the financing plights of enterprises and improved their financing abilities. Hypothesis 1 was verified. In Column (3), the regression coefficients of government-enterprise relation and financing plight for enterprise growth were significantly positive at the 1% level, and the partial mediating effect of financing ability between government-enterprise relation and enterprise growth was verified.

### 3.3. Grouping test

- Regression of sample division according to enterprise ownership system

As different ownership systems exert different effects in enterprise production process and enterprises with different ownership systems establish different relations with the government (Fan et al., 2007), the samples were divided into state-owned enterprises,

private enterprises, and foreign-owned enterprises for the regression according to enterprise registration type in the data. Table no.4 presents the regression results.

**Table no. 4. Regression Results of Sample Division According to Enterprise Ownership System**

| | (1) *Growth* | (2) *Growth* | (3) *Growth* | (4) *Finance* | (5) *Finance* | (6) *Finance* | (7) *Growth* | (8) *Growth* | (9) *Growth* |
|---|---|---|---|---|---|---|---|---|---|
| | State-owned | Private | Foreign-owned | State-owned | Private | Foreign-owned | State-owned | Private | Foreign-owned |
| **Relation** | 0.234 | 0.232*** | 2.189** | 0.049 | 0.033* | 0.129 | 0.177 | 0.203*** | 2.160 |
| | (0.582) | (3.083) | (2.066) | (0.462) | (1.763) | (0.304) | (0.418) | (2.581) | (1.388) |
| **Finance** | | | | | | | 1.172** | 0.502*** | −1.280 |
| | | | | | | | (2.026) | (4.891) | (−0.606) |
| **Age** | 0.360 | 0.336*** | 0.519 | 0.085* | 0.008 | −0.087 | 0.261 | 0.350*** | 0.436 |
| | (0.972) | (3.716) | (1.381) | (1.675) | (0.389) | (−0.389) | (0.687) | (3.808) | (0.577) |
| **Exper** | 0.365 | 0.650*** | 1.549 | −0.111 | 0.040 | 0.183 | 0.495 | 0.630*** | 2.035 |
| | (0.739) | (5.784) | (1.509) | (−1.397) | (1.399) | (0.239) | (1.106) | (5.567) | (0.656) |
| **ExpDum** | 2.057*** | 0.567*** | 0.363 | 0.057 | 0.054 | −0.145 | 1.990*** | 0.546*** | 0.521 |
| | (2.677) | (4.428) | (0.340) | (0.570) | (1.632) | (−0.389) | (2.784) | (4.224) | (0.409) |
| **Competition** | −3.193*** | 0.302 | −5.923 | 0.000 | 0.268 | 0.825 | 0.000 | 0.157 | −3.957 |
| | (−5.033) | (0.623) | (−1.624) | (.) | (1.522) | (0.324) | (.) | (0.303) | (−0.477) |
| **GdpPop** | −0.483** | 0.099 | −0.157 | −0.014 | 0.095*** | −0.075 | −0.466** | 0.070 | −0.344 |
| | (−2.107) | (1.291) | (−0.444) | (−0.181) | (3.505) | (−0.310) | (−2.360) | (1.094) | (−0.501) |
| **Constant** | 23.861*** | 12.615*** | 13.247*** | 0.156 | −0.829** | 0.061 | 20.486*** | 12.940*** | 12.799 |
| | (8.971) | (13.154) | (5.059) | (0.219) | (−2.486) | (0.028) | (8.002) | (14.160) | (1.552) |
| **CityFE** | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes |
| **Industry FE** | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes |
| **N** | 116 | 1368 | 46 | 114 | 1315 | 44 | 114 | 1309 | 44 |
| **Adj.$R^2$** | 0.264 | 0.219 | 0.913 | 0.387 | 0.233 | 0.469 | 0.291 | 0.232 | 0.895 |

*Note: ***, **, and * represent the significance levels of 1%, 5%, and 10%, respectively; the estimated coefficient values obtained through the regression are displayed in the above table, and the values in brackets are the standard clustering errors corrected based on the company clustering effect; Constant denotes the constant term, and N is the sample number.*

Columns (1) to (3) in Table no.4 show that the regression coefficient of government-enterprise relation for enterprise growth was significantly positive at least at the 5% level among private enterprises and foreign-owned enterprises. This result indicated that private enterprises and foreign-owned enterprises could achieve their growth by establishing government-enterprise relations. In Columns (4) to (6), only the regression coefficient of government-enterprise relation established by private enterprises for financing ability was positive at the 10% significance level. Thus, private enterprises could enhance their financing abilities through good government-enterprise relation; hence, Hypothesis 2 was verified. In Column (7)–(9), the regression coefficient of government-enterprise relation established by private enterprises for enterprise growth was significantly positive in Column (8), and so was the financing ability of private enterprises for enterprise growth. Therefore, the partial mediating effect of financing ability of private enterprises between government-enterprise relation and enterprise growth was verified.

- Regression of sample division according to enterprise scale

This section investigates whether government-enterprise relation exerted heterogeneous effects on the growth of enterprises with different scales. As different enterprise scales had different influencing mechanisms and effects on enterprise growth and financing abilities, large enterprises were generally not faced with financing plights, thanks to capital adequacy. By contrast, small and medium-sized enterprises, which were characterized by high risks and weak financing abilities, tended to improve their financing abilities by

keeping close contact with the government. On this basis, the samples were divided into large and medium-sized enterprises and small enterprises for the regression. In accordance with the related standard of the National Bureau of Statistics, enterprises with less than 300 employees were defined as small enterprises, and those with over 300 employees were large and medium-sized enterprises. Table no.5 displays the regression results.

**Table no. 5. Regression Results of Sample Division According to Enterprise Scale**

| | (1) *Growth* | (2) *Growth* | (3) *Finance* | (4) *Finance* | (5) *Growth* | (6) *Growth* |
|---|---|---|---|---|---|---|
| | **Large and medium-sized enterprises** | **Small enterprises** | **Large and medium-sized enterprises** | **Small enterprises** | **Large and medium-sized enterprises** | **Small enterprises** |
| **Relation** | −0.101<br>(−0.371) | 0.203***<br>(2.974) | 2.189**<br>(2.066) | 0.049<br>(0.462) | −0.299<br>(−1.190) | 0.177**<br>(2.485) |
| **Finance** | | | | | 1.156**<br>(2.417) | 0.407***<br>(4.317) |
| **Age** | 0.236<br>(0.936) | 0.028<br>(0.352) | 0.519<br>(1.381) | 0.085*<br>(1.675) | 0.348<br>(1.447) | 0.038<br>(0.476) |
| **Exper** | 0.488<br>(1.598) | 0.602***<br>(5.922) | 1.549<br>(1.509) | −0.111<br>(−1.397) | 0.424<br>(1.289) | 0.603***<br>(5.912) |
| **ExpDum** | 0.572*<br>(1.829) | 0.424***<br>(3.640) | 0.363<br>(0.340) | 0.057<br>(0.570) | 0.754***<br>(2.650) | 0.391***<br>(3.339) |
| **Competition** | −0.373<br>(−0.545) | −0.158<br>(−0.300) | −5.923<br>(−1.624) | 0.000<br>(.) | 0.000<br>(.) | −0.261<br>(−0.483) |
| **GdpPop** | −0.556**<br>(−2.129) | 0.067<br>(0.908) | −0.157<br>(−0.444) | −0.014<br>(−0.181) | −0.606***<br>(−2.648) | 0.040<br>(0.601) |
| **Constant** | 22.853***<br>(6.739) | 14.161***<br>(14.997) | 13.247***<br>(5.059) | 0.156<br>(0.219) | 22.264***<br>(7.542) | 14.410***<br>(15.866) |
| **City FE** | Yes | Yes | Yes | Yes | Yes | Yes |
| **Industry FE** | Yes | Yes | Yes | Yes | Yes | Yes |
| **N** | 201 | 1,342 | 46 | 114 | 187 | 1,292 |
| **Adj.$R^2$** | 0.03 | 0.198 | 0.913 | 0.387 | 0.09 | 0.208 |

Note: ***, **, and * represent the significance levels of 1%, 5%, and 10%, respectively; the estimated coefficient values obtained through the regression are displayed in the above table, and the values in brackets are the standard clustering errors corrected based on the company clustering effect; Constant denotes the constant term, and N is the sample number.

In Column (1)–(2) in Table no.5, the regression coefficient of government-enterprise relation for enterprise growth was significantly positive at the 1% level among small samples. Thus, the growth of small enterprises could be facilitated by establishing a good government-enterprise relation. In Column (3)–(4), only the government-enterprise relation established by large and medium-sized enterprises showed a significant regression coefficient for financing ability. In Column (5)–(6), the regression coefficient of government-enterprise relation and financing ability of small enterprises for enterprise growth was significantly positive at least at the 5% level. Sobel test should be performed for the regression coefficient of the government-enterprise relation of small and medium-sized enterprises and their financing abilities, which was not significant as seen in Column (2), according to Wen (2014)'s method. The Sobel test results satisfied the significance test requirements. The statistical *Z* value of Sobel test was 2.025 ($p$=0.0428), indicating that the mediating effect exceeded the 5% significance level and accounted for 24.9% of the total

effect. Therefore, the partial mediating role played by the financing ability of small enterprises between government-enterprise relation and enterprise growth was verified. This finding further proved that small enterprises were under high operating risks and narrow financing channels; hence, establishing a stable government-enterprise relation could expand their financing channels, remit their financing difficulties, which can ultimately boost their growth.

### 3.4. Endogeneity and robustness test

- Endogeneity problem and instrumental variables

Endogeneity problem should be eliminated to explore the government-enterprise relation. The benign government-enterprise interaction contributes to enterprise growth, and enterprises with good growth momentum can usually acquire government support. Therefore, the endogeneity problem of reverse cause and effect exists between government-enterprise relation and enterprise growth, indicating that the estimation coefficients obtained through the regression in this study were biased.

To mitigate the endogeneity problem between government-enterprise relation and enterprise growth, the number of times that enterprises had been inspected or visited by officials was taken as the instrumental variable of government-enterprise relation. The value was estimated by using the two-stage least squares method. On the one hand, that an enterprise was visited by government officials could influence government-enterprise relation. Enterprises could construct a good communication channel with the government through an inspection (Liu, 2004). On the other hand, that an enterprise was visited by government officials was an internal decision made by the government. The number of official visits was relatively independent of enterprise growth, and government officials made autonomous decisions to visit target enterprises at their discretion (Pan et al., 2009). Therefore, the number of times that enterprises had been inspected or visited by officials was used as an instrumental variable. The influence of political connection on enterprises could be measured by activities of government officials, namely, inspection and visit, which were occasional events, thus remitting the endogeneity problem between government-enterprise relation and enterprise growth. On this basis, a two-stage regression model was constructed as follows:

Stage 1: $$Relation_i = \alpha_0 + \beta Interview_i + \gamma Control_i + \varepsilon_1 \quad (4)$$

Stage 2: $$Growth_i = \alpha_1 + \beta_1 Relation_i + \gamma_1 Control_i + \varepsilon_2 \quad (5)$$

Where:

$Growth_i$ – enterprise *i* growth;

$Relation_i$ – enterprise *i* government-enterprise relation;

$Interview_i$ – Instrument variable is natural logarithm taken from the number of times than enterprises had been inspected or visited plus 1;

$Control_i$ – control variable;

$\varepsilon_1$, $\varepsilon_2$ – random error terms.

**Table no. 6. Regression Results of Instrumental Variable Conclusions**

| | (1) OLS *Relation* | (2) IV *Growth* |
|---|---|---|
| **Interview** | 0.085*** (4.833) | |
| **Relation** | | 1.702*** (2.594) |
| **Age** | −0.015 (−0.331) | 0.188 (1.420) |
| **Exper** | 0.070 (1.226) | 0.765*** (4.591) |
| **ExpDum** | 0.185*** (2.825) | 0.294 (1.303) |
| **Competition** | −0.046 (−0.316) | −0.240 (−0.326) |
| **GdpPop** | −0.007 (−0.090) | −0.004 (−0.022) |
| **Constant** | 0.725 (1.009) | 13.263*** (6.373) |
| **City FE** | Yes | Yes |
| **Industry FE** | Yes | Yes |
| **N** | 1,015 | 1,010 |
| **Adj.$R^2$** | 0.264 | −0.038 |

Note: ***, **, and * represent the significance levels of 1%, 5%, and 10%, respectively; the estimated coefficient values obtained through the regression are displayed in the above table, and the values in brackets are the standard clustering errors corrected based on the company clustering effect; Constant denotes the constant term, and N is the sample number.

Column (1) of Table no.6 presents the first-stage regression results. The coefficient of the number of times that enterprises had been inspected or visited by government officials was positive at the 1% significance level. This finding indicates that the number of times that enterprises had been inspected or visited by government officials had a significant positive correlation with government-enterprise relation. Moreover, the t value of this instrumental variable was 4.833, thus passing the test of weak instrumental variable. Column (2) reports the second-stage regression results. The explained variable was enterprise growth, and the coefficient of government-enterprise relation was significantly positive at the 1% level, indicating that after the endogeneity problem was controlled, enterprise growth could be driven by good government-enterprise relation. In addition, the conclusions achieved from the basic regression were not perplexed by the endogeneity problem.

- Robustness test

In this study, the government-enterprise relation was better measured from two dimensions: enterprise acquisition of government contract and informal payment. The government-enterprise relation variable in the basic regression was replaced by establishment of government-enterprise relation (*RelationDummy*), whether the enterprise had any guarantee or attempted to acquire a government contract in the previous year (*ContractDummy*), the total amount of informal payment (*InformalPay*), and whether the presents or informal payment were required in the contact between enterprise and government official

(*OfficerInformalPayDummy*), in an effort to perform the robustness test. Table no. 7 lists the regression results.

**Table no. 7. Robustness Test**

| | (1) Growth | (2) Growth | (3) Growth | (4) Growth |
|---|---|---|---|---|
| **RelationDummy** | 0.559*** (5.260) | | | |
| **ContractDumm** | | 0.739*** (6.085) | | |
| **InformalPay** | | | 0.138*** (3.457) | |
| **OfficerInformalPayDummy** | | | | 0.496** (2.552) |
| **Age** | 0.251*** (2.853) | 0.308*** (3.275) | 0.164* (1.664) | 0.205* (1.886) |
| **Exper** | 0.699*** (6.545) | 0.643*** (6.149) | 0.763*** (6.588) | 0.807*** (5.743) |
| **ExpDum** | 0.626*** (5.008) | 0.694*** (5.774) | 0.738*** (5.349) | 0.710*** (4.756) |
| **Competition** | −0.275 (−0.538) | −0.351 (−0.637) | −0.286 (−0.571) | −0.815 (−1.207) |
| **GdpPop** | 0.011 (0.142) | 0.142* (1.725) | 0.126 (1.141) | 0.189* (1.863) |
| **Constant** | 14.084*** (13.888) | 13.121*** (12.763) | 13.196*** (10.869) | 13.411*** (10.325) |
| **City FE** | Yes | Yes | Yes | Yes |
| **Industry FE** | Yes | Yes | Yes | Yes |
| **N** | 1,543 | 1,590 | 1,298 | 1,018 |
| **Adj.$R^2$** | 0.232 | 0.238 | 0.212 | 0.214 |

Note: ***, **, and * represent the significance levels of 1%, 5%, and 10%, respectively; the estimated coefficient values obtained through the regression are displayed in the above table, and the values in brackets are the standard clustering errors corrected based on the company clustering effect; Constant denotes the constant term, and N is the sample number.

Table no. 7 reveals that after government-enterprise relation was substituted, the four substitutive indexes were positive at least at the 5% significance level, indicating that the results remained robust after the two-dimension indexes – enterprise acquisition of government contract and informal payment – were used to replace government-enterprise relation in the basic regression.

## 4. Discussion

The above analysis results show that Hypothesis 1, Hypothesis 2, and Hypothesis 3 are supported. According to the research findings, government-enterprise relation mitigates the financing constraints and difficulties faced by enterprises, thus promoting enterprise growth. Therefore, enterprises are motivated to establish close relations with the government and spend time reading and studying the department rules and regulations and interacting with the government. Given this finding, the government can drive enterprise development, give them preferential policies of a certain proportion such as subsidies, and promote enterprise growth. The grouping test shows that the financing plights of private

enterprises and small enterprises can be remitted by establishing good government-enterprise relation. Enterprise growth can be further enhanced, specifically as follows:

First, the regression coefficient of government-enterprise relation for enterprise growth is positive at the 1% significance level as seen in Table no.3, proving that enterprises can achieve their growth by establishing a connection with the government. Moreover, the regression coefficient of government-enterprise relation for enterprise financing ability is significantly positive at the 10% level, showing that a benign government-enterprise relation mitigates the financing plights of enterprises and strengthens their financing abilities. This finding accorded with the viewpoint of Faccio et al. (2006) and Yu and Pan (2008): enterprises can gain direct access to government fiscal subsidies and tax preferences by keeping contact with the government, and acquire more bank loans by virtue of government-endorsed letters of credit. In the end, the regression coefficients of government-enterprise relation and financing plight for enterprise growth are positive at the 1% significance level. Therefore, the partial mediating effect of enterprise financing ability between government-enterprise relation and enterprise growth is verified, which supports the lubricating effect hypothesis from the theoretical level. This finding coincides with the viewpoint of Boubakri et al. (2012) and Liu et al. (2013). Government-enterprise relation could help enterprises obtain more credit resources or government subsidies (Johnson and Milton, 2003; Claessens et al., 2008). Moreover, good government-enterprise interaction could facilitate lowering financing costs necessary for enterprise growth (Boubakri et al., 2012; Liu et al., 2013). Among the main control variables, the regression coefficient of enterprise age and experience of senior managers was positive at the 1% significance level, indicating that older enterprise age and richer experience of senior managers were better for enterprise growth. A possible reason is that enterprises founded earlier occupy more social resources, along with mature management mode and entrepreneurship, which can improve enterprise performance. The regression coefficient of enterprise export was also positive at the 1% significance level, indicating that the increase in enterprise export value expanded the market scope, increased the sales channels, and further boosted enterprise growth (Batra et al., 2003; Du and Guo, 2012).

Second, the regression coefficient of government-enterprise relation for enterprise growth is significantly positive at the 5% level among private enterprises and foreign-owned enterprises as shown in Table no.4. This result demonstrates that the growth of these enterprises can be promoted by establishing government-enterprise relation. The regression coefficient of government-enterprise relation established by private enterprises is positive at the 10% significance level, showing that private enterprises enhance their financing abilities through a benign government-enterprise relation. The regression coefficient of financing ability of private enterprises for enterprise growth is significantly positive at the 1% level; hence, the mediating effect of the financing ability of private enterprises between government-enterprise relation and enterprise growth is validated. Relative to state-owned enterprises, private enterprises may bear more financing limitations; hence, they seek to establish a stable relation with the government to expand their financing channels (Yu et al., 2012) and to relieve their financing difficulties owing to small scale, few mortgages, and high risks, so as to boost their growth.

Third, the regression coefficient of government-enterprise relation for enterprise growth among small enterprises is significantly positive at the 1% level as shown in Table no.5. Therefore, small enterprises can achieve vigorous growth by establishing good

government-enterprise relation. The regression coefficients of government-enterprise relation and financing ability for enterprise growth are significantly positive at the 5% level, and the Sobel test results satisfy the significance test requirements. These results prove that the mediating effect passes the significance test at the 5% level. At the same time, referring to Wondirad (2020), this study also recommends that deepening financial outreach to the small enterprises, countries need to initiate and encouraging competition in their microfinance market. Along with this, policy regulators also need to design a policy framework that creates a sound competitive microfinance market.

Fourth, the number of times that enterprises had been inspected or visited by government officials was selected as the instrumental variable of government-enterprise relation. The first-stage regression results show that the coefficient of the number of times that enterprises had been inspected or visited is positive at the 1% significance level. In the second-stage regression results, the coefficient of government-enterprise relation is significantly positive at the 1% level. This result indicates that after the endogeneity problem is controlled, enterprise growth can be facilitated by establishing good government-enterprise relation. Moreover, the basic regression conclusions are perplexed slightly by the endogeneity problem. Table no.7 shows the robustness test after the substitution of the government-enterprise relation variable. The result indicates that government-enterprise relation exerts a significant positive influence (over 5%) on enterprise growth.

**Conclusions**

Using the World Bank Survey of Chinese Enterprises data in 2012, mediating effect models were utilized to empirically test how government-enterprise relation influenced enterprise growth. The following conclusions were drawn: (1) Good government-enterprise relation positively influences enterprise growth. (2) Government-enterprise relation can facilitate enterprise growth by mitigating enterprises' financing difficulties. This conclusion remains significant after the endogeneity problem is weakened by the instrumental variable method and the robustness test is carried out. (3) In the sample-specific research, private enterprises, foreign-owned enterprises, and small enterprises seek for their growth by establishing a connection with the government; a good government-enterprise relation can relieve them from financing plights and boosted their growth.

This study provides the following managerial implication: (1) this study reports that political ties have a positive effect on enterprise growth, whereas business ties have a positive effect on enterprise growth. This means that when an SME can obtain policy and financial support from the government, it should pursue the enterprise growth strategy. (2) This study indicates if managers of SMEs want to effectively utilise good managerial ties to improve their growth, the role of social network and political ties cannot be ignored. (3) This study shows that governments in China play a very important role in the implementation of growth strategies by SMEs. it is necessary for SMEs to focus on the national key development direction (such as digital economy, blockchain and artificial intelligence) when making enterprise growth plan.

Although this study reveals the influencing mechanism of government-enterprise relation on enterprise growth to some extent, some problems remain to be solved. (1) World Bank Survey of Chinese Enterprises data is used to unfold this study. However, the institutional

background and industry structure in China are significantly different from that in Western countries. Therefore, whether the conclusions apply to the market environment in developed countries and regions needs to be tested. (2) the government-enterprise relation is measured by using the time spent by senior managers in handling government rules and regulations, and the robustness test of government-enterprise relation is implemented by using the following variables: whether enterprises establish the government-enterprise relation, whether they are guaranteed or attempt to acquire government contract, the total amount of informal payment, and whether presents or informal payment are required in the communication with the government. Nevertheless, the government-enterprise relation can be measured from diversified dimensions. It can be comprehensively analyzed from the perspectives of social network, corporate shareholders, and management layer. In the follow-up research, the government-enterprise relation can be profoundly depicted, and its influences on enterprises may be further discussed.

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# FACTORS WITH A MAJOR EFFECT ON THE BUDGETARY CONTROL PROCESS – AN EMPIRICAL STUDY FROM THE CZECH REPUBLIC

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**Abstract**
Superlatives are commonplace in descriptions of traditional budgeting. Within managerial accounting techniques, it is one of the most frequently used, the most researched, but also the most criticized. While academics are largely united in criticism of traditional budgeting practices due to their inflexibility and consumption of resources, the existing studies have not identified universal assumptions to improve this system. The inconsistent conclusions in current literature create a need to explore approaches to mitigation of budgetary weaknesses. Furthermore, this incomplete knowledge is an impulse to examine factors influencing the choice of these approaches.
The authors conducted a review of the literature to amass information on approaches developed to enhance traditional budgeting methods. Subsequently, research was conducted on the extent of utilization and the subjective perception of such methods at a sample of companies operating in the Czech Republic. The authors additionally attempted to determine which factors influenced the decisions of managers in selection of such a tool. A web-based survey was devised with the aim of gathering data, followed by analysis of correlation between selected variables through application of Pearson's chi-square test.
The literature review revealed the importance of conducting a budgetary review in improving the budgetary control. In total, 136 Czech companies took part in the survey, and it was discovered that a significant number of them had implemented traditional budgeting methods. More than 80% of respondents monitored any variation within their budgets. In the following part, the share of foreign capital was identified as the factor that influenced choices made in budgetary control. Since no correlation was discerned between revision of a budget and subsequent perception of its efficiency, the results lend support to arguments that minor improvements do not radically affect budgeting overall.

**Keywords:** budgeting, planning, budget review, Czech businesses.

**JEL Classification:** M41, M19

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## Introduction

Budgeting and budgetary control require that a business sets goals for itself and devises processes with the aim of achieving the desired outcome (Isaac et al., 2015). Many studies emphasize the dominant role of budgeting in management control (Ostergren and Stensaker, 2009; Libby and Lindsay, 2010). According to Lorain et al. (2014), the terms management control and budgetary control are synonymous.

Studies published in the past decade on traditional budgeting methods and budgetary control have reported findings that are somewhat contradictory. While arguments have been made that a budget constitutes an ineffective tool and is merely formal in function, numerous surveys in Europe and America show that budgeting is still considered a critical method in the corporate sector. Although certain enterprises, e.g. Volvo and Swedish banks, now view budgeting as systematically broken and have abandoned the practice (Hope and Fraser, 2003), they are the exception rather than the rule. This fact is supported by surveys conducted in the Poland and Lithuania (Wnuk-Pel and Christauskas, 2018), the Czech Republic (Popesko et al., 2015), North America and Canada (Libby and Lindsay, 2010), which reveal a great many businesses continue to apply budgeting techniques in traditional form or with minor alterations.

The unanswered question is why some companies have been able to cope with the inherent weaknesses of a traditional budget, while others have abandoned the traditional budgeting system. Interestingly, study of the ways such established practices are changed to heighten their efficiency in a corporate environment and any consequent benefits for decision-making is absent from the literature. Setting aside alternative methods, such as Activity-Based Budgeting or Beyond Budgeting, some authors (Libby and Lindsay, 2010; Drury, 2015) have attempted to propose improvements to traditional budgeting practices, although this has not led to development of a unified and recognized approach.

This study summarizes recommendations for improving traditional budgeting, while also examining their application in the real world. This predominantly concerned budget review in the context of regular comparison of targets and actual performance to discern any variance therein, as implemented by companies in the Czech business environment. Research was also conducted to identify factors that contribute to adoption of such enhanced methods and gauge perception of their success following implementation.

## 1. Review of the scientific literature

Budgeting is considered a fundamental part of management accounting as an instrument assisting managers in decision-making processes (Williams et al., 2018). Classic monographs on management accounting describe a budget as a technique for coordinating various activities by means of preparing plans for future periods, respectively as a technique which aids control, communication, motivation and allocation of resources (Noreen et al., 2017; Král, 2018). A traditional budgeting system is also characterized by monitoring financial indicators and setting annual targets (Popesko et al., 2015).

Lohan (2013), following a comprehensive review of the literature, declared that budgeting is one of the most frequently researched topics in management accounting. Kenno et al. (2018) revealed that budgeting appeared in 251 articles indexed in the ABI Inform and ProQuest databases between 1972 and 2016. Hilton and Platt (2013) state that a budget is

the most widely employed technique to facilitate planning and control, although it would be inaccurate to consider budgeting merely in these terms. Wnuk-Pel and Christauskas, in the introduction to their study (2018), emphasize how a budget supports implementation of a business strategy or the remuneration of managers.

Since the global economy continues to change apace, with emphasis placed on flexibility and adaptation to keep up with innovations in technology, new requirements have arisen for methods that aid management. Given the speed at which alteration takes place in the marketplace, the need to administer a company more flexibly has been identified by senior executives (Miodek and Wnuk-Pel, 2017). As a consequence, an annual budget, usually completed a few months prior to its implementation, is no longer viewed as an ideal managerial tool (Ekholm and Wallin, 2000). Hope and Fraser (2003) observe that traditional budgeting can make companies less adaptive to change in the business environment, often causing dysfunctional behavior. According to Hansen et al. (2003), these "budget games" relate to traditional budgeting's financial, top-down and commandand-control nature of traditional budgeting, as embedded in processes for annual budgetary planning and evaluation of performance. Higgins (2005) points out that budgeting often fails to reflect the commercial strategy in place, while Neely et al. (2003) comment that a budget with fixed targets could lead to a circumstance of it being outdated even before it is implemented. Jansen (2001) writes that a major drawback is an impact made on relations between employees, whereby managers might err towards dishonesty, potentially pitching colleagues against one another.

Further criticism levelled at budgeting is founded on the excessive consumption of resources involved. Numerous surveys have documented that the process is time-consuming and exerts an impact on the productivity of managers. This view is espoused by Neely et al. (2003) and is supported by Libby and Lindsay (2010). Østergren and Stensaker (2009) also point out that a great deal of time is required for it, with focus being placed on reducing costs at the neglect of value creation. Bourmistrov and Kaarbøe (2013) perceive budgeting as stifling creativity and innovation. Others talk of discontinuity and contradiction in corporate plans and budgets, and the fact that the latter are often based on figures from the previous year with a reliance on prior notions. The process also reinforcing barriers between departments rather than encouraging the sharing of knowledge (Hansen et al., 2003; Hope and Fraser, 2003; Neely et al., 2003; Lohan, 2013).

In response to growing dissatisfaction with traditional budgeting, alternative methods, such as Beyond Budgeting and Activity-Based Budgeting, have been devised and picked up on in business practice (Réka, 2014). Attempts at conceiving means different from conventional procedure are in line with the opinion of Hope and Fraser (2003), who do not believe it is possible to evolve traditional budgeting at all, the only solution being to scrap it altogether due to its fundamental flaws. When Hope and Fraser expressed this courageous opinion, they backed it up with examples of contemporary, well-known companies that were abandoning traditional budgets. However, subsequent surveys have shown that such moves by the likes of Volvo and IKEA did not stir many others do follow suit, going against expectations. In fact, a significant number of studies indicate that budgeting retains its importance in management accounting, with several providing evidence of this in various countries. Ekholm and Wallin (2000) reported that very few Finnish enterprises out of the 168 surveyed had decided to abandon their traditional annual budgets. In Turkey, 94% of respondents declared their firms still carried them out (Yalcin, 2012). This trend

echoed also in a study by Wnuk-Pel and Christauskas (2018), who discerned traditional budgeting took place in 86.96% of large Polish companies and every participating firm in Lithuania of similar size. The finding that it continued to play a crucial role in management planning and control was confirmed by Libby and Lindsay (2010) and Popesko et al. (2015). The former examined budgeting practices in Canada and North America, with only 7% of Canadian and 3% of American enterprises considering the possibility of abandoning it. Comparable figures were discerned by Popesko et al. in a sample of Czech businesses, wherein less than 5% of respondents were thinking about doing away with a budget or had already decided to do so. Šiška (2016) notes that the size of an enterprise plays a vital role in decisions on whether to maintain or end the practice, with small businesses tending towards the latter. This finding is in line with the opinion of those who advocate for the Beyond Budgeting concept, who suggest traditional budgeting is usually abandoned by flexible organizations with a high level of decentralization, i.e. primarily small companies.

A clear conclusion from this is that budgeting remains a widespread managerial technique. According to Wnuk-Pel and Christauskas (2018), although the use of operational budgets had decreased compared to previous research, managers still regard budgeting (either in traditional or modified form) as maybe not perfect, but a useful tool which is difficult to find a substitute. De Waal (2011) writes that only a handful of organizations had decided to radically change their budgeting processes due to the central role they played in financial management. Hänninen (2013) notes that implementing alternative methods has proven problematic as replacements for existing budgeting systems, while their plausibility remained theoretical. Consequently, it can be assumed that such commonplace employment of a traditional process means the pros of it outweigh the cons. An analogous opinion is presented by Lidia (2014), whose research in Romania concludes that the benefits of a budget outweigh the associated disadvantages. Becker et al. (2016) take the view that in a dynamic age of crisis and essential change some functions of budgeting become especially evident, primarily its importance in planning and resource allocation, although its plays less of a part in evaluating performance. All of this points to the growth in interest in the specifics of budgeting in the current business environment (Lorain et al., 2014).

Based on these experiences by professionals and academics, we could state that usage of this system does not have to be the wrong way for companies if the system's setting flexibly responds to change in the external environment. In this context Libby and Lindsay (2010) assume any related issue lies in actual usage of budgeting, not a failure of the method as a whole. They have advised firms to seek inspiration in Codman & Shurtleff (Simons, 1987), a company which enhanced its budgeting system in various ways. Therein, ten principles were applied, e.g. highly detailed budgets across responsibility centres, operational plans linked to a long-term (strategic) plan, multiple revisions, a budgeting system which is managed interactively (not diagnostically) and a strongly decentralized management structure. Drury (2015) presents a similar approach to such enhancement, stating that budgets need to be reviewed more frequently than in the past, and new resources must be allocated outside the budgetary process to respond to changes in the business environment. A trend for carrying out systemic revisions more frequently is confirmed in research by Lorain et al. (2014), where almost 40% of the sampled Spanish companies revised budgets every month, with 38% doing so quarterly, while the remainder gave no response. Wnuk-Pel and Christauskas (2018) surveyed Polish and Lithuanian businesses, finding they did not make references to budgetary revisions but control reports. According to their findings,

more than 86% of the Polish and almost 62% of the Lithuanian enterprises produced control reports, usually monthly.

The suggestions about frequent revisions of budgets are linked with a modern concept for cost management by Stiller (2007), who declares that managerial tools should go beyond cost analysis by effectively influencing such costs. This view aligns with statements by Kaczyńska and Wnuk-Pel (2016), who perceive the transformation of economics and enhancement of strategically oriented managerial accounting as a catalyst for significant change in management methods. In the turbulent economy of the 21st century, such processes should analyse past periods and generate data for the future.

## 2. Research methodology

Taking the findings of the review of the literature into consideration, the aim of the study is to examine how traditional budgeting processes have been amended to suit companies in the Czech business environment and to identify factors informing the choices made.

### 2.1 Sample selection and research design

Although a lot of research referenced in the literature review pertained to large or medium-sized enterprises (Libby and Lindsay, 2010; Klimaitienė and Ramanauskaitė, 2019), the smaller sample would made impossible to assess the validity of statements by Šiška (2016) and the creators of the Beyond Budgeting concept (Hope and Fraser, 2003), who argue small, flexible enterprises with a higher degree of decentralization no longer largely practice traditional budgeting. Instead, the research presented is founded on a final sample of small, medium and large businesses, analogous to a study by Becker et al. (2016). The targeted group consisted of commercial enterprises operating in the Czech Republic with an arbitrary number of employees (i.e. more than nought) and an annual recorded turnover exceeding 1 million CZK (Czech crowns; approx. 40,000 EUR).

In order to gain a wide range of respondents, quantitative research was conducted in the form of a web-based questionnaire distributed via e-mail. Contact information on senior staff at firms was sourced from the Albertina database, the target group comprising executives and employees in positions such as the CEO, CFO, heads of financial and controlling departments and project managers. Individuals such as these were considered optimal due to their experience in establishing and working with budgets.

Data collection was carried out in the period from January to June 2017. In total, 1,490 companies were contacted, out of which 136 completed the questionnaire. Although this represents a return rate of about 9.1%, which might be considered relatively low, but the anonymous nature of the questionnaire did not allow for further contact with those who had not responded. Data on the respondents are given in table no. 1.

**Table no. 1. Data on respondents**

| Sector | Frequency | Percentage |
|---|---|---|
| Manufacturing | 55 | 40.4% |
| Automotive | 7 | 5.1% |
| Construction | 10 | 7.4% |

| Sector | Frequency | Percentage |
|---|---|---|
| Engineering | 10 | 7.4% |
| Agriculture | 7 | 5.1% |
| Services | 27 | 19.9% |
| Energy supply | 3 | 2.2% |
| Other | 17 | 12.5% |
| **Number of employees** | **Frequency** | **Percentage** |
| Less than 50 | 33 | 24.3% |
| 50-100 | 39 | 28.7% |
| 100-250 | 40 | 29.4% |
| More than 250 | 24 | 17.6% |
| **Share of foreign entities in total capital** | **Frequency** | **Percentage** |
| A share of more than 20% | 36 | 26.5% |
| A share of less than 20% | 100 | 73.5% |
| **Total number of respondents** | **136** | **100%** |

### 2.2. Determination of hypotheses

While previous studies by the authors (Dokulil et al., 2018; Dokulil et al., 2020) focused on essential parameters of budgeting in companies operating in the Czech Republic (budgeting purposes, indicators, the procedure for establishing a budget, the role of the ownership structure etc.), this paper is aimed at improving budgeting process.

Following the review of the literature, the authors determined the research questions below as a basis for formulating hypotheses:

- Does the perception of the external environment influence a decision by a company on carrying out budgetary control measures?

- Are foreign-controlled companies more interested in reviewing budgets regularly than those with domestic owners?

- Is it possible to affect the efficiency of a budget by conducting revision of it? Do senior staff believe frequent review of a budget positively influences its effectiveness?

Other authors (Libby and Lindsay, 2010; Drury, 2015) have expressed that, in their experience, carrying out regular revisions can diminish the fundamental limitations of conventional budgeting. A budget revision or budget(ary) review is defined as the act of comparing a quantitatively expressed plan and the actual values achieved for a given period. The survey conducted herein primarily gauged the factors that affected whether a company reviewed its budget or not. Firstly, we proceeded from the statement that budgeting, in its traditional form, is not suitable for a dynamic business environment (Neely et al., 2003; Ekholm and Wallin, 2011). Lorain et al. (2014) even state that the global economic crisis in 2008 made managers even more sceptical about the possibility of drawing up accurate budgets due to changes in the external environment. In response to such statements, budgetary review is recommended, especially if the external environment is deemed unstable. In this context, the first hypothesis below examined the impact of

perception of stability in the external environment, measured by subjective evaluation of the recipients on a scale of 1 to 5 (from "very unstable" to "very stable") in decisions on whether to carry out budget revisions.

**H1a:** Subjective perception of stability in the external environment is a statistically significant factor that influences whether a company regularly conducts budget reviews.

The second aspect examined the influence of foreign capital on decisions to conduct budgetary reviews. This hypothesis was initiated by two publications, the first of which referring to a specific circumstance in Czech business sector. The Czech Statistical Office wrote in 2015 that added value by foreign-controlled enterprises (880 billion CZK) accounted for approximately 42% of the total figure for the Czech Republic, highlighting the great importance of such entities. Enterprises with foreign owners, especially members of global concerns, require senior managers to control the allocation of resources and monitor economic results, with a preference for budgeting for this very purpose. The other publication, a study, concurred with this statement. Sandalgaard and Bukh (2014) describe the barriers faced by FoodCorp, a large agricultural concern, when moving away from traditional budgeting processes. These references confirm that budgets play an important controlling role for the foreign owners of, especially large, enterprises. In this context, it is possible to assume that owners request frequent monitoring of actual results and, in direct connection with this, budget revisions.

**H1b:** A significant share of foreign capital (more than 20% of total capital) is a statistically significant factor that influences whether a company regularly conducts budget reviews.

The previous hypothesis was devised to examine how effective budgeting was perceived to be as a result of conducting budget revisions, as an expression of a subjective perspective rather than a financial indicator. To hypothesis testing, we used answers to the question where respondents regarded whether they consider budget as a formal technique that is not supportive to manage, or they do not.

**H2:** Conducting a budget review is a statistically significant factor that influences subjective perception of the efficiency of budgeting processes.

The defined hypotheses were all tested by Pearson's chi-square test of independence, whereby comparison of observed frequencies with expected ones was made, assuming normal distribution. It follows that the variables were tested to see if they were dependent on each other. While the zero hypothesis (H0) assumed the independence of both variables, the alternative hypothesis (H1) was confirmed if the variables were dependent on each other. The level of significance was set at $\alpha = 0.05$. After collating the answers to the survey in Google forms, the database containing these responses was transferred to MS Excel. The calculation occurred in XL Statistics statistical software.

## 3. Results and discussion

Since the study investigated potential enhancement of traditional budgeting processes, it was necessary to find out which respondents employ a conventional budget. So as to avoid different interpretations of traditional budgeting, the term was defined in the questionnaire as a technique for planning on an annual basis that utilized financial variables.

According to said definition, most respondents stated that traditional budgeting did take place (88 respondents = 64.7%). Budgets are applied in 11 out of the 33 small companies (33.3%), in 57 out of 79 medium-sized ones (72.2%) and in 20 out of 24 large enterprises (83.3%). The lesser portion of small businesses that work with budgets lent support to the statement by Šiška (2016), i.e. the tendency of small, flexible businesses to dispense with traditional budgeting. However, given the disproportionate representation of enterprise groups by size (according to a number of employees as the main criterion), this statement could not be deemed as conclusively supported. The sample of respondents who answered affirmatively to the first question and carried on in the questionnaire consisted of 11 small, 57 medium-sized and 20 large enterprises. In total, 88 entities completed the survey. (Table no. 2)

**Table no. 2. Link between budgeting and strategic planning**

| Is the budgeting process in your company linked to strategic planning? | Frequency | Percentage |
|---|---|---|
| Always | 62 | 70.5% |
| Occasionally | 22 | 25% |
| Never | 4 | 4.5% |

This question opened up the part of the survey focused on improving traditional budgets. The review of the literature revealed the lack of connection between budgeting and company strategy, thereby constituting a common issue which undermines the effectiveness of the instrument. Libby and Lindsay (2010) emphasize that linking operational plans (budgets) to the long-term (strategic) plan is one of ten significant aspects presented by the firm Codman & Shurtleff for improving conventional budgeting. The results herein show that this is not an issue for the Czech companies, since most respondents said the budget followed the corporate strategy and was not isolated from long-term planning.

The following questions focused on budget revisions. We consider budget deviations as a higher degree of managerial control to assess whether the results of a company progress in accordance with a plan. This kind of procedure was employed by almost 90% of the sample of respondents who compiled budgets, mostly on a monthly basis. Ten respondents declared no budget revisions were carried out, most of these working at small and medium-sized enterprises. This number included only one large company, which responded to the next question by saying it regularly adjusted its budget during the budgetary period, which would be almost impossible without a budgetary review. The mentioned answer to the question on budget revisions was probably caused by a misunderstanding of a question. (Table no. 3)

**Table no. 3. Budgetary control**

| Do you regularly carry out budget review? | Frequency | Percentage |
|---|---|---|
| Yes | 78 | 88.6% |
| No | 10 | 11.4% |
| **If yes, at what interval?** | **Frequency** | **Percentage** |
| Semi-annually | 5 | 6.4% |
| Monthly | 69 | 88.5% |
| Weekly and in shorter intervals | 2 | 2.6% |
| No response | 2 | 2.6% |

The section about budget review was followed by a section on adjustments to the budget during the period of its duration. The results are shown below (table no. 4).

**Table no. 4. Adjustments to a budget during the budgetary period**

| Is the budget adjusted during the year to reflect the continual progress of the monitored variables? | Frequency | Percentage |
|---|---|---|
| Yes | 51 | 58% |
| No | 37 | 42% |

While the majority of respondents update budgets at quarterly intervals, a significant percentage of respondents did not answer this question at all. Numerous firms alter their budgets according to current circumstances and needs. In this context, for example, a respondent claimed that the budget was only modified when a significant investment or unplanned repair required it. Another respondent from the agricultural sector adjusts the budget after the harvest, usually in September. Other participants referred to updating the budget continually or at fixed intervals, e.g. at the end of the first or second quarter.

The question below, on subjective perception of the external environment, was included in the questionnaire to assess the possible impact of this factor on the setting of the budgeting system, especially the periodicity and form of any budget revisions. Most considered the business environment to be very stable, stable or relatively stable (about 89%), whereas about 11% judged it as relatively unstable or very unstable. (Table no. 5)

**Table no. 5. Subjective evaluation of the external environment**

| How do you perceive the external environment to the company? | Frequency | Percentage |
|---|---|---|
| Very stable | 16 | 18.2% |
| Stable | 33 | 37.5% |
| Relatively stable | 29 | 33% |
| Unstable | 9 | 10.2% |
| Very unstable | 1 | 1.1% |

The last question was directed at assessing the correctness of a statement on the efficiency of budgeting. (Table no. 6)

**Table no. 6. Assessment of the correctness of a statement**

| A budget is a formal tool unsuitable for managing a company, which usually is obsolete upon its approved. | Frequency | Percentage |
|---|---|---|
| I completely disagree | 9 | 10.2% |
| I tend not to agree | 47 | 53.4% |
| I do not know | 0 | 0% |
| I tend to agree | 23 | 26.1% |
| I completely agree | 9 | 10.2% |

This part of the questionnaire follows the critical comments of many authors (Hope and Fraser, 2003; Lohan, 2013), who pointed out the formal status of budgeting and its inability to assist company executives having to contend with a dynamic business environment.

Analysing such validity in the sample of Czech firms reveals that most respondents did not agree with the sceptical statement, with no more than 36% opting to answer "I agree" or "I completely agree". While the tendency was to take an opposing stance, it was not overwhelmingly positive. The respondents predominantly chose the option "I tend to agree", indicating a slightly optimistic or neutral perception of the efficiency of a budget.

### 3.1. Testing the hypotheses

Pearson´s chi-square test of independence was applied for this purpose. For each of the three hypotheses presented in the "Methodology" section, a null hypothesis was defined, which expressed a variant of the independence of the investigated phenomena. If the alternative hypothesis was rejected, the null hypothesis was supported.

The first hypothesis covered the relationship between perception of the external environment and a decision to carry out budget revisions. The figures for respondents who answered "very stable", "stable" and "rather stable" were merged into a combined group of "stable", whereas those for "unstable" and "very unstable" were incorporated as "non-stable". This hypothesis was tested on the sample of 88 companies that met the condition of employing traditional budgets. The results of such testing are given below (Table no. 7).

**Table no. 7. Testing H1a**

| **Perception of the stability of the external environment** | **Budget review** | | **Total number (row)** |
|---|---|---|---|
| **P-value** = 0.361 | Yes | No | |
| **Observed frequency** | | | |
| Non-stable | 8 | 2 | 10 |
| Stable | 70 | 8 | 78 |
| Total | 78 | 10 | 88 |
| | | | **Expected frequency** |
| Non-stable | 8.9 | 1.1 | 10.0 |
| Stable | 69.1 | 8.9 | 78.0 |
| Total | 78.0 | 10.0 | 88.0 |
| **Observed freq. minus expected freq. (remainder)** | | | |
| Non-stable | -0.3 | 0.8 | |
| Stable | 0.1 | -0.3 | |

The data in table no. 7 reveal it was not possible to validate that a significant relationship existed between perception of the external environment and a decision by a firm to carry out budget revisions. Therefore, at the level of significance $\alpha = 0.05$, the zero hypothesis on the independence of these variables was confirmed.

The second hypothesis examined the validity of another possible factor influencing the application of budget review nationally. Due to the nature of the Czech economy, it was necessary to evaluate the impact a significant share of foreign capital had on undertaking alteration to a budget. The P-value (0.013) in this case indicated a significant dependence between both variables. It can be stated that at the level of significance $\alpha = 0.05$, the zero hypothesis of independence was rejected. According to the results in table no. 8, budget reviews are typically conducted in organizations with a significant share of foreign capital.

**Table no. 8. Testing H1b**

| Significant share of foreign capital | Budget review | | Total number |
|---|---|---|---|
| **P-value** = 0.013 | Yes | No | **(row)** |
| **Observed frequency** | | | |
| Significant share of capital | 27 | 9 | 36 |
| Insignificant share of capital | 51 | 49 | 100 |
| Total | 78 | 58 | 136 |
| **Expected frequency** | | | |
| Significant share of capital | 20.6 | 15.4 | 36.0 |
| Insignificant share of capital | 57.4 | 42.6 | 100.0 |
| Total | 78 | 58 | 136 |
| **Observed freq. minus expected freq. (remainder)** | | | |
| Significant share of capital | 1.4 | -1.6 | |
| Insignificant share of capital | -0.8 | 1.0 | |

An opposing trend was recognized in tests on the relationship between conducting budget revisions and subjective perception of the efficiency of a budget. Despite numerous authors recommending companies to conduct frequent budget reviews to mitigate the weaknesses of traditional budgeting, the views of the respondents did not support this notion. The P-value in table no. 9 (0.502) did not indicate statistically significant differences between enterprises that carried out budget revisions and those who answered negatively, in connection with the perceived efficiency of a budget. Consequently, at the level of significance $\alpha = 0.05$, the zero hypothesis of independence was confirmed.

**Table no. 9. Testing H2**

| Subjective perception of efficiency of budgeting | Budget review | | Total number |
|---|---|---|---|
| **P-value** = 0.502 | Yes | No | **(row)** |
| **Observed frequency** | | | |
| The company considers budgeting to be effective. | 32 | 3 | 35 |
| The company considers budgeting to be ineffective. | 46 | 7 | 53 |
| Total | 78 | 10 | 88 |
| **Expected frequency** | | | |
| The company considers budgeting to be effective. | 31.0 | 4.0 | 35.0 |
| The company considers budgeting to be ineffective. | 47.0 | 6.0 | 53.0 |
| Total | 78.0 | 10.0 | 88.0 |
| **Observed freq. minus expected freq. (remainder)** | | | |
| The company considers budgeting to be effective. | 0.2 | -0.5 | |
| The company considers budgeting to be ineffective. | -0.1 | 0.4 | |

### 3.2. Discussions

The outputs from tests of the hypotheses favour the sceptics and critics of budgets. The results showed that decisions made on the parameters of budgets at Czech companies is not primarily influenced by objective factors in the external environment, instead they pertained to ownership structure.

Conducting a budgetary review is commonplace for the vast majority of the surveyed companies operating in the Czech Republic. The authors had expected that in response to the consequences of the global economic crisis in the period 2008-2010, statistically significant differences would be evident between organizations that perceived the external

economic environment as stable and those who declared it unstable, although this supposition was not confirmed. However, these results should be viewed in the context of the time at which the research was conducted. Before the beginning of the coronavirus pandemic, the Czech economy was characterized by long-term growth in GDP, reflected in expansion of the corporate sector and a tendency towards optimism by the respondents.

Acceptance of the H1b hypothesis confirmed the privileged role that budgeting plays for business owners. Not in the sense of a technique that supports effective management, but rather as one which affords executives insight as to financial results and the allocation of resources. These characteristics are especially appreciated in the Czech corporate environment, where foreign entities own a significant percentage of the most profitable companies. As previous research by the authors has shown, a significant share of foreign capital affects the autonomy of a company within the budgeting process, hence a similar outcome could be expected in decisions on budget review. The findings for H1b fully met with the expectations of the authors.

Based on statements by Drury (2015) and Libby and Lindsay (2010), it was assumed that repeatedly undertaking budget revisions would contribute to a more positive perception of the efficiency of a budget. This assumption, as transposed in hypothesis H2, was not confirmed by statistical testing. The respondents instead declared that decisions on carrying out budget reviews were influenced by pragmatic factors, such as a requirement by business owners rather than actual managerial experience.

Nevertheless, these results could not be interpreted as confirmation of the ineffectiveness of budget review. The literature affirms that budget revision constitutes a tool capable of mitigating the inherent weaknesses of a budget. As a consequence, it can be assumed that budgeting is made more efficient by employing more than one recommended tool at a time. The example of the company Codman & Shurtleff (Simons, 1987) demonstrates that an effective budgeting system is founded on several principles, such as operational plans linked to a long-term (strategic) plan, managerial mechanisms that function interactively (not diagnostically) and a strongly decentralized management structure.

## Conclusions

This study can be considered as contributing to ongoing discussions on the role of traditional budgeting systems in the economic conditions of the 21st century. The aim was to investigate real-world attempts to enhance traditional budgeting in Czech companies and to identify factors influencing choices made during these attempts.

Based on findings from review of the literature, the authors focused on budget revisions – the tool most frequently recommended for mitigating the weaknesses of conventional budgeting. The practice of conducting budgeting reviews was examined in a sample of 136 companies (about 1,490 entities were initially addressed) operating in the Czech Republic. Although the total return rate of the web-based questionnaire only equalled about 9%, which might be considered relatively low, the anonymous nature of the survey did not allow for further contact with individuals who failed to respond the first time. In any case, the rate of return is not significantly different from those for similar studies by renowned authors (e.g. 13.6% for Libby and Lindsay's (2010) work).

Three hypotheses were devised to test certain aspects of the topic as discussed in the literature. The "Results" section reveals that budget review is a commonplace for the majority of respondents, with over half of them regularly adjusting budgeting objectives to reflect the progress of associated indicators. Applying Pearson's chi-square test ruled out the hypothesis that decisions on budget review were influenced by the subjective perception of the external economic environment by the respondents. The only factor confirmed as exerting a statistically significant impact on decisions on budget review was the share of foreign capital present, since foreign owners usually required their companies to regularly carry them out. However, no relationship was discerned between the undertaking of budget revisions and perception of efficiency of a budget.

The results are presented with the aim of broadening the debate on budgetary procedures and their validity in the conditions of highly opened-up, transformed economies – mainly in Central and Eastern Europe. The budgeting practices of respondents support a notion of the derived nature of procedures conducted by companies in the Czech Republic. Such derivation has its origins in the dominant position of foreign capital in a significant percentage of companies in the country. As similar research was conducted in Spain in 2014 (focused on budgetary reviews and changes in budgeting procedures due to the development of the external economic environment), the authors intend to compare the results of both studies to identify differences in the behaviour of firms entrenched in the Western liberal economic tradition and those of the Central European country, following its economic transformation in the 1990s.

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# Contents

## Amfiteatru Economic recommends

# 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). Millenials 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, Babeș-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.

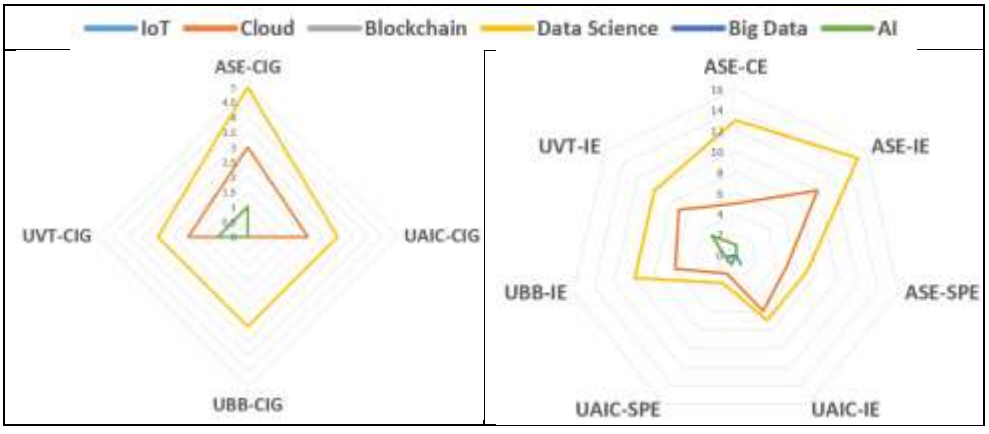


**Figure 1. DTAs in the curricula**

*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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# MATHEMATICAL MODEL FOR DETERMINING COSTS OF UNSATISFIED CUSTOMERS OF HoReCa INDUSTRY

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**Abstract**
Customer relationship management (CRM) plays an important role in ensuring the success of companies. Attracting and retaining valuable, satisfied, and loyal customers are important goals of CRM. The aim of the paper is to highlight the crucial role of the relationship between companies and their satisfied customers in achieving long-term performance. Using mathematical, relational, and accounting models, companies could answer the question posed by the research: "How do we reduce the costs of unsatisfied customers and how do we improve the relationship with customers?". The research results show that by implementing these models, only 2 out of 10 restaurants have positive Net Promoter Score (NPS) and Customer Satisfaction Index (CSI), the costs related to unsatisfied customers being high for all other restaurants. The research results show the number of dissatisfied customers and a plan to turn them into satisfied customers and achieve superior performance. By knowing these issues in advance, companies can improve these relationships, increasing customer satisfaction and loyalty and thus improving their economic performance.

**Keywords**: Customer Relationship Management (CRM), Net Promoter Score (NPS), Customer Satisfaction Index (CSI), satisfied and loyal customers, costs related to dissatisfied customers, HoReCa (hotel, restaurant, and cafe industry)

**JEL Classification:** C40, C55, M31

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**Introduction**

The COVID-19 crisis affected all economic activities and processes, including the relationship of organizations with customers, who changed their buying habits, frequency of purchases, visiting times of stores, but also products and favorite brands. It is found that during this period there is an increasingly intense trend of using online retail, parcel deliveries of purchases experiencing a strong increase. Aware of the danger of a considerable decrease in the number of customers, due to the restrictions imposed by the pandemic, organizations sought to maintain their relationship with existing customers, but also to identify new target segments, respectively to adapt to their needs and preferences (Vătămănescu et al., 2021). In this regard, organizations have resorted to strict monitoring of existing problems or risks, of costs, conducting complex analysis of communication between the company and customers, but also monitoring through communication technologies the number of orders and electronic payments over time, acting on consumers through e-commerce tools, e-mail, websites, etc. Of course, companies have sought in this time to increase their own organizational performance, using simulations and modeling, implementing telework or offering the possibility of flexible working time and time of day when employees assume the tasks and responsibilities received (Nemțeanu et al., 2021).

Mathematical modeling and simulation are important in various fields, including CRM. Predicting the evolution of the number of customers using Big Data is one of the emerging areas that have received much attention (Javaid et al., 2020). The two-way relationship between the company and its customers is important, because the parties involved offer and receive benefits simultaneously: customers gain utility, value, trust, reliability, personalization, quality, involvement, meeting social, psychological and/or economic needs, while companies earn value, profit, competitive advantage, information and databases, performance, success, image (Shaw, 2001; Payne and Frow, 2005; Knox et al., 2007; Jha, 2008; Vogt, 2009; Heyn, 2012; Varajao et al., 2013; Perna and Baraldi, 2014; Buttle and Maklan, 2015; Shabdar, 2017).

In order to achieve success in the long run, any company aims not only to increase the number of customers, but especially to increase their satisfaction, because unsatisfied customers act as a barometer in determining the performance of a business, but also an opportunity to turn them into satisfied customers. Knowing in advance the negative opinions and/or reasons why customers are dissatisfied can reduce the gap between them and those who are satisfied. In this sense, it will be used to determine specific indicators, such as NPS (Net Promoter Score), CSI (Customer Satisfaction Index), the 3/10 of CRM principle, application of modeling using mathematical integrals, etc. In order to determine the costs of dissatisfied customers, indicators such as NPS and CSI were determined. The novelty and originality of the research consists in determining the number of dissatisfied customers and transforming them into satisfied customers using the 3/10 principle in the field of CRM and mathematical calculations. The novelty of this study lies in the mathematical calculations that allow finding out in advance the possible future problems related to the costs of poor customer relations and the costs associated with dissatisfied customers. The usefulness of the research results from the importance for any company that wants to reduce its costs, especially when the relationship with customers represents the future of performance for both parties.

In order to implement the research goal, a selection of ten restaurants was used, and the criteria used in choosing the analyzed restaurants were (Cant et al., 2006; Kotler, 2010;

Florea, 2014): i) geographical criteria (analyzed area – the most representative city of Dambovita county, were analyzed responses of customers who frequented restaurants in different areas of the city, of both sexes, in both areas (rural/urban); ii) behavioral criteria (restaurants with the highest flow of customers were chosen , with different loyalties and different degrees of satisfaction); iii) psychographic criteria (with different personal values and opinions, different personalities). In total, 150 respondents were approached, and it was found that only 2 of the 10 analyzed restaurants have a positive Net Promoter Score (NPS) and a Customer Satisfaction Index (CSI), the costs related to dissatisfied customers being high for all other restaurants. By determining the number of dissatisfied customers, we managed to determine a plan necessary to turn them into satisfied customers and achieve superior performance.

The paper is structured as follows: The first section contains an analysis of the literature on management of relationship between the company and its customers, analyzing behavioral vectors such as satisfaction/dissatisfaction or loyalty, while the second section begins by presenting the purpose and objectives of research, but also of NPS and CSI indicators. In the third part, the data and results obtained from the application of NPS, CSI, the specific CRM principle 3/10, the mathematical integral and the determination of the cost of dissatisfied customers are presented. In the proposals and discussions some improvement measures are developed for the analyzed companies that obtained low values for the calculated indicators, measures resulting from the discussions with the surveyed clients. In the discussions, a parallel is made with the existing studies in the field and the originality and novelty of the study are highlighted. Finally, the conclusions of the study are presented, which consist in determining the theoretical implications, the managerial implications and the limits of the study and the future research directions are determined.

## 1. Management of the relationship between the company and customers

Customer relationship management (CRM) has become a critical research topic for researchers and practitioners (Liu et al., 2020). CRM is a multi-faceted process activated by new technologies, which addresses the consumer with multiple needs (Saint Clair and Forehand, 2020), respectively who buys a wide range of items due to marketing tactics used by companies (Sokolova and Li, 2021). Customer relationship management processes and systems are increasingly used, being crucial in managing contemporary business challenges (Capuano et al., 2021). In fact, CRM must be properly understood and used appropriately at the level of corporate governance. CRM is based on innovative data management technologies on them, which aim to improve customer satisfaction, loyalty and profitability through effective relationships developed over time by an organization with them (Bashar et al., 2020).

Social media has brought important changes in CRM, literature (Marolt et al., 2020) considering e-CRM as the strategy through which the company's objectives align with the interests, preferences and expectations of internal customers, employees, but also those of external customers, i.e. consumers. Thus, e-CRM is based on different stages of development, namely: consumer-brand matching (Gilal et al., 2021) based on facilities and passion; consumer-organization matching (Hu et al., 2021) which refers to the efficiency of the policies, actions and employees of the considered company; consumer – environment match through which environmental challenges and public health problems are managed (as the

COVID-19 pandemic could be considered) (Carnevale and Hatak, 2020), respectively digital consumer – digital marketing match by resorting to various new communication technologies for the procurement process (Reich and Pittman, 2020). No company can afford to make mistakes or waste resources; only by implementing an e-CRM program they can have better control over customer relations.

The use of Big Data systems in relation to customers will lead to increased sales (Hallikainen et al., 2020) and to the establishment of pricing strategies based on personalization/ customization (Li et al., 2020). The smart IoT environment is accelerating changes in CRM (Yan et al., 2020), which is one of the fastest growing business solutions in recent years (Guerola-Navarro et al., 2020). Digitization reveals a great impact on industries and facilitates the development of new products, changing the rules of competition (Gellweiler and Krishnamurthi, 2020), but also traditions, respectively purchasing behaviors, which are mainly aimed at using artificial intelligence and/or robots in many fields of activity (Pelău et al., 2021). Modern commerce frequently uses customer attention when shopping online – through photos, images, audio-video files – using the principle of "seeing is like touching" (Jai et al., 2021). Consumer decisions occur in an interactive context of social relations facilitated by technology (Hamilton et al., 2020). The benefits of CRM are crucial for entrepreneurial success (Gil-Gomez et al., 2020), being supported by technologies and obtaining information about buyers (Itani et al., 2020).

Companies have as their main objective in addition to making a profit, maintaining and developing relationships with customers (Gibbs and Humphries, 2009). When customers enter into a relationship, they must obtain a representative added value for them, contentment, but also satisfaction. In this context, the definition of satisfaction is: if you get what you wanted, if your requirements are met, you are satisfied (Hill and Alexander, 2006). There is important evidence that customer satisfaction is a predictive indicator of companies' future financial performance (Bhattacharya et al., 2020). Satisfied customers are economically active, being prone to take risks more easily in terms of purchasing a new product from a company they know and with which they have a relationship based on trust. At the same time, these customers generate high returns for the companies with which they have developed relationships, always returning to it and buying back their products. On the other hand, dissatisfied customers bring risks to a company, which must reduce or even eliminate any risk or uncertainty that may arise from approaching them (Fornell et al., 2020). A very satisfied customer becomes very loyal to the company over time, reaching a loyalty that tends to the maximum, while a just satisfied one reaches an average loyalty, an unsatisfied one to a low loyalty, and the dissatisfied to the lack of loyalty (Hill and Alexander, 2006).

Customers prefer the purchases of a company's brands or products due to the motivations of i) hedonistic consumption consisting of feelings, beliefs, gender differences (Govind et al., 2020), age and human proximity (Wu et al., 2021), privacy issues (Okazaki et al., 2020), the secret of joy (Rodas and John, 2020), the experience of using luxury products (Wang et al., 2021); ii) rational consumption: based on low or free price in the mind of the consumer (Ku and Suk, 2020), cost, convenience or reliable online reviews (Lantzy et al., 2021); iii) consumption based on loyalty – personal: experience, preference, behavior and communication of the sales force (Packard and Berger, 2021), resilience and perseverance (Good et al., 2021), accessible spaces and attachment (Borghini et al., 2021) or the characteristic flavor of food (Hildebrand et al., 2020); iv) social consumption: brand standardization (Nath et al., 2020), global brands incorporating local cultural elements (Nie

and Wang, 2019), the influence of family, friends or experts, personalized advertising (Hess et al., 2020) and the language used to convey brand messages (Pezzuti et al., 2021).

In the 21st century, companies must offer a reasonable level of customer satisfaction and loyalty and challenge their desire to return constantly and continuously to the company's products/services, making them happy, helping them to make friends in difficult times for the company or causing them to recommend the company's products to others, to continue to buy the company's brands and/or products, even if it has increased the prices of the products or has not developed new variants of the existing ones (Hennig-Thurau and Hansen, 2013). Any company needs to be customer-centric in order to challenge the customer to buy, gain their trust, and increase their satisfaction (Hill and Alexander, 2006).

The goal of any manager is to reduce the number of unhappy, dissatisfied customers. Customer dissatisfaction has a greater short-term effect compared to customer satisfaction (Malshe et al., 2020). The dissatisfied customer determines costs for the company as follows: if he is dissatisfied with previous experience, he will make his next purchase or transaction elsewhere or file a complaint, which could cost the company an average of $ 26.85 (Zairi, 1998). A single dissatisfied customer can damage the company's well-cultivated market image (Knox et al., 2007). A negative shopping experience could cause a rumor (Olson and Ahluwalia, 2021). Due to human psychology, a dissatisfied client is more likely to talk about this topic more often than a satisfied client. The loss of a customer is the loss of an opportunity for the company (Knox et al., 2007). Dissatisfied customers file complaints, but their number must be increased, because their ideas can be considered a "gift" for the company, being a way to improve the business (Reich and Pittman, 2020).

## 2. Research methodology

The purpose of this study is to determine the number of dissatisfied customers and transform them into satisfied customers, using the 3/10 principle in the field of CRM: a satisfied customer brings at least 3 more customers; a dissatisfied customer will talk about his negative experience to 10 other potential customers (Raab et al., 2008); a single dissatisfied customer could cancel the effect of 3 satisfied customers. Starting from this idea, the customers' existing on the NPS scheme were transferred to the loyalty scheme, subsequently determining the number of satisfied customers using the mathematical integral calculations. The gap between dissatisfied and satisfied customers at each restaurant and the cost of a dissatisfied customer was determined based on the 3/10 principle. Thus, in the end, the costs of dissatisfied customers on each restaurant were determined. In order to achieve performance according to the 1/1 principle, several measures have been developed for restaurants that have the highest dissatisfied customer costs, based on the answers to the question: "What were the reasons for awarding points between 0-6 on the NPS scale?".

NPS has become a practical tool for determining the performance used in the COVID-19 pandemic period and will surely be used after this crisis (Aguinis and Burgi-Tian, 2021). NPS is a recent model, developed in 2006 that provides quantitative evaluations, determining customer satisfaction and the degree of loyalty required to increase overall performance (Florea et al., 2018). The calculation formula of NPS is (Sauro and Lewis, 2016; Reichheld and Markey, 2011):

$$NPS = \frac{(P-D)}{Ntic} x100 = P\ \% - D\ \% \quad (1)$$

where: P- promoters, Pa- passives, D- detractors, and Ntic (the total number of investigated persons) = (P)+ (Pa)+ (D).

This score can vary from - 100 to + 100 (Freed, 2013). An NPS value above 50% is considered a good score, and one above 70-80% is considered a very good one (Tatzesberger and Sawhney, 2017), but most companies get an average score around 15% (Bremer and McKibben , 2016). Many indicators fail to determine performance (Lean manufacturing, Six Sigma, or Benchamarking), but NPS (also considered the indicator of determining customer happiness) succeeds (Davis et al., 2020), being considered along with CLV (Customer Lifetime Value) an indicator very important used in CRM (Baxter, 2020). NPS is an important self-assessment tool (Blokdyk, 2019), which helps organizations outperform their competitors (Reichheld and Markey, 2011). NPS measures the loyalty of customers who think positively about products or services or employees or a brand and share their opinion with other potential customers (Sauro, 2015; Chernev, 2017). NPS measures satisfaction (Farris et al., 2017) and is an indicator of growth potential (Padveen, 2017).

The three specific categories of the model are (Neidhardt and Wörndl, 2019; Campbell-Pretty and Wilson, 2020;): i) promoters (score 9-10) – means "absolutely!" and represents the green area of the model (Christensen, 2017), are enthusiastic, happy with their relationship, loyal, repeat shopping, talk about the company and its products with friends, offer positive feedback, suggestions (Reichheld and Markey, 2011); ii) passives (score 7-8) – means "probably yes!" and represents the yellow area of the model, customers are satisfied, but not enthusiastic or loyal, from this point of view are not included in the formula. They are unlikely to recommend the company's products and are easily attracted to competitors (Tarnowska et al., 2019); iii) detractors (score 0-6) - 0 and 1 means "certainly not!", 2, 3, and 4 mean "better not!", and 5 and 6 mean "I don't know!", being the red area of the model, customers are neither satisfied nor loyal. Not all detractors are anti-promoters, but their recommendations are weak, discouraging friends from buying (Sauro, 2015), they are not happy with the relationship and lower employee morale (Reichheld and Markey, 2011). They make complaints, spread negative news and reduce performance (D'Alessandro et al., 2020), often criticizing high prices and employee attitudes.

The CSI is a tool for measuring total customer satisfaction. The CSI calculation formula is (Sugandhi, 2003):

$$CSI=\frac{\text{total grades obtained by the company based on customer feedback}}{\text{total grades expected by the company to obtain from customers}} \quad (2)$$

CSI can take values between 0-100 or 0-10 (Hill and Alexander, 2006) and a maximum satisfaction index of 100% can be obtained. CSI helps companies determine their competency to meet customer needs and helps sales staff monitor the effort to become customer-oriented (Sugandhi, 2003). It is used for internal purposes such as: monitoring the improvement of services, motivating employees and in determining the total level of customer satisfaction (Hill and Alexander, 2006).

Sample size: The research was conducted on 150 customers (119 women and 31 men), with different education (120 higher education, 30 secondary education), from different areas (108 from urban and 42 from rural area), on to the relationship with 10 restaurants from Targoviste, Dambovita County, Romania. The questionnaire was applied face to face (15 questionnaires) and online (135 questionnaires). The data were collected using the question: "How likely are you to recommend (the product, service or brand analyzed) to a

friend or colleague using the 0-10 scale?", "What are the reasons why you awarded between 0-6 points?". The answers were added as input data from the survey, and they were processed and modeled using new methods and calculations, to achieve the objective of the study. The tools used for data processing are: NPS method, CSI, 3/10 CRM principle, cost-based method, mathematical integral, and Excel application. Analysis tools: the research started from the following existing principles in the field of CRM: a satisfied customer brings at least 3 more customers; a dissatisfied customer will talk about his negative experience to 10 other potential customers (Raab et al., 2008); a single dissatisfied customer could cancel the effect of 3 satisfied customers.

## 3. Presentation of data and results

The research was performed on 10 restaurants in Targoviste, on 150 customers who frequented the analyzed restaurants (which are marked as R1-R10 for ethical and strategic reasons). R1, R5 and R7 are on the outskirts of the city (but at different points), R2, R6 and R9 are in the new city center, R3, R4 are in the old city center, R8, R10 are outside the city/center, but in a picturesque and historic area. Thus, in the first part of the model were determined using the scale 0-6 the number of dissatisfied customers and between 7-10 the number of satisfied customers. Based on the formula described above, NPS and CSI were determined (Table no. 1).

**Table no. 1. Points obtained by the analyzed restaurants, NPS and CSI**

| Rest. | UC | | | | | | | Σ1 ($UC_i$) | SC | | | | Σ2 ($SC_i$) | TC (Σ1+ Σ2) | NPS | CSI |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | | NEL | | EL | | | | | |
| | 0 | 1 | 2 | 3 | 4 | 5 | 6 | | 7 | 8 | 9 | 10 | | | | |
| R01 | 0 | 9 | 9 | 9 | 22 | 18 | 13 | 80 | 26 | 18 | 4 | 22 | 70 | 150 | -36 | 59.4 |
| R02 | 9 | 13 | 22 | 31 | 26 | 13 | 18 | 132 | 4 | 9 | 5 | 0 | 18 | 150 | -84.6 | 38.1 |
| R03 | 0 | 0 | 4 | 5 | 0 | 18 | 13 | 40 | 18 | 44 | 26 | 22 | 110 | 150 | 5.3 | 74.8 |
| R04 | 0 | 0 | 0 | 0 | 4 | 9 | 9 | 22 | 13 | 31 | 35 | 49 | 128 | 150 | 41.3 | 83.9 |
| R05 | 4 | 0 | 9 | 4 | 5 | 5 | 18 | 45 | 26 | 18 | 26 | 35 | 105 | 150 | 10.6 | 72.8 |
| R06 | 9 | 13 | 31 | 9 | 22 | 4 | 26 | 114 | 18 | 5 | 9 | 4 | 36 | 150 | -67.3 | 43.5 |
| R07 | 0 | 0 | 0 | 4 | 9 | 22 | 9 | 44 | 31 | 39 | 18 | 18 | 106 | 150 | -5.3 | 72.2 |
| R08 | 4 | 4 | 0 | 0 | 0 | 4 | 4 | 16 | 22 | 9 | 62 | 41 | 134 | 150 | 58 | 82.8 |
| R09 | 4 | 5 | 22 | 9 | 13 | 22 | 13 | 88 | 5 | 18 | 26 | 13 | 62 | 150 | -32.6 | 65.9 |
| R10 | 13 | 18 | 4 | 31 | 5 | 26 | 9 | 106 | 13 | 9 | 13 | 9 | 44 | 150 | -56 | 46.2 |

*Notes:* UC – unsatisfied customers, SC – satisfied customers, NEL – non-enthusiastic and loyal, EL-enthusiastic, and loyal, TC – total customers

It can be observed that R2 and R6 have the lowest values for NPS, -84.6 and -67.3, respectively, and the highest values are for R8 (58) and R4 (41.3). According to the literature, a score over 30% is good, and an excellent score is over 50%. Thus, R4 obtained an NPS of 41.3, being a good score and R8 obtained the only score above the limit of 50%, the one of 58%, being an excellent score. With the exception of 2 restaurants, all the analyzed

restaurants have low scores, which means that they have to improve their relationship with customers; 6 restaurants have negative scores (5 of them being low and very low, between -32.6 and -84.6%). Analyzing the CSI (general customer satisfaction) it can be seen that the lowest values are obtained by the same restaurants: R2 (38.1) and R6 (43.5), and the highest values are obtained for R4 (83.9) and R8 (82.8).

The connection between loyalty and satisfaction (SL) for the 10 analyzed restaurants, is made by: i) the NPS model with its scale between 0 and 10 (whose points were put on the SL model); ii) the SL model (Hill et al., 2007), based on customer satisfaction and loyalty, was calculated on a scale from 1 to 10 for satisfaction and from 0 to 100% for loyalty, as shown in table no. 2.

**Table no. 2. Loyalty, customer satisfaction/dissatisfaction and NPS**

| C/S/L | Satisfaction/dissatisfaction (according to NPS and SL model) | Loyalty (according to the SL model) |
|---|---|---|
| Dissatisfied customers | (0-1) – "certainly not" | **S**aboteur (0-20%) |
| | (2-4) – "rather not" | **D**esertion Zone (20-40%) |
| | (5-6) – "I don't know" | **I**ndifference Zone (40-60%) |
| Satisfied customers | (7-8) – "probably yes" | **A**ffection Zone (60-80%) |
| | (9-10) – "absolutely yes" | **A**postle (80-100%) |

The number of customers who responded on the NPS-specific 0-10 scale was established on the five loyalty categories (Table no. 3).

**Table no. 3. Calculations for the five loyalty categories according to NPS**

| Rest | S | D | I | A | Ap | Uc | Sc | Tc | Uc (%) | Sc (%) |
|---|---|---|---|---|---|---|---|---|---|---|
| R01 | 9 | 40 | 31 | 44 | 26 | 80 | 70 | 150 | 53% | 47% |
| R02 | 22 | 79 | 31 | 13 | 5 | 132 | 18 | 150 | 88% | 12% |
| R03 | 0 | 9 | 31 | 62 | 48 | 40 | 110 | 150 | 27% | 73% |
| R04 | 0 | 4 | 18 | 44 | 84 | 22 | 128 | 150 | 15% | 85% |
| R05 | 4 | 18 | 23 | 44 | 61 | 45 | 105 | 150 | 30% | 70% |
| R06 | 22 | 62 | 30 | 23 | 13 | 114 | 36 | 150 | 76% | 24% |
| R07 | 0 | 13 | 31 | 70 | 36 | 44 | 106 | 150 | 29% | 71% |
| R08 | 8 | 0 | 8 | 31 | 103 | 16 | 134 | 150 | 11% | 89% |
| R09 | 9 | 44 | 35 | 23 | 39 | 88 | 62 | 150 | 59% | 41% |
| R10 | 31 | 40 | 35 | 22 | 22 | 106 | 44 | 150 | 71% | 29% |
| T average | 11 | 31 | 27 | 38 | 43 | 69 | 81 | 150 | 46% | 54% |

*Notes*: S – saboteur, D – desertor, I – Indifferent, A – Affection, Ap – Apostle; Uc – Unsatisfied customers, Sc – Satisfied customers, Tc – total customers.

By transforming each value obtained into percentages and representing these values for each restaurant analyzed, the following graphical representation is obtained (Figure no. 1).

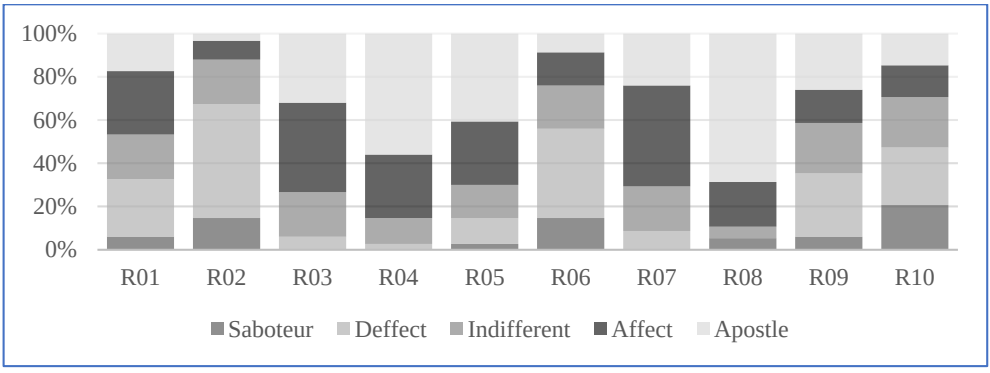


**Figure no. 1. Representation of the loyalty chart for the 10 restaurants analyzed**

From this representation it is observed that: i) from the "saboteur" group the highest values are for R10 (31 clients accounting for 21%), R2 (22 clients - 15%) and R6 (22-15%); ii) from the group of "deserters", the highest values are recorded in the case of R2 (79 customers-52%) and R6 (62 customers-41%); iii) from the "indifferent" group we find the highest values for R9 and R10 by 24%; iv) from the "affection" group the highest values are for R7 (70- with 46%) and R3 (62- with 41%); v) from the "apostles" group the highest values are in the case of R8 (103- with 69%) and R4 (84- with 56%). As can be seen, the 10 restaurants analyzed have an average of 46% dissatisfied customers and 54% satisfied customers.

The use of the mathematical integral allows the determination of the value of satisfied/dissatisfied customers. Based on the 3/10 principle, explained above, the value of satisfied customers (who spread word to three other customers) and dissatisfied customers (who tell 10 other customers) was determined, and to limit their scope, the value of satisfied customers was determined between 3 and 9 (up to 10, the value for dissatisfied customers), and dissatisfied customers between 10 and 16, to keep the same value gap, ie a step of 6.

Determining satisfied customers using the mathematical integral:

$$R1 = \int_3^9 70dx = 70 \cdot x|_3^9 = 420 \quad (3)$$

$$R2 = \int_3^9 18dx = 18 \cdot x|_3^9 = 108 \quad (4)$$

$$R3 = \int_3^9 110\,dx = 110x|_3^9 = 660 \quad (5)$$

$$R4 = \int_3^9 128\,dx = 128 \cdot x|_3^9 = 768 \quad (6)$$

$$R5 = \int_3^9 105dx = 105 \cdot x|_3^9 = 630 \quad (7)$$

$$R6 = \int_3^9 36dx = 36 \cdot x_3^9 = 216 \quad (8)$$

$$R7 = \int_3^9 106dx = 106 \cdot x|_3^9 = 636 \quad (9)$$

$$R8 = \int_3^9 134dx = 134 \cdot x|_3^9 = 804 \quad (10)$$

$$R9 = \int_3^9 62dx = 62 \cdot x|_3^9 = 372 \quad (11)$$

$$R10 = \int_3^9 44dx = 44 \cdot x|_3^9 = 264 \quad (12)$$

Determining dissatisfied customers using the mathematical integral:

$$R1 = \int_{10}^{16} 80dx = 80 \cdot x|_{10}^{16} = 480 \quad (13)$$

$$R2 = \int_{10}^{16} 132dx = 132 \cdot x|_{10}^{16} = 792 \quad (14)$$

$$R3 = \int_{10}^{16} 40dx = 40 \cdot x|_{10}^{16} = 240 \quad (15)$$

$$R4 = \int_{10}^{16} 22dx = 22 \cdot x|_{10}^{16} = 132 \quad (16)$$

$$R5 = \int_{10}^{16} 45dx = 45 \cdot x|_{10}^{16} = 270 \quad (17)$$

$$R6 = \int_{10}^{16} 114dx = 114 \cdot x|_{10}^{16} = 684 \quad (18)$$

$$R7 = \int_{10}^{16} 44\,dx = 44 \cdot x|_{10}^{16} = 264 \quad (19)$$

$$R8 = \int_{10}^{16} 16\,dx = 16 \cdot x|_{10}^{16} = 96 \quad (20)$$

$$R9 = \int_{10}^{16} 88\,dx = 88 \cdot x|_{10}^{16} = 528 \quad (21)$$

$$R10 = \int_{10}^{16} 106dx = 106 \cdot x|_{10}^{16} = 636 \quad (22)$$

According to previous calculations: i) the percentage of satisfied customers (54%) is higher than that of dissatisfied customers (46%), according to loyalty and satisfaction calculations (Table no. 4); ii) the number of satisfied customers (+4878) is higher than the number of dissatisfied customers (-4122), based on the mathematical integral calculations (Table no. 4). The graphical representation of satisfied/dissatisfied customers for the 10 restaurants analyzed is represented below (Figure no. 2). The following restaurants have dissatisfied customers and need to take improvement measures: R1, R2, R6, R9 and R10.

**Table 4. Determining the value gap for satisfied/dissatisfied customers**

| Rest | Pt. Sc (+) | Pt. Uc (-) | Dif val. Sc/Uc (+/-) |
|---|---|---|---|
| R01 | 420 | 480 | - 60 |
| R02 | 108 | 792 | - 684 |
| R03 | 660 | 240 | +420 |
| R04 | 768 | 132 | +636 |
| R05 | 630 | 270 | +360 |
| R06 | 216 | 684 | - 468 |
| R07 | 636 | 264 | +372 |
| R08 | 804 | 96 | +708 |
| R09 | 372 | 528 | - 156 |
| R10 | 264 | 636 | - 372 |
| **Σ** | **4,878** | **4,122** | **+756** |

*Notes*: Sc – satisfied customers, Uc – unsatisfied customers

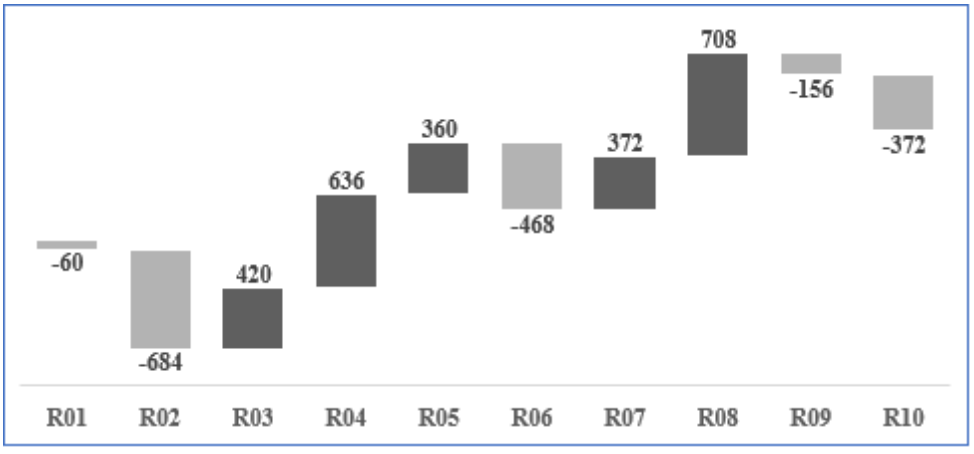


**Figure no. 2. Graphical representation of Sc/Uc using the mathematical integral**

Based on the principles that 1 dissatisfied customer provides this information to 10 other customers and 1 satisfied customer provides this information to 3 other customers, we need to consider this and make other determinations (Table no. 5) to quantify the costs associated with dissatisfied customers. According to the author (Graham, 2014): $C_{uc/y}=A_{cm}\times C_{sb}\times C_{s/p}$ (21) where: $C_{uc/y}$ = annual cost of an unhappy (dissatisfied) customer, $A_{cm}$ = analyzed consumer market,% $C_{sb}$ =% of customers who changed business due to poor experience, % $C_{s/p}$ =% of customers who had changed the business and claim that the company could have prevented this.

Extracting the data from table no. 1 about the total respondents ($A_{cm}$), about the customers who changed the business due to poor experience (in our case the customers who rated between 0-6 points) and about the customers who changed the business and say that the company could have to prevent it (in our case the customers who offered 7 and 8 points), the cost of dissatisfied customers per month ($C_{uc/}$m) and per day ($C_{uc}$/d) could also be determined (Table no. 5).

**Table no. 5. Cost of an unhappy/dissatisfied customer**

| Rest | Acm | Csb (0-6p) | Csb % | Cs/p (7-8p) | Cs/p % | Cuc/y | Cuc/m | Cuc/d | Cuc (EUR) |
|---|---|---|---|---|---|---|---|---|---|
| | 1 | 2 | 3=2/1 | 4 | 5=4/1 | 6=1*3*5 | 7=6/12 | 8=7/30 | 9=8/5 |
| R01 | 150 | 80 | 53.333 | 44 | 29.33 | 234666.7 | 19555.556 | 651.85 | 130.37 |
| R02 | 150 | 132 | 88 | 13 | 8.66 | 114400 | 9533.33 | 317.77 | 63.55 |
| R03 | 150 | 40 | 26.667 | 62 | 41.33 | 165333.3 | 13777.77 | 459.25 | 91.85 |
| R04 | 150 | 22 | 14.667 | 44 | 29.33 | 64533.3 | 5377.77 | 179.25 | 35.85 |
| R05 | 150 | 45 | 30 | 44 | 29.33 | 132000 | 11000 | 366.66 | 73.33 |
| R06 | 150 | 114 | 76 | 23 | 15.33 | 174800 | 14566.66 | 485.55 | 97.11 |
| R07 | 150 | 44 | 29.333 | 70 | 46.66 | 205333.3 | 17111.11 | 570.37 | 114.07 |
| R08 | 150 | 16 | 10.667 | 31 | 20.66 | 33066.67 | 2755.55 | 91.85 | 18.37 |

| Rest | Acm | Csb (0-6p) | Csb % | Cs/p (7-8p) | Cs/p % | Cuc/y | Cuc/m | Cuc/d | Cuc (EUR) |
|---|---|---|---|---|---|---|---|---|---|
| R09 | 150 | 88 | 58.667 | 23 | 15.33 | 134933.3 | 1124.44 | 374.81 | 74.96 |
| R10 | 150 | 106 | 70,667 | 22 | 14,6667 | 155466,7 | 12955.55 | 431.85 | 86.37 |
| $\bar{X}$ | | | | | | | | 392.92 | 78.58 |

*Notes*: $C_{sb}$% =% of customers who changed business due to poor experience, $C_{s/p}$% =% of customers who changed business and claim that the company could have prevented this, $C_{uc}$/y or m = annual cost/monthly of an unhappy (dissatisfied) customer.

As it can be seen, the average daily cost of a dissatisfied customer is EUR 78.58. The highest costs for a dissatisfied customer are for R1 (130.3 EUR) and R7 (114.07 EUR). The lowest are for R4 (35.85 EUR) and R8 (18.37 EUR), showing that these analyzed restaurants are the best performing and have a positive and strong relationship with their customers. Based on these calculations, the rate of lost and attracted customers can be determined (Table no. 6).

According to principle 3/10, satisfied customers pass on their experience to another 3 customers (Sc * 3), and dissatisfied customers to another 10 (Uc * 10); the difference between them refers to newly attracted customers (Nac) or lost customers (Lc). This difference between lost and attracted customers (Dl-a), the cost of a dissatisfied customer (Cuc) and the rate of lost/attracted customers (Rl-a) are determined in table no. 6.

**Table no. 6. Customer satisfaction and dissatisfaction calculation (principle 3/10)**

| Rest | Sc | Uc | Sc*3 | Uc*10 | Nac | Lc | Dl-a | Cuc | Rl-a |
|---|---|---|---|---|---|---|---|---|---|
| | 1 | 2 | 3 | 4 | 5=3-1 | 6=4-2 | 7=6-5 | 8=7*78.58 Eur | 9=6/5 |
| R01 | 70 | 80 | 210 | 800 | 140 | 720 | 580 | 45,576.4 | 5.14 |
| R02 | 18 | 132 | 54 | 1320 | 36 | 1188 | 1152 | 90,524.16 | 33 |
| R03 | 110 | 40 | 330 | 400 | 220 | 360 | 140 | 11,001.2 | 1.63 |
| R04 | 128 | 22 | 384 | 220 | 256 | 198 | -58 | -4,557.64 | 0.77 |
| R05 | 105 | 45 | 315 | 450 | 210 | 405 | 195 | 15,323.1 | 1.92 |
| R06 | 36 | 114 | 108 | 1140 | 72 | 1026 | 954 | 74,965.32 | 14.25 |
| R07 | 106 | 44 | 318 | 440 | 212 | 396 | 184 | 14,458.72 | 1.86 |
| R08 | 134 | 16 | 402 | 160 | 268 | 144 | -124 | -9,743.92 | 0.53 |
| R09 | 62 | 88 | 186 | 880 | 124 | 792 | 668 | 52,491.44 | 6.38 |
| R10 | 44 | 106 | 132 | 1060 | 88 | 954 | 866 | 68,050.28 | 10.84 |
| **Cuc** | | | | | **1,626** | **6,183** | **4557** | **358,089.06** | |
| **$\bar{X}$ (Rl-a)** | | | | | | **3.802** | | | |

*Notes*: Sc – satisfied customers, Uc – dissatisfied customers, Nac – attracted new customers, Lc – lost customers, Cuc – cost of an dissatisfied customer, Rl-a – rate of lost customers

The total cost of dissatisfied customers is 358,089.06 EUR. R4 and R8 earn a profit, while R2 and R6 have the highest costs. Thus, these restaurants need to plan to improve the relationship with dissatisfied customers and increase profits. This means that an attracted customer can lose almost 3,802 dissatisfied customers, and the company must find solutions to attract more customers, at least to have a ratio of 1/1. As can be seen, the principle "one dissatisfied customer could cancel the effect of 3 satisfied customers" is fulfilled.

## 4. Proposals and discussions

Based on an open discussion with customers with a score between 0 and 6 points, the problems they had with the restaurants were found, so some measures were developed and restaurants could turn them into satisfied customers, being able to reduce the costs of dissatisfied customers (Table no. 7).

**Table no. 7. Measures to reduce the costs of dissatisfied customers**

| Rest | Cuc/rest (Eur) | Measures resulting from unsatisfied customer responses |
|---|---|---|
| R1 | 45,576.4 | More emphasis on the internal atmosphere created for customers and the relationship created with them (choice of musical themes). |
| R2 | 90,524.16 | More time invested and value offered to customers (the restaurant must increase the degree of comfort created for customers; the renovation could have involved a designer, because the space was covered, and customers can no longer see each other). The restaurant is designed more for events than for everyday meetings. Staff need to improve their communication and networking skills. |
| R3 | 11,001.2 | Further investment is still required to obtain the comfort of customers (they complain about the low temperature in the restaurant in the winter season). |
| R4 | -4,557.64 | Increased attention to keeping customers satisfied and reducing the number of complaints (about high prices, menu diversification or reduced space). It requires more time invested in networking and listening to customer issues. |
| R5 | 15,323.1 | The restaurant must consider the value for money. |
| R6 | 74,965.32 | Caring for customers, offering them a more diverse menu. |
| R7 | 14,458.72 | Customers complain about the design, which is not related to a common theme (internal and external), parking space must be enlarged, there is parking but only for a small number of cars. |
| R8 | -9,743.92 | They need to be careful to keep customers from making a profit and to maintain a lasting and ongoing relationship based on trust. |
| R9 | 52,491.44 | Measures to diversify the menu and the atmosphere created will be taken into account. |
| R10 | 68,050.28 | The restaurant must improve its atmosphere and relationship with customers, actions that will be undertaken by restaurant staff (skills, communication, attention). |

If they are going to implement some improvement measures, the analyzed restaurants (measures determined by questioning these customers, could reduce costs and improve performance. This means that for an attracted and satisfied customer they can lose almost 3,802 dissatisfied customers and the company must find solutions. to attract more customers at least to have a ratio of 1/1. As it can be seen, the principle "one dissatisfied customer could cancel the effect of 3 satisfied customers" is met. Based on the 3/10 principle (Table no. 8) and on the equation for equality $x + y = 150$ ($3 * x = 10 * y$), it results that $x = 116$ and $y = 34$, so that the satisfied customers (Sc) are at least equal to the dissatisfied customers (Uc) and to obtain a ratio of 1/1.

**Table no. 8. Ratio 1/1 between satisfied/dissatisfied customers and principle 3/10**

| Restaurant | Sc | Ecuation (Sc=Uc) | Newly attracted customers |
|---|---|---|---|
| R01 | 70 | 116-70 | 46 |
| R02 | 18 | 116-18 | 98 |
| R03 | 110 | 116-110 | 6 |
| R04 | 128 | 116-128 | -12 |

| Restaurant | Sc | Ecuation (Sc=Uc) | Newly attracted customers |
|---|---|---|---|
| R05 | 105 | 116-105 | 11 |
| R06 | 36 | 116-36 | 80 |
| R07 | 106 | 116-106 | 20 |
| R08 | 134 | 116-134 | -18 |
| R09 | 62 | 116-62 | 54 |
| R10 | 44 | 116-44 | 72 |
| **Σ** | | | **357** |

*Notes*: Sc- satisfied customers, Uc- dissatisfied customers

Analyzed restaurants, according to the equalization equation, in which the number of satisfied customers is at least equal to the number of dissatisfied customers and the 3/10 principle is met, 357 of new customers must be converted into loyal customers to achieve this condition and obtain profit.

The restaurants that need to attract more customers are R2 (98 customers), R6 (80 customers) and R10 (72 customers) (Figure 3). Again, the same restaurants need to improve the relationship with their customers. The methods used showed that these restaurants need to improve their CRM process, using: NPS, CSI, mathematical integral, cost method, principle 3/10 and the equation Sc = Uc. As can be seen, R4 (-12) and R8 (-18) are well positioned in the relationship with customers. They also obtained higher values for NPS, so our calculations are confirmed and well selected. Knowing this problem in advance, organizations could better understand their losses, costs, number of potential customers lost, when they could start to improve customer relationship or better to hire more qualified sales force to improve relationships with the customers.

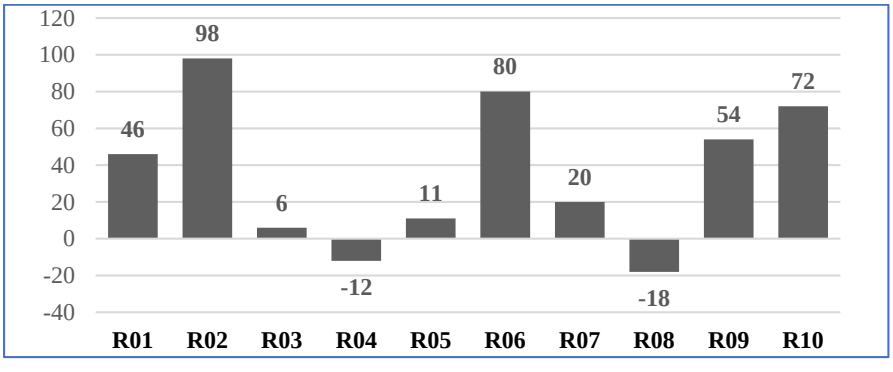


**Figure no. 3. Number of new customers to be converted to loyal for each restaurant analyzed**

This study analyzes NPS, CSI, implements principle 3/10 of CRM and determines the cost of dissatisfied customers in the field of HORECA. Several studies have been conducted using indicators for research such as NPS (Hamilton et al., 2014; Laitinen, 2018; Fisher and Kordupleski, 2019; Aguinis and Burgi-Tian, 2021) and CSI (Koehl, 2008; Sandoiu, 2008; Ilieska, 2013; Sun and Kim, 2013; Turkyilmaz, 2013), but regarding the determination of satisfaction based on the use of the 3/10 principle (which is only a theoretical part) has not been applied so far in any research. Therefore, this theoretical principle, transferred by the authors in practice, is an approach of originality and novelty in the field of CRM, and

especially of determining the degree of customer satisfaction and customer costs dissatisfied with the relationship they have with companies.

**Conclusions**

This article presents a new approach in CRM based on the use of mathematical, relational, and accounting models. These models are of great importance for researchers and professionals, due to the turbulent economic environment (such as during COVID-19), high costs, the era of the relationship we are in and the use of BIG Data, challenging business objectives and performance.

The study indicates that the application of NPS, CSI, CRM-specific 3/10 principle and the determination of dissatisfied customer costs are significant tools for optimizing organizations and their customer relationships. Thus, it has been shown that there is a direct relationship between these models and the determination of the costs of dissatisfied customers and the degree of loyalty of satisfied customers. The results show that only two restaurants (R4 and R8) obtained a NPS with a good score and an excellent score. The rest of the analyzed restaurants obtained low scores, having to improve their relationship with customers. Analyzing the CSI (overall customer satisfaction) it was observed that the lowest values are obtained by the same restaurants.

The theoretical implications brought by this study lie in bringing to the forefront the literature in the field of CRM and mainly customer satisfaction, through models to determine the degree of satisfaction and, implicitly, to achieve sustainable performance through relationships. From the analysis of the total costs of future dissatisfied customers and those specific to each restaurant, the study highlights several implications at the managerial level: i) determining unsatisfied customers and implicitly measures to transform them into satisfied customers, using simple and inexpensive models; ii) the calculations show that for an attracted and satisfied customer, the company can lose about four dissatisfied customers, and it must identify solutions to attract more customers, at least to have a ratio of 1/1, according to principle 3/10; iii) based on the 3/10 principle and the equality equation: companies can determine the required number of attracted new customers who need to be converted into loyal customers in order to achieve this condition and make a profit; iv) based on these models, companies can determine if they are well positioned in the relationship with customers, but must maintain their position to stay longer in a lasting relationship.

The research is limited by the small number of restaurants analyzed (only 10), and the analysis is performed in only one area. But future research can be done for more companies, in different fields and for much larger areas. Improving values for NPS and CSI, increasing the rate of return, reducing the number of dissatisfied customers, converting them into satisfied customers and maintaining customer acquisition costs are just a few methods that can be implemented by any organization that wants sustainable performance.

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# GOOD PRACTICES FOR OVERCOMING THE IMPACT OF THE SARS-CoV-2 CRISIS ON THE HoReCa INDUSTRY

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**Abstract**
The pandemic crisis of SARS-CoV (Severe Acute Respiratory Syndrome Coronavirus) -2 has profoundly and often dramatically changed our lives. In this paper we have proved that, despite all the vicissitudes, one of the sine qua non conditions for success is the dynamic and constructive adaptation of any entrepreneur to the new conditions of existence. Especially since, perhaps, no other area of activity has been so deeply and severely affected as that of the hotel, restaurant, and cafe (catering) industry, briefly called HoReCa. Our study first addressed several aspects of the diversity of shifts and characteristics of the HoReCa industry during the SARS-CoV-2 pandemic crisis, both in the country and abroad. We have presented below some of the most important challenges faced by the management of the HoReCa industry units, as well as some proposals capable of bringing adaptability and sustainability to the development of this vital area for any economy. In the final part of our study, we revealed a series of good practices proving the relevance and viability of the measures taken.

**Keywords:** SARS-CoV-2 pandemic crisis, HoReCa, management, changes, good practices.

**JEL Classification:** L25, L83, M16

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**Introduction**

As demonstrated, crises deeply affect the personal development of each of us. In particular, with its global expansion, the crisis of SARS-CoV-2 has had a major impact on the hotel, restaurant and coffee shop industry (HoReCa), which has been at the heart of implementing unprecedented restrictive measures but proved to be essential to the effectiveness of all actions aimed at flattening the pandemic epidemic curve (Foroudi, Tabaghdehi and Marvi, 2021). In our study, we aimed to formulate a series of viable proposals, able to give sustainability to the specific activities and the greatest profitability in this area put to the hard test by the pandemic of SARS-CoV-2. The introduction of a considerable number of actors in the HoReCa industry in technical unemployment, as well as the temporary or definitive cessation of the activity of some operators in this area, added to the change of many of the customers' preferences. And what seemed unimaginable or hard to conceive just a few months before the onset of the pandemic became perfectly possible and also manageable. Although the only certainty during the pandemic crisis was the uncertainty, given the existing good practices in the field, we have also proposed several potential directions for recovery of the HoReCa industry, in the national context so favorable to a new paradigm. Giving up the defeatist attitude that still takes, as if too many operators in the HoReCa field in Romania, we wanted, through this paper, to propose a different way of thinking and acting, promoting, as a priority, optimism, professionalism and new in addressing and solving real challenges that stand before any performant manager and creating his strong desire to be the winner. Even more so, we were strongly motivated by the reality that, in the face of a multitude of new challenges and opportunities, the time has come to make the transition to theorizing practice. Respectively, let us prove that the maximum adaptability and mental flexibility of the HoReCa industry unit management will facilitate the transposition of some elements of practice into new concepts and theoretical-methodological notions. This way, we make it possible to give up a "traditional" way of thinking, according to which we were forced to implement theoretical elements in more or less conjunctural events. Events that are often characteristic of an increasingly turbulent, unpredictable, and favorable environment for a natural selection in which not necessarily the most financially powerful will win. Receptiveness and maximum adaptability to the new shifts in the HoReCa industry. As a result of the effects of the SARS-CoV-2 pandemic crisis, such as sensitivity, empathy, professionalism, and deontology proven in designing and carrying out actions aimed at introducing the new are just some of the coordinates that, in our opinion, are called to characterize the way of thinking and acting of entrepreneurs and managers in the hospitality field.

Finally, the scientific management of the changes generated by the SARS-CoV-2 pandemic crisis imposes the maximum adaptability of the HoReCa industry to what was certainly and still is a huge *touchstone*, which quickly turns into an excellent opportunity for redesigning and restarting the profile activities in the hospitality industry. Within this framework, efforts must be concentrated and harmoniously correlated for a more predictable, viable and sustainable future, adapted to the increasingly surprising shifts for each of us.

**1. Shifts and characteristics of the HoReCa industry during the SARS-CoV-2 pandemic crisis**

Numerous researches have addressed most of the events generated by natural disasters, terrorist attacks and various types of crisis. However, very few studies were dedicated to public health crises (Shapoval et al., 2021). This is, for example, the case of the SARS-CoV-2 pandemic crisis, which has upset the life of the entire planet and which, in 2020 alone, in only 31 countries, caused the loss of over 28 million lives, more than five times more than those associated with the 2015 seasonal flu epidemic (Islam et al., 2021).

The deepest shifts were produced by the SARS-CoV-2 pandemic crisis in the specific activities of the HoReCa industry, in the context in which it contributes almost 5% to the Gross Domestic Product of Romania and provides more than 4% of the total employees with individual labor contract at national level (Popa, 2021). Practically, in the case of HoReCa activities, the binomial dilemma of "working to live or living to work?" almost instantly turned *living* into *surviving*. It is quite obvious: those who survived the pandemic are confronted with a "dark" period through equally confusing consequences, during which social distancing and isolation, associated with the bankruptcy of more than 30% of the companies and with about 3 billion lei lost due to various restrictions, managed to completely upset this field of activity (Marinescu, 2021).

The major shifts caused by the SARS-CoV-2 pandemic crisis in the HoReCa industry have had the direct consequence of changing the consumption preferences of the population. Thus, as the data of the National Institute of Statistics reveal, at the level of 2020 the expenses for HoReCa have reached a minimum of 0.5% of the average monthly income on a household, amounting to slightly more than 5.4 thousand lei (INS, 2021). Also, specialized studies have revealed that, globally, 43% of consumers said that they do online shopping more often than before the pandemic of SARS-CoV-2 (Plaster, 2021). Consequently, as an effect of the SARS-CoV-2 pandemic crisis, Romanians ate less outside their homes, being forced and even preferring to use online orders. The implications were multiple. Thus, on the one hand, there has been an increased interest in take-out options and/or in the use of home delivery services. They proved more effective and preferable to cooking food in your own kitchen. As dining at home or at work has become more convenient and comfortable. At the same time, the reorientation of the population's consumption preferences towards food products produced in restaurants and delivered *at the door* imposed as necessary the dynamic adaptation of the operators in the HoReCa industry to the new context, saving many entrepreneurs from bankruptcy.

Equally, many of those who lost their jobs as a result of reorganizing their fields of activity and moving to work at home or who wanted to obtain additional income have adapted quickly and become either employees of home delivery firms or – why not? – even initiators of such business in the HoReCa industry. The reorientation, reorganization, redesign and even the restart of the specific activities of the hospitality sector have become major challenges both for the managerial and business processes reengineering of the profile units, the change imposing new strategic options, much better adapted to the turbulent and increasingly less predictable environment. Also, in the context in which the dynamics of adaptability to the new requirements imposed to the HoReCa industry by the pandemic of SARS-CoV-2 has registered a size never before seen, only those who proved able and managed to make the most of the opportunities offered to update and improve the skills specific to information and communication technology (IT&C) remained in the field.

## 2. Literature Review

Specialists have revealed that the immediate impacts caused by the pandemic of SARS-CoV-2 on the HoReCa industry were devastating for both businesses and human resources in the field (Baum et al., 2020). Successfully overcoming the negative implications of the pandemic crisis is only achievable if there is, in the given cultural context, social cohesion and cooperation between all hospitality professionals (Gkoumas, 2021), which are corroborated with governments' efforts to create environmental conditions conducive to the sustainability of healthy and intelligent organizations, able to adopt proactive measures that ensure the welfare of all employees (Bhrammamachote and Sawangdee, 2021). The management of the HoReCa industry units has the mission to ensure, with the major increase of the trust of human resources in the values proper to the organizational culture, the reduction and even the elimination of anxieties, fears and threats to the health and safety of the workplace, all these generated by the devastating effects of the pandemic crisis that we are going through today (He et al., 2021). Especially since the professional satisfaction of the employees in the HoReCa field is affected positively by motivation at work and negatively by burnout (Silva et al., 2021).

Given that business failure rates in the hospitality industry recorded an exponential dynamic, their franchising exerted a significant favorable impact and facilitated better understanding of the foundations of knowledge management implementation (KM) in the face of the pandemic outbreak of SARS-CoV-2 (Hsieh et al., 2020).

An extremely important role was played, for the restart and even success of some businesses in HoReCa, discussing, on the occasion of various profile events, those that occurred during the SARS-CoV-2 pandemic crisis. Thus, storytelling favored and facilitated enormously, as a true *cornerstone* (Karzen and Demonja, 2020) the overcoming of some critical situations, difficult to overcome. Case studies and experiences were shared by managers through the storytelling events in the field of HoReCa, depending on their expertise, contributing fully to the creation of opinions and to the adoption on scientific basis of decisions essential to the future of the hospitality industry. First of all, the cohesion needed to build confidence in a much less predictable future was created, promoting innovative approaches, with both theoretical and managerial implications, by accepting and improving the technologies applicable during health crises (Kim et al., 2021). Secondly, collaboration and cooperation in various joint actions have been enhanced, encouraging and facilitating supervisory processes capable of providing safety to HoReCa customers (Robina-Ramirez et al., 2021).

In other news, the restrictions, both on travel and on direct networking, imposed specific measures, so that the pandemic was kept in full control and its effects were as bearable as possible for the workers in the HoReCa industry. The tendency of some entrepreneurs to force their employees to accept unpaid holidays had to be tempered (Lai and Wong, 2020), especially as hospitality activities, perhaps more than any other, have a major labor shortage. Not to mention that policies and strategies of employee retention (Szentesi et al., 2021) are still neologisms for many entrepreneurs, especially for small and medium-sized ones. However, the perspectives are encouraging, especially considering that the perceptions of the students who are going to graduate in specialized studies are increasingly changing from production-oriented activities to those that ensure an increasing diversity of hospitality services. And this requires universities to take measures and actions to improve

the self-efficacy of future graduates so that they are more and more able to maintain their career commitments (Lee et al., 2021).

A special consequence of the effects of the SARS-CoV-2 pandemic crisis was a severe reduction in the size of some activities aimed at ensuring economic sustainability by the management of the HoReCa industry units. In this context, the correct and real identification of the perceptions of the hospitality entrepreneurs regarding the directions to be followed, the measures and the governmental strategies operable according to the lessons learned after the blocking of the activities in the HoReCa industry, combined with the resilience in the face of the future are important points of reflection and constitute absolute priorities for the strategic management of the changes in the hospitality field (Madeira, Palrao and Mendes, 2021). Especially because, as experience proves, individuals with higher emotional intelligence (EQ) tend to do much more proof of knowledge sharing behavior, being more likely to disseminate them organizationally (Cetini and Karakas, 2021).

The panic and the chaos of the business in the HoReCa area led to the adoption of profound structural changes that, however, rarely, have encountered the resistance of many entrepreneurs, especially the elderly and those for whom the adaptability to the new are real dangers that can profoundly alter the area of their own comfort (Neise, Verfurt and Franz, 2021). And it is also about panic and chaos, as well as uncertainty, when we refer to the major reduction in the attractiveness of hospitality industry occupations, particularly for top and middle management positions, whose holders opt for more secure and rewarding jobs in other economic sectors (Filimonau, Derqui and Matute, 2020). The organizational resilience of HoReCa operators, like the response to the SARS-CoV-2 pandemic crisis and corporate social responsibility (CSR) practices, can, however, affect the job security of senior management and thus decisively influence its retention commitment.

The impact of the SARS-CoV-2 crisis on HoReCa's activities has led many countries to implement drastic rules, often considered even draconian, to prevent the spread of the virus. Many decisions were taken in conditions of uncertainty and lack of experience, reality being often replaced by appearances and/or presumptions. It has even reached the stage when decisions adopted in some Western European countries influence, obviously in a negative way, economic activities in most countries, spreading fear and uncertainty in many geographical areas (Rodriguez-Anton and Alonso-Almeida, 2020). To all this were added the rumored campaigns and, especially, the fake-news campaigns, which amplified the panic that became, in turn, endemic. Such a state of facts has only damaged and destabilized a sector of activity with certain possibilities of strategic reorganization and resizing, phenomena to which the market and life in general have coped exceptionally. Even though small and medium-sized enterprises (SMEs) in hospitality had limited knowledge about the multiple possibilities to restart and adapt their activities to the new pandemic and post-pandemic context (Varelas and Apostolopoulos, 2020), the HoReCa businesses that have resisted and even developed were based on creative and sustainable management philosophies, as well as information technologies and new branding strategies (Varelas, Karvela and Georgopoulos, 2021).

Last but not least, special and of utmost importance, requiring special solutions is, as a direct effect of the SARS-CoV-2 pandemic crisis, the increasing share of food waste from the HoReCa sector. According to the specialists, it is mandatory to adopt organizational measures proven to be able to lead to a major decrease in food waste and, implicitly, in the hospitality sector, as a condition of sustainable development (Buczacki, Gładysz and

Palmer, 2021). This is even more so as the use of catering and home delivery services encourages food waste both at the organizational (business) and individual (home) levels. A solution to this is the implementation of lean management in the food service business as a viable and sustainable element of sustainable restaurant management (Gładysz, Buczacki, and Haskins, 2020).

Certainly, the major conceptual-methodological changes and, especially, the practical ones brought about by the SARS-CoV-2 crisis on the HoReCa industry are found in the form of new concepts and new ways to adapt the supply chains to the profound changes in consumer behavior and planning of its scenario. There are changes that led to the emergence and development of new theories, studies and even strategic competitive intelligence disciplines. Changes at the center of which a new type of final customer is located, respectively, the one for which the priority, in the conditions imposed by the pandemic of SARS-CoV-2, is its own security, in all its dimensions: physical, emotional, economic and digital (García-Madurga, Esteban-Navarro and Morte-Nadal, 2021). Generating better customer experience, rigorous and very courageous decision making, as well as the explosion of digital transformation were potentially strategic options almost impossible to imagine before the disastrous events generated by the pandemic crisis of COVID-19 (Antonio and Rita, 2021). However, in most areas of activity, as we will see, good practices of physical remoteness, like the very severe restrictions adopted by governments in all countries, have acted as excellent catalysts to foster new experiences and challenges.

It becomes obvious that successfully overcoming the complex problems generated by the SARS-CoV-2 pandemic to the HoReCa industry is possible only by adopting well-founded, coordinated, and maximum efficiency and effectiveness measures and actions. Based on cooperation and collaboration including through storytelling, the "competitive intelligence" has overrated searches on social media, especially in the context in which the sustainability and reliability of any performant decision-making system is decisively conditioned by quality information obtained through a set of structured cognitive processes and modeling the innovation of configurational systems (Stylos et al., 2021).

## 3. Best practices for overcoming the impact of the SARS-CoV-2 pandemic crisis on the HoReCa industry

In the context of one of the most serious pandemic crises in the history of humanity, redesigning, rethinking and re-launching the production and service processes specific to the HoReCa industry requires specific measures, as eloquent as possible evidence of mental flexibility, adaptability, dynamism and, above all, of a creative intelligence specific to the new generation of managers, called upon to ensure the advancement of the Romanian economy.

We will summarize some examples of good practice in adapting the HoReCa industry to the context of the SARS-CoV-2 pandemic crisis for each of the three components of the hospitality industry.

(a) In *the hotel* sector, adaptability-imposed measures of operators to ensure maximum safety accommodation and greater flexibility of tariff packages in order to attract and maintain customers. Given that hotels everywhere had the toughest restrictions, being

forced to limit and / or even close, for a period of time, business trips were the only ones able to ensure, even at a very small size, the survival of accommodation units. Our chance consisted in the fact that between 60% and 75% of the total hotel entries are aimed at business (Draghici, 2020), which gave hotel management the opportunity to reinvent many profile activities. In this respect, given that the business environment could not afford new malfunctions and the demands for safe locations increased, attracting, and retaining customers were only possible for those accommodation units that proved the maximum flexibility of the tariff packages, offering, for example, without any additional fees, early check-in and late check-out. At the same time, the attention to detail in the process of preparing and serving meals, with strict observance of all the sanitary restrictions imposed by the pandemic context. Also, as the commissioning in 2020 and 2021 of 14 new hotel units totaling over 2 000 rooms was delayed due to the coronavirus crisis, the pandemic was an excellent opportunity for entrepreneurs to carry out extensive renovation/ interior refurbishment works. From an investment perspective, the crisis period of SARS-CoV-2 was and still is an ideal one for investments in the hospitality sector, especially since the sanitary restrictions imposed the total or partial closure of most hotel units. It was an opportunity from which they took full advantage of especially very strong and experienced organizations in HoReCa, which proved that they know where, what, how and when to invest, being eloquent examples of good practices such as:

- *Phoenicia Hotels* is the largest network of hotels in Romania, which includes 20 hotels with more than 2300 rooms and, as a special achievement in 2020, taking advantage of the opportunity offered by the SARS-CoV-2 pandemic crisis, completed the renovation of the famous complex Amfiteatru-Panoramic-Belvedere from Neptun-Olimp, belonging to the group Hotel Phoenicia Blue View Resort, owned by it (Pop, 2021).

- *Ana Hotels*, a group valued at 44 million euros and including hotels Athénée Palace Hilton and Crowne Plaza in Bucharest, Bradul, Poiana and Sport, in Poiana Brasov and Europa (together with Ana Aslan Health SPA) and Astra, in Eforie Nord. During the pandemic period, when the entry of tourists could be redirected to Crowne Plaza, Ana Hotels offered an eloquent example of good practice, deciding to invest 25 million euro in the renovation of Athénée Palace Hilton hotel, one of the emblematic landmarks of the capital, founded in 1914. The investment involved the latest technologies in the field of hospitality and natural materials, ensuring high energy efficiency, as well as environmental protection (Diaconu, 2020).

- (b) In *the area of restaurants*, the pandemic acted as a veritable *cleaner* for businesses that, even if they didn't offer quality services, continued to survive, especially as demand surpluses supply. One of the most relevant examples of success in the transition in the fight against the devastating effects of the crisis of SARS-CoV-2 is provided, in the case of HoReCa, by the rapid growth of the food delivery market and the ordering of gastronomic assortments through online means. The digitization of orders aimed at procuring the most varied types of (semi-)agri-food preparations and was an excellent proof of good practice, resulting in adaptability to the new conditions of the environment both turbulent and unpredictable, and, on the other hand, deeply stimulating for new business opportunities, until today difficult to imagine. Given that the aberrant rhythm of life against the clock led us to turn to professionals, especially in situations where we no longer have time to cook, the coronavirus pandemic highlighted the need to develop the circular economy. An economy based on the paradigm of reducing distribution channels, the use of local raw

materials and, in particular, on minimizing waste production throughout the product life cycle (Kochanska, Lukasik and Dzikuc, 2021). In this context, the expansion of fast-moving restaurants was only one of the proofs of the rapid adaptability of the HoReCa industry to new needs arising from the SARS-CoV-2 pandemic crisis. Bolt Food, Bringo, Foodpanda, Glovo, MGC Delivery, Takeaway and Tazz by eMag are just some of those who have adapted extremely quickly to the new context of various restrictions imposed by the pandemic, offering quality and appreciated customer service. Some, however, did not succeed, having a lower profitability threshold than expected and closed, taking the decision to withdraw from Romania (Uber Eats, in May 2020). Equally, managers of more and more restaurants have dynamically adapted to the new context, creating their own home delivery services. In general, especially since large events (weddings, baptisms, festive dinners, etc.) were allowed only for short periods of time, over two thirds of the restaurant turnover was generated, in 2020, by home deliveries, double the level of 2019.

- *Internationally*, one of the largest restaurant chains in the US, "Darden", although it had to close no less than 1,800 units between March 2019 and December 2020, registering a 60% drop in sales, managed to manage the negative impact of the pandemic crisis of COVID-19 by identifying strategies to retain and help his own employees, while reducing marketing expenses and switching quickly to home deliveries, reaching in 2021 almost 70% of the 2019 turnover (Yost, Kizildag, and Ridderstaat, 2021).

- At *national level*, the diversification of activities was an excellent proof of adaptability to the context imposed by the SARS-CoV-2 pandemic crisis. Two names are eloquent for revealing examples of good practices in the restaurant industry:

  - Mandachi Industry owns the largest chain of restaurants in Romania and the largest chain of Greek-type restaurants in Eastern Europe: Spartan. The company has adapted excellently to the restrictions imposed by the pandemic crisis and, from a fast food establishment, opened in Suceava, in less than ten years, in 2020, it has reached 55 units and more than 1 000 employees. Also in 2020, seizing the new opportunities offered by the SARS-CoV-2 pandemic crisis, the company decided to give up, for an unlimited period, the royalty for the brand "Spartan" especially in the context in which the fight for survival is far more fierce than the one for enlargement. And also as an example of good practice and adaptability to the new pandemic context, the same company diversified its activity and launched on the market a new brand of disinfectants ("Ţepeş"), in order to contribute more to the fight to prevent the effects of coronavirus crisis (Andriescu, 2021);

  - City Grill Restaurants is a symbol of business success in HoReCa. From a City Grill (CG) restaurant opened in 2004 and 50 of its employees, by diversifying its activities, the group had in its composition, at the end of 2021, 9 brands, 19 restaurants (among which the famous Caru' cu Bere, Hanu' Berarilor and Hanu' lui Manuc), numerous cafes and a team of over 1500 professionals (Dumitru, 2021), being the largest Romanian hospitality employer and having an annual turnover estimated at over 47 million euro in 2020, by opening City Grill Delivery, one of the five most important deliveries on the HoReCa market. Delivery is estimated to have 20% (600-800 million euro) of the total restaurant market at the end of 2021, estimated at 3 billion euro. Based on an exceptional visionary expertise, since 2020 the group invests a lot in training and education of young people, as the only hope for a better future, so that in 2022-2023 it hopes to be able to reach about 80% of the existing capacity in 2019. sacrifice management: the transition from serving to mass, to penetrating the markets of the large retailers with ready-to-eat or ready-to-cook products; Customer

loyalty actions, through deliveries, both by adapting the menus according to customer's wishes and by offering lunch menus in a pick-up system (Dumitru, 2021).

(c) In *the field of cafes*, the most relevant example of good practice is a 100% Romanian business: *5 to go*. A cafe opened in January 2015 in a small and stylish 12 square meter garage, located in Lahovari Square has been transformed in less than three years into a wide franchise network. At the beginning, those who were passing bought, extremely quickly, coffee *packaged*, in exchange for 5 lei (approximately, the equivalent of one euro). Hence the name *5 to go*, which became more than an example of good practice. From 2016 to 2021 inclusive, the brand was rated as The Best Café by Gala Food & Bar. Also in 2016, Forbes quote *5 to go* as Best New Entry Romania and in Top 100 Cool Brands. The concept has developed rapidly, from 2020 adapting to the new pandemic context. From no 30 units in 2016, the brand has grown, due to the extremely advantageous conditions of franchising (requiring a global investment of 15-20 thousand euros), to over 300 such cafes and a turnover of over 13.5 million euros in 2021. Recently, in December 2021, to encourage young entrepreneurs in particular, *5 to go* announced that by the end of 2022, the franchise tax is zero, to encourage young people in particular to choose entrepreneurship, so that the period of the pandemic of SARS-CoV-2 is successfully exceeded. And also for 2022, *5 to go* has proposed to add 200 new units to the business. At the end of 2026, the largest chain of cafes in Romania aims to own 1,000 units, both at home and abroad (Andriescu, 2021). Already, the first franchise, a donuterie, was opened in Paris.

Finally, it should be noted that the Romanian state has also supported entrepreneurs in the HoReCa industry providing, besides compensation for the transition to technical unemployment equal to the equivalent of 75% of the minimum employment salary, exemptions for certain taxes, loans granted under preferential conditions, etc. Recently, in early December 2021, it was announced that more than 8.3 thousand companies in the HoReCa industry will receive funding from the government amounting to 200 million euro (Cornea, 2021).

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