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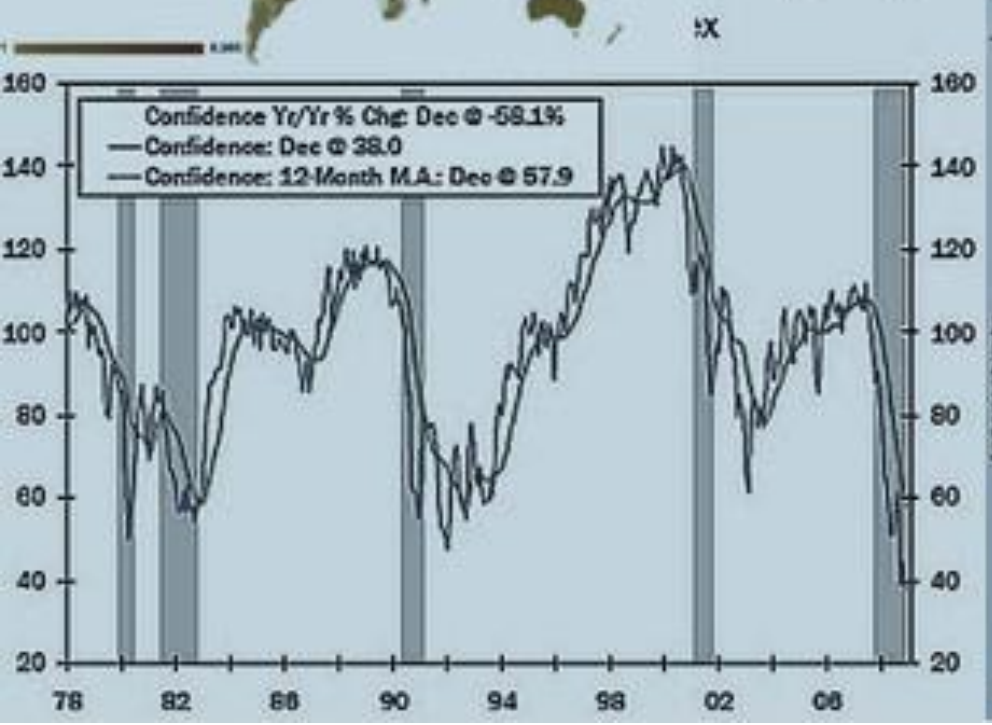

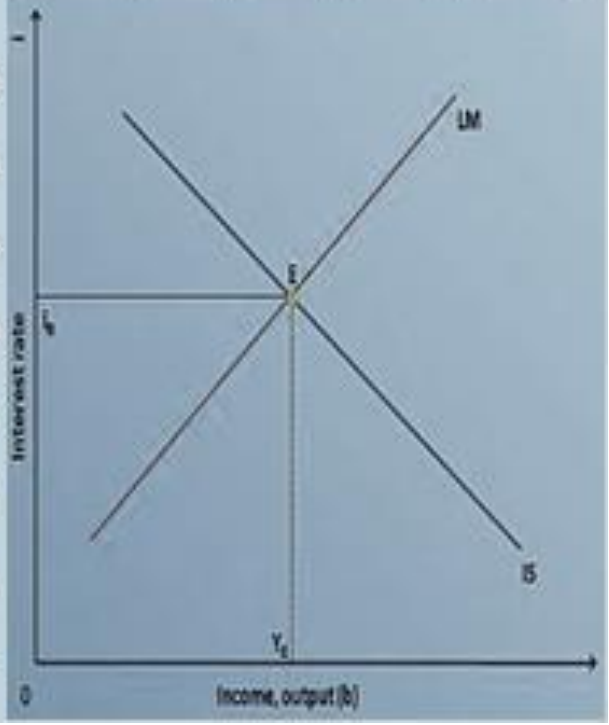

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THE IMPACT OF PACKAGING ON CONSUMER PURCHASING DECISIONS: AN INTEGRATIVE ANALYSIS OF AFFECTIVE AND BEHAVIOURAL FACTORS

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ABSTRACT: *This paper investigates the impact of positive and negative advertisements on consumers' emotional responses and purchasing behaviour. To explore this topic, I conducted a pilot study using electrocardiography to monitor the emotional reactions of a small group of subjects while they viewed a pre-determined set of advertisements. Our findings suggest that the emotional impact of positive and negative advertisements differs significantly. Positive advertisements are more likely to evoke positive emotional responses, whereas negative advertisements are more likely to elicit negative emotional responses. These results have important implications for companies seeking to develop effective marketing strategies that influence consumers' emotional responses and purchasing behaviour. By considering the emotional impact of advertising, companies can better understand the affective foundations of consumer decision-making utility. Although this study is limited to a small number of subjects, it serves as an example in a larger study on multiple subjects and contributes to the development of an electro-physiological approach to the impact of packaging on purchasing decisions. In conclusion, this study provides valuable insights into the role of emotions in the consumer decision-making process and the importance of advertising in shaping consumers' emotional responses.*

Keywords: *effective marketing, packaging, electrocardiography, purchasing behaviour*

JEL Classification: *D10, D70*

1. INTRODUCTION

In the context of the current economy, characterized by fierce competition and an increasing diversity of offerings, companies face the challenge of attracting and retaining consumers through effective marketing strategies. In this sense, understanding the consumer decision-making process and the factors that influence it is extremely important. In recent years, researchers have focused on the role of emotions in the purchase process and have highlighted the affective foundation of consumer decision-making utility, as well as the importance of consumers' emotional reactions in determining purchasing behavior. Within this integrative analysis of current research, we propose to explore a specific aspect of this process, namely, how positive and negative advertisements can modulate consumers' emotional

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responses and, implicitly, their purchasing behavior. To this end, we conducted a pilot study in which we monitored the emotional reactions of a group of subjects using electrocardiography while they viewed a pre-determined set of advertisements, thus analyzing their emotional responses. Although the study is limited to a small number of subjects, it can serve as an example in a larger study on multiple subjects and can contribute to the development of an electro-physiological approach to the impact of packaging on purchasing decisions.

2. AFFECTIVE FOUNDATION OF CONSUMER DECISION-MAKING UTILITY

Our quality as consumers to motivate and explain our choices through their utility offers us a somewhat favourable response, which soothes our conscience when we come out of the concentration of making a purchase. We discover the process in which we engage governed by emotional impulses and demonstrate through rational arguments the necessity and well-being that the purchased product or service offers us. Thus, we become decisively involved in the pre-purchase moment, stimulating our cognition to discover the need, during the purchase process, especially by exalting the neurohormones responsible for creating and maintaining the feeling of happiness and fulfilment. And most importantly, because it encompasses the longest duration, in the post-purchase moment, when we are left with ourselves and ourselves and we strive to find rational and satisfying answers for the action we have just taken.

Our emotional attachment to a purchase often stems from the memories and emotions associated with it, rather than the usefulness of the object itself, which may or may not serve us. We link the product of our action to the moments and emotional state that characterized us, in order to motivate and absolve the buying process of any impulsive implication that may arise in response. Recent research has shown that consumers' emotional attachment to products can play a significant role in their purchasing decisions. For example, a study by Belk (2020) found that consumers often develop emotional bonds with products that remind them of important events or people in their lives. These emotional bonds can influence their decision to purchase the product, even if it may not be the most rational choice.

The reasoning used in these processes often involves the information at hand, somatic markers, and most importantly, the influence of people with whom we maintain close relationships or whom we consider decision-making or behavioural leaders. Most importantly, we mimic a cognitive behaviour, minimize any negative impulse, transfer the decision to the representative we consider rational, and develop this perspective, but ultimately reject the decision if it does not align with the momentary need for us to fulfil our happiness through the desired product or service.

The utility of most outcomes shaped by such consumer decisions is minimal or momentary. Rational justification is rarely part of the emotional cover, which is not denied. The feeling of fulfilment often takes the place of a satisfying rational response. And this motivates the consumer to engage in other purchasing and consumption activities.

Discernment and the processing of information obtained through an individual's contact with promotional campaigns, even those focused on awareness, reveal an affective tendency that guides their cognitive behavior. This stimulates marketers' interest in identifying moments of weaker cognitive concentration, or more importantly, what influences this rational process. "When the motivation and capacity of human individuals to analyze information are reduced or less profound, they generally seek to make decisions that benefit them, using a series of cognitive mechanisms to cope with information overload. Known as heuristics and naturally developed in the individual's process of adapting to the social world, these cognitive mechanisms serve the attribution of meanings and analysis of perceived information. Heuristics are automatically activated, without any conscious intention, and can simplify both the

processes of evaluating analyzed information and those of choice" (Richard and Redlawsk, 2001).

Thus, the affective basis of the consumption decision, and implicitly of the utility that arises from this process, allows for a personal demonstration of cognitive processes, real motivations, and recognition of an affective sensitivity born from the action of external factors that favour consumption through emotional stimulation. The consumption decision is often motivated by a series of details that characterize an affective behaviour. In this way, we help ourselves to demonstrate the usefulness of purchase by appealing to an affective form.

3. THE ROLE OF PACKAGING IN STIMULATING AND MODULATING THE EMOTIONAL AND BEHAVIORAL RESPONSES OF CONSUMERS IN THE PURCHASE PROCESS: AN INTEGRATIVE ANALYSIS OF CURRENT RESEARCH

In recent years, studies on the impact of packaging on consumer decisions have become increasingly numerous and sophisticated. Researchers have analyzed both the aesthetic, sensory, and informational characteristics of packaging to better understand how they influence consumers in the purchase process. Currently, packaging represents an important factor in product marketing, as it can influence the emotional and behavioural responses of consumers in the purchase process.

In such a context, the role of packaging can be approached from two perspectives: stimulating and modulating emotional and behavioural responses (Piqueras-Fiszman et al., 2019). In terms of stimulation perspective, packaging can generate a series of positive emotional responses, such as visual attraction, pleasure, and positive anticipation, which can increase purchase intention and brand loyalty. For example, packaging with an attractive design and a unique visual presentation can stimulate positive responses from consumers and can make a strong impression on them. Furthermore, the information presented on the packaging can also influence consumers' purchasing decisions. For example, studies show that mentioning natural ingredients on the packaging can increase the credibility of the product and can stimulate positive emotional responses such as trust and safety. Additionally, research suggests that packaging can influence consumers' behaviour through cognitive aspects such as perception of value and quality. For example, elegant and sophisticated packaging can suggest a high-quality product and can make consumers allocate more money to that product (Kumar, 2020).

On the other hand, packaging can modulate the emotional and behavioral responses of consumers through specific characteristics such as color, shape, texture, and packaging material. For example, packaging with cool colors and textures can convey a sense of calm and relaxation, while packaging with vibrant colors and rough textures can convey a sense of energy and power. Additionally, packaging can modulate the emotional and behavioral responses of consumers through specific communication elements, such as the logo, slogan, and product description. These elements can influence the consumer's perception of the product and can determine the purchasing decision. For example, a well-formulated slogan can convey a powerful message and generate a positive image of the product in the consumer's mind. At the same time, Hoque and Uddin (2020) investigated the packaging elements that influence consumer buying decisions in the consumer goods industry in Bangladesh. The study showed that the appearance and quality of the packaging, together with the information on the packaging, significantly influence consumer buying decisions. Similarly, Song and Kim (2019) conducted a study on 350 subjects investigating the impact of packaging design elements on consumer emotions and purchase intentions, and the results showed that packaging design has a significant impact on consumer emotions, and especially on their purchase intentions.

In conclusion, the role of packaging in stimulating and modulating the emotional and behavioral responses of consumers in the purchasing process is an important topic in product marketing. Although there have been numerous studies that have addressed this topic, current research is far from exhaustive, and there is a need for further research in this direction to better understand the impact of packaging on consumer purchasing decisions.

4. RESEARCH ON EMOTION AS A DETERMINING FACTOR IN CONSUMER DECISION MAKING

This paper aims to examine the involvement of emotions as a determining factor in influencing consumer decision-making. Based on the analysis of specialized literature (Lerner et al., 2020), the importance of the emotional framework and its involvement in the cognitive process was understood. Due to its neural belonging, emotion is expressed through specific behaviour, often reflected in habits and gestures that are harder to control or hide. According to behaviourist researchers (Hassani et al., 2020), negative emotions depersonalize people and inhibit their rational processing of the data they have access to or the information they possess. This encourages strategies from different fields of activity to include elements of fear and anxiety in their actions targeted towards the population. In addition to this depersonalization action, negative emotions are able to activate important parts of the brain responsible for decision-making in a short time. Thus, there are behavioural correlations between the negative emotional influence and individual decision-making in various situations, including consumer ones.

On the other hand, positive emotion produces unforeseeable and decisive changes. This emotion develops the quickest behaviour by neglecting reason after its involvement. Furthermore, most of the time, the influence of positive emotion is recognized as a mark in terms of memorizing a moment or a situation. In turn, this detail creates the so-called nostalgia, once again, a powerful emotional factor. Its presence in the consumerist and commercial context translates into the development of a consumption behaviour that reduces the rational aspect at the time of purchase decision. This theory formed the basis of my research idea and also motivated me to devise a scheme to verify how the emotion manifests itself.

The research question of this study is whether there is a direct influence of emotions in the decision-making process. To answer this question, I have organized an experimental framework using video material resources to construct an exaggerated environment, in order to observe if there is an attitudinal change manifested in decision-making.

I conducted a pilot study on two male volunteers who are right-handed, non-smokers, occasional alcohol consumers, athletic, 24 years old, with undergraduate and graduate degrees in public administration. With the help of a group of specialists in the field of electrophysiology and a cardiologist, I conducted a pilot study on these two volunteers to investigate the effect of emotional advertising on the cardiac activity of groups based on negative and positive emotions. The aim was to determine whether there is a cognitive integration and a vegetative reaction associated with this cognitive integration, in addition to the emotional response.

The experimental framework I considered appropriate for this study involves three main instruments: FACET, Electrocardiogram, and PDA Plus - Affective Distress Profile. The latter two instruments were applied during the research. These instruments are considered important to obtain relevant results in my evaluation study of the effects of certain informative/advertising spots on psychoemotional and physiological reactivity.

I chose the electrocardiogram as the instrument to measure the effects of emotions because it measures the heart rate. I made this decision based on my review of the relevant literature, which led me to understand that the vagal afferents of the heart determine the vegetative reactions associated with emotions, which among other things, led to the concept of

the localization of the soul in the heart. Socrates believed that the soul is the essence of a person or any being, and it decides how that being behaves. Later, Aristotle, in his work De Anima, localized the soul in the heart and offered a full argument in support of this theory. These concepts formed the basis of my decision to prefer the use of electrocardiogram monitoring to measure emotions.

In addition to the electrocardiogram as the primary measuring instrument, I also used alternative methods to ensure the results were relevant. I monitored the subjects' heart rate using a stethoscope and their respiratory rate.

To prepare the subjects for the experiment itself, I prepared a set of questions that checked their current state and emotional background. I sought to understand their participation in similar experiments in the past, if they have recently experienced traumatic situations, if they develop addictive behaviors, and some self-assessment elements at the level of status and behavioral assumption. The experiment took place in a sterile, comfortable, and discreet setting, to ensure a normal disposition of the subjects. To comply with the ethical norms surrounding this type of research, I drafted an agreement that the two subjects signed, understanding the entire process they were participating in.

4.1. AFFECTIVE DISTRESS PROFILE (PDA PLUS PRE-EXPERIMENT)

The research instrument PDA Plus (Opriș and Macavei, 2007) was patented by two Romanian researchers based on a universal model known in universal psychoemotional research. This instrument measures functional and dysfunctional negative emotion. It contains 26 items identified as a relevant concentration of terms that describe the state of the respondent and provide significant informational contribution to the desired results. This formulation of its content can be quantified and translated as efficient because it allows for a global estimation as well as calculation of individual scores. The physical format of the PDA Plus consists of 26 items that allow for the association of a degree of values numbered according to increasing significance. Thus, the evaluation of the state of each item begins from 1 to 5, as follows: Not at all, Very little, Medium, Much, Very much. Reliability is most often expressed based on internal consistency coefficients and the stability score over time. To this instrument, we added 7 questions that verify the subjects' state and measure their self-positioning in relation to perceived external influence. Furthermore, through the last three questions, we aimed to emphasize the process of self-recognition of details and the refreshing of assuming a status in relation to the decision-making phenomenon.

Both subjects answered negatively to the first question. We can understand the lack of previous experience in such testing. On the second question, the first respondent recounted a recent car accident in which his father and a friend of his were involved. This experience marked him because, even though his father was ultimately okay, his father's friend was seriously injured. From this response, we understand an increased sensitivity regarding the content of advertisements that use such negative actions. This subject presents a predisposition to react more acutely in moments involving accidents. On the other hand, the second respondent answered negatively, characterizing a relaxed attitude that has been constant up until this point.

The third question was designed to highlight a predisposition towards addictive behaviour. The smoker's identity may sustain a behaviour based on weaknesses, and especially a tendency to respond by copying the social behaviours of those around them. However, both subjects answered negatively to this question. This result keeps the characteristics of the subjects within the normal range, without details that highlight them in a particular way.

Positive answers were obtained for the fourth question, with the mention that the first respondent holds a driving license but has not driven for 18 months. This question was asked

to verify the impact that the commercials in the advertising set containing messages addressed to drivers will have. The fact that these two respondents hold a driving license indicates an increased sensitivity and heightened attention to messages addressed to them, whether in advertising content or in any kind of campaign.

For the fifth question, the first respondent answered positively, while the second one answered negatively. This question was considered necessary even if the answer is exclusively subjective. The answers help me understand the status that each respondent considers representative and assumes for themselves, and they help me understand how each respondent perceives themselves. I will not consider this answer in my study as a characteristic and rational answer. However, it is important during the observation of their behavior during the experiment.

In the context of assuming external influence from close acquaintances, both respondents answered positively to the sixth question, acknowledging a relatively high percentage in terms of paying attention to and adopting the ideas of their acquaintances in relation to their own decision-making. Once again, this is a subjective answer to a question intentionally formulated in this way to bring the respondent face-to-face with a natural tendency and, especially, to recognize this "weakness" in front of their own rationality. This answer helps me understand a tendency to verify one's own ideas through the perspective of those around them. This local event can be extrapolated and represents an important behavior when establishing the details of any campaign. The influence that a loyal individual has in relation to a brand or a social behavior that is intended to be inserted into a group is significant and can decisively change the behavior of another indecisive individual or one who has not had prior personal experience with the product or service being promoted.

The seventh and final question obtained common responses that characterize the same sources. Among the answers were "internet reviews", "the opinion of acquaintances", "previous experience", and "forums". These sources generally represent proximity environments from which the subjects' way of acting can be understood. At the same time, we can observe that they do not make hasty decisions without being informed. This aspect provides merchants with the opportunity to develop sources that will benefit them when future consumers seek to purchase a product or service that is the subject of their sales.

The following questions in this instrument actually measure the history of emotions in the last seven days. The result of this questionnaire revealed quite similar scores, with a difference of one point. This score is calculated by adding up the values given by the subjects for each state separately. During this time, the obtained score is quite high, which indicates a tense state in which they are placed. Thus, the first respondent obtained a total of 119 points out of a maximum of 130, and the second respondent obtained a score of 120. This characteristic state of the subjects helped me understand their predisposition to react less rationally, given the conditions under which they entered this experiment.

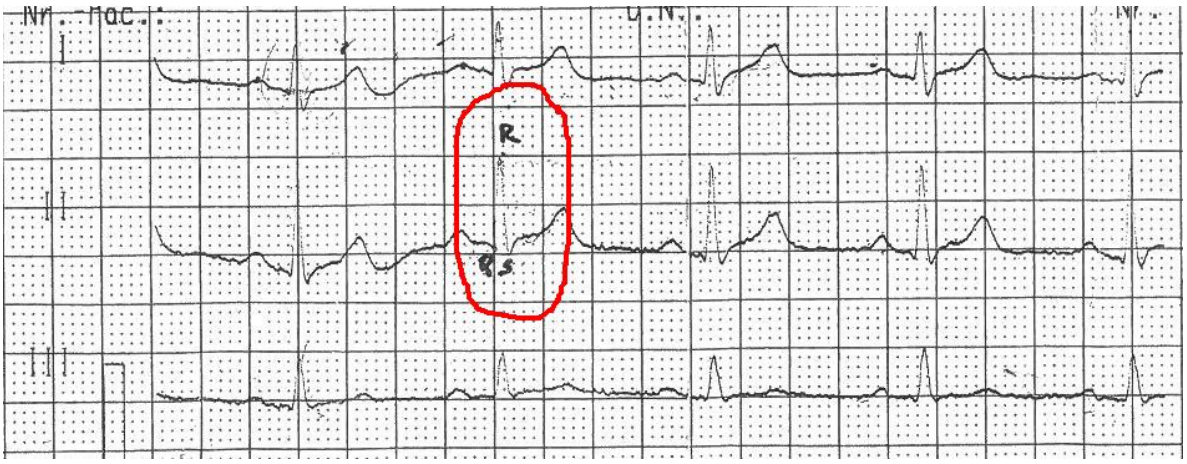
4.2 ELECTROCARDIOGRAM

The use of electrophysiological methods in evaluating emotional reactivity is a commonly used practice in the field of clinical psychology. Among the most commonly used methods are electroencephalography, electrocardiography, electromyography, and measurement of skin electrical resistance. To outline an overview of the obtained data in such research, the data are correlated and lead to the establishment of the psycho-emotional reactivity characteristics of the individual. Electrocardiography, a simple and non-invasive method, provides information on cardiac activity correlated with emotional status. Through the pair of cranial nerves X (vagus nerves/cardio-pneumo-gastric), the myocardium receives sympathetic and parasympathetic vegetative afferents intended to ensure cardiac adaptive

mechanisms under conditions of stress, physical exertion, and risky or life-threatening situations.

Cardiac activity is characterized by a well-defined electrical activity based on the myocardial excito-conductive network, which includes, in general terms, the sinoatrial node, the His bundle, and the Purkinje network. Furthermore, electrical activity is generated and sustained by pacemaker cells located in the cardiac tissue, auto-excitable cells that produce continuous electrical signals. Electrocardiography represents the graphic recording of these electrical signals, which are supported by the pacemaker cells, sinoatrial node, His bundle, and Purkinje network. The main sector of electrocardiography is the QRS complex (Figure 1). This complex, derived from EKG, provides information about the activity of the autonomic nervous system and the myocardial conducting system. Additionally, it can be used to understand the mechanisms of emotions to which a person is exposed.

Figure 1 QRS Complex



Within my project, I aimed to investigate the effect of advertisements on cardiac electrical activity (through the autonomic nervous system). In the pilot study that I conducted, I obtained four electrocardiographic expressions, two for each individual. The exposure process involved individually introducing each subject into the experimental room, where heart rate monitors were applied. The details of the process were explained to them, and they were instructed to focus solely on the set of advertisements prepared to run on the laptop screen in front of them. They were also given a pair of high-quality headphones for auditory safety. These headphones isolate the ear from any external sounds, to avoid any disturbances to their hearing. On the laptop screen, a set of positive advertisements was shown for a duration of 10 minutes and 44 seconds. These advertisements were campaigns by MetLife, Pfizer, Coca-Cola, Edeka, Monster, and P&G. They exploited the mother-son/daughter relationship, the idea of free happiness and smiles, kindness and presence, sustained and unconditional trust. These situations created a relatively strong emotional state, which conveyed a natural sense of kindness.

After recording the heart rate frequency based on the display of the set of positive ads, the experiment moved on to the second part, in which the subject had to watch the prepared ads based on negative emotion. These negative ads are mostly awareness campaigns, social campaigns like "don't drink and drive" or campaigns to reduce speed in traffic. These campaigns range from a scare factor of 2/10 to the last one that covers 10/10. This scare factor describes the impact of stress induced by fear and the details derived from the construction of the image on a negative background to ensure a feeling of fear. This fear is especially understood more brutally towards the end, when explicit images appear in the construction of

the ad. Figures 2a and 2b, 3a and 3b reflect the changes in cardiac electrical activity following exposure of the subjects to the ads explained above.

Figure 2a - The aspect of the cardiac electrical activity in a healthy individual (1) exposed to a set of positive advertisements.

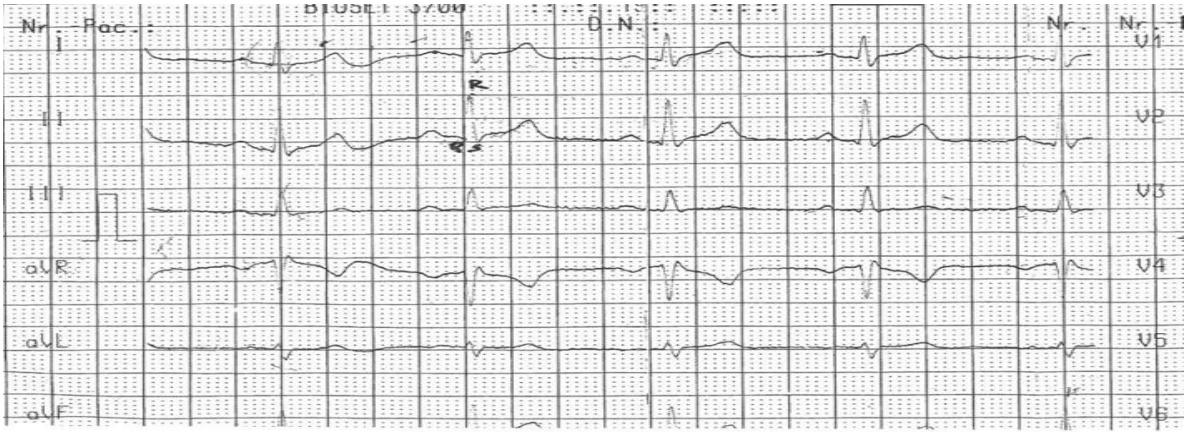
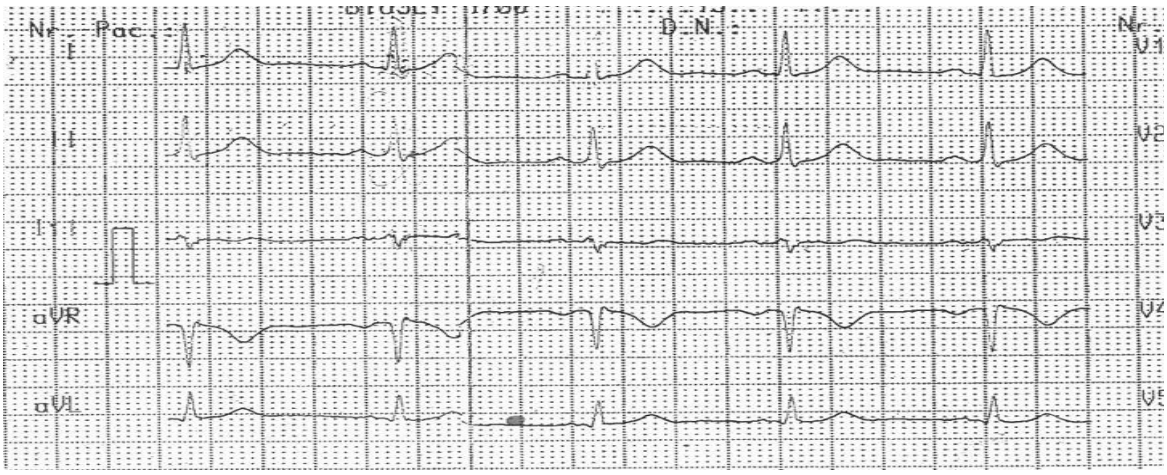


Figure 2b - The aspect of the cardiac electrical activity in a healthy individual (2) exposed to a set of positive advertisements.



Figures 3a and 3b show normal electrocardiographic sectors with non-deviated QRS complexes, suggesting that advertisements that use positive emotions do not have a negative impact on cardiac activity in a strict interpretation of EKG morphology. Furthermore, both Figure 3a and Figure 3b show a constant heart rate around the average value of 76 beats per minute, which falls within normal parameters. This analysis indicates that the subjects were relaxed while being exposed to the set of advertisements. Emotional involvement reflected by changes in heart rate would require such an exaggeration of the moment that the subject becomes emotionally unstable, anxious, and undergoes a sudden affective change. However, this part of my experiment aimed to test a real experience without recording extreme emotions, even positive ones.

Figure 3a - The aspect of cardiac electrical activity in a healthy individual (1) exposed to a set of negative advertisements

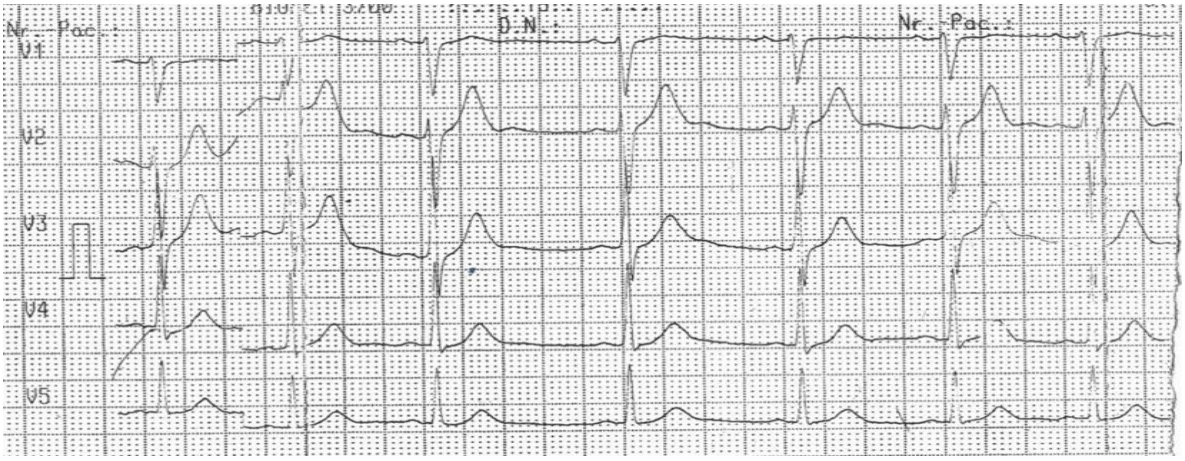
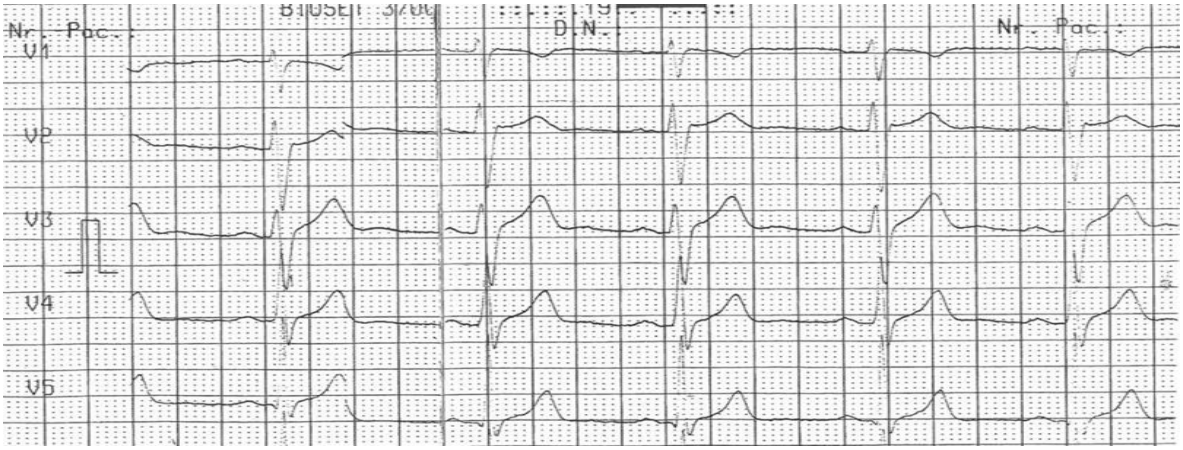


Figure 3b - The aspect of cardiac electrical activity in a healthy individual (2) exposed to a set of negative advertisements



Figures 3a and 3b reflect the effect of negative message commercials on cardiac activity via the autonomic branch of the cranial nerve X pair. The increase in QRS interval amplitude and the decrease in heart rate are observed in Figure 3a, while the heart rate remains at 76 beats per minute in Figure 3b. Moreover, the decrease in heart rate by 15 beats per minute compared to the normal value (75 beats per minute) in Figure 3a highlights an apparently paradoxical inhibitory action of the autonomic nervous system on cardiac activity. This fact also shows the depth at which certain commercials can act in activating neuro-vegetative and hemodynamic circuits.

It is interesting that exposure to negative situations (such as these ads) led to a decrease in heart rate, an apparently unjustified fact, considering that in such situations, there is an activation of the sympathetic vegetative system which results in an increase in blood concentration of adrenaline, which in turn has a stimulating effect on the heart (increased heart rate), hypertensive and increases receptivity to signals from the environment. The decrease in heart rate in this experimental context suggests that advertising spots, negative message ads, may activate partially different pathways than those activated by exposure to stressful or dangerous conditions. In perspective, to verify this hypothesis, studies on a larger number of

subjects associated with more types of measurements (electroencephalography, stress hormones) are necessary.

The fact that the second subject exhibited a different behavior in terms of cardiac frequency dynamics can be explained either by their personal history of exposure to events or by a different neurovegetative reactivity. The natural manifestation of the heart under stress induced by exposure to a negative situation is monitored in the form of a strong initial increase in heart rate when the individual becomes aware of the unpleasant event, which then decreases to a heart rate slightly below normal limits. On the other hand, when an individual experiences positive emotions in response to a situation, the characteristic heart rate is strong throughout the event, and the constancy of this high frequency is recognized.

On the other hand, respiratory dynamics also present vegetative influences associated with the cardio-pulmonary-gastric nerves (the X nerves). Therefore, we monitored the number of breaths per minute of the subjects. Counting breaths is done by quantifying each chest rise. This rise is complete from the inhalation phase to the exhaustion of air from the lungs. The number of these breaths per minute under normal conditions is 16-20, while in conditions of anxiety, the frequency of these breaths increases up to 30. In my study, the first subject averaged 23 breaths per minute when viewing advertisements based on positive emotions and 19 breaths per minute when exposed to negative context. The second subject developed a respiratory rhythm that was almost similar in both exposures. Thus, in the first set of positive advertisements, we counted an average of 18 breaths per minute, while in the second case, we quantified an average of 17 breaths per minute. The result of this observation can be interpreted as the development of an anxious behavior in the first case, which was also reflected in the graphic measurements obtained by electrocardiogram. At the same time, a constant emotional state was identified through a normal heart rate that was almost similar between the two exposures in the case of the second subject.

4.3 AFFECTIVE DISTRESS PROFILE (PDA PLUS POST-EXPERIMENT)

In order to verify whether there was a change in the emotional state following exposure to the two sets of advertisements among the participants in this experiment, we administered the PDA Plus instrument once again. However, this time we asked the participants to only fill in the spaces related to their emotional characterization at that moment. Thus, the first subject obtained a total of 123 points. This score represents a state of high anxiety. The values obtained are consistent with the indices monitored during the experiment, through the graph obtained from the electrocardiogram. These values support the behavior of the first subject as an interesting one to study, especially regarding the development of a below-average heart rate in the case of advertisements formulated on negative emotions. Keeping in mind the method of interpreting the results of this instrument, and knowing how the scores obtained relate to a maximum of 130 points, we can verify the first score obtained before the experiment and the latest recorded values. Thus, a difference of four points is observed, supporting the evolution of the subject's anxiety and bringing it closer to the maximum limit.

On the other hand, the second subject obtained 117 points. This score highlights a small change in the emotion felt by the subject, with a negative difference of 3 points compared to the value obtained in the first test. It is interesting to study what caused this deviation from the maximum score, relaxing the subject. One interpretation could be supported by the creation over time of a resistance to stress, being less affected by an emotional mix. From another perspective, it can be said that the subject does not react significantly to the elements used in these ads.

Regarding the decisions made in the last set of A-B format questions, we found only one interesting and noteworthy detail. As can be seen, the first participant showed sensitivity

during the viewing of the negative set of advertisements. This was due to an accident involving his father. The emotional sensitivity was physically manifested by the development of discomfort in the second part of the experiment, during the viewing of ads that exploited the parent-child relationship as a basis for influence by creating a positive emotion. In the first case, it was manifested by a low heart rate, and in the second, by an attitude change. These combined details led to the influence of the final choice moment, when the participant avoided choosing the "car" option as a means of transportation, opting for a different option each time.

In the second case, the subject was relaxed throughout the experiment, not being disturbed in any way that would later manifest in their final decision.

5. CONCLUSION

The conclusion of this study is formulated by fulfilling all chapters in order to represent a verified informational complex. The research idea emerged from the analysis of existing theory, which constitutes the starting point of this work. Beyond the analytical dimension, we tried to demonstrate practically the attitudinal and emotional changes that occur by creating a certain context favorable to these fluctuations.

Therefore, the paper presents in turn the establishment of a marked affective identity, a tendency to justify the decision-making process through an affiliation of one's own responses, using an affective grounding of decision-making cognitive processes. Then, in the same theoretical context, the paper brings together different and interdisciplinary perspectives that refer to the anatomy of emotions and their power to influence an act considered rational.

According to the initial results obtained from this pilot study, from the analysis of the information obtained through the application of the PDA Plus tool, we understand an increased sensitivity regarding the content of advertisements that use negative actions. The subjects show a predisposition to react more sharply in moments that involve negative emotions. However, it is interesting how the first subject participating in this study reacted according to his response to the second question of this tool. My expectations were that his heart rate would increase, and a significant increase in frequency would be noticed when he was exposed to ads that exploited negative emotions in public campaigns featuring accidents. These expectations were formed following recognition of a precedent involving his father. However, contrary to my predictions, the subject lowered his heart rate by 15 beats per minute below normal. Thus, I identified the second phase of the natural reaction in the anxiety phase. Based on the literature, in situations that trigger negative emotions, the heart rate increases abruptly at first, and then it decreases to a level recognized as normal. Continuing this observation with the first subject, in the case of ads that use positive emotions, no notable changes were reported. Again, based on their antecedent, my prediction was that there would be some sort of influence on their heart rate, suggesting that the parent-child relationship exploited by some of these ads could produce a significant change. On the other hand, from my observations during the experiment, I noticed an attitudinal change. Specifically, the subject began to fidget and show signs of discomfort. Studying the final results, I could not find any correlations between the electrocardiogram recordings and the moment of agitation manifested by the subject.

Furthermore, during the post-experiment questionnaire, the subject modified their obtained score by increasing it, reflecting a high level of anxiety. Therefore, we can say that the first subject went through different states explained by the development of emotions due to the advertisements they were exposed to, and due to the context created. Regarding the decision-making system at the end of the questionnaire, the subject chose different means of transportation than driving twice. This may reflect a sensitivity resulting from their antecedent (father's accident) and exposure to public health campaigns referring to accidents and traffic safety.

According to the observations made during the experimental process, the second subject exhibited a relaxed attitude from the beginning. This emotional balance can also be seen in the difference in the score obtained after the post-experiment questionnaire. Furthermore, the subject was able to relax more than before participating in the experiment, which is an unusual and interesting situation. The subject maintained a heart rate close to normal estimates and exhibited a natural attitude during the viewing of the advertisement sets. There were no notable reactions or behavioural expressions that could indicate the impact of these advertisements on the subject. Regarding the decision-making process in the second subject at the end of the experiment, there was no significant difference in their choices. Therefore, I acknowledge the need to study these aspects on a larger number of participants, to observe whether there is a tendency to reject emotional influence or whether this is a particular case, in order to understand what makes it such a strong emotional inhibitor.

It is necessary to mention the ethical dimension present throughout my experiment. I prepared an agreement which the subjects signed, indicating their commitment to the entire process. They were only given this agreement after receiving a set of information to understand the meaning of their participation, as well as the freedom to withdraw at any time if they no longer feel safe.

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INNOVATION PERFORMANCE IN ROMANIA

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ABSTRACT: *Innovation has become the modern society symbol, a solution for solving many problems and a phenomenon that must be studied. Although it has always existed, innovation gained real importance in the 20th century. To some extent, every person is innovative: the artists are innovative, the scientists are innovative, and so are organizations.*

Research and innovation provide us with the knowledge and solutions needed for urgent issues, such as socio-economic crises, but also for long-term societal challenges. In everyday life, research and innovation bring improvements in various socio-economic fields and is the launching pad for many new products and services.

Although Romania is a modest innovator, the export of high-tech products and the penetration of broadband Internet services are the only two indicators in the European Innovation Scoreboard that show our country's innovation performance. For this reason we consider that it important to analyse in this paper the place that Romania occupies in the European Union through the lens of the two indicators mentioned above, as well as the position of our country compared to the group of leading innovative countries, but also to the group of emerging innovative countries, group of which Romania is a part.

Keywords: *research, development, innovation, performance, Romania*

JEL Classification*: O00, O31*

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1. INTRODUCTION

Innovation has become the modern society symbol, a solution for solving many problems and a phenomenon that must be studied. Although it always existed, innovation gained real importance in the 20th century. To some extent, every individual is innovative: artists are innovative, scientists are innovative, and so are organizations.

In the current approach, innovation is a process by which a domain, product or service is renewed and updated by applying new processes, introducing new techniques or establishing successful ideas to create a new value. Innovation is not just the introduction or implementation of new ideas or methods, but it can be defined as a process involving multiple activities to discover new ways of doing things.

In the present, we are positioned in a fast-paced environment where technology is advancing and globalization is developing. This means that the market competition is increasing and customer expectations are higher. For a business or organization to gain competitive advantages, it must be able to adapt and innovate according to changing trends and new generations.

Innovation creates great opportunities and is essential to a company's survival, economic growth and success. Innovation helps develop original concepts and is an engine for optimizing operations. Companies that innovate are able to place the organization in a different paradigm to identify both opportunities and the best ways to solve current problems, actions needed to create new ideas, processes or products that, when implemented, lead to positive and effective changes. [1]

Research and innovation provide us with the knowledge and solutions needed for urgent problems, such as socio-economic crises, but also for long-term societal challenges. In everyday life, they bring improvements in various socio-economic fields and are the launching pad for many new products and services. That is why we consider it necessary to analyse the factors that favour innovation in our country.

2. FAVOURABLE FACTORS OF INNOVATION IN ROMANIA

In terms of the innovation system performance Romania ranks last in the European Union, belonging to the group of emerging innovative countries. Our country registers the lowest values, being at a considerable distance even from the countries in its group (emerging innovators). However, the export of high-tech products and the penetration of broadband Internet services are, in our opinion, indicators that show our country's innovation performance.

In this context, we consider it important to analyse the place that Romania occupies in the European Union through the prism of the two indicators mentioned above, as well as the position of our country compared to the group of leading innovative countries, but also to the group of emerging innovative countries. According to the innovation systems performance of the European Union Member States, the group of leading innovative countries (with the performance of innovation systems well above the EU average) consists of Belgium, Denmark, Finland and Sweden, and the group of emerging innovative countries (with the performance of innovation systems well below the EU average) is made up of Romania, Bulgaria, Latvia, Poland, Slovakia, Hungary and Croatia.

Export of high-tech products

"High technology" is a term generally applied to economic and industrial sectors where technological innovation is emphasized. High-tech industries play an important role in the modern economy. [8] The creation of new technologies, their efficient use and their

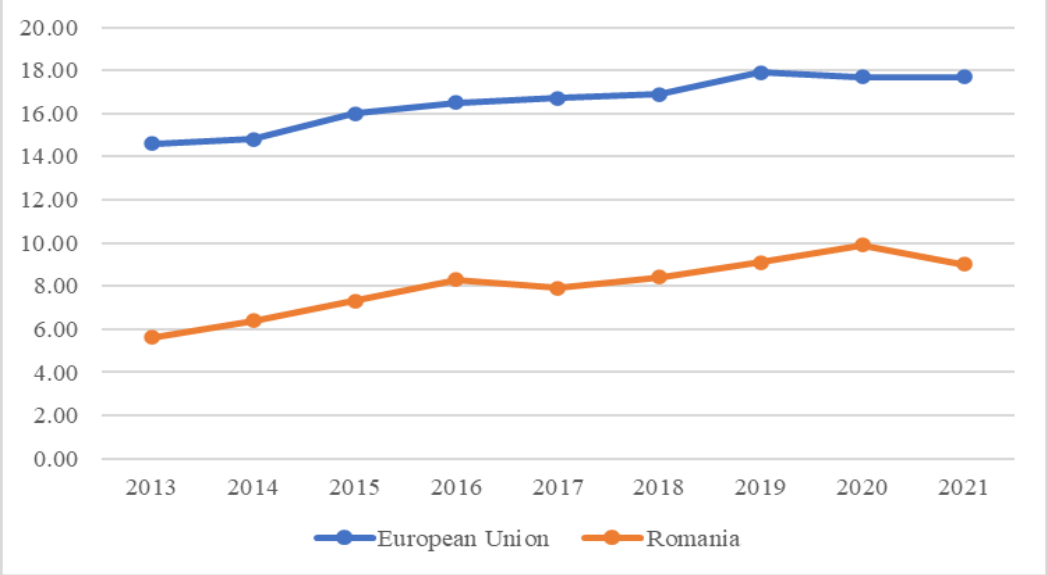
introduction to the market are essential in the global race for competitiveness. High-tech sectors and enterprises are key drivers of economic growth and productivity and generally provide high-value-added jobs. [4]

The indicator "export of high-tech products" shows the share of exports of all high-tech products in total exports. The high-tech products included in this indicator are defined as the sum of products from the fields of: aerospace, computers-office machines, electronics-telecommunications, pharmacy, scientific instruments, electric machines, chemistry, non-electric machines and armaments. A first analysis of this indicator aims at the positioning of Romania in relation to the average of the European Union.

As it can be seen, in the last 9 years Romania had, in general, an increasing evolution in terms of exports of high-tech products, being in most of the analysed period at half of the European Union average. Regarding the trend in the European Union, it is also predominantly increasing in the analysed period, the highest value being reached in 2019.

The increasing evolution of the high-tech products exports can be explained by the increase in the complexity of the exported products and the advanced technologies underlying them, as well as by the evolution of global demand and supply, which influences the prices of these products. These trends highlight, at the same time, the increase in the degree of adaptation of Romanian export products to the conjuncture of foreign markets.

Figure 1. Exports of high-tech products Romania – EU



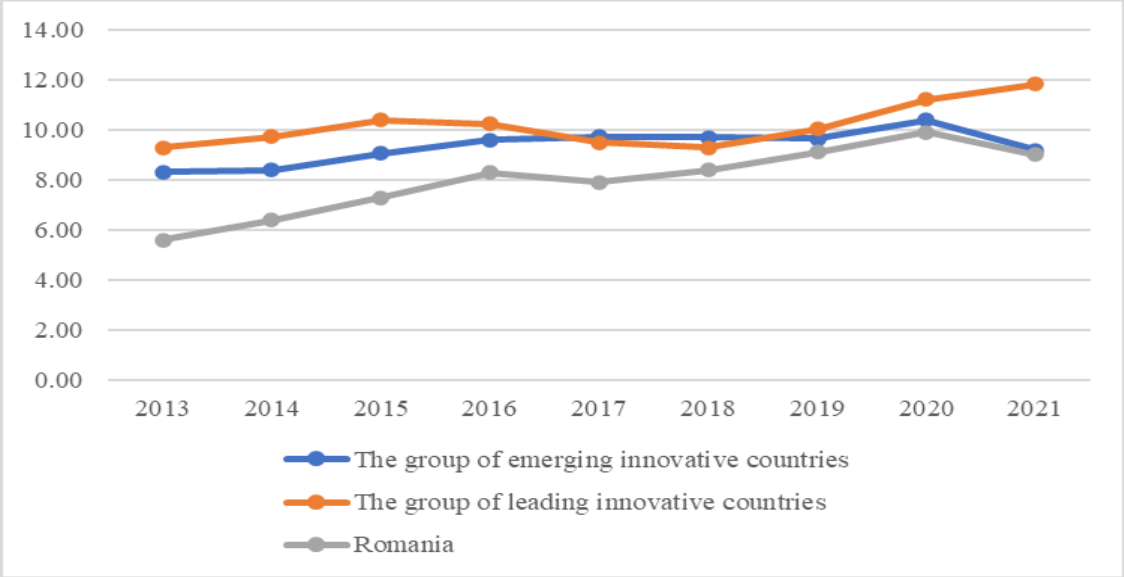
Source: https://ec.europa.eu/eurostat/data/database

It is also worth mentioning that Romania is an important regional centre for software developers, several cities in this country being associated with the IT sector. Among them is not only Bucharest, but also Cluj, being often referred to as the "Silicon Valley of Europe", Timișoara, Iași or Brașov. Statistics show that Romania has a higher number of software developers per capita than in the United States of America, China or Russia. IT specialists from Romania are particularly renowned for software development, web pages or fintech. From the point of view of employees in the IT sector, Romania presents a high level, having almost 200,000 specialists and being close to the level of the Czech Republic. [2]

Regarding Romania's position in relation to the two groups of analyzed countries (leading innovators and emerging innovators) we can appreciate that the differences between the exports of high-tech products of our country and the exports of high-tech products of the

other countries (expressed as a percentage of total exports) have softened considerably in the last 9 years.

Figure 2. Exports of high-tech products Romania – group of emerging innovative countries – group of leading innovative countries



Source: author own processing, https://ec.europa.eu/eurostat/data/database

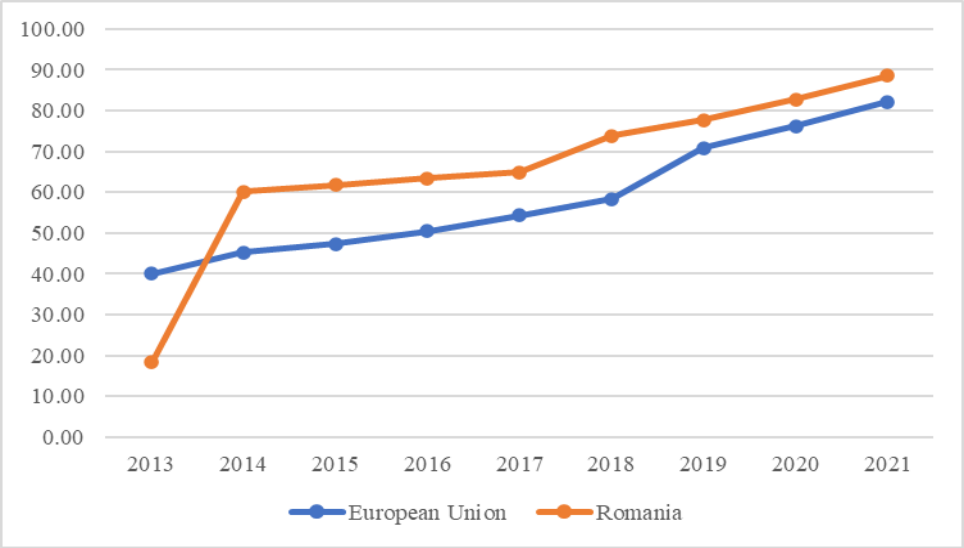
Thus, in 2021 the difference between Romania and the group of leading innovative countries was 2.83% compared to 3.70% in 2013, and last year the difference between Romania and the group of emerging innovative countries was only 0.20% compared to 2.71% in 2013. Therefore, we can say that our country has constantly improved the level of the share of high-tech product exports in Romania's total exports (from 5.60% in 2013 to 9.00% in 2021), thus aligning with the average of the group of countries to which it belongs.

Penetration of broadband internet services

Broadband Internet refers to high-speed Internet, namely faster and better Internet access, which is becoming increasingly important not only for business competitiveness, but also for supporting social inclusion. [7] The development of society depends to some extent on the use of broadband networks, thus these services become absolutely necessary to maintain and increase the quality of everyday life.

The indicator we use in our analysis shows the percentage of high-speed Internet users (over 100 megabits per second) in Romania compared to the European Union average, the group of leading innovative countries and the group of emerging innovative countries.

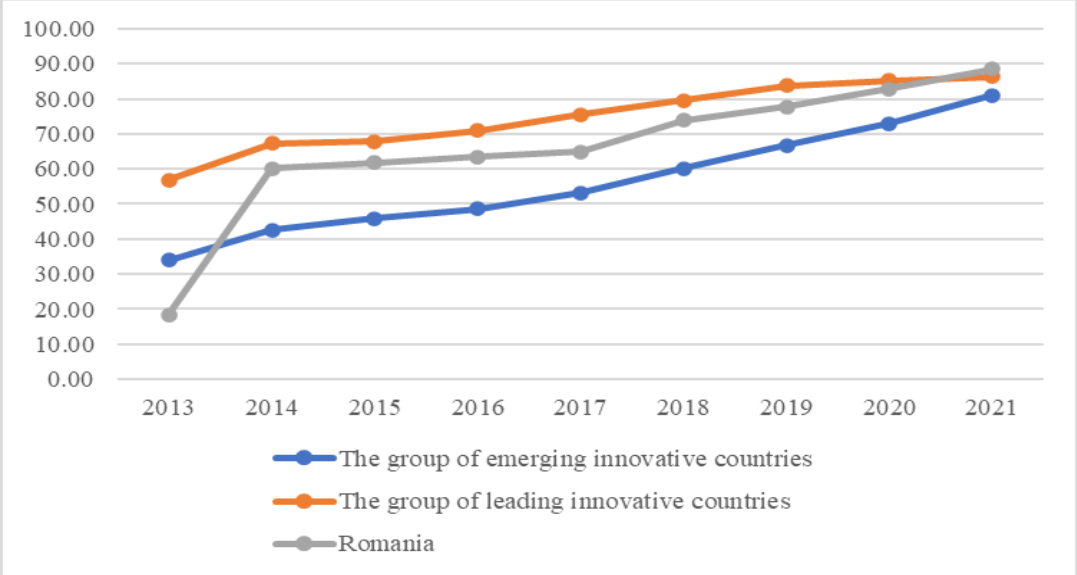
Figure 3. Penetration of broadband Internet services Romania – EU



Source: https://ec.europa.eu/eurostat/data/database

Regarding the penetration of broadband internet services, Romania had an upward evolution during the last 9 years, registering a spectacular increase in 2014 with over 40% compared to 2013. This increase was due to the introduction of 4G technology in Romania, a technology that offered broadband internet speeds of up to 150 Mbps [3], the transition from analogue to digital television and access to European funds, through the RO-NET project [6], for the expansion of broadband internet in rural areas for economic reasons and social inclusion. Since 2014, our country has consistently exceeded the European Union average, reaching 88.6% broadband Internet users in 2021, compared to 82.10%, which was the average of EU countries.

Figure 4. Penetration of broadband internet services Romania – group of emerging innovative countries – group of leading innovative countries



Source: author own processing, https://ec.europa.eu/eurostat/data/database

The evolution of the analysed indicator is increasing both in Romania and in the groups of leading and emerging innovative countries. As an absolute novelty we can observe that in 2021 Romania even exceeded the average of the group of leading innovative countries by 2.30%.

In addition to the investments made to expand broadband internet services in Romania, one explanation could be that our country has the lowest price for these services in the European Union, followed by Lithuania, Poland and Bulgaria. [5]

Therefore, almost 89% of the Romanian population has access to the Internet. Efforts to reduce costs and make the Internet accessible (Romanians pay 1.1% of income for the Internet) have led to an increase in education and the consumption of digital products. We believe that it is necessary to strengthen trust in digital services. To do this, standards must be set and information provided. Users should know (especially from a legal point of view) what it means to issue an electronic invoice, sign an electronic contract, the legal value of a digital signature, the rights and obligations of processing personal data.

3. CONCLUSIONS

Romania is an emerging innovative country, occupying the last place in the European Union in the field of innovation, with an innovation performance well below the EU average. We believe that the existing research-development-innovation system in Romania is not able to ensure overcoming the condition of a modest innovator, due to some of its weaknesses, among which the most important are: extremely low R&D expenses, compared to innovative countries leader and even with the average of the European Union, the excessive priority given by some institutes to fundamental research, to the detriment of applied research, the lack of adequate incentives in favor of CDI, the lack of a periodic analysis of the real correlation between the needs of Romanian society and the priority programs as a research direction within national programs.

In conclusion, we can say that thanks to recent developments, the next "normal" world will be more digital than today. The transformations that society has gone through in the last two years have shown how important digitization is for national economies, allowing the continuation of work and economic activities in many sectors of activity, and the fact that our country is a leader in the penetration of broadband Internet services is an advantage. Pandemic restrictions have accelerated citizens' use of digital services and forced companies and governments to adjust how they interact with them. Many business decision-makers have seen digitization as a necessary step forward, but to successfully achieve digital transformation, companies need a holistic approach, digitizing interactions and optimizing customer operations.

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DEVELOPMENT PROCESS ANALYSIS OF DIGITAL ECONOMY TECHNOLOGIES

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ABSTRACT: *Most countries are in the process of digital transformation of society and economy, but the process is very different from country to country. In some countries there are more innovation and social development projects than in other countries, these projects address global as well as local social difficulties. The potential for social innovation could be influenced by the different levels of digital transformation. This study investigates the degree of influence of the transformation of the digital economy on society and the capacity for Social Innovation. Based on the data processed within the framework of the article it is concluded that the digital transformation of the economy and society has a significant positive impact on the capacity for Social Innovation. In conclusion, digital transformation with all its advances has a beneficial role on the capacity for Social Innovation.*

Keywords: *digital economy, digital information, automation, digital society, technology.*

JEL Classification: *D83, D84, O33.*

1. INTRODUCTION

The digitization of economic processes is gradually turning into a broad trend, which covers both the communications and Information Industry and all areas of economic activity. Regardless of the direction we consider, the importance of digital evolution is felt everywhere, for example in digital agriculture, e-commerce, smart grid systems, and personalized healthcare. In this situation, individual countries, regions and companies begin to dynamically engage in the process of creating and implementing strategic decisions in the field of digital economy, trying to establish their long-term competitive advantages in new emerging markets, new types of technologies, goods and services. The orientation towards digitization requires, in addition to a well-organized implementation plan, a change in the mentality of the human factor corroborated with the evolution of the organizational culture of economic entities (Coman D.M. et al., 2022).

In actual society, man is significantly affected by the globalization of all processes, the digital economy, the import and exports of educational services, the increasing uncertainty of political and economic development, and the creation of a society of knowledge, and this forces us to consider all these aspects. But the human brain continues to trust traditions and not accept innovations that impede the development of professional careers and personal lives more quickly (Negrea M, 2009). Technology is an essential condition that contributes to the

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influence of global economic competitiveness and European economies. High-tech industries are expanding in international trade and their strength of movement helps to improve performance within other sectors. A key EU policy area is investment in development, innovation and skills, which are fundamental to growth as well as the development of the knowledge economy.

2. LITERATURE REVIEW: DIGITAL TECHNOLOGY

The history of the modern computer did not begin with the Internet, as many believe, but begins in 1945 with the commercialization of technologies that were developed during the Second World War. The first machines of this kind focused on fast computing, but had little information retrieval and data storage capacity. In the year 1950, magnetic core memories began to have the ability to efficiently store digital information, and automatically then the first benefit of representing information in bits resulted, that is, automatically and the lower cost of reproducing information. Over the years these storage technologies, software and hardware have acquired a higher quality, resulting in greater processing and reproduction of information worldwide with a wide spread, these industries are expanding rapidly.

Although the advent of computers has made manual calculation easier, there is still limited communication between them due to the lack of internet. After the advent of the Internet, it was the starting point for cheap, commercial communications and the representation of information in bits, which had an increased effect on several markets. This development was reinforced on key advanced inventions due to US military funding in the 1960s and 1970s. For example, the Defense Advanced Research Projects Agency (DARPA) sponsored the invention of packet switching, which involved breaking down a long message into several shorter messages that can be sent over a network and reorganized upon receipt. DARPA funded the researchers, who made advanced improvements to the special packet-switching standards that are supposed to drive communication over the Internet, such as Transmission Control Protocol/Internet Protocol (TCP/IP). During 1980, the National Science Foundation (NSF) created the first part of a network based on that protocol, thus creating a reliable infrastructure, easy to adopt, but with a limited research area.

Between 1990 and 1995, privatization took place, transforming the modern commercial Internet. The commercial Internet spread rapidly, and universities played a key role in this spread. Over the years, new technologies have been layered over the TCP/IP-based consolidated core Internet, along with browsers, search engines, social networks, online shopping, mobile communication protocols, and more. These technologies, along with many others, have enabled the collection and application of data at an increased level.

All these development processes gave birth to the question of who should control the various aspects of commercial activity on the Internet, given the historical context of decentralization, standards being repeatedly agreed upon through the mediation of committees with delegates from academia and industry. Such standards have particular bearing on widely adopted technologies, their establishment creating winners and losers. Simcoe in 2012 examined the incentives in expanding standards for the standards-setting organization, the Internet Engineering Task Force, showing convincingly that the commercialization of the Internet has led to a decrease in the intensity of standards development due to competing commercial interests. Knowing their importance, the automatic control of hardware and software standards is a controversial one (Simcoe T., 2012). Combining emerging technologies (Artificial Intelligence (AI), Machine Learning, Virtual Reality (VR), Big Data Analytics, Internet of Things (IoT)) with improved 5G connectivity will significantly contribute to the metamorphosis of society and the economy to the 4th industrial revolution or Industry 4.0. Artificial intelligence, automation processes, Big Data, the cloud, algorithms, and 5G

technology contribute to machine activation and industries such as food, retail, and banking becoming more digitalized (Ionescu C.A. et al., 2021).

3. IMPACT OF DIGITAL TECHNOLOGIES TOWARDS ECONOMIC AND SOCIAL DEVELOPMENT

In recent years there has been a transformation of economic activities worldwide especially due to digitization, drastic mitigation of the costs of collecting, storing and processing data and increasing computing power (UNCTAD, 2019).

The UN reports present the volume of new opportunities that are allowed due to the development of the digital economy, including support for small companies in developing countries to access the global market, which allows freedom to integrate more effectively with the global market and achieve new opportunities for income generation. Information and communication technologies (ICT), new digital applications and e-commerce are used to advance entrepreneurship, as well as to support creative innovation and production activities and to achieve attractive new jobs, including supporting the skills of women as entrepreneurs and traders. The financial integration is also facilitated by mobile and digital solutions. Through free access to the internet, the small companies in the process of development can have the opportunity to access various services "in cloud" and of course to receive financing to carry out their activity on various internet platforms (Casella B., et al., 2019).

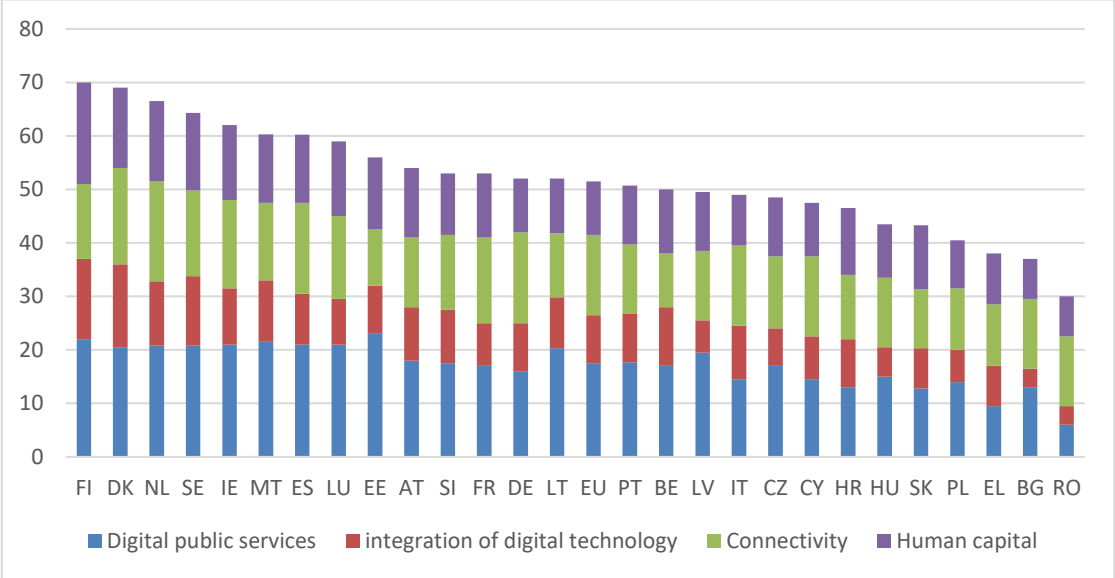
Although there are so many opportunities, UNCTAD experts say that many developing countries, especially the least developed countries (LDCs), are not yet sufficiently prepared to take advantage of these opportunities that digitization offers. As such, there is also a risk that digitalization will increase polarization and deepen income inequality, as the essential gains from labor productivity can be generated by a limited group of highly skilled professionals. The increased dynamics of development is specific for economies that use mainly internet platforms, where good functioning offers increased benefits, especially for first contractors. True, the world's top four companies by market capitalization - Apple, Google, Microsoft and Amazon - are closely tied to the digital economy. There are also concerns about how data streams are used in the context of online security and Privacy difficulties. The rapid evolution of the digital economy is due to innovations and technologies that are being used more and more often and that have developed in recent times. The digitization process was made easier by high-speed free access to increased computing power, storage, and reduced ICT hardware and data management costs. The technologies of particular importance underlying the development of the digital economy are artificial intelligence, advanced robotics, the Internet of things, big data analysis, cloud computing and three-dimensional (3D) printing.

Global digital platforms have taken a number of actions to stabilize their competitive position, including procuring potential competitors and expanding into new markets. Microsoft's acquisitions of LinkedIn and Facebook’s of WhatsApp are the most important achievements. Both Google and Microsoft have made investments in telecommunications equipment, buying Motorola and Nokia. Of course, major companies have made multiple acquisitions in the retail, marketing and advertising industries, accessing non-residential real estate markets (Goldfarb A., & Tucker C. 2019). The other phases include strategic investments in research and development and lobbying in national and international decision-making areas. Also, the strategic associations between multinational companies in established sectors are explored.

4. INTEGRATION OF DIGITAL TECHNOLOGIES AT EUROPEAN LEVEL

On the European ranking, Finland, Denmark and the Netherlands have the most developed digital economies in the European Union, followed by Sweden, Ireland, Malta and Spain. Greece, Bulgaria and Romania have the lowest DESI scores (Figure 1.).

Figure 1. Digital Economy and Society Index (DESI) 2022 ranking



Source: Digital Economy and Society Index (DESI) 2022

Some of the most recently published data on the integration of digital technologies at European level in 2021 show that only 55% of SMEs have held at least a basic status to adopt digital technologies, of course with colossal differences between member states (86% Sweden, and 22%-Romania). At least 90% of SMEs in the EU to achieve the digital decade target need to have a core level of digital volume by the end of 2030. Basic digital intensity means that a company consistently uses at least 4 of the 12 chosen digital technologies. For example: social information platforms, the use of cloud technology, online sales platforms, artificial intelligence and enterprise resource programming software. Data published in recent years show that businesses are increasingly digitized, but the application of progressive digital technologies remains low and fluctuates differently depending on the type of technology used. Although data show that 34% of companies in the European Union in 2021 used cloud computing, AI-based technologies and Big Data research are much more unused: only 8% in 2021 of companies used AI and 14% in 2020 used large volumes of data. As a consequence, under the political agreement on the "path to the digital decade" programme by 2030, at least three-thirds of companies are required to start using cloud computing, AI-based technologies and large volumes of data (Evangelista R., et al., 2014).

The "path to the digital decade" programme establishes a way of economic, social and political organization of surveillance and cooperation which has the main aim of achieving the common objectives regarding the digital evolution of Europe. The main focus is on the digitization of online public services, infrastructure, connectivity, digitalization of enterprises and, last but not least, achieving the general objectives of respecting the digital rights and principles of the European Union (Hilbert M., 2022).

4.1. INTEGRATION OF DIGITAL TECHNOLOGY IN ROMANIA

Romania has one of the worst results regarding the integration of digital technologies, ranking last. Most of the indicators rank below the European Union's overall average, some have even declined or stagnated in the past year, although Romania ranks 15th out of 27 countries (Table 1). The share of small and medium-sized enterprises with at least a basic level of digital power was 22%, with the EU average of 55%, so more work is needed to achieve the digital decade target of 90% of SMEs reaching a basic level of digital intensity by 2030.

Table 1. Integration of digital technology

Integration of digital technology	**Romania**		**EU**
	rank	**score**	**score**
DESI 2022	**27**	**15.2**	**36.1**

Source: Digital Economy and Society Index (DESI) 2022

Romania has been outperformed by other EU member states, considering that it makes online sales only 12% of businesses and online sales across borders only 4% of businesses. The uptake of advanced technology, such as cloud technology, reached only 11% , compared to the Union average of 34%, no longer saying that only 1% of companies have introduced such technology in their activity. The share of large data processing is also low, at 5% (compared to the EU average of 14%) (Table 2).

There is also a major gap that needs to be addressed by 2030 to successfully achieve the Digital Decade goal of 75% of businesses using cloud, big data and AI technology. The only satisfactory percentage for Romania, which is slightly above the EU average of 66%, is that of enterprises that have medium to high intensity of green actions through the use of ICT.

Table 2. Indicators of digital technology integration in Romania compared to the EU

Indicators of digital technology integration	**Romania**			**EU**
	NA	**NA**	**22% 2021**	**55% 2021**
SMEs with at least a basic level of digital intensity % SMEs	23% 2019	23% 2019	17% 2021	38% 2021
Electronic information sharing % enterprises	8% 2019	8% 2019	12% 2021	29% 2021
Social media % enterprises	11% 2018	5% 2020	5% 2020	14% 2020
Big data % enterprises	NA	NA	11% 2021	34% 2021
Cloud % enterprises	NA	NA	1% 2021	8% 2021
AI % enterprises	NA	68% 2021	68% 2021	66% 2021
ICT for environmental sustainability	20% 2018	17% 2020	17% 2020	32% 2020

Indicators of digital technology integration	**Romania**			**EU**
	NA	**NA**	**22% 2021**	**55% 2021**
% enterprises having medium/high intensity of green action through ICT				
e-Invoices % enterprises	11% 2019	17% 2020	12% 2021	18% 2021
SMEs selling online % SMEs	5% 2019	8% 2020	7% 2021	12% 2021
e-Commerce turnover % SME turnover	6% 2019	6% 2019	4% 2021	9% 2021

Source: Digital Economy and Society Index (DESI) 2022

The government strategy called "The development of the SME sector and the improvement of the business environment in Romania towards the digital economy in the period 2021-2027" contains transversal measures, such as:

- expanding the network of centers for digital innovation. The process of selecting digital innovation centers that will participate in the network of European digital innovation centers is ongoing. Seven proposals regarding the European digital innovation centers in Romania have registered positive results following the evaluation, namely they are invited to draw up grant agreements (which do not represent a formal funding commitment). An additional proposal is expected to be selected in the coming year.
- opportunities to obtain useful skills for SMEs to benefit from new technologies;
- supporting SMEs for the easy transfer of data, when there is a change of digital service providers, in other words, the free movement of data without a personal character, as the regulation provides;
- would be to raise awareness among small and medium-sized enterprises about the security threat and activate investments in the cyber security sector.

Romania's main obstacles to the transformation of SMEs and most of the economy are structural obstacles. They require the adoption of cross-cutting and comprehensive measures aimed at increasing the level of digital education and the perception of the role of use of digital tools among business leaders. Another factor contributing to the adoption of digital management such as accounting among SMEs is the low level of progress of digital public services. Increasing efforts, in terms of supply in the form of a compelling compound of services and tools to improve business processes and train their employees and management on the use of those services and tools, can facilitate the development of demand from small and medium-sized enterprises.

All these percentages show exactly that there is a significant gap between Romania and the other more developed countries of the European Union. Let's hope that by 2030 with the help of the program "the way to the digital decade" Romania will succeed to align with the other EU countries.

5. CONCLUSIONS

As a result of everything I said in the article above, technology and technological innovation has rapidly infiltrated all areas of society, from business, education and health, to an ever-increasing range of services useful and appropriate to human life. However, it is very difficult for some countries to recover in terms of digital transformation.

Over the last few years, economists have been studying how digital technologies have contributed to the transformation of economic activity in various fields. Although all these articles often have different perspectives and cite different sources, most of them agree that digitization has benefited the economy, reducing a number of specific costs, such as search, tracking, verification, transport and reproduction costs.

Acknowledgement

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THE CURRENT STATE OF INNOVATION IN ROMANIA IN THE EUROPEAN CONTEXT

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ABSTRACT: *In the actual approach, the innovation is a process by which a domain, product or service is renewed and updated by applying new processes, introducing new techniques or establishing successful ideas to create new value. Innovation does not represent just the new ideas or methods introduction or implementation, but can be defined as a process involving multiple activities to discover new ways of doing things.*

In the present paper, we analysed the place occupied by Romania in the european context, through the European Innovation Scoreboard. The purpose of the European Innovation Scoreboard is not to rank economies in terms of innovation, but aim to improve innovation by measuring it as accurately as possible and by identifying policies, best practices and other levers that encourage innovation. The European Innovation Scoreboard supports the EU's commitment to research-development and innovation and to policy development to improve innovation in Europe. According to the latest report of European Innovation Scoreboard Romania is only in the fourth group of innovators in the EU, the emerging ones, which present an innovation performance level below 70% of the European average, our country being in last place in the EU in 2021.

Keywords: *research, development, innovation, Romania, European context*

JEL Classification: *O30, O31.*

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1. INTRODUCTION

The European Innovation Scoreboard (EIS) provides a comparative analysis of innovation performance in the European Union and supports the EU's commitment to research and innovation and policy development to improve innovation in Europe. [5] The European Innovation Scoreboard helps decision-makers to assess the strengths and weaknesses of national research and innovation systems, track progress and identify priority areas to enhance innovation performance. [7]

The new European Innovation Scoreboard measurement framework distinguishes between four main groups of activities, comprising 12 dimensions of innovation and a total of 32 different indicators. Each main group includes a number of indicators and has an equal weight in the EIS. Within each group, each indicator has the same weight.

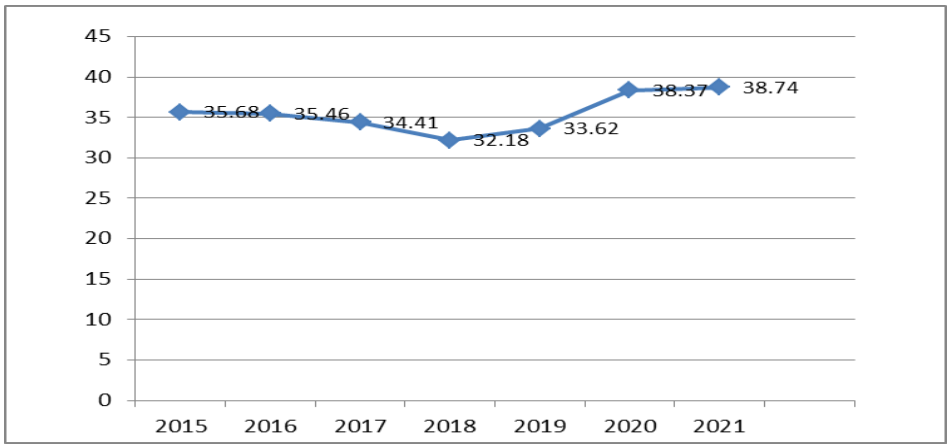
According to the European Innovation Scoreboard 2021, compared to 2014, innovation performance for all EU Member States increased by 12.5%, mainly due to improved broadband internet penetration, venture capital investments and increasing the number of international scientific co-publications. In previous EIS reports, less innovative countries tended to improve their performance faster than more innovative countries. Between 2014 and 2021, there was a moderate rate of convergence in innovation performance across Member States, the countries with lower economic performance improved their level of innovation performance at a higher rate than countries with higher economic performance.

2. ROMANIA'S POSITION IN THE EUROPEAN INNOVATION SCOREBOARD

According to the European Innovation Scoreboard 2021, Romania is an emerging innovator and in terms of innovation performance occupies the last position in EU. As can be seen in Figure 1, the evolution of the global innovation index for Romania has not changed significantly over time. If in the period 2015-2016 the relative performance compared to the EU recorded the value of approximately 35%, in 2021 it recorded a modest progress reaching the value of 38.74%.

In order to deepen the analysis of Romania's position in the European innovation landscape, we will analyse the sub-indices calculated by groups of indicators for 2021. The analysis of these innovation sub-indices will allow the identification of the weak and strong points of innovation in Romania, which ranks last in 7 of the 12 dimensions of EIS.

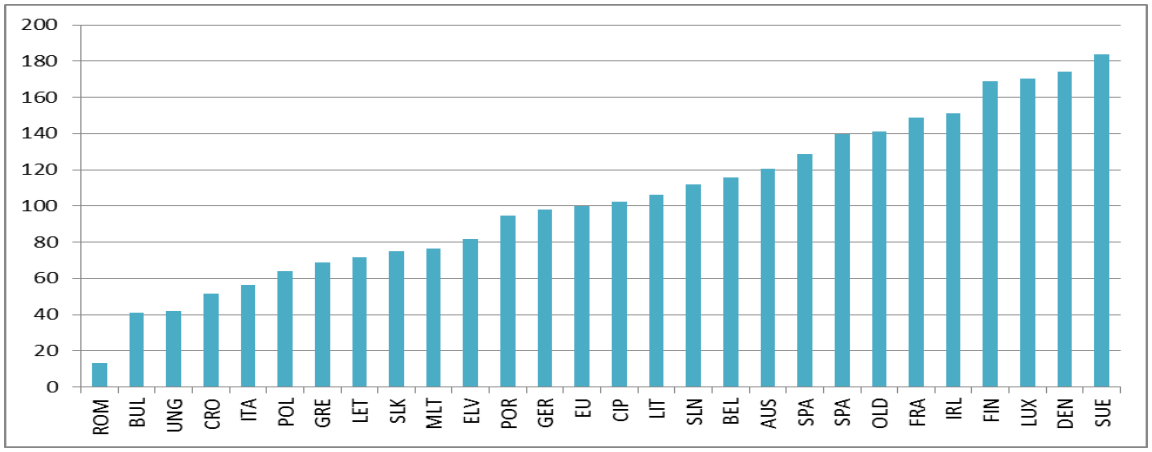
Figure 1. Evolution of the Global Innovation Index for Romania (2015-2021)



Source: Author own processing based on EIS 2021 data, https://ec.europa.eu/research-and-innovation/en/statistics/performance-indicators/european-innovation-scoreboard/eis

Romania occupies the last position in the EU depending on the value of the human resources dimension synthetic index with a value of 17.37. The value of this index was in 2021 at only 13.2% compared to the EU average.

Figure 2. Synthetic index of the human resources dimension in the EU



Source: Author own processing based on EIS 2021 data, https://ec.europa.eu/research-and-innovation/en/statistics/performance-indicators/european-innovation-scoreboard/eis

This last position is primarily determined by the decrease compared to 2014 in the number of graduates with a doctorate and in the number of people with lifelong training. At the same time, according to Eurostat, Romania is the European state with the lowest number of people with higher education, about 23% of the country's population aged between 25 and 34 graduating from tertiary education. [6]

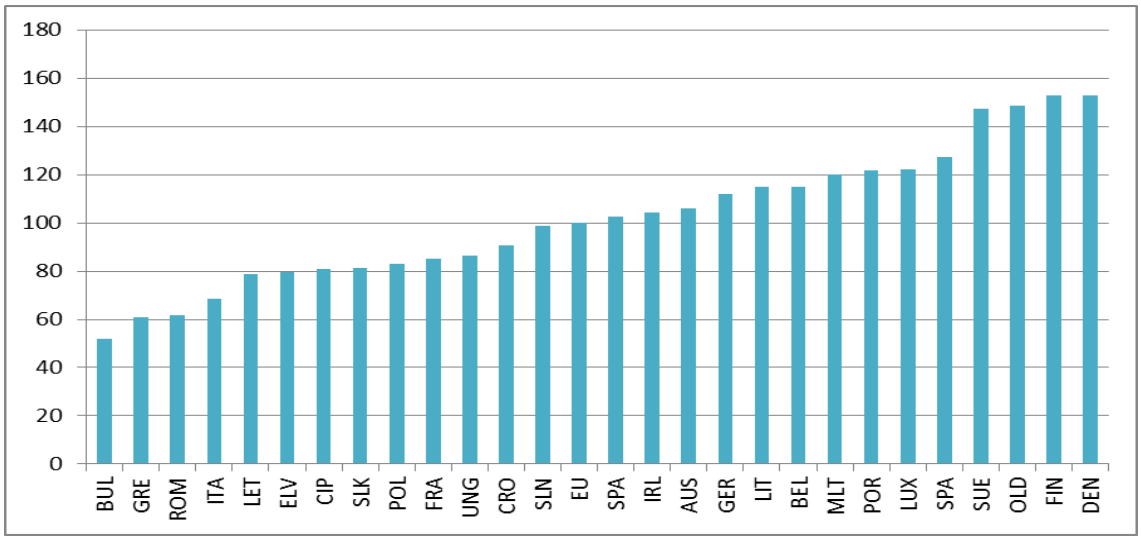
Closely related to this dimension, it is important to mention that Romania has the lowest number of researchers in the EU 27. Since 1993 the total research and development personnel has decreased substantially from over 73,611 to 33,892 in 2000. Since then the number of researchers it stabilized around the value of 30,000, reaching in 2020 the value of 33,189. However, the number of R&D personnel in higher education has increased over the past two decades from 3,780 in 2000 to 8,862 in 2020, peaking at 9,000 in 2015.

Regarding the research attractiveness dimension, Romania is in the category of modest innovators, occupying the penultimate place, ahead of Bulgaria and well below the EU average (research attractiveness being in 2021 at 35% compared to the EU average). This position is determined by the poor research and development funding and the low prestige of research organizations (research institutes, public or private universities).

Regarding the digitization dimension Romania ranks 25th out of the 27 EU member states, the synthetic index of the digitization dimension registering in 2021 a value of 61.8% of the EU average. One factor that has contributed to this position is the broadband internet coverage increasing. According to DESI 2020, Romania ranks 10th in the EU in terms of connectivity, it has improved its results in terms of coverage, with broadband coverage increasing up to 87% and reaching the EU average. [1]

Even if in terms of broadband internet penetration Romania has reached the EU average, in terms of the population with digital skills above the basic level the situation is not favourable, Romania occupying the last place in the EU with only 10% of people having these skills (comparatively with 30% European average).

Figure 3. Synthetic index of the digitization dimension in the EU



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The value of the finance dimension synthetic index in Romania represents 28.7% of the EU average value, which determined Romania's 23rd place among European states. Within this dimension, the most unfavourable situation is recorded in terms of the level of expenditures for research and development in the public sector. Public spending on research and development in recent years was far from the target of 1% of GDP, respectively: 0.13% of GDP in 2020, 0.17% in 2019, 0.15% of GDP in 2018.

In 2020, Romania had the lowest value of the research and development expenditure as a percentage of GDP in the EU (0.47% of GDP, of which business R&D expenditure was 0.28% of GDP) and the 2% target for 2020 was not reached.

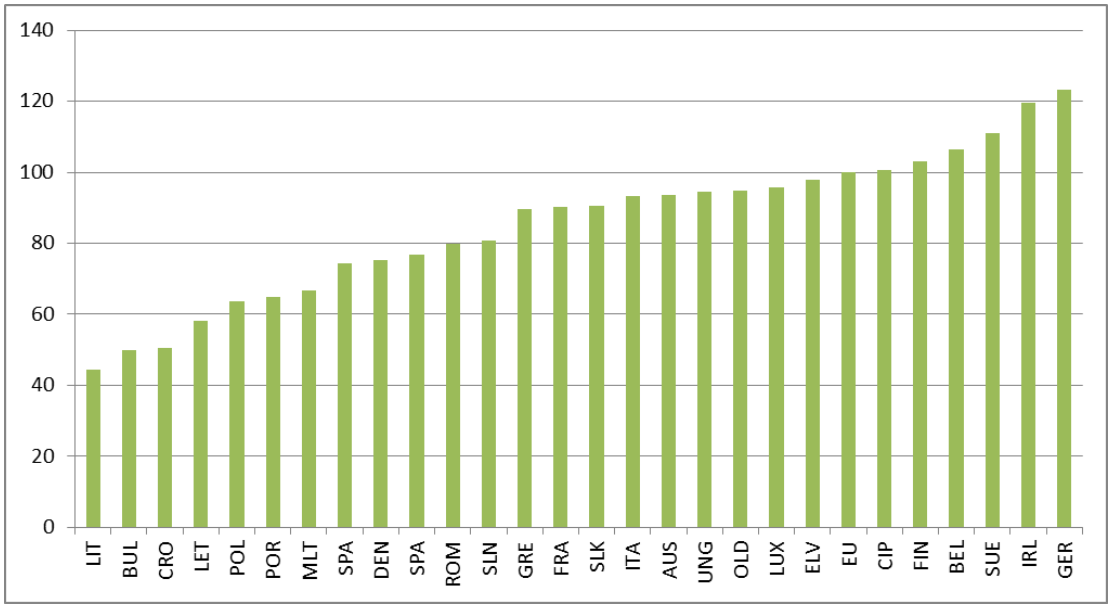
Romania's position in the Finance and support dimension was improved by the value of venture capital investments. In 2021, the Romanian venture capital market broke the 100 million euro barrier of venture transactions for the first time in the post-UiPath era. The amount of capital raised in 2021 by Romanian start-ups more than tripled compared to the previous year, going from 30 million euros in 2020 to over 116 million euros in 2021. [8]

The value of the synthetic index of the Firm Investments dimension places Romania in last place in the EU (representing 7.2% of the European average in 2021). The research and development expenses of the private sector environment in Romania were in 2020 only 0.28% of GDP, Romania occupying the penultimate place in the EU (the EU average being 1.46% of GDP). [10] Through the National Strategy for Research, Innovation and Smart Specialization 2021-2027, Romania aims to reach the level of 1% by 2027 also for the research and development expenses of the business environment. [3]

Romania takes the last place in the EU also in the Use of information technologies dimension. The relative position in relation to the EU in 2020 of Romanian businesses that offer training to develop or improve their staff's ICT skills is 6.7%. A relatively better position within this dimension is occupied by the share of ICT specialists employed, Romania registering in 2021 a share of 2.6% (compared to 4.6% in the EU) increasing compared to 2020 (when it had a value of 2, 4%). However, Romania is far from the European leader Sweden, which recorded a share of ICT specialists in total employees of 8%.

The highest position is occupied by Romania in the case of the Sales Impact dimension (Figure 4). The indicator that contributed to Romania occupying a relatively good position in this dimension is the export of high-tech products. Romania is an important centre for software developers, and IT specialists are recognized in this field. However, the lack of sophistication of the national market, the weak public procurement of innovation, along with other factors, block the development and internationalization and are the cause of the export of innovation-based businesses. [4]

Figure 4. Sales impact synthetic index in EU



Source: Author own processing based on EIS 2021 data, https://ec.europa.eu/research-and-innovation/en/statistics/performance-indicators/european-innovation-scoreboard/eis

Even in the case of the Innovators dimension, the situation is not favorable for Romania, occupying the 27th place among European states. The provisional results of the statistical research on innovation in business enterprises show that in the period 2018-2020, the share of enterprises that introduced new or improved products or business processes to the market, in the total number of enterprises, was 10.7 %, which represents a decrease of 3.9 percentage points compared to the period 2016-2018. Of the total enterprises, 4.4% were innovative only of new or improved products, 3.1% applied only for business process innovations, and 2.6% implemented only product and business process innovations. The decrease in the share of innovative product enterprises is due to both the decrease in the share of innovative goods and service enterprises. [2]

The value of the Linkages dimension synthetic index places Romania in the last place in the EU. Within this dimension, the indicator that has a positive influence is the number of public-private Co-publications. Romania had 19.1 public-private co-publications per 1 million

inhabitants in 2018 (latest available data), according to the European Commission report. Even so, Romania is in second to last place in the EU for this indicator.

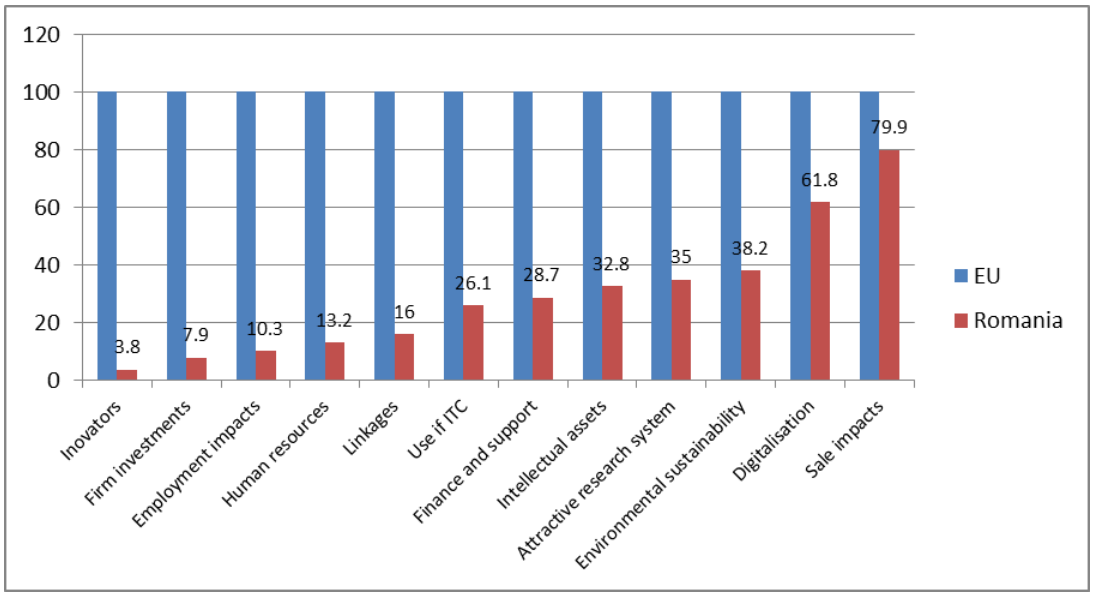
Even in the case of the Intellectual Assets dimension, Romania's situation is not favourable, occupying the last place in the EU according to the value of the index related to this dimension (the value of the Intellectual Assets dimension index representing 32.8% of the EU average). The indicator that has a negative influence on the value of the intellectual asset dimension index is the number of PCT (Patent Cooperation Treaty) patent applications. Romania registered only 40 applications in 2019 at the European Patents Office (EPO), 3 times less than the target for the year 2020.

The last place is occupied by Romania also in the case of the Employment Impact dimension, the mobility of human resources in science and technology (HRST) being the lowest in the EU (2% compared to 7.8% in the EU). [9]

Analysing the relative position of Romania vis-à-vis the EU in 2020 within the 12 dimensions of the EIS, it can be observed that in the case of two dimensions - Sales Impact and Digitization Romania is close to the EU average (recording values of 79.9% and 61.8% respectively of the EU average). At the opposite pole are the dimensions Human resources, Employment Impact, Firm investments and Innovators, for which Romania recorded values far below the EU average (Figure 5)

Romania scores best in the Connectivity dimension and is well positioned in terms of ICT (Human Capital) graduates, but the digitization of the economy lags far behind. Regarding digital public services and the use of internet services, Romania has the worst performance in the EU [1].

Figure 5. Innovation performance in Romania compared to the EU



Source: Author own processing based on EIS 2021 data, https://ec.europa.eu/research-and-innovation/en/statistics/performance-indicators/european-innovation-scoreboard/eis

3. CONCLUSIONS

According to the European Innovation Scoreboard 2021, the evolution of the global innovation index has not changed significantly over time, Romania occupying the last place in seven of the twelve dimensions of the EIS. However, compared to 2014, Romania's

performance improved in the case of most of the dimensions analysed in the European Innovation Scoreboard (less so in the case of the Human Resources, Business Investments, Innovators and Environmental Sustainability dimensions).

Among the areas in which Romania recorded values of the indicators close to or above the EU average are the export of high-tech goods, broadband internet penetration and venture capital investments. On the other hand, the list of weak points includes a much larger number of indicators, which reflects the poor level of innovation performance in Romania.

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INNOVATIVE MANAGEMENT OF PUBLIC UTILITIES – THE CASE OF PUBLIC-PRIVATE PARTNERSHIPS IN WATER SUPPLY

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ABSTRACT: *The current paper analyses the particularities of managing public utilities such as drinking water supply and sewerage, in the larger context of sustainable development, with an inter-disciplinary approach tangent to marketing and public communication and offers several innovative solutions to the issues identified, with particular interest to implementing public-private partnerships.*

Keywords*:* *Innovative management, sustainable development, water, public communication, public-private partnership*

JEL codes : O13, O31, Q25, Q55

1. INTRODUCTION

As the world changes, with population growth and technological advancement putting a higher stress on the natural resources, our understanding of the ecosystem and its fragile equilibrium, brought closer and closer to a breaking point becomes clearer, and so does the need to take immediate, practical measures to ensure sustainable development, as well as affordable access to public utilities, such as drinking water, energy, waste collection, sanitation. Therefore, the management of these services needs to embrace innovation, not only by investing in state-of-the-art technology for water treatment and distribution, but also regarding the organisational culture, the communication processes and the general relationship with the customer. Traditionally, public utilities have been managed mainly by the state, focusing on service continuity, avoiding risks and complaints, complying with the regulations etc. Whenever private companies manage utilities, their main objective is, of course, obtaining profit, while keeping customers and other stake-holders satisfied. Consequently, private companies tend to be more innovative and flexible, more careful about cutting losses and costs, as well as more client-oriented; on the downside, they face competition, possibly higher costs for financing investments and might be less motivated regarding service affordability or social responsibility. By joining the two parties, in a public-private partnership, the advantages brought by each approach can be bound together, benefiting the population as well as the economic environment.

2. CONTEXT. KEY ISSUES CONCERNING WATER SUPPLY MANAGEMENT

The global context regarding water supply shows increasing challenges and growing concerns, despite the fact that access to potable water is a fundamental human right, as well as

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a critical resource for sustaining life, ecosystems, and economies. Water scarcity, inefficient water management practices, pollution, over-extraction of groundwater and inadequate wastewater treatment, poor infrastructure, effects of climate change, such as severe droughts and floods, energy requirements for providing safe water, up to wasteful water consumption create a complicated scenario for public or private utilities companies. Currently, at global level, international organizations, governments, and civil society groups are trying to mitigate these issues by promoting water conservation and efficient water management practices, infrastructure investments, developing water quality monitoring and pollution control measures, adapting the regulatory framework, encouraging cooperation and collaboration between sectors (with a higher involvement of the research institutions) and raising awareness on these aspects.

Researchers identified the major trends in cities, that will impact water supply services:

- Urbanization – by 2050, it will reach 86% in urban developed regions and 64% in less developed regions; Approximately 80% of the world's GDP is produced, and 75% of the global energy and material flows are consumed in cities.
- Climate change - may worsen water services and quality of life in cities.
- Water use & water scarcity - Water withdrawals have tripled over the last 50 years. In 2030, there will be a 40% water supply shortage.
- Sanitation - Currently, 2.5 billion people are without improved sanitation facilities.
- Human health - Yearly, 3.4 million deaths - mostly children –from water-borne diseases.
- Hazards - Water-related hazards account for 90% of all-natural hazards.

According to the World Economic Forum (2015), the largest concerns for the next years are: water crises (39.8%), failure of climate-change mitigation adaptation (36.7%), extreme weather events (26.5%), food crises (25.2%), profound social instability (23.3%)

With an expected doubling of the population in the next 25 to 35 years, drinking water security is a major challenge (World Economic Forum, 2016; Koop & Van Leeuwen, 2016a). According to the researchers led by Kees van Leeuwen, **major improvements** can be obtained by **increasing the efficiency of cooperation between all stakeholders** (including citizens and small firms) and by creating more **public awareness** about the city's high drinking water consumption. Previous studies showed that there is a need to enhance city-to-city learning. The water-related challenges require a multi-level water governance approach, a long-term strategy, a bottom-up approach and collaboration among cities and region. Therefore, cities are encouraged to participate in learning alliances to actively share knowledge and experiences on implementation of state-of-the-art technologies as well as governance experiences (Koop et al., 2015; Koop & Van Leeuwen, 2016 a, b).

In a broad view, **water supply is managed either by public companies, by private providers or by hybrid solutions, consisting in public-private partnerships**. Since each case has specific parameters in terms of natural resources available, regulation, population numbers, infrastructure, culture, there cannot be a unique solution to guarantee the most efficient management approach for supplying water. However, based on the literature review on the matter and the large number of case studies available, the advantages and challenges for each approach can be outlined.

Public companies are focused on providing equitable access to water services and are not oriented towards profit, but are frequently affected by bureaucratic inefficiencies, lack of innovation, and sometimes limited access to funding for infrastructure development. Transparency and accountability can be an issue, as well as communication with clients.

Private companies can bring efficiency, innovation, and expertise in managing water supply systems. Since they are focused on profit, they tend to communicate better with clients and are more strict in cutting losses and costs, this leading to affordability and equitable access issues, as well as reduced service quality. Concerns arise also in terms of transparency and accountability.

A **public-private partnership** (PPP) is essentially a transaction that transfers overall responsibility for the provision of a public service or the making of a commercial investment to a private company, while the relevant public authority retains political responsibility and becomes a profit and loss partner, and may include structures such as joint venture contracts, rental contracts, leasing contracts, joint venture contracts, design and build contracts, etc. PPPs aim to combine the strengths of both public and private sectors, with the private sector bringing investment, technical expertise, and innovation, while the public partner ensures that the service remains focused on the public interest. However, it is difficult to balance the interests of both partners and maintain transparency, to be profitable and affordable, as well as committed to social and environmental problems.

Cooperation between the public and private sectors can take various forms, from a simple relationship between the buyer and seller of an asset to complex joint ventures.

A PPP business model can take any of the following forms:

- **BOT (Build-Operate-Transfer)** - this model involves the private sector building and operating public infrastructure for a number of years, after which the infrastructure is transferred to public ownership.
- **BOO (Build-Own-Operate)** - this model involves the private sector building, owning and operating public infrastructure for a number of years, after which the infrastructure is transferred to public ownership.
- **BLT (Build-Lease-Transfer)** - this model involves the construction of public infrastructure by the private sector, followed by its lease to the public sector for a number of years, after which the infrastructure is transferred to public ownership.
- **BOOT (Build-Own-Operate-Transfer)** - this model involves the private sector building, owning, operating and transferring a public infrastructure for a number of years, after which the infrastructure is transferred to public ownership.
- **Concession** - this model involves granting the right to build and operate public infrastructure for a certain period of time to the private sector in return for a certain tariff or user charge.

Until recent, the market for utilities was almost monopolistic, with a strong presence of governmental entities and industry giants and minimal competition. This image is starting to change due to utility innovation technology and focus on environmental sustainability, energy efficiency and transparency.

3. CASE STUDY – BUCHAREST WATER SUPPLY MANAGEMENT

Bucharest is a European capital that has changes significantly during the last 30 years, following the fall of Communism, with rapid urbanization and economic growth that led not only to positive outcomes, but also to challenges, such as overdevelopment, urban sprawl, and environmental concerns, social and economic disparities. The transportation infrastructure is overwhelmed, and the water supply infrastructure is also under severe stress.

Looking closer at the particularities of water supply services in Bucharest, managed through a public-private partnership (concession contract) since 2000, by a company created for this purpose, Apa Nova Bucuresti, it is important to note the following issues:

- **concerning infrastructure:**

- Bucharest has a large infrastructure, planned and executed for a much smaller population; it was "patched" to suit the needs of a much larger number of users
- Outdated infrastructure, with mainly maintenance works and not capital refurbishment

❖ **concerning the market**
- Captive consumers – consumers don't have alternatives for selecting a drinking water supplier and frequently feel taken advantage of

❖ **concerning consumers**
- Uninformed consumers
- Wasteful behaviour patterns of the general population
- Lack of systemic view – at the consumers' end, at least.
- Technical parameters of the household appliances that use water

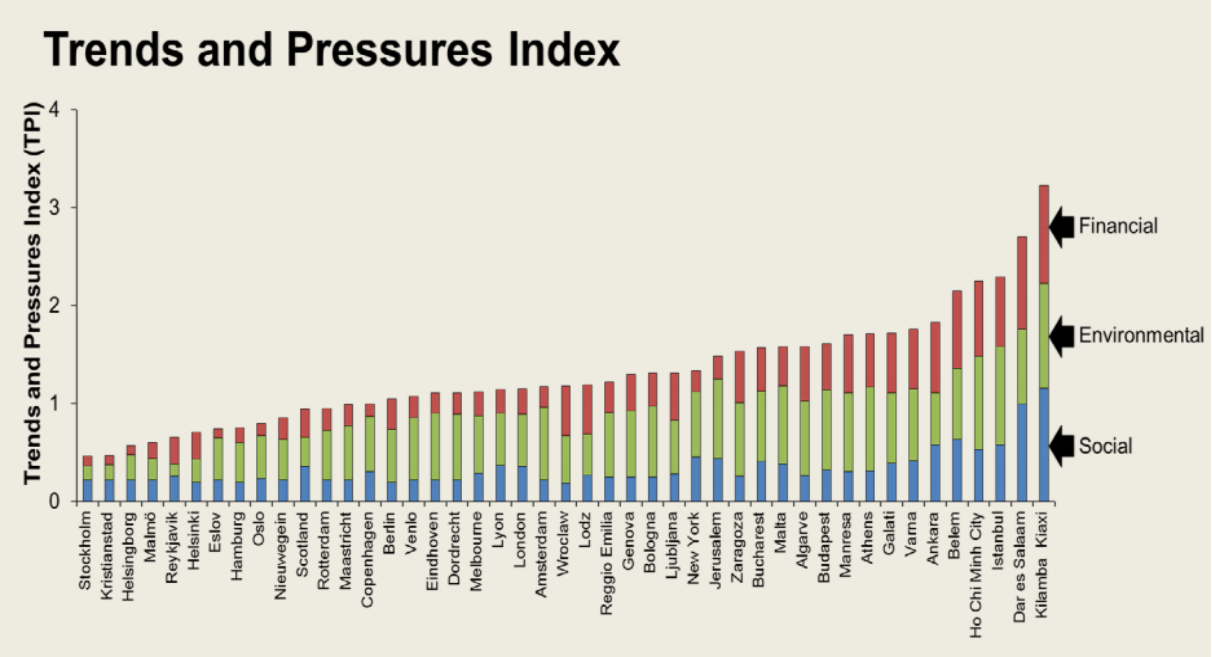
❖ **concerning service management**
- Lack of transparency concerning management and public communication
- Bureaucracy
- Insufficient transparency concerning pricing mechanisms

❖ **legal issues**
- Environmental and legal aspects that are increasingly more demanding
- Highly regulated sector, due to the large number of consumers and the potential impact of the service
- Matter of national safety

❖ **social issues**
- Social considerations – the need to make the service cost accessible to all the social groups

In comparison to other relevant cities, Bucharest faces significant pressures, especially related to social and environmental aspects.

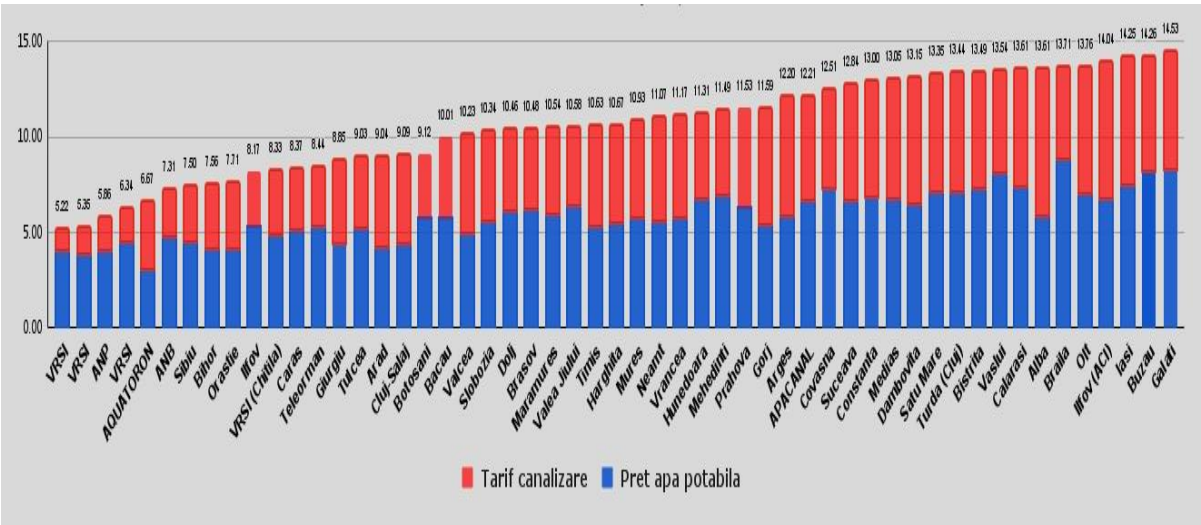
Figure 1 Trends and pressure index



Source: van Leuwen, 2016, https://www.eip-water.eu/

Despite these negative aspects, the tariffs for water and sewerage in Bucharest are amongst the lowest in the country (sixth position, 7.3 lei/cubic meter), according to the official information published by the relevant authority, ANRSC, in 2023, with the average national price being 10.67 lei/cubic meter.

Figure 2 Prices/tariffs for regional water and sewerage providers in Romania



Source: adaptation after ANRSC public list of tariffs approved in July 2022

The company's performance is measured yearly according to a list of service levels, that are included in the concession contract. This lists comprises of 23 indicators, that cover drinking water quality, water pressure at branch, water distribution efficiency, service continuity, intervention times for various situations, invoicing, treatment of complaints, waste water elimination, execution of new branching, investment program.

The concession project was overseen by the World Bank, institution with extensive capabilities in the field, while the private partner was Veolia, a leading company in water and energy.

Adding to these the fact that the local provider's activity is monitored by several institutions and very closely by A.M.R.S.P (Municipal Authority for Public Service Regulation), it was reasonable to expect that the operations would run smoothly.

However, in 2015, on account of corruption charges and customer's dissatisfaction with the services, the management of Apa Nova Bucuresti was replaced. The new approach favoured more transparency, better communication with the customers and changes in the organizational culture, towards embracing innovation, social responsibility and sustainable development. The reports published in the following years showed that the company met the performance criteria in the concession contract and managed to significantly improve customer satisfaction.

In our opinion, the Bucharest water supply case study can be used as a good starting point to create a more effective framework for public utilities, and especially water supply and sanitation.

4. INNOVATIVE APPROACHES TO MANAGING WATER SUPPLY SERVICES

Weighing the advantages and challenges corresponding to each type of ownership (public, private, hybrid), we reached the conclusion that public-private partnerships,

established in competitive circumstances, could represent the most efficient solution for managing public utilities, especially water supply services.

In our opinion, the partnership should be focused on developing long-term alliances that are built on shared objectives, a commitment to excellence, and emphasis on delivering sustainable and innovative solutions.

PPPs can lead to increased efficiency in the delivery of public services as private sector partners often bring innovation, expertise, and resources to the project, which can result in faster project delivery and completion. Furthermore, PPPs allow for the sharing of risks between public and private partners, reducing the burden on either party, so that each party can contribute its strengths and minimize its weaknesses, leading to better risk management.

From a financial aspect, PPPs can provide access to private financing, allowing for public projects that may not have been possible with public funding alone, reducing the burden on taxpayers and diversifying funding sources. PPPs can provide better value for money as private partners are incentivized to keep costs down and deliver the project on time and on budget, allowing for cost savings for the public sector.

Also, PPPs can lead to improved quality of services or facilities as private partners have a financial incentive to maintain and operate them at a high level, leading to better service delivery and greater customer satisfaction.

In terms of innovation and flexibility, PPPs can allow for greater innovation and flexibility in the delivery of public services. Private partners can bring new technologies, processes, and management practices to the project, which can result in better outcomes.

Finally, PPPs can provide for long-term sustainability of public infrastructure, services, or facilities as private partners have a long-term stake in their success. This can result in better maintenance and upkeep, and greater longevity of public assets.

In Romania, the legal framework for PPPs, regulated by Government Emergency Ordinance (GEO) no.39 of 10 May 2018 (although not perfect) creates the necessary guidelines for initiating, efficiently implementing and monitoring public-private partnerships.

However, as shown in the case study analysed previously, a set of indicators (although extensive) and the monitoring of public authorities are not sufficient do drive performance in water supply services.

An innovative approach could be derived from the methodology of the City Blueprint Approach, which is based on long-term goals, to monitor progress of the transformation process towards adaptive water management and governance in cities. This approach allows for a comprehensive and standardized way to evaluate various aspects of water management in urban areas, helping cities identify challenges and opportunities to improve their water-related practices. The indicators are structured in six categories (Figue 3).

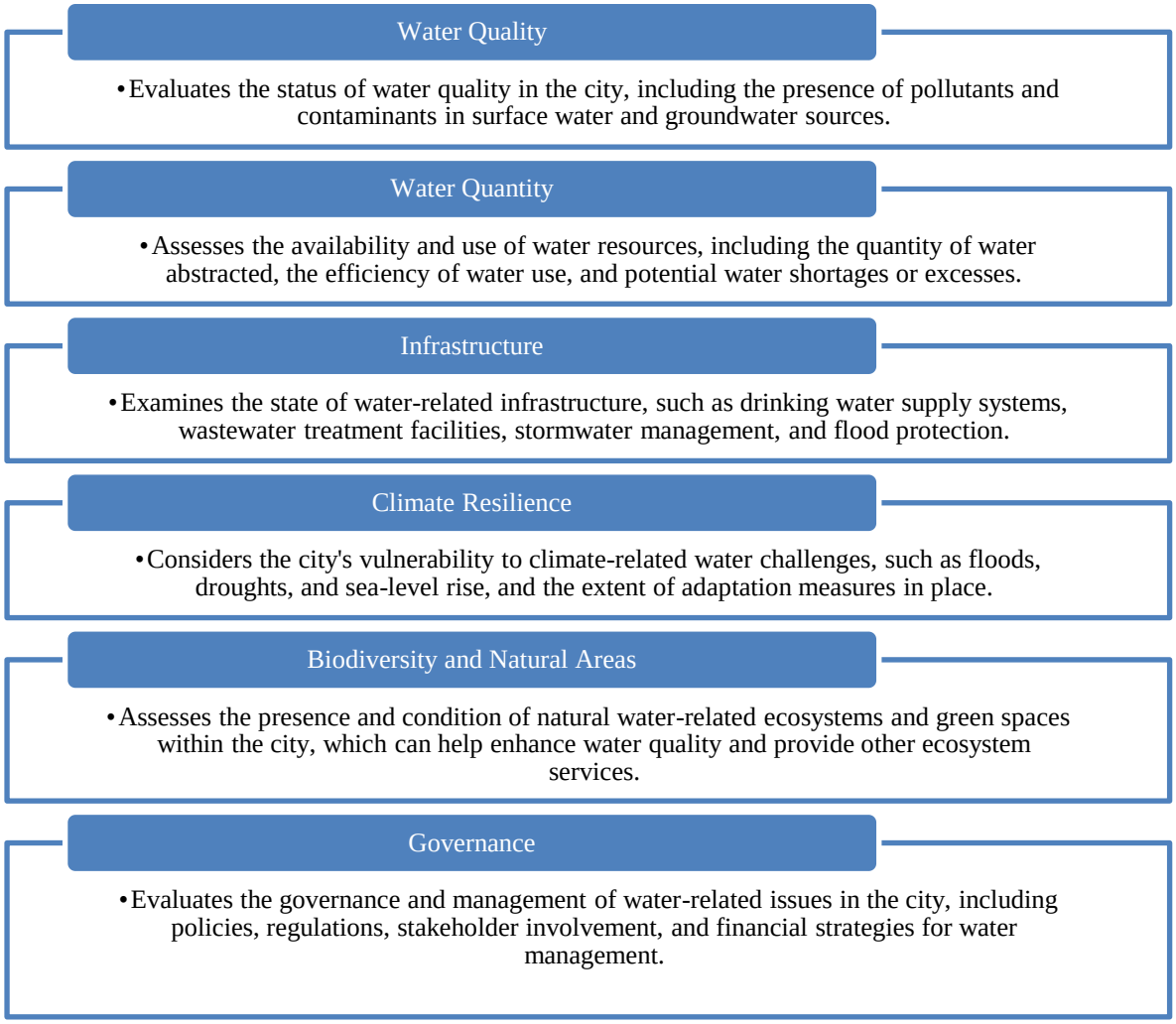
For each indicator a score ranging from low to high is assigned, providing an image of the city's performance in each of the six categories.

Stakeholders, such as public authorities, policymakers, the managers involved in water supply can use this instrument to identify water-related challenges and potential areas for improvement, make comparisons to other cities or global benchmarks, fundament decisions, monitor overall progress and the efficiency of water-related policies and initiatives, educate the public and raise awareness regarding the pressing issues.

The City Blueprint approach shows the city’s main challenges concerning the water services, helps evaluate the performance of these services and points to the areas where the governance can be improved.

By using the City Blueprint Approach, cities can take steps towards more sustainable and resilient water management practices, ensuring a healthier and more livable environment for their residents.

Figure 3 Categories of Indicators used in the City Blueprint Approach



Source: author's adaptation

This approach has already been implemented by 45 large cities across the globe (Quito, Dar es Salaam, Melbourne, Amsterdam etc) with promising results, especiall where it was included in a comprehensive smart city strategy.

A comprehensive view on water supply performance must take into consideration the internal processes, customers and stakeholders and look into economic performance, social and environment aspects.

Internal processes must be analysed, from an economic perspective, in terms of financial health and sustainability, general profitability, investment programs, implementing innovation, effective approach of water losses. Social performance translates to working conditions, social dialogue, organizational culture and professional development. The environment achievements concern carbon footprint, consumption of natural resources, protection of the natural resources by reducing pollution.

The **customers'** perspective, from an economic point of view, must be reflected by service quality indicators; the social aspect concerns affordability and social responsibility, while the sustainable development relates to raising public's awareness of the environment issues.

The **stakeholders'** perspective, in terms of economic performance must take into consideration accomplishing the contract's objectives, fiscal and regulatory compliance; the social dimension is translated through knowledge transfer and corporate social responsibility projects; the sustainable development objectives would be met through ecological projects and partnerships.

In correlation to the issues identified in the previous paragraphs, the following solutions could be addressed, in a long-term view, taking into considerations the interests and particularities of all the stakeholders and the foreseeable evolution of major trends related to the subject.

- **concerning infrastructure:**
  - Urban planning must take into consideration the water supply and sewerage aspects, throughout all the levels, from masterplans up to individual construction authorizations
  - Investment plans (refurbishment and maintenance) should have a long-term view, based on a public policy assumed by the Government
  - Implement innovative technical solutions, with minimum impact on local traffic and comfort (for example: pipe-in-pipe solutions for fixing leaks, instead of open digging on the entire length of the pipe)
  - Correct maintenance plans, that are properly followed will have a positive impact on the service quality and overall costs.
  - Use of digitalisation and automatization to shift maintenance from interventions when problems occur to pre-emptive maintenance, thus minimising costs, downtime and customers' dissatisfaction.
- **the market**
  - Captive consumers - monopoly or very limited options. Consumers have little or no choice regarding water supply and sewerage, therefore a feeling of being "captive" is widely spread, fuelling animosities concerning the provider of the service. Most of the criticism relates to prices, service quality and the company's attitude towards costumers. Therefore, transparency in setting and communicating prices, consistent service quality and a reverent attitude towards the citizens are important elements in turning public perception towards a favourable register.
- **The consumers**
  - Uninformed consumers. Although it may seem intuitive, that water should have no smell, colour or residues, a proper evaluation of water quality is far more complex. However, a full list of technical parameters is not compatible with the understanding of the general public and can create adverse effects. The solution is to synthesize and explain the most important features of the service, in a Book of service, possibly accompanied by accessible video materials that explain the key performance parameters of the services. The most important aspect of the book of service is a questionnaire that consumers can use in order to evaluate correctly the quality of the services provided and also send feed-back upon their own experiences, thus initiating a real dialogue with the supplier. Also, the company should respond to these feed-back, empowering the customers and transforming their relationship into a real partnership.
  - Wasteful behaviour patterns of the general population can be changed, in time, through information and education campaign. Once again, we stress the importance of good communication with the government bodies, that can assume the implementation of large-scale education projects.

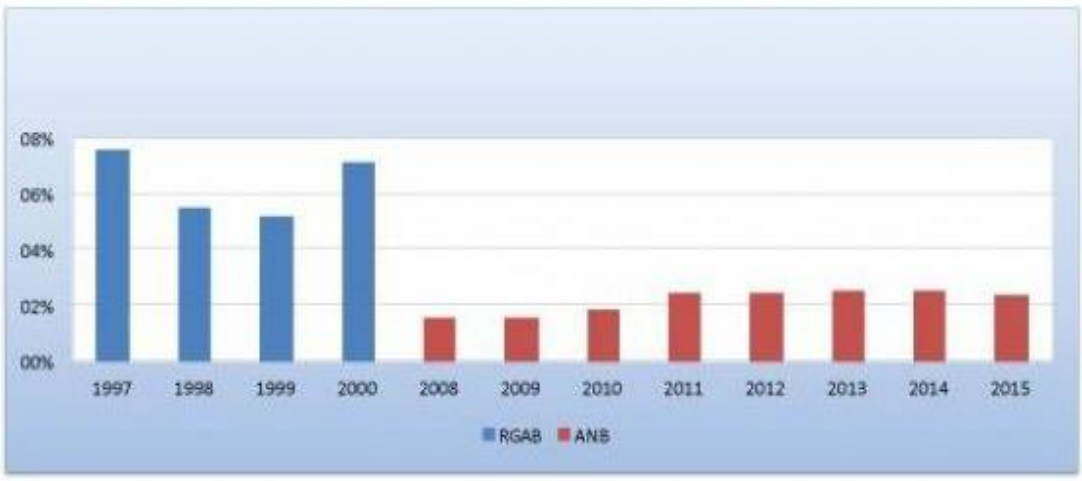
- Lack of systemic view – information and education activities can enlarge the consumers' view on natural resources, climate change and, at a personal level, financial benefits.
- Technical parameters of the household appliances – laundry machines and dishwashers are the main water-consuming appliances; the evolution of the manufacturing industry brings more efficient products on the market, in terms of water and energy efficiency.

❖ **service management**

- Period press releases, open-doors day, occasional public events, consistent communication through the available channels (website, social media platforms etc) are solutions that tackle the lack of transparency concerning management and public communication.
- Bureaucracy – Streamlining procedures, using technology, automation, customer-friendly solutions will increase the provider's efficiency and the customers' satisfaction. Furthermore, it is necessary to implement and promote customer satisfaction monitoring systems.
- Lack of transparency concerning pricing mechanisms. Prices are calculated, for Bucharest, according to a complex formula, by a group of international specialists designated by the World Bank and adjusted according to the impact of the agreed investment plan, currency exchange rate, inflation rate etc. Therefore, it is not an accessible, transparent process for the consumer, who is unable to determine whether the price is fair or not. As in other cases involving technical information and consumers, honesty and transparency are the best course of action. We suggest making use of the available technology in order to create an app, available to the public, where they can make price simulations, in order to have a better understanding of the pricing mechanisms. Also, comparisons with other relevant cities/ services/ goods could be useful.
- Ownership

According to the data available, the joint ownership brought the best results in terms of service efficiency.

Figure 4 Water supply and sewerage costs in the household budget, Bucharest, 1997-2015



Source: Apa Nova Bucuresti SA, 2016

Analyzing the information above, the costs supported by the end users diminished significantly once the service was transferred from the state to Apa Nova.

As previously shown, the price comparison at national level shows that Bucharest had the 3rd cheapest tariffs for water supply and sewage services, in 2022.

❖ **Legal aspects**

- Firstly, since Romania is a member of the European Union and other international organisms relevant for the matter of our research, it is very likely that steps will be taken to comply with the international legislation and regional strategies. However, the way in which European legislation will be enforced may lead to a more bureaucratic approach or to simplified procedures with respect to the current situation. According to previous examples, chances are that bureaucracy will increase, leaving utility companies with the burden of streamlining information and procedures for the understanding of the general public. Therefore, the public communication of these companies will have utmost importance, the solution
- being that of setting up specialized internal teams, capable of translating technical and legal information and ensuring that the communication flow between company and state is functional.
- Implementation of fast response procedures in case crisis situations or suspicions appear;
- Transparency and traceability of data undertaken as core values of the water supply companies.

❖ **Social aspects**

- Social considerations – the need to make the service cost accessible to all the social groups will impact the price of the service the investment plans and the overall quality of the service. Social aspects can be the subject of two courses of action: a negotiation of public subsidy policy, for the vulnerable consumers and, secondly, corporate social responsibility actions taken by the company.

5. CONCLUSIONS

Innovative management of public services can be at the same time challenging and rewarding. However, taking into consideration the growing pressure of climate and social change, adjustments cannot be ignored or delayed indefinitely. The bases for efficiency in this sector consist of interdisciplinary approach, transparency, openness to communication and learning, technical innovation, education and modelling behaviour in a complex matrix of relationships (with the governing and regulatory bodies, with the consumers, media and other stakeholders).

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ANALYSIS OF THE DYNAMICS OF ECONOMIC PROFITABILITY RATE AND RATE OF RETURN ON PERMANENT CAPITAL IN A COMMERCIAL COMPANY

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ABSTRACT: *The current focus on managerial concerns for the consolidation and development of businesses involves a logic grounded in scientific methodological considerations, aimed at facilitating the identification of factors and respective causes that explain a specific economic and financial state of the company. This ensures the necessary conditions for implementing the best decisions that lead to an increase in financial performance and, based on this, the strengthening of the functional state of the business operator. In this context of opportunity, the analysis of the dynamics of the economic profitability rate and, respectively, the rate of return on permanent capital is presented. The influences of the factors considered are quantified within specific factorial relationships, and conclusions are formulated.*

Keywords: *economic profitability rate, rate of return on permanent capital, equity, borrowed or foreign capital, fixed assets, current assets, total assets*

JEL Classification*: G10, G15, G39*

1. INTRODUCTION

The rates of return are relative indicators that succinctly summarize the economic and financial performance of a business operator. The magnitude of the economic profitability rate is directly determined by the efficiency of utilizing the assets of the commercial company, both fixed and current. Meanwhile, the magnitude of the rate of return on permanent capital expresses the efficiency of using both equity and borrowed capital.

Analyzing these relative profitability indicators provides the opportunity to identify the strengths and weaknesses in the commercial company's operations, forming the basis for corrective measures. From an economic motivation standpoint, it is worth noting that:

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- The economic profitability rate expresses the efficiency of utilizing the total assets of a commercial company, and an increase in this indicator directly reflects in the magnitude and dynamics of the financial profitability rate;

- The efficiency of using current assets, with their main component being current assets, exerts a determinant influence on the economic profitability rate and plays a crucial role in achieving competitive economic and financial performance.;

- The way in which capital is utilized serves as a measure of the efficiency of managerial decision-making.

The considerations presented can provide the basis for conducting a study aimed at gathering useful information to support decisions intended to promote functional progress and financial performance of the business operator.

The accounting information that will be used to conduct the analysis of the dynamics of the economic profitability rate and the rate of return on permanent capital pertains to the activities of a business operator with a productive profile, as presented in Table 1.

Tabelul 1. The system of economic and financial indicators for analyzing the dynamics of the economic profitability rate and the rate of return on permanent capital

Indicators	M.U.	Natations	Base period (2021)	Calculation period (2022)
1- Turnover (Sold Production)	lei	$CA = \Sigma qp$	500.000	540.000
2- Operating Expenses Related to Turnover	lei	$C = \Sigma qc$	440.000	475.000
3- Operating Profit (Result) Related to Turnover	lei	Re	60.000	65.000
4- The production sold during the calculation period expressed in: - the delivery prices applied in the base period - in complete unit costs from the base period		 $\Sigma q_1 p_0$ $\Sigma q_1 c_0$	 - -	 510.000 420.000
5- Equity" or "Owner's Equity	lei	Cp	300.000	300.000
6- Foreign Capital (Liabilities: amounts payable in a period greater than one year)	lei	CS	150.000	220.000
7- Permanent Capital (line 5 + line 6)	lei	$Cperm$	450.000	520.000
8Total assets - Fixed assets - Current assets	lei	Act Aim Acu	480.000 430.000 50.000	545.000 493.000 52.000
9- The Return on Investment (Return on Total Assets)	%	$Rre = \frac{Re}{Act} \cdot 100$	12,50	11,93
10- The Rate of Return on Permanent Capital	%	$Rrcp = \frac{Re}{Cperm} \cdot 100$	13,33	12,50

2. ANALYSIS OF THE DYNAMICS OF ECONOMIC PROFITABILITY RATE (RETURN ON TOTAL ASSETS), CALCULATED BASED ON OPERATING PROFIT RELATED TO TURNOVER

In the context of analyzing the dynamics of economic profitability rate, consideration is given to a relationship that allows for the assessment of the influences caused by the modification of factors included in the following equation:

$Rre = \frac{Re}{Act} \cdot 100 = \frac{\Sigma qp - \Sigma qc}{Aim + Acu} \cdot 100$, namely,

1- total assets, of which:

1a- fixed assets

1b- current assets

2- operating profit related to turnover, of which:

2a- physical volume of turnover, of which:

$2a_1$- The relative level of turnover change due to the physical volume.

$2a_2$- The structure of the physical volume of turnover

2b- delivery prices

2c- full unit costs

The system of calculations required for the factorial analysis of the dynamics of economic profitability rate is based on the method of successive substitutions, as follows:

The absolute change in economic profitability rate:

$$\Delta = \left[\frac{Re_1}{Act_1} - \frac{Re_0}{Act_0}\right] \cdot 100 = 11{,}93 - 12{,}50 = -0{,}57 \text{ percentage points}$$

$$\Delta = \Delta(Act) + \Delta(Re) = -1{,}49 + 0{,}92 = -0{,}57 \text{ percentage points}$$

din care:

1- The impact of changing the total assets,

$$\Delta(Act) = \left[\frac{Re_0}{Act_1} - \frac{Re_0}{Act_0}\right] \cdot 100$$

$$= \left[\frac{60.000}{545.000} - \frac{60.000}{480.000}\right] \cdot 100 = \ 11{,}01 - 12{,}50 = -1{,}49 \text{ percentage points}$$

$$\Delta(Act) = \Delta(Aim) + \Delta(Acu) = -1{,}45 - 0{,}04 = -1{,}49 \text{ percentage points}$$

of which:

1a- the impact of changing the value of fixed assets,

$$\Delta(Aim) = \left[\frac{Re_0}{Aim_1 + Acu_0} - \frac{Re_0}{Aim_0 + Acu_0}\right] \cdot 100 =$$

$$= \left[\frac{60.000}{493.000 + 50.000} - \frac{60.000}{430.000 + 50.000}\right] \cdot 100 =$$

$$= 11{,}05 - 12{,}50 = -1{,}45 \text{ percentage points}$$

1b- The impact of changing the value of current assets

$$\Delta(Acu)=\left[\frac{Re_0}{Aim_1+Acu_1}-\frac{Re_0}{Aim_1+Acu_0}\right]\cdot 100=$$
$$=\left[\frac{60.000}{493.000+52.000}-\frac{60.000}{493.000+50.000}\right]\cdot 100=$$

=11,01-11,05=-0,04 percentage points

2- The impact of changing the result (profit) from operations related to turnover,

$$\Delta(Re)=\left[\frac{Re_1}{Act_1}-\frac{Re_0}{Act_1}\right]\cdot 100=\left[\frac{65.000}{545.000}-\frac{60.000}{545.000}\right]\cdot 100=$$
$$=11{,}93-11{,}01=+0{,}92 \text{ percentage point}$$
$$\Delta(Re)=\Delta(q)+\Delta(p)+\Delta(c)=+5{,}50+5{,}51-10{,}09=+0{,}92$$

din care:

2a- The impact of changing the physical volume of turnover

$$\Delta(q)=\left[\frac{\Sigma q_1p_0-\Sigma q_1c_0}{Act_1}-\frac{\Sigma q_0p_0-\Sigma q_0c_0}{Act_1}\right]\cdot 100=$$
$$=\left[\frac{510.000-420.000}{545.000}-\frac{60.000}{545.000}\right]\cdot 100=$$
$$=16{,}51-11{,}01=+5{,}50 \text{ percentage points}$$

$$\Delta(q)=\Delta\left(I_{(q)}^{CA}\right)+\Delta(s)=+0{,}22+5{,}28=+5{,}50 \text{ percentage points}$$

of which:

2a$_1$- The impact of changing the relative level of turnover due to the physical volume.

$$\Delta\left(I_{(q)}^{CA}\right)=\left[\frac{Re_0\cdot I_{(q)}^{CA}-Re_0}{Act_1}\right]\cdot 100=\left[\frac{60.000\cdot 1{,}02-60.000}{545.000}\right]\cdot 100=$$
$$=\frac{61.200-60.000}{545.000}\cdot 100=+0{,}22 \text{ percentage points}$$

Note. *The index of dynamics for the physical volume of turnover, used in calculating this influence, has the following value:*

$$I_{(q)}^{CA}=\frac{\Sigma q_1p_0}{\Sigma q_0p_0}=\frac{510.000}{500.000}=1{,}02$$

2a$_2$- The impact of changing the structure of the physical volume of turnover.

$$\Delta(s)=\left[\frac{(\Sigma q_1p_0-\Sigma q_1c_0)-Re_0\cdot I_{(q)}^{CA}}{Act_1}\right]\cdot 100=$$
$$=\left[\frac{(510.000-420.000)-60.000\cdot 1{,}02}{545.000}\right]\cdot 100=$$
$$=+5{,}28 \text{ percentage points}$$

2b- The impact of changing delivery prices,

$$\Delta(p) = \left[\frac{\Sigma q_1 p_1 - \Sigma q_1 c_0}{Act_1} - \frac{\Sigma q_1 p_0 - \Sigma q_1 c_0}{Act_1}\right] \cdot 100 =$$
$$= \left[\frac{540.000 - 420.000}{545.000} - \frac{510.000 - 420.000}{545.000}\right] \cdot 100 =$$
$$= 22{,}02 - 16{,}51 = +5{,}51 \text{ percentage points}$$

2c- The impact of changing full unit costs,

$$\Delta(c) = \left[\frac{\Sigma q_1 p_1 - \Sigma q_1 c_1}{Act_1} - \frac{\Sigma q_1 p_1 - \Sigma q_1 c_0}{Act_1}\right] \cdot 100 =$$
$$= \left[\frac{65.000}{545.000} - \frac{540.000 - 420.000}{545.000}\right] \cdot 100 =$$
$$= 11{,}93 - 22{,}02 = -10{,}09 \text{ percentage points}$$

3. ANALYSIS OF THE DYNAMICS OF THE RATE OF RETURN ON PERMANENT CAPITAL, CALCULATED BASED ON THE OPERATING PROFIT (RESULT) RELATED TO TURNOVER

The rate of return on permanent capital, through its analytical calculation form, highlights the influence of the changes in factors formalized in the relationship:

$Rrcp = \frac{Re}{Cperm} \cdot 100 = \frac{\Sigma qp - \Sigma qc}{Cp + CS} \cdot 100$, specifically

1- permanent capital, of which:
- 1a- owner's equity
- 1b- foreign capital (Liabilities: amounts payable in a period greater than one year)

2 - rezultatul (profitul) din exploatare aferent cifrei de afaceri, din care:
- 2a- operating result (profit) related to turnover, of which:
  - $2a_1$- the relative level of turnover change due to the physical volume
  - $2a_2$- the structure of the physical volume of turnover
- 2b- delivery prices
- 2c- Full unit costs

The system of calculations required for the factorial analysis of the dynamics of the rate of return on permanent capital is operationally supported by the method of successive substitutions and is conducted as follows:

The absolute change in the rate of return on permanent capital:

$$\Delta = \left[\frac{Re_1}{Cperm_1} - \frac{Re_0}{Cperm_0}\right] \cdot 100 = 12{,}50 - 13{,}33 = -0{,}83 \text{ percentage points}$$
$$\Delta = \Delta(Cperm) + \Delta(Re) = -1{,}79 + 0{,}96 = -0{,}83 \quad \text{percentage points}$$

of which:

1- The influence of changing permanent capital

$$\Delta(Cperm) = \left[\frac{Re_0}{Cperm_1} - \frac{Re_0}{Cperm_0}\right] \cdot 100 = \left[\frac{60.000}{520.000} - \frac{60.000}{450.000}\right] \cdot 100 =$$
$$= 11{,}54 - 13{,}33 = -1{,}79 \text{ percentage points}$$

$$\Delta(Cperm) = \Delta(Cp) + \Delta(CS) = 0{,}00 - 1{,}79 = -1{,}79 \text{ percentage points}$$

of which:

1a- The influence of changing equity

$$\Delta(Cp) = \left[\frac{Re_0}{Cp_1 + CS_0} - \frac{Re_0}{Cp_0 + CS_0}\right] \cdot 100 =$$
$$= \left[\frac{60.000}{300.000 + 150.000} - \frac{60.000}{300.000 + 150.000}\right] \cdot 100 =$$
$$= 13{,}33 - 13{,}33 = 0{,}00 \text{ percentage points}$$

1b- The influence of changing foreign capital,

$$\Delta(CS) = \left[\frac{Re_0}{Cp_1 + CS_1} - \frac{Re_0}{Cp_1 + CS_0}\right] \cdot 100 =$$
$$= \left[\frac{60.000}{300.000 + 220.000} - \frac{60.000}{300.000 + 150.000}\right] \cdot 100 =$$
$$= 11{,}54 - 13{,}33 = -1{,}79 \text{ percentage points}$$

2- The influence of changing the result (profit) from operations related to turnover,

$$\Delta(Re) = \left[\frac{Re_1}{Cperm_1} - \frac{Re_0}{Cperm_1}\right] \cdot 100 = \left[\frac{65.000}{520.000} - \frac{60.000}{520.000}\right] \cdot 100 =$$
$$= 12{,}50 - 11{,}54 = +0{,}96 \text{ percentage points}$$
$$\Delta(Re) = \Delta(q) + \Delta(p) + \Delta(c) = +5{,}77 + 5{,}77 - 10{,}58 =$$
$$= +0{,}96 \text{ percentage points}$$

of which:

2a- The impact of changing the physical volume of turnover

$$\Delta(q) = \left[\frac{\Sigma q_1 p_0 - \Sigma q_1 c_0}{Cperm_1} - \frac{\Sigma q_0 p_0 - \Sigma q_0 c_0}{Cperm_1}\right] \cdot 100 =$$
$$= \left[\frac{510.000 - 420.000}{520.000} - \frac{60.000}{520.000}\right] \cdot 100 = 17{,}31 - 11{,}54 =$$
$$= +5{,}77 \text{ percentage points}$$
$$\Delta(q) = \Delta\left(I_{(q)}^{CA}\right) + \Delta(s) = +0{,}23 + 5{,}54 = +5{,}77 \text{ percentage points}$$

of which:

$2a_1$- The impact of changing the relative level of turnover due to the physical volume (the relative level of dynamics in the physical volume of turnover).

$$\Delta\left(I_{(q)}^{CA}\right) = \left[\frac{Re_0 \cdot I_{(q)}^{CA} - Re_0}{Cperm_1}\right] \cdot 100 =$$

$$= \left[\frac{60.000 \cdot 1{,}02 - 60.000}{520.000}\right] \cdot 100 = \frac{61.200 - 60.000}{520.000} \cdot 100 =$$
$$= +0{,}23 \text{ percentage points}$$

2a$_2$- The impact of changing the structure of the physical volume of turnover

$$\Delta(s) = \left[\frac{(\Sigma q_1 p_0 - \Sigma q_1 c_0) - Re_0 \cdot I_{(q)}^{CA}}{Cperm_1}\right] \cdot 100 =$$

$$= \left[\frac{(510.000 - 420.000) - 60.000 \cdot 1{,}02}{520.000}\right] \cdot 100 =$$
$$= +5{,}54 \text{ percentage points}$$

2b- The impact of changing delivery prices

$$\Delta(p) = \left[\frac{\Sigma q_1 p_1 - \Sigma q_1 c_0}{Cperm_1} - \frac{\Sigma q_1 p_0 - \Sigma q_1 c_0}{Cperm_1}\right] \cdot 100 =$$
$$= \left[\frac{540.000 - 420.000}{520.000} - \frac{510.000 - 420.000}{520.000}\right] \cdot 100 =$$
$$= 23{,}08 - 17{,}31 = +5{,}77 \text{ percentage points}$$

2c- The impact of changing full unit costs,

$$\Delta(c) = \left[\frac{\Sigma q_1 p_1 - \Sigma q_1 c_1}{Cperm_1} - \frac{\Sigma q_1 p_1 - \Sigma q_1 c_0}{Cperm_1}\right] \cdot 100 =$$
$$= \left[\frac{65.000}{520.000} - \frac{540.000 - 420.000}{520.000}\right] \cdot 100 =$$
$$= 12{,}50 - 23{,}08 = -10{,}58 \text{ percentage points}$$

4. CONCLUSIONS

The results of the calculations allow us to conclude on the dynamics of economic profitability rate, in light of the factors that explain it:

- the economic profitability rate decreased during the calculation period compared to the base period, by 0.57 percentage points, as a result of the negative influence exerted by the increase in total assets value. The increase in fixed assets value by 14.65% caused a decrease in economic profitability rate by 1.45 percentage points, while the increase in current assets value by 4.00% led to a decrease in economic profitability rate by 0.04 percentage points;
- during the time period covered by the analysis, the operating profit related to turnover increased by 8.33%, leading to an increase in economic profitability rate by 0.92 percentage points;
- It is notable, therefore, that the value of fixed assets increased at a faster pace compared to the rate of operating profit related to turnover. This situation reflects a decrease in the efficiency of utilizing fixed assets;
- The positive impact of the increase in operating profit related to turnover on the economic profitability rate is explained by the growth in the physical volume of sales (+5.50 percentage points) as well as the rise in delivery prices (+5.51 percentage points). However, these favorable changes were offset by the increase in full unit costs (-10.09 percentage points). It is evident that in this case, an investigation into the causes of the rise in full unit costs is

necessary in order to specify the expense categories where intervention is possible and necessary for rationalization.

The calculations provide the opportunity to make the following assessments:

- The decrease in the rate of return on permanent capital by 0.83 percentage points during the calculation period, compared to the base period, reflects an inefficiency in the use of foreign capital. In the time interval under consideration, foreign capital shows an increase of 46.67% and surpasses the operating result (profit) related to turnover by 35.38%. Under these circumstances, decision-makers are advised to monitor how the new loans contracted during the calculation period are being used, if the investments are being executed according to the projected timelines to become operational, and if the new technologies contribute as expected to the increase in turnover and, respectively, profit growth:

- Since the analysed commercial company maintained a constant level of equity in the two compared periods, this factor did not cause a change in the rate of return on permanent capital;

- The increase in operating result (profit) related to turnover by 8.33% favored the increase in the rate of return on permanent capital by 0.96 percentage points. However, as observed, this does not compensate for the negative influence of the increase in foreign capital (-1.79 percentage points);

- The positive influence of the increase in operating result (profit) related to turnover on the rate of return on permanent capital is explained by the growth in the physical volume of sales (+5.77 percentage points) as well as the rise in delivery prices (+5.77 percentage points). However, these favorable changes were significantly diminished by the increase in full unit costs (-10.58 percentage points);

- The increase in the rate of return on permanent capital due to the growth in the physical volume of sales is supported by both the positive change in the relative level of turnover due to the physical volume (+0.23 percentage points) and the modification in the structure of the physical volume of sales (+5.54 percentage points). It is notable that there is an increase in the proportion of physical sales in those assortments that have a higher unit profitability level compared to the average level associated with the assortments of turnover.

The obtained results allow us to observe that, in the case of analyzing the dynamics of the rate of return on permanent capital, the negative influence of full unit costs is identified. This alerts decision-makers to intervene in a targeted manner by implementing measures with clear effects of rationalization and relative reduction. Additionally, it clearly demonstrates the necessity to produce more of those assortments assimilated by the market and with higher unit profitability.

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BIBLIOMETRIC ANALYSIS OF THE PERFORMANCE OF THE USE OF EUROPEAN FUNDS AND THEIR IMPACT ON RURAL DEVELOPMENT

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ABSTRACT: *The present paper aims to perform a bibliometric analysis of the literature on European funds. The European Union members contracted the funds to support economic growth and reduce the development gap. Growth, competitiveness, workforce, and improving the environment are the most essential benefits of funding. The literature on the field of fund absorption has been exploited since 1900. The articles that formed the basis of the research were selected from the international Web of Science database. Following a bibliometric analysis of these articles through the VOSviewer program, we made scientific maps to show the field cooperation between the countries and a scientific map of the keywords for publication. The findings show that the most cited journals in the field of European funds are Regional Studies, with 984 citations, followed by Energy Policy. Several 7745 articles were identified in the WOS database between 1900 and 2021, which included 4895 research articles, 1850 proceedings papers, 116 reviews, 199 books, and 594 early access. Of these, 4589 were published between 2010 and 2021, and the rest were published between 1975 and 2021. It is essential to evaluate the quality of such a large number of research papers and to obtain valuable information.*

Keywords: *bibliometric, European Union; European funds, economic growth*

JEL classification: *G41, F42*

1. INTRODUCTION

European funds have been created based on the development of specific areas and the country's member states to reach the highest standards in the world. These funds are non-refundable if they are not reimbursed in the form of a loan, and the money does not have to be

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reimbursed. European funds are those financial instruments created by the European Union for its members to develop certain domains and support countries to achieve specific standards of development, both at economic but also at socio-cultural levels. Non-refundable funds are those financial aid that will be paid without being reimbursed. They are not credited, no interest is charged on their loan, and they do not have to pay any amount of 1 euro.

The Structural Funds are financial instruments eligible for the removal of the European company; the financial framework of the Structural Funds is intended, in particular, for less developed regions, to strengthen economic and social cohesion in the E.U. The Structural Funds contribute to three E.U. economic, social, and policy strategic objectives.

The absorption of European funds helps to develop the whole economy. Many factors may affect the performance of absorption funds, such as the efficiency of public governance, institutional quality, economic development, or socio-cultural factors (Achim & Borlea, 2015). In this regard, funds fraud to obtain illicit gains is widely encountered (Roman, Achim & McGee, 2023). According to some estimations, organized crime costs the European Union between 2.0 and 2.7 billion euros annually. This amounts to between 1% and 1.6% of the E.U. budget for 2020, which is 160 billion EUR (CSES, 2021). Official data reveals that there is a greater willingness to break the rules when applying for EU subsidies at the level of some EU member states. It has been noted that the former communist nations—Romania, Poland, Slovakia, and the Czech Republic—that entered the Union after 2004 are among the top nations with the highest amount of frauds or anomalies that have been detected. Spain, Italy, the United Kingdom, Germany, and Portugal are among the western European nations that report having a high number of cases (Roman et al, 2022).In addition, for the period 2014-2020, the level of absorption of European funds was negatively influenced by corruption (Roman, Popescu & Achim 2023).

The rest of the paper is organized as follows: The "Literature Review" section analyzes and evaluates existing research. The "Research Methodology" section describes the techniques, variables, and work data. The "Results and Discussions" section presents and comments on the results obtained. The "Conclusions" section highlights the main conclusions of the paper.

2. A BRIEF REVIEW OF THE LITERATURE

We find the concept of rural development all more mentioned today. Although it is a new concept, it has appeared in the literature since the 1980s. The humility of maintaining rural areas by diversifying the rural economy leads to improved quality of life in rural areas. The objective of rural development is to avoid the migration of the population from rural to urban areas and to try to use natural resources in other economic sectors.

The concept of the E.U.'s agricultural policy has been mentioned since 1957, in the Treaty of Rome, because the economies of the six states were predominantly agricultural, and food security was a priority today and abroad. Thus, in 1962, the Common Agricultural Policy of the European Union came into force.

According to Profiroiu and Profiroiu (2008), the following arguments were based on the establishment of the Common Agricultural Policy (from now on referred to as the CAP): "Agricultural activity cannot be compared with other economic activities. The production in this domain comes from several sectors and depends on climatic influences. The difficulties encountered in balancing agricultural production, in collaboration with the constant demand for food, could lead to significant price fluctuations within the Union if it did not take measures to regulate the market. 50% of the E.U.'s population lives in rural areas, representing 80% of the community's territory " (Profiroiu et al., 2008).

Rural development policy is currently the second pillar of the CAP and plays an essential role in solving the problems facing the "school." Strengthening rural development policy is a

priority for the E.U., as it seeks to stimulate job creation in rural areas, improve the quality of life in rural areas, and create rewards for sustainable development.

Since the last statement of CAP in 1957, within the Treaty of Rome framework, this European Union policy has undergone a series of changes and improvements. During this chapter, we will see the evolution of this policy and the reforms applied to the CAP.

The evolution of the CAP has been a complex process. Only six years after the entry of the CAP into force in 1968, Commissioner Sicco Mansholt drew attention to the need to introduce radical reforms. The commissioner's report highlighted the rising costs of the standard agricultural policy and overproduction. The Mansholt plan contained a set of proposals that should have changed the form of the CAP by 1980. The plan suggested an increase in the size of farms, their specialization, their modernization, the withdrawal of 5 million hectares of agricultural land for afforestation and recreational purposes, and a reduction in the number of people employed in E.U. agriculture (6) from 10 million, in 1968 to 5 million in 1980. This would have been achieved through a system of early retirement of older farmers and the retraining of others.

However, this reform was rejected by the Member States at the time, as it was considered far too radical. Despite rejecting the Mansholt plan, the European Commission continued its aspirations to reform the CAP. Although on a less ambitious scale, these attempts were incorporated into various works in the period 1973-1985, which were much more analytical than the initial reform.

An excellent opportunity to change the CAP was immediately after the first wave of accession in 1973, when the United Kingdom, Denmark, and Ireland joined. In addition, enlargement has made the E.U. a significant player in the world market for agricultural products. However, the CAP has remained virtually unchanged. As a result, self-sufficiency for most agricultural products led to a doubling of CAP expenditure between 1975 and 1985. Throughout the 1980s, the CAP was in a constant crisis. This was due not only to the growing surplus of all essential agricultural products but also to the rapid increase in expenditure. Aware of this problem, the E.U. implemented various measures in that decade, but these have had a limited impact on mitigating the significant problems of the CAP (costs and surpluses). The measures included co-responsibility fees. These taxes have been applied to sugar production since the beginning of the CAP. The purpose of these taxes was to make sugar producers bear part of the CAP's expenditure on this commodity and reduce sugar production. In practice, the tax burden has shifted to consumers, and guaranteed threshold prices for cereals reduced support prices for the following year if production exceeded the agreed level. However, pre-production quotas were set relatively high, so their impact could have been much higher. The experience with milk market shares was similar.

The MacSharry Plan (proposed by Commissioner Raymond Mac Sharry) in 1992 was the first real reform of the CAP. The changes were less profound than some economists would have liked.

In essence, the MacSharry Reform proposed: “lowering the guaranteed price of agricultural goods, as the main instrument against overproduction and in favor of expanding the domestic market; the establishment of the land rest period in favor of the adjustment of cultivated areas and agricultural production capacities according to market demand; however, this is linked to a new system of specific aid, those to compensate for the consequences of falling prices on farmers' incomes; to these measures of economic-financial principle were added others aimed at rural development, with an emphasis on environmental protection. ”(Liviu, 2009).

In Jovanovic Miroslav's view, the MacSharry reform had to bring at least two types of gain to the E.U. budget. Firstly, a reduction in prices would reduce the incentives for overproduction, and secondly, a reduction in prices would eliminate part of the tax that

consumers pay. The problem with this reform was that it benefited farmers with below-average yields, while those farmers who practiced efficient agriculture were discouraged. The reform sanctioned large and efficient farmers (Miroslav, 2015.). The E.U. presented the reform as an exclusively domestic matter. However, this was a great concession the Uruguay Round partners granted. Following extensive negotiations, the MacSharry reform was sufficient to achieve the Uruguay Round. Some negotiating partners, such as Japan, considered that the reform went too far, while others, such as the Cairns Group, considered that it offered too little.

The role of Agenda 2000 was also to contribute to the reform of the E.U. and, at the same time, to prepare it for enlargement to the East in 2004. Agenda 2000 refers to the European model that should be adopted for the 21st century. It covers the following three dimensions:

Economic: Agriculture needs to be competitive, and gradually, it needs to cope with global competition without excessive subsidies. The market balance needs to be improved.

Social: The farming community must have a stable income and a reasonable standard of living. This social dimension must provide a diversification of sources of income for households.

Environment: The production should be environmentally friendly (ecological). Agricultural products should be of high quality, safe, and to the taste of consumers (Miroslav, 2015).

In addition, the future European model of agriculture should take into account the following elements:

Agricultural production should not be limited to quantity. Rural communities and European traditions must also be maintained.

Policymaking in agriculture should be simplified and easier to understand. A clear distinction must be made between what the E.U. wants and what the Member States need.

Expenditure for the CAP should align with the services it provides and the company's requirements in terms of expectations from the agricultural sector. Budgetary constraints must be taken into account when setting specific measures.

3. BIBLIOMETRIC ANALYSIS, METHODS

In carrying out this part, the focus is on existing research, both nationally and internationally, conducted by specialists. In this paper, through the bibliometric analysis of this topic, we propose to add value to the specialized literature. Starting from the bibliometric analysis, we will move on to the detailed analysis of the specialized literature. At the same time, the information provided reveals a way to visualize the results as clearly as possible in the form of scientific maps. Through this analysis, we test the quantitative aspects of the information. The literature on European funds published in 1900-2021 was selected from the Web of Science database. This analysis is based on data extracted from publications, bibliographic references, citations, and authors; through this information, we have the opportunity to examine the historical developments between individual scientific fields and the discovery of relationships between disciplines.

Bibliometric analysis allows us to select information from a quantitative perspective, using mathematical and descriptive statistical methods to obtain results. The source of information for bibliometric analysis is records found in databases such as the Web of Science, which is an online database that provides access to the following citation indexes: Extended Science Citation Index (SCIE) and Social Science Citation Index (SSCI).

Our contribution focuses on the descriptive statistics used. The statistical methods used in the bibliometric analysis will be presented with the help of bibliometric maps. The search terms used to identify the nearest publication included keywords such as "European funds" on the Web of Science platform, the period analyzed being 1900-2021, for documents that meet

the requirements of the year of publication, language, journal, title, author, affiliation, keywords, document type, abstract and number of citations that were exported in txt format. The query for the database was 01.03.2021.

3. RESULTS

Bibliometric analysis of publication output

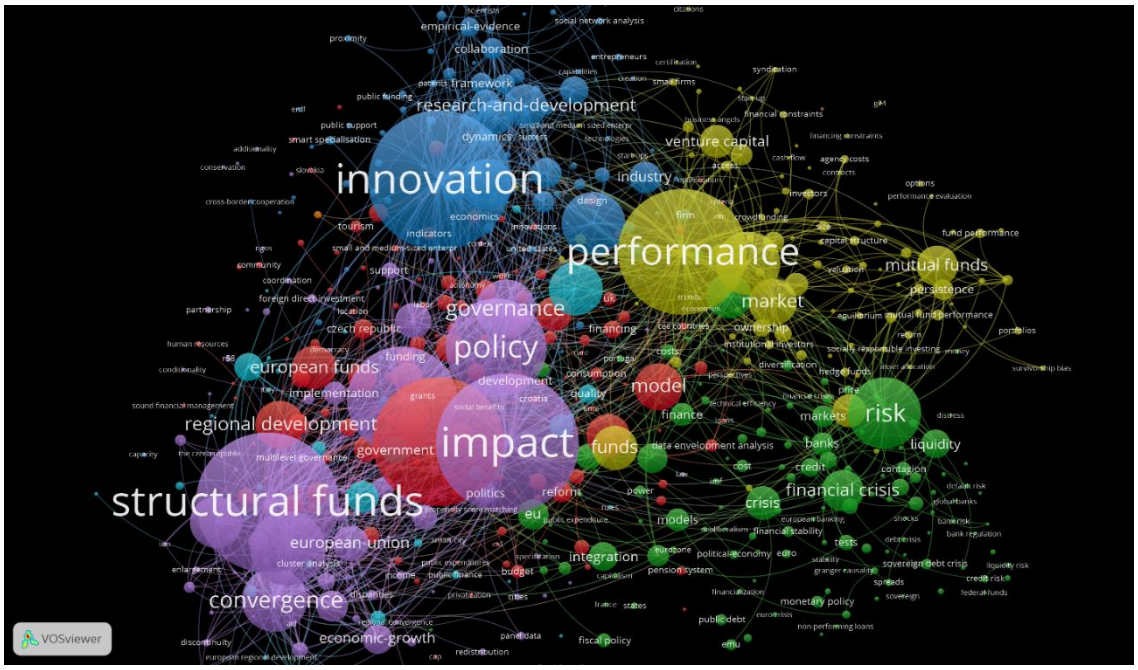
On the chosen topic, we identified 7745 articles in the WOS database between 1900 and 2021, which included 4895 research articles, 1850 proceedings papers, 116 reviews, 199 books, and 594 early access. Of these, 4589 were published between 2010 and 2021, and the rest were published between 1975 and 2021. Almost all publications were written in English (5698), followed by 150 publications in Chinese and the rest in other languages.

Bibliometric analysis of the keywords

The keywords provided by the authors of the paper, which appeared more than ten times in the primary WOS database, were entered in the final analysis. Of the 50,000 keywords, 1658 reached the threshold. The most common keywords were "European funds" (total link strength 2,649), which were strongly linked to "structural funds," "performance," and "innovation. (Figure 1).

A word cloud was also created to show the frequency of keywords that appeared more than 15 times. It was indicated that "European funds" were most often followed by "structural funds" and "governance" (Figure 2).

Figure 1. Keyword map



Source: authors' processing using Vosviewer

Bibliometric analysis of keywords from "European funds" publications. Co-occurrence of keywords. The size of the nodes indicates the frequency of occurrence. The curves between the nodes represent their co-appearance in the same publication. The smaller the distance between two nodes, the greater the co-occurrences of the two keywords.

Figure 2. Keyword Cloud

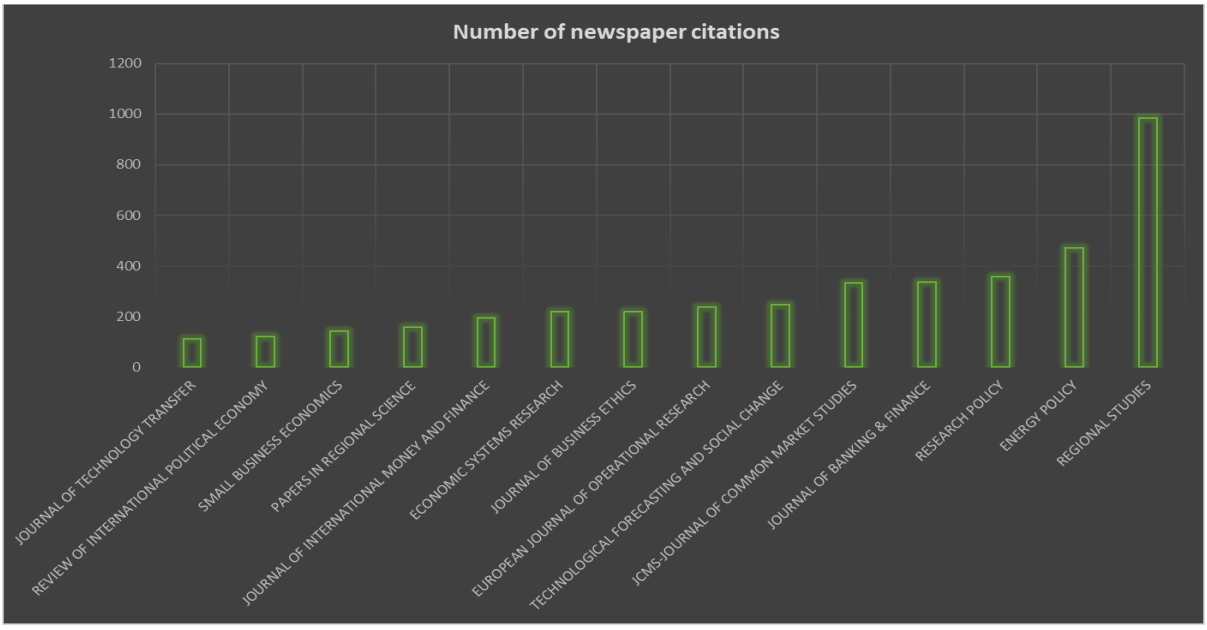
Source: author processing using WordCloud

Word Cloud 256 keywords that appeared over 15 times were entered. Font size is the frequency of occurrence. Keywords such as "structural funds" and "governance" were identified and other words related to the topic studied, but they are rarer than those mentioned above.

Bibliometric analysis of the citations and publications

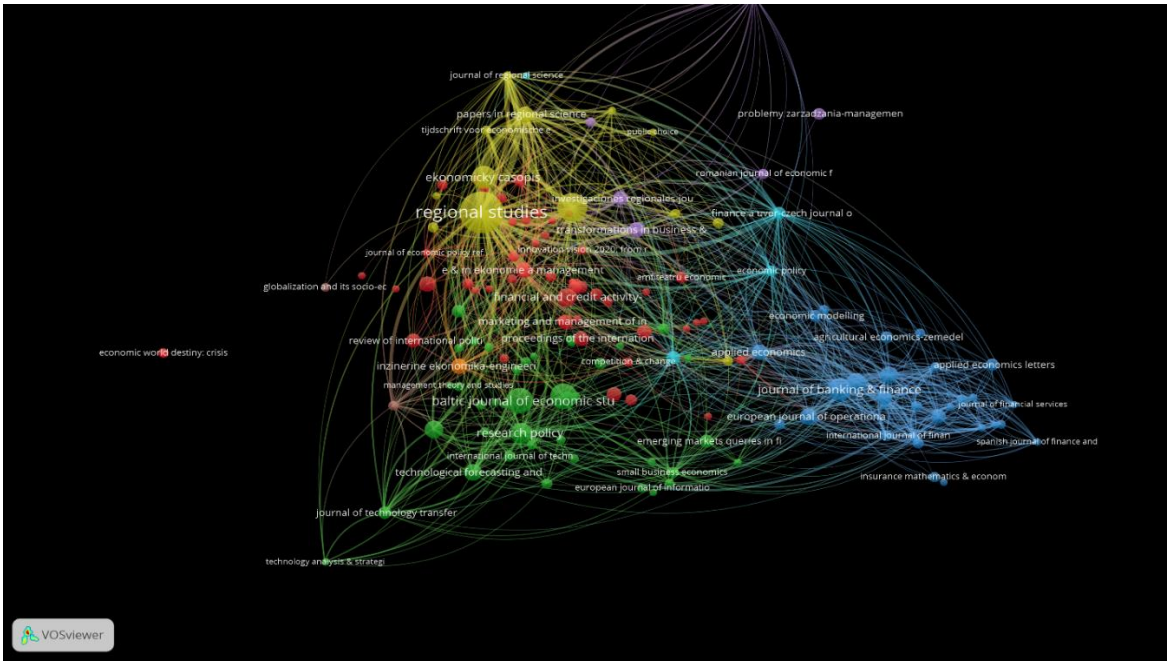
Many journals have published papers with European funds, and 14 have published more than five articles. The most cited journal was Regional Studies, with 984 citations, followed by Energy Policy (Figures 3 and 4)

Figure 3 The most essential 14 active journals



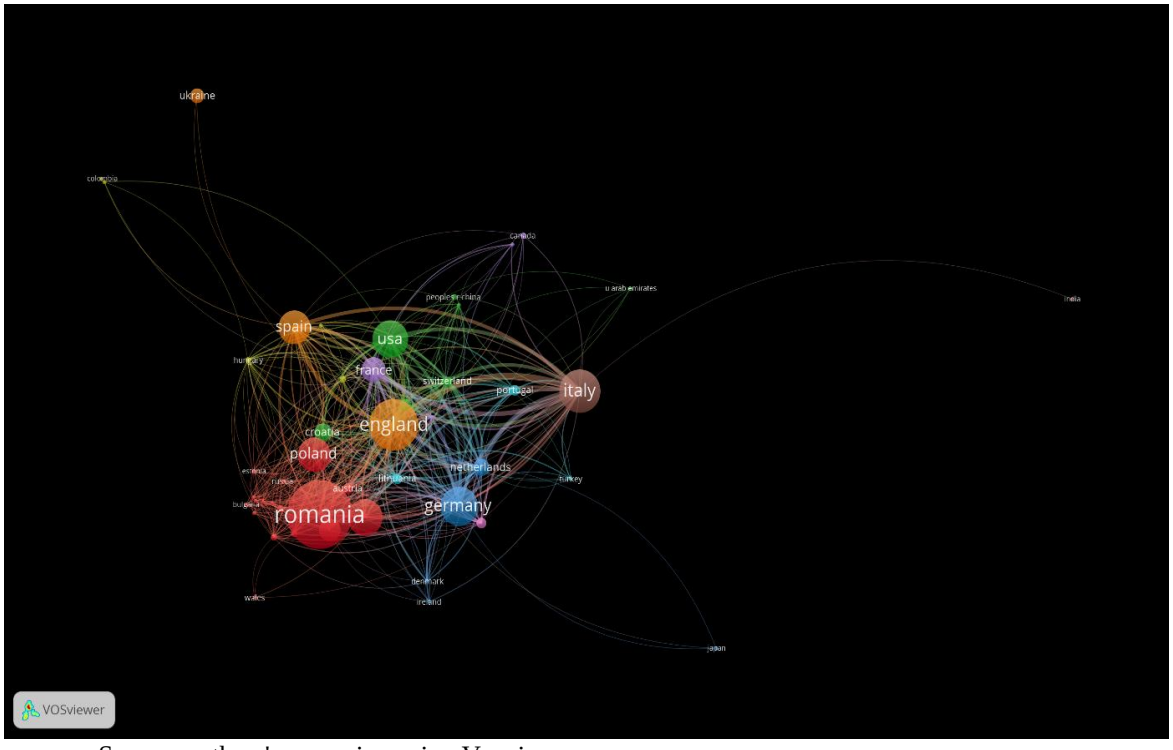
Source: authors' processing

Figure 4 Map of citation journals



Source: authors' processing through the VOSviewer program

Figure 5. Countries where European-funded publications have been published



Source: authors' processing using Vosviewer

The size of the nodes indicates the frequency of occurrence. The curves between the nodes represent their co-appearance in the same publication. The smaller the distance between two nodes, the greater the co-occurrences of the two keywords.

5. CONCLUSIONS

European funds are those tool financial institutions created by the European Union for its members. Most of the European financial allocations for European Union countries represent funds made available for investments in regional development. However, it is essential to ensure that it does not lack development compared to other countries. We can see an increased interest in studying this topic through bibliometric analysis using "European funds" as keywords. The findings also show that the most cited journals in the field of European funds are Regional Studies, with 984 citations, followed by Energy Policy. Several 7745 articles were identified in the WOS database between 1900 and 2021, which included 4895 research articles, 1850 proceedings papers, 116 reviews, 199 books, and 594 early access. Of these, 4589 were published between 2010 and 2021, and the rest were published between 1975 and 2021. It is essential to evaluate the quality of such a large number of research papers and to obtain valuable information.

In future studies, we intend to expand our research on the literature and the application of existing models in the literature. It is essential to evaluate the quality of such a large number of research papers and to obtain valuable information.

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AVOIDING UNEXPECTED COSTS IN PUBLIC PROJECTS

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Abstract: *In a constantly changing environment, projects face many challenges. In most public projects, unforeseen events occur that increase costs beyond initial estimates. If some of the estimates are exceeded, the estimates are too high and the estimation method must be revised. Altough it is often impossible to predict which activities will cost more than expected, it is safe to assume that some activities will cost more. Assesing the likelihood of such an event occurring is part of the project management task of event occurrence risk analysis. Avoiding unexpected costs in public projects depends on the skills of the project manager. Rather than overestimating all cost, funds are budgeted to cover unplanned but statistically predictable cost increases. Funds allocated for this purpose are called contingency reserves. If this funding is sufficient to cover unplanned expenses, the project will be completed on budget. Considering these facts and focusing on the investment project model, this document aims to avoid unforeseen and the purpose is to explore cost alternatives.*

Key words: *project management, budget, productivity, costs control, estimators.*

JEL Classification: *H400*

1. INTRODUCTION

Avoiding cost overruns of investments in public projects

The main objective of this paper is to identify the primary reasons for cost overruns in challenging investment projects, especially construction and infrastructure investments in Romania, as well as critical success factors that help prevent these costs from being incurred. For this, the existing literature is reviewed, various factors contributing to overcrowding are identified, and a questionnaire is designed. The data was collected using a structured questionnaire between client beneficiary contracting authorities, consultants and contractors in the South-East Region. The statistical method (Method of relative importance) was used for data analysis. After conducting a detailed study of the existing literature and engaging in discussions with industry experts, we have identified 43 common factors that are frequently responsible for causing cost overruns in various projects. We hope that this paper will serve as a valuable resource for project managers and all involved parties and that it will provide actionable insights to help reduce project cost overruns.

The construction industry seems to be struggling with poor cost management, which is leading to significant cost overruns. This problem is prevalent in both developed and developing countries, and it's crucial to address it to improve construction cost performance

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since projects are hardly ever completed within the budget. Flyvbjerg et al.'s study, which explored the issue of cost performance in construction projects worldwide, discovered that cost escalation is a widespread practice, with nearly nine out of ten projects experiencing it, with costs being 28% higher than forecasted. According to the study, average cost growth in Europe was 25.7%, North America 23.6%, and other geographies were 64.6%. The study also found that cost performance in construction projects hasn't improved over time and is in the same order of magnitude today as it was in the 70s. Additionally, The World Bank reported that 63% of the 1778 construction projects financed experienced poor performance, with an average of 40% over budget, as cited by Ameh (2010) and Zujo (2010).

Public projects play a crucial role in the economic development of any country, particularly in developing nations. However, the construction industry in these countries faces various issues that affect the project's time, cost, and quality performance. Successfully completing construction projects within the predetermined budget has become a challenging task. It's rare for a project to be completed within the estimated time, budget, and desired quality. [Stoian, 1993]

Effective cost management is vital for the successful completion of a project. Unfortunately, it's often tough to achieve good cost management, and the project ends up facing significant cost overruns. Efficient cost planning involves linking building designs to their cost so that the project's cost is planned in a way that considers quality, changes, risks, utility, and appearance, ensuring that it stays within the economic limits of expenditure (Stoian, 1993).

Cost overrun constitutes the variance between the originally agreed contract amount and the actual cost incurred. It is quantified by computing the difference between the two figures and dividing it by the original contract value, converting the outcome to a percentage. The resulting percentage value is a useful tool for assessing and comparing cost overruns across diverse projects. The formulaic expression of cost overrun is as follows:

$$\textit{Cost overrun} = \frac{\textit{Final Contract Amount} - \textit{Original Contract Amount}}{\textit{The initial value of the contract}}$$

The cost refers to the estimated expenses that a financier agrees to incur in order to create or acquire a fixed asset. Cost overrun, on the other hand, is the difference between the actual final cost of a completed construction project and the initial contract value agreed upon by the contractor and financier during contract signing. Such overruns may take the form of cost escalation, going over budget or other types of cost overruns (Lock, 1999).

To investigate the reasons for cost overruns in public investment projects, a questionnaire was designed and distributed to public project managers in the South-Eastern Region of Romania. A statistical method was used to analyze the opinions of public project managers on the factors that contribute to cost overruns in public investment projects. The questionnaire survey involved the use of an ordinal measurement scale to collect data, and the ranking of each factor was determined based on its relative importance score.

The financier agrees to spend a certain amount of money to create or obtain a desired fixed asset, which is referred to as cost. The discrepancy between the actual final cost of a completed construction project and the initial contract value agreed upon by the contractor and financier at the contract signing is referred to as cost overrun. Cost overruns can manifest in the form of cost escalation, going over budget, or cost overruns. To investigate the causes of cost overruns in public investment projects, a survey was conducted. Public project managers from the South-Eastern Region of Romania were questioned for feedback. The statistical method was used to understand public project managers' perceptions of the factors that contribute to cost overruns in public investment projects. An ordinal measurement scale is used

to quantify data in the questionnaire survey. The questionnaire survey was conducted using a structured questionnaire. The factor's ranking is determined based on the index's relative importance value.

2. LITERATURE REVIEW

A key element to a successful project is sticking to your budget. Furthermore, cost performance is the most important measure of a company's productivity and profitability. Project cost overrun is measured as the difference between the planned cost (estimate) and the actual construction cost at completion. Investors from the Southeast region and beyond are generally unable to complete projects within the originally estimated costs.

Many studies have been conducted to investigate the issues and factors that lead to project cost overruns.

Numerous studies have been conducted on this phenomenon around the world, and a study by Flyvbjerg et al found that 9 out of 10 construction projects experienced cost overruns, with an average budget overrun rate of 28%. They investigated 258 construction projects in 20 countries with very poor cost performance. Another study by Cantarelli et al. showed that cost overruns are a common problem in construction projects. The study looked at 87 projects and found that an average of 10.3% of projects had cost overruns.

In Malaysia, 359 projects (308 public and 51 private) were evaluated. As a result, only 46.8% of public projects and 37.2% of private projects were completed as contracted (Lock, 1999).

If we were to go into detail and examine capital budgeting and decision making for large industrial projects and how unexpected costs are generated and managed, we would find that every decision making incident in this industry leads to unexpected costs. The results show that the capital budgeting process has to manage conflicting interests, which lead to trade-offs, as well as the characteristics of decision processes (sequentiality), which can generate unexpected costs.

Another approach to the life-cycle costs (LLC) of a large-scale environmental impact project can be had after a conceptual discussion of environmental decision-making. The impact on these environmental costs can be so great that the investment project can be prefigured as a premature failure.

Ten LCC-oriented environmental accounting tools were identified and proposed to aid in environmental decision-making. However, adoption in the construction industry appears to be limited and requires conceptual discussion. The purpose of this article is to discuss the theoretical premises and practical usefulness of his LCC approach in green investment decisions. While the expansion of LCC monetary units and scope may favor the use of LCCs, LCCs fail to address irreversible decisions, ignore unowned goods, and do not consider costs to future generations. Furthermore, LCC does not take into account the limited ability of decision makers to make rational decisions under uncertainty. The practicality of LCCs is limited by oversimplification into monetary units, lack of reliable data, complexity of the design process, and conceptual confusion.

Whether a project is delivered to a private or public beneficiary, reliable cost estimates are needed. Without estimates, it would be impossible to perform financial assessments, create business plans, create detailed budgets, control expenses, determine staffing needs, or perform many other management procedures.

It is generally agreed in the accounting community that the word 'cost' should not be used alone without a qualifying adjective. Costing terms that frequently appear in project management include direct costs and indirect costs, which can lead to differences in associated costs.

There are considerable differences between companies in the interpretation of the classification of direct and indirect costs. Therefore, within the projects, the direct related costs (material, labor, machinery, transport) but also indirect costs are paid, in order to recover all these costs from the financier. Some specialists consider that all other costs apart from direct ones are indirect costs and are charged to general expenses. Therefore, the classification of costs as direct or indirect varies from one project to another within each executing company depending on the administrative performance of each one.

Cost estimators and project managers must be clear about the direction between direct costs and direct costs of the performing companies. They must also be aware of any exceptions to the rule caused by special provisions in a project contract that allow the subcontractor to bill for items that would otherwise be covered in overhead.

Accurately estimating costs is essential for successful allocation of resources in both private and public projects. Cost estimates play a crucial role in financial assessments, business planning, budgeting, expense management, labor needs assessment, and other important managerial tasks.

In the field of accounting, it is widely acknowledged that the term "cost" should always be accompanied by a descriptive adjective. Within project management, the usage of phrases like "direct" and "indirect" costs is common, as they can significantly impact project timelines and outcomes. It is imperative to consider these factors while preparing project cost estimates, as they have a direct bearing on the project's profitability and success.

The accuracy of the estimate depends primarily on the elaborated specifications, on the lists of measured quantities, from here the first errors appear or not. However, the possibility of the occurrence of such an error can always be reduced to zero by checks and the resumption of measurements by another specialist. A project is good because it is calculated well and there can be no surprises. However, most of the time the final quantities of the project did not happen to be equal to the initial estimates. In this case, it is possible to not be able to declare with confidence what the real costs are in the realization of a project, due to the complexity of collecting the initial data (works and quantities).

There are clearly several reasons beyond the control of the estimator why the final design costs more than the best possible design estimates. It is much more appropriate to label the early estimates as accurate, because the result can be seen with great certainty, it discourages slippages and with the accuracy it is real it determines that the true costs become known.

Steps can, of course, be taken to eliminate sources of estimation error. Cost estimators should be aware of the problems, but they must not allow them to detract from their primary task, which must always be to use all the necessary data available to produce the best possible estimate - in other words, a very rigorous technical estimate of what the project would cost if everything goes according to plan.

Many studies have been conducted to identify the causes of cost overruns in public investment projects. Among them, it can be said that construction projects face many complex issues such as: Examples: lack of qualified personnel, delays in the delivery of materials and equipment, material shortages, material waste rates, escalation and turnover rates.material prices, quality of equipment and raw materials, ongoing payment delays, project cash flow, change order costs, currency price variances, rework costs, cost management systems, site management, inadequate product quality by owners or other parts. Communication and coordination, conformance specifications, project complexity, project absenteeism rates, planned construction time, time required to correct defects, inadequate planning and scheduling, errors and discrepancies in design documentation, , delays in document review and approval by the advisors and customers.

Other researchers believe that factors contributing to cost overruns include inexperience of contractors and subcontractors, incorrect estimates of time and costs (Abtab Hamed Memon (2010)), or lack of software, incorrect estimates of time and costs, found that these include project funding flows, breakdown, shortage of materials (Yakubu Adisa Olawale (2010)).

Similarly, Ismail Abdul (2013) states that the key factors leading to cost overruns in construction projects are labor shortages, low labor productivity, inexperience of contractors and subcontractors, equipment breakdown, contractor's financial difficulties, unclear and inadequate detail drawing, design modification (Shambalid, 2017).

3. OBJECTIVES OF THE STUDY

a) To identify the major causes of cost overruns and associated remedies in construction through a thorough literature review.

b) To determine the primary factors causing cost overruns, conduct a questionnaire survey of project managers and engineering experts.

c) To recommend possible solutions/prevention to avoid cost overrun.

4. RESEARCH METHODOLOGY

The research method is a systematic way of carrying out a survey activity, which involves several phases, such as literature reviews, data collection, data analysis, and conclusions. In this study, 43 factors influencing cost overruns in the construction industries were identified through specialized literature analysis. The next step was distributing questionnaires to funders, consultants, and contractors to collect data. The respondents involved in the survey had several years of experience in managing different types of projects. Based on the characteristics of the survey respondents, it was observed that most of them work for contractors, followed by consultants and funding authorities.

5. DATA ANALYSIS

The causes of cost overruns were assessed using a 4-point Likert scale from 1 to 4, representing cannot be at all, no, most of the time, and yes, respectively. Data analysis was performed by calculating the Relative Importance Index (RII) through the following formula, adopted from Memon et al. (2013), as the relative importance index (RII) is the most suitable method for the ranking analysis.

Change in scope of project

- RII = Relative importance index
- W = Weighting given to each factor by respondents, and its ranges from 1-4
- X = Frequency of the response given for each factor
- A =Highest weight (i.e., 4 in case)
- N = Total no. of respondents. (52 validates)

6. DATA COLLECTION

A total of 60 sets of questionnaires were distributed to different contracting authorities, construction companies, and project consulting firms. Out of the 60 questionnaires, 52 completed sets (86%) were received and evaluated to determine the significant factors that contribute to cost overruns in investment projects. The data collected from the completed questionnaires is presented below.

Table 1. Demographic Characteristic of Answers

	Frequency	Percentage (%)	Cumulative (%)
Type of Groups			
Customer	14	26.92	26.92
Advisor	7	13.46	40.38
Entrepreneur	31	59.61	100.00
Level of Qualifications			
Master	5	9.61	9.61
Degree	21	40.38	50.0
Diploma	17	32.69	82.69
Others	9	17.31	100.00
Work experience			
8-12 Years	19	36.54	36.54
12-16 Years	16	30.77	67.31
16-20 Years	13	25.00	92.31
More than 20	4	7.69	100.0

Table 2. Arrangement Causes of Cost Overrun Factors Overall

Factor ID	Cause of Cost Overrun	RII	Rank
1.	Lack of competent staff	0.47	41
2.	Labour shortages	0.81	7
3.	Low productivity levels of workers	0.67	21
4.	Inexperience of contractors and sub-contractors	0.61	27
5.	High Labour costs	0.59	29
6.	Labour disputes and strikes	0.46	42
7.	Delays in delivery of materials and equipment	0.60	28
8.	Material Shortages	0.80	8
9.	Material wastage rates	0.55	33
10.	Price increases and fluctuations	0.68	20
11.	Delays in material procurement	0.58	30
12.	Changes in material specification type	0.57	31
13.	Equipment breakdowns	0.69	19
14.	Quality of Equipment and Raw Material	0.49	39
15.	Inadecquate of equipment operating skills	0.59	31
16.	Equipment availability	0.83	6
17.	Lack of modern equipment	0.50	38
18.	Payment delays	0.54	34
19.	Rework costs	0.87	2
20.	Inaccurate Time and Cost Estimates	0.78	10
21.	Contractor Financial Distress	0.85	4
22.	Project Overhead	0.51	37
23.	Financial difficulties of Owner	0.53	35
24.	Incurrence Owner	0.45	43
25.	Financial Distress Poor Site	0.56	32
26.	Finnacial Management Delays in payment to suppliers and contractors	0.71	17
27.	Error during construction	0.72	16
28.	Inadequate Cost control systems	0.73	15

Factor ID	Cause of Cost Overrun	RII	Rank
29.	Inadequate Supervision	0.74	14
30.	Inadequate Programming	0.86	3
31.	Inadequate Construction Control	0.75	13
32.	Inaccurate Site Management	0.77	11
33.	Inaccurate Quantification	0.65	23
34.	Inadequate communication and coordination by owner and other stakeholders	0.66	22
35.	Compliance to Specification	0.64	24
36.	Changes in project scope	0.76	12
37.	Delays in decision making	0.62	26
38.	Obstacles from government laws and politics	0.79	9
39.	Unclear and insufficiently detailed drawing	0.48	40
40.	Frequent design changes	0.70	18
41.	Errors in drawings	0.63	25
42.	Delays in Preparation and approval of project	0.88	1
43.	Incomplete design at the time	0.84	5
44.	Poor design	0.52	36

7. CONCLUSIONS AND RECOMMENDATION

This study, conducted in the southeastern region, has identified and analyzed the major causes of cost overruns in public projects. The analysis found that significant contributors to cost overruns include delays in the preparation and approval of drawings, the cost of rework, inadequate planning and scheduling, equipment availability, changes in project scope, incomplete design at the time of tender, shortage of labor, inaccurate time and cost estimates, financial difficulties faced by contractors, poor site management, and material shortages.

In addition, the study also identified major factors related to consultants, which include delays in the preparation and approval of drawings, inadequate planning and scheduling, material shortages, changes in project scope, cost of rework, inaccurate time and cost estimates, shortage of labor, poor site management, conformance to specifications, incomplete design at the time of tender, and financial difficulties faced by contractors.

To prevent cost overruns, it is imperative to address all the contributing factors. The following list provides some possible preventive measures.

- Appoint competent staff
- Have approved GFC drawings ready before starting
- Freeze all quantities beforehand
- Allow buffer time between indent and delivery
- Consider multiple contractors
- Finalize specifications before starting
- Use ERP and relevant software
- Analyze contractors' past performances
- A competent person should plan and schedule
- Regular market analysis required
- Check equipment availability
- Finalize the scope of work before the project

Note: Natural calamities (droughts, earthquakes, storms) have not been considered in the research as they are unpredictable.

As solutions to this problem we mention only a few of them: the simplification of the legislation and the development of a system based on reference prices (to eliminate situations such as over- or under-sizing of a contract), the running of public procurement procedures during the project organization stage (in this way the implementation period would not be extended).

On the other hand, aspects related to financial management are elements that, as our analysis shows, affect the quality of the implementation phase. We observe that in the vast majority of situations there is no analysis of the financial capacity of the public beneficiary regarding the development of a project. Therefore, in the implementation stage, many public institutions get stuck with the development of the project, having a limited capacity for pre-financing or co-financing (especially of ineligible expenses per project). We propose the realization at the level of public institutions of some analyzes regarding the ability to finance projects and the inclusion of this indicator in the criteria for granting financing. Even if we consider pre-financing mechanisms through guarantee funds, we observe in many cases the blocking of projects due to lack of financial capacity, because even these mechanisms do not completely solve the problem (for example, in the last installment anyway the beneficiaries must have the money little to secure this tranche) and implementation becomes more expensive than for institutions that do not apply for such funding schemes.

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FROM BIG DATA TO ARTIFICIAL INTELLIGENCE: THE FUTURE FOR THE AUDITING PROFESSION

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ABSTRACT: *In the history of the auditing profession, there have been many changes in the way financial statements are audited. In recent years, the changes have been the result of various transformations in the environment in which companies operate and in which auditing is carried out. New technologies available today allow us to capture and communicate data digitally and instantaneously on an unprecedented scale. This technological evolution results in a growing interest in data, whether structured or unstructured, internally generated or not. In response to these developments, companies are innovatively changing their business models because they now have information systems that are increasingly capable of processing, analyzing, communicating, and responding to data-related changes. Therefore, how the audit is carried out must also evolve. Thanks to new technologies, auditing has evolved into a more automated one. Today, there are many new technologies and techniques to change the way this is done. Currently, audit firms integrate these methods into their daily audit procedures, as the environment in which these firms operate is characterized by a constant increase in available data. As part of this stack of information, Big Data pushes auditors beyond their comfort zone of traditional auditing methods. The objective of this article is to analyze the impact of emerging technologies, such as Big Data and Artificial Intelligence (AI), on the auditing profession. The article aims to explore how these technologies can transform auditing practices and requirements, bringing with them a range of opportunities and challenges for auditors. The main purpose of this article is to provide a comprehensive perspective on the direction the audit profession is heading in the digital age, highlighting the advantages brought by Big Data and AI technologies, but also the possible changes and adjustments needed within this profession.*

Keywords: *artificial intelligence, audit, companies, financial statements.*

JEL Classification*:* M42.

1. INTRODUCTION

Throughout history, the auditing profession has seen many significant changes in the way financial statements are audited. In recent years, these changes have been the result of transformations in the business environment and technological advances. New technologies available today have revolutionized the way data is collected and communicated, providing unprecedented scalability. This technological evolution has increased interest in data, whether structured or unstructured, regardless of its source (BinSaeed et al., 2023).

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In response to these developments, companies have begun to adapt their business models innovatively, having access to increasingly advanced information systems capable of rapidly processing, analyzing, and communicating data-related changes. This change required an evolution in the way financial auditing is carried out (Dănăilă et al., 2023).

The chart below illustrates how auditing has changed over time. At first, audit procedures were manual, and audits were based on sampling a limited number of transactions. Then, as technology advanced, auditing became increasingly automated, allowing the use of much larger samples. Technology tools make it possible today to test the entire population of transactions, evaluate patterns, analyze anomalies, and identify trends for process improvement. Thus, the audit of the future becomes a reality.

Today, many new technologies and techniques are transforming how auditing is done. This research focuses on such innovations as artificial intelligence, Big Data, and data analytics. Audit firms increasingly integrate these methods into their daily procedures as they face an ever-increasing amount of available data. Big Data, in particular, challenges auditors to go beyond traditional auditing methods and adapt to the new realities of the digital world.

2. THE METHODOLOGICAL APPROACH

For this article, we have taken a traditional approach to conducting a literature review, to investigate a wide range of relevant topics and themes. In this process, we managed to outline multiple concepts and themes related to the issue addressed in the article. Of these topics, we paid particular attention, first of all, to the evolution of the audit profession in a constantly changing and increasingly regulated environment. This journey thus took us in the direction of providing a contextual perspective on the significant changes that have influenced the way financial statements are audited. These changes seem to be the result of recent transformations in the business environment and the field of auditing (Tabirca et al., 2020).

Second, we examined the various digitization tools and technologies that impact the daily activities of our businesses. These technologies are increasingly numerous, and in this category, we include Big Data, Data Analytics and especially artificial intelligence, a development that raises profound questions about the place of man in the modern world. We also wanted to understand the expectations of audit professionals regarding Big Data and artificial intelligence, and whether these phenomena can represent a solution for improving the effectiveness and efficiency of the audit process. In the context of technological advancement, we see real competition for innovation within audit firms, with the constant use of updated tools (Tebergaoui et al., 2022).

The methodology of writing this article using qualitative research is a rigorous and informative approach to exploring the impact of emerging technologies on the audit field. This methodology aims to provide a deep understanding of the transformations and challenges facing the auditing profession in the age of Big Data and Artificial Intelligence.

The auditing profession is facing significant changes and unprecedented challenges in the context of the evolution of technology. The transformations brought about by Big Data and Artificial Intelligence have redefined the way auditing is done and opened doors to an exciting future full of opportunities. To explore and understand these fundamental changes, qualitative research becomes an essential tool for writing this article. One of the main reasons why qualitative research is so valuable in this context is that it provides direct and deep insight into the experiences, opinions and perceptions of auditors and technology experts.

This type of research brings to the surface trends, advantages and challenges that we might not normally observe through quantitative methods. When auditors share their perspectives, they can provide valuable insights into how emerging technologies are impacting audit efficiency, accuracy, and value.

Through qualitative analysis, we can identify recurring themes, innovative approaches, and ethical dilemmas that professionals face in practice.

Another great value of qualitative research is its ability to capture not only what is happening, but also to explore why and how things happen. Through interviews and content analysis, we can delve deep into the context and reasoning behind auditors' decisions in a Big Data and AI-driven audit environment.

3. REVIEW OF SPECIALIZED LITERATURE

A. The evolution of the audit

In the history of the audit field, many transformations have been observed in the process of examining financial statements. These changes were the result of significant changes in the business and audit environment in recent years. Before today's approach to risk-based auditing, the environment in which business operations took place was much simpler than it is today. Therefore, the audit was mainly performed manually, with a high concentration on verifying financial information, but with little emphasis on identifying and understanding the material risks of misstatement of financial data (according to IAASB, 2016).

Over time, risk-based auditing has evolved for several reasons:

- Higher volumes of transactions;
- Increased complexity;
- Increased regulation in response to listed company failures;
- Technological limitations.

In a risk-based audit engagement, the focus is on identifying and assessing the significant risks of data distortion, with particular attention paid to understanding the internal control systems implemented by the audited entity (Radu et al., 2016). In addition, tests are performed to obtain conclusive evidence about the effectiveness of these internal controls (as per IAASB, 2016).

Recent technological advances allow us to collect and communicate data digitally and instantaneously on an unprecedented scale. This technological evolution has increased interest in data, whether structured or unstructured, internally or externally generated. Consequently, companies are adjusting their business models to benefit from increasingly advanced information systems capable of processing, analyzing and responding to data-related changes (according to IAASB, 2016).

Also, the expectations of interested parties regarding the use of new technologies in the audit of financial statements are evolving. Technological advances in the information systems used to collect, process and store data, as well as the tools and techniques available to auditors to analyze this data, are causing users of financial statements to question how data analysis fits into the current approach based on risk audit (Radu, 2009).

In some cases, entities request information about the auditor's data analytics skills and expect the auditor to use technology extensively, especially data analytics, in the audit process (according to IAASB, 2016).

B. Big Data

B.1 What is Big Data?

The exponential growth of digital data has led to increased interest by researchers in finding new ways to collect, search, distribute, store, analyze and present this data. This evolution gave rise to the concept of "Big Data" (Bremme, 2016). The term "Big Data" refers to massive amounts of data, characterized by enormous volume, considerable diversity and a

processing speed that can approach real-time (Laffargue B. et al., 2014). Later, this definition evolved to include an economic perspective, taking into account the value and veracity of the data.

Even though there is no exact or universal definition for "Big Data," the concept refers to a huge set of data that requires special storage and processing solutions, often exceeding the capacity of traditional databases and using advanced algorithms. In essence, "Big Data" is based on the massive production of digital data, measured in accuracy, due to the ever-widening availability of highly efficient digital technologies that are permanently connected to the Internet. Moreover, we are seeing a significant increase in data generated by interconnected objects, a trend that could become more widespread in the coming years through the development of the Internet of Things. In 2014, it was estimated that every two years, amounts of data equivalent to the total amount of data generated since the beginning of human history were produced (Laffargue B. et al., 2014).

B.2 The 5Vs of Big Data

In an era where companies generate significant amounts of data, we can characterize these data flows using the five key characteristics of Big Data, known as the 5Vs (Espinasse B. and Bellot P., 2017):

1. Volume: This dimension refers to the large amount of data that can be collected, stored, processed, analyzed and distributed by traditional technologies. Volume indicates that such data exceeds the usual data handling capacity.

2. Variety: This characteristic describes the diversity of data formats, types and qualities. In other words, data can be collected and analyzed in various forms, as it comes from various sources, such as different sensors, exchanged messages, online publications, etc. Notably, about 80% of existing data is unstructured, such as emails, social networks, images or videos.

3. Speed: This dimension refers to the rapid pace of data generation, collection and analysis. Data is no longer analyzed traditionally, offline, but in (almost) real-time, thanks to modern technologies and tools.

4. Value: This aspect refers to the intrinsic value of the data collected for analysis. Big Data analysis requires considerable expertise both in terms of analysis methods and techniques, as well as in the interpretation of the results obtained. Therefore, a company must identify the costs and benefits associated with collecting and analyzing this data when deciding to implement Big Data projects.

5. Veracity (or validity): This dimension refers to the quality of the data and, in some cases, to the ethical aspects of their use. It also involves the degree of confidence we can place in the collected data so that we can make informed decisions based on it. Data validity is essential to ensure the quality of the analyses and the results obtained from them.

B.3. Results

Factors of Big Data generalization and integration:

In this regard, several experts agree that the explosion of digital data would have had no value without technological advances and that the innovation related to Big Data was primarily a technological innovation, by transforming the tools of data storage and processing.

1. *Increasing storage capacities:* With the exponential explosion of data volume, it has become crucial to advance in traditional technologies to be able to manage and store this data effectively in real-time. This need is reflected in the concept of "scalability," which involves the continuous and progressive adjustment of storage tools to cope with the massive increase in collected data (Laffargue B. et al., 2014).

2. *Influence of cloud computing*: A second factor that contributed to the spread of Big Data was the advent of cloud computing. The development of Big Data has seen a significant

increase with the advent of cloud computing. Cloud computing has facilitated the creation of the necessary conditions for the generalization of Big Data by sharing data in the cloud and by democratizing access to the storage and processing of various types of data (Laffargue B. et al., 2014).

3. *The emergence of adaptive processing technologies:* The last factor that contributed to the development of Big Data was probably the emergence of new databases and processing tools adapted to unstructured data, such as Hadoop, and the development of high-performance computing methods, such as MapReduce (Laffargue B. et al., 2014). These innovations formed the basis of today's Big Data processing, enabling the manipulation of large volumes of data, whether structured or unstructured, in a much shorter time, approximately 50 times faster compared to older technologies. The fact that Hadoop was offered as open-source contributed to the spread of the tool and its subsequent expansion into the field of Big Data.

The provision of new data storage and processing tools, along with the explosion of digital data, has contributed to the rise of Big Data. However, in the literature, there is a debate about the degree of revolution brought by Big Data. Some believe that while the data has changed, the algorithms remain quite similar and that Big Data is just an extension of traditional processing with greater quantity and precision. On the other hand, others see Big Data as a fundamental change, enabling new uses of data and innovative methods of analysis.

C. Artificial intelligence

The growth of Big Data can be explained, in part, by the provision of new technological tools. According to Ben Taieb (2020), Big Data is not enough. Indeed, collecting or accessing large data sets is not enough to produce a result (Big Data, 2018). The data must be able to be analyzed correctly. To do this, we need to use tools equipped with artificial intelligence.

C1. What is artificial intelligence?

Artificial intelligence (AI) is a broad field of research and technologies aimed at improving the cognitive capabilities of computers and software. The term "artificial intelligence" is often used as a synonym for "AI" or "cognitive computing". The central objective of AI is to enable machines to perform activities such as perception, reasoning and learning similar to human cognitive processes. The ultimate goal is to create computer systems that are fully autonomous and capable of interacting with the real world (KPMG Business School, 2019).

Currently, there are two main types of artificial intelligence:

1. *Weak Artificial Intelligence:* This form of AI is currently used in many digital applications. She specializes in solving specific tasks. If we compare the execution speed with humans, weak AI can complete this task in an extremely fast time. Weak artificial intelligence is capable of processing huge amounts of data quickly. However, it is important to note that it operates under human supervision to ensure that it acts properly. Even at this early stage of development, weak AI brings significant value to the business world.

2. *Powerful Artificial Intelligence:* This form of AI aims to integrate intelligence into a robotic system capable of thinking and performing a wide range of tasks. The ultimate goal is to create a robot that has mental abilities comparable to those of human beings. This type of AI is an ambitious aspiration and raises complex questions about its impact on human society.

Artificial intelligence represents a significant revolution in the field of technology, even its weaker form brings considerable value in various business sectors. Strong artificial intelligence, although still in development, represents an exciting and challenging prospect for the future, as it could have a significant impact on society and everyday life.

C2. The different forms of artificial intelligence

The world of artificial intelligence remains quite vast and varied, which is why it remains difficult to fully understand. However, there are a multitude of interconnected fields and disciplines that are necessary for artificial intelligence to be applicable. Here are some of the more well-known concepts:

Machine Learning

Machine Learning is a branch of artificial intelligence that allows algorithms to improve their performance frequently as they process data. In other words, Machine Learning allows computer systems to learn and develop without being explicitly programmed to do so. It is a modern discipline that relies on statistics, data mining, pattern recognition and predictive analytics to discover patterns and make predictions from data.

Big Data is the foundation for machine learning, as this technology requires massive amounts of data to work effectively (Le Big Data, 2018). Machine Learning is what makes it possible to fully exploit the potential of Big Data, as traditional analytical tools are not effective for processing massive amounts of data and identifying complex correlations between them (Big Data, 2018).

Advances in machine learning have had a significant impact on artificial intelligence because they allow computer systems to adjust and optimize their performance autonomously. This eliminates the need to manually program all possible scenarios, accelerating the development of robust and efficient algorithms (KPMG Business School, 2019).

Within machine learning, there are two main approaches:

1. *Supervised Learning:* This method involves learning a function that, given input data and desired outputs, can estimate the relationship between input variables (X) and an output variable (Y). This approach is used in classification (e.g. for detecting credit card fraud or spam emails) and regression (e.g. for real estate price estimation or stock price prediction) problems (Ismaili, 2019).

2. *Unsupervised learning:* This method does not assume the availability of labeled results and focuses on inferring natural structure from a data set. In this case, we only have input data (X) with no corresponding output variables (Y). Unsupervised learning is based on algorithms that discover and present interesting structures in data without a predefined correct answer. Although both approaches are important in machine learning, most applications are based on supervised learning (Ismaili, 2019).

Deep Learning

Deep Learning is a subcategory of Machine Learning and artificial intelligence technology that enables the acquisition of special intellectual abilities. This technology successfully tackles complex tasks such as image recognition or understanding human language. At its core, Deep Learning is based on an "artificial neural network" inspired by human brain structures. This artificial neural network is composed of thousands of digital neurons, which perform thousands of small calculations. These accumulated calculations allow machines to perform highly complex calculations comparable to computer geniuses.

To implement Deep Learning in various applications, developers need to decide which type of learning is suitable for the intended purpose. This can involve supervised or unsupervised learning, where the machine is trained with previously selected or unselected data, or semi-supervised learning, where algorithms apply learned solutions to a new context (The Big Data, 2018). To achieve successful results, Deep Learning requires a significant amount of data for training (Big Data, 2018).

Natural Language Processing (NLP) is an essential component of Deep Learning and, implicitly, of Artificial Intelligence. NLP enables machines to recognize and understand human language, be it text or speech. It is used in various applications such as voice recognition in devices such as Google Translate, Amazon Echo/Alexa, or Apple Siri. As artificial intelligence continues to develop, we will increasingly be required to interact with robots and digital

entities. To do this naturally and for machines to understand us, natural language processing is becoming increasingly important (Big Data, 2019).

Computer Vision

Computer Vision (or artificial vision) is an artificial intelligence technology that aims to reproduce the visual perception abilities of the human eye. The main goal of Computer Vision is to enable computers to analyze and understand the content of images in a human-like manner, such as in the case of facial recognition technology used in smartphones (KPMG Business School, 2019).

C3. Artificial intelligence growth factors

Data growth

Many of the recent advances in artificial intelligence are associated with the emergence of new types of computer networks, such as artificial neural networks, which can model computer systems in a way similar to how neurons transmit and process information in the brain human (KPMG Business School, 2019). However, it is worth noting that most of these techniques were developed by researchers a long time ago. However, their real benefits only became apparent with the massive availability of data to frequently refine and improve algorithms.

Today, digital technology has led to the creation of an incredible amount of data, especially thanks to the development of technologies such as the Internet of Things (IoT). This data is constantly produced and feeds the machine learning of computer systems and the development of artificial intelligence.

To cope with this explosion of data, significant improvements in the available technological tools have been required. The traditional processors (CPU - central processing unit) in our computers have proven to be insufficient in terms of the computing power and speed required to manage and process this data. As a result, engineers have turned to graphics processors (GPUs), which are much more powerful and can handle larger computing tasks, including the massively parallel processing required for many artificial intelligence algorithms (KPMG Business School, 2019). As interest and demand for artificial intelligence continues to grow, the development and improvement of such hardware is expected to remain a priority in the IT industry.

Consumer demand

With the advent of consumer technologies such as intelligent voice assistants, artificial intelligence has become a technology accepted by the general population for the convenience it brings. As consumers become more accustomed to the efficiencies that AI technologies enable, the more they will demand and expect AI to be integrated into many other aspects of their daily lives. This will stimulate research and investment in this type of technology (KPMG Business School, 2019).

4. BIG DATA AND ARTIFICIAL INTELLIGENCE: A REVOLUTIONARY CONVERGENCE?

Big Data and artificial intelligence are two booming technologies with significant potential for various businesses. However, their true power can be realized through their convergence. As mentioned in Big Data (2018), these two fields are closely related, often called "Big Data Intelligence". According to Ben Taieb (2020), artificial intelligence should not be seen as a separate field, but as a global concept that includes under its umbrella disciplines such as Data Mining, Data Science and Machine Learning. He points out that to successfully implement artificial intelligence, we need the massive volume of data provided by Big Data, and to fully exploit the potential of Big Data, artificial intelligence is essential. However, he acknowledges that this perspective may be open to debate.

In sectors where decision automation is in full swing, artificial intelligence plays a ubiquitous role. This trend is driven by the need to make more informed decisions and effectively manage large data, as Big Data (2018) mentions. As decision automation becomes the next stage in the evolution of Big Data, the convergence of these two technologies seems inevitable. This convergence can bring benefits such as increased flexibility, smarter processes and increased productivity.

However, progress in data management has also brought with it challenges. Simply collecting or accessing large volumes of data does not guarantee a successful outcome, as many users are not prepared to mine the data and quickly respond to the demands of the competitive market. Today, the use of Machine Learning, expert systems and analysis techniques in tandem with Big Data is a natural evolution of these fields. Thus, their convergence becomes inevitable. Capturing data to identify trends and patterns in customer or employee behavior is useful, but interpreting that data to make optimal decisions is even more valuable. Artificial intelligence is the key to making sense of data, getting more accurate results and making quick decisions from a large volume of information. In a world dominated by Big Data, artificial intelligence will play a crucial role in understanding and monetizing data, shaping the future of business and the economy as a whole.

In sectors such as finance, banking and commerce, Big Data alone is not enough. That is why the integration of artificial intelligence is imperative. It is critical not to view these technologies as separate entities, as their convergence will directly impact employees, customers, services and markets, requiring a holistic approach (Big Data, 2018).

5. THE FUTURE AUDIT

In the digital information age, the speed with which data spreads and its accessibility requires a reassessment of business models for companies. The use of digital technologies has a significant impact on organizations, disrupting corporate culture through innovation, digitization of support functions and generating exponential amounts of data (EY, 2019). Auditors working with these companies are not immune to these disruptions as they face profound changes and technological developments in the business model.

Today, auditors operate in a highly dynamic and challenging economic environment. Therefore, their role in the financial markets is more crucial than ever. To serve the public interest, auditors must conduct audits with rigor, providing more information and value to users of financial statements and constantly improving the quality of their audits. The impact of Big Data on improving audit quality has long been recognized in the audit profession. However, the widespread use of Big Data has been slowed by the lack of appropriate and efficient technologies, difficulties in data management, and data protection and privacy concerns.

However, recent technological advances in the analysis of large volumes of data are causing a reconsideration of how audits are conducted. Technological developments are truly the main source of disruption in the audit world, as they enable audits to be conducted in real-time and continuously, changing the pace of processes and the way teams operate (EY, 2019). These technological innovations mainly focus on automation through robotics, artificial intelligence, blockchain and detailed process analysis (also known as "process mining").

Artificial intelligence systems are quickly adapting to perform tasks that were previously reserved for humans in many industries, including auditing. These new technologies enable audits to be faster and more efficient while reducing the risk of errors. Although these technologies are still in their infancy in the audit industry, they are already being used to improve the quality of audits. Artificial intelligence can detect patterns and anomalies in data sets and learn from identified problems, applying these learnings to the analysis of subsequent data sets.

With these advanced technologies, audit techniques evolve from testing samples to analyzing entire populations of audit-relevant data. By using these new analysis techniques, auditors can provide higher-quality audit evidence and more relevant information. Data and the analysis of this data enable auditors to more effectively identify a company's fraud and operational risks and adapt their approach to perform a more informed audit (EY, 2015). Although auditors are beginning to understand the benefits of Big Data in auditing, we must recognize that the transition from traditional approaches to those that fully integrate Big Data and its analysis will not happen overnight.

6. CONCLUSIONS

The article provides a synthesized and informative perspective on the impact of emerging technologies on the audit field. This article explored the significant transformations and challenges facing the auditing profession in the era of Big Data and Artificial Intelligence, highlighting key research findings and conclusions. Here are some key takeaways:

The auditing profession is undergoing a profound transformation: Changes brought about by Big Data and Artificial Intelligence have transformed the way auditors conduct auditing. This technological revolution has brought immense opportunities to improve audit efficiency and accuracy, but also significant challenges related to adapting to new technologies and managing massive data.

Qualitative Research Reveals Valuable Insights: The use of qualitative research enabled a deep understanding of the experiences, opinions and perceptions of auditors and technology experts. Interviews and content analysis revealed trends, advantages and challenges that could not have been observed through quantitative methods.

Technological innovation brings benefits and risks: Big Data and Artificial Intelligence bring obvious advantages for auditing, such as efficient data analysis and more accurate identification of risks. However, they also come with risks related to data security and the ethics of using artificial intelligence in auditing.

The future of auditing is constantly evolving: The auditing profession must adapt to the accelerating pace of technology and continue to learn and develop. Auditing based on Big Data and Artificial Intelligence represents a paradigm shift that will continue to influence the way auditing is conducted in the future.

The role of auditors remains essential*:* With all the technological transformations, the role of auditors remains crucial in ensuring the integrity and trust in financial reports. Auditors must develop their technological skills and adapt to the new demands of the profession.

The article emphasizes the importance of a deep understanding of the impact of emerging technologies on the auditing profession and emphasizes the need for continuous adaptation and evolution. Big Data and Artificial Intelligence represent an opportunity to transform auditing and make it more efficient, accurate and relevant in the ever-evolving technological world. However, to make the most of these technologies, the auditing profession must remain flexible and learning, ensuring it remains relevant and valuable in the digital future.

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ANALYSIS OF THE CURRENT STATE OF RESEARCH ON MANAGEMENT ACCOUNTING – A LITERATURE REVIEW

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Abstract: *Management accounting is an integrated aspect of the decision-making, budgeting and managerial process and has an important mission on supporting management in making the best decisions. This article focuses on the knowledge of the management accounting concept and presents various approaches to its performance and strategy, through the analysis of descriptive statistics, of the influence of specialized journals, authors, publications, institutions and countries, as well as their bibliometric analysis, providing a holistic perspective on the researched field.*

Keywords: *management accounting, literature review, strategic management accounting, performance, management accounting systems*

JEL Classification: *G32, M21, M41, N01, C38*

1. INTRODUCTION

Businesses face an uncertain world that is constantly changing due to the social environment, consumer demand and product competitiveness, representing the determining factor of competitive pressures in the market. To choose between alternative business opportunities, managers need information about future costs and revenues and how they may vary at different levels of activity.

Good estimates have a direct and important impact on the effectiveness of companies, being the reason why time and resources have been invested to study and develop new techniques and methodologies aimed at optimizing this type of processes (Iban R. et al., 2021). For at least 50 years, the concept of managerial control has been linked to strategy. Managerial accounting is an integrated aspect of the decision-making, budgetary and managerial process and has an important mission to support management in making the best decisions.

This article focuses on the knowledge of the concept of management accounting and presents various approaches to its performance and strategy, through the analysis of descriptive statistics, the influence of specialized journals, authors, publications, institutions and countries, as well as their bibliometric analysis, providing a holistic perspective on the researched field.

To survive in a competitive environment, it is essential that managers identify and understand emerging problems as a prerequisite for strategic changes. Based on this fact, managerial accounting represents a key role in strategic decision-making, evolving from the role of recording information on cost calculation to that of informational support in strategic decision-making.

The scientific approach brings to the fore the theme of managerial accounting and its role in the company's strategic decision-making, thus ensuring the efficient and effective

acquisition and use of resources in order to achieve the organization's objectives. The argument for choosing the research topic is based on the importance of managerial accounting and its interdependencies.

From the theoretical composition point of view, the motivation for choosing the research topic is proven by the desire to determine the current state of understanding regarding the field of management accounting debate.

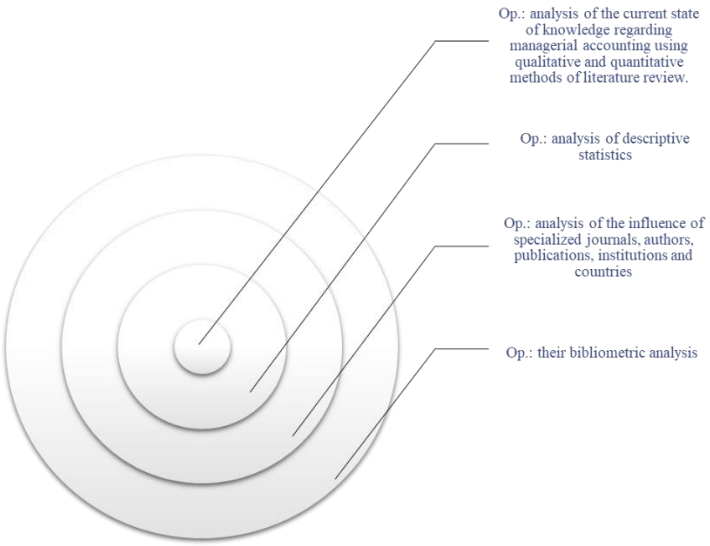
Through the bibliometric analyzes undertaken, from the point of view of scientific research, we argue that this scientific approach is fundamental to interested researchers because it presents the analysis and mapping of research directions in the studied field and undertakes future research approaches. Regarding the statistical research and the empirical study carried out, the impact of the determining factors on the variation of the production cost is analyzed in the context of cost center accounting. Analyzing the specialized literature, it is observed that the level of scientific research in this field is not as popularized as other subjects in the field of managerial accounting research.

The relevance of the research theme denotes the emphasis on the major tasks of managerial accounting to support management in decision-making by providing information, analysis and recommendations, a topic of current time and great importance because it is an integrated part of the decision-making, managerial and budgeting and has an extremely important mission to support management in making the best decisions, providing information for internal use aimed at efficient asset management. It has the role of supporting the company's business from the inside, through the design, implementation and management of internal information systems.

The scientific approach brings to the fore the knowledge of the management accounting concept and presents various approaches to its performance and strategy, through the analysis of descriptive statistics, of the influence of specialized journals, authors, publications, institutions and countries, as well as their bibliometric analysis, providing a holistic perspective on the researched field.

In order to achieve the proposed goal and facilitate the research process, the following objectives are set:

Figure 1. Research objectives

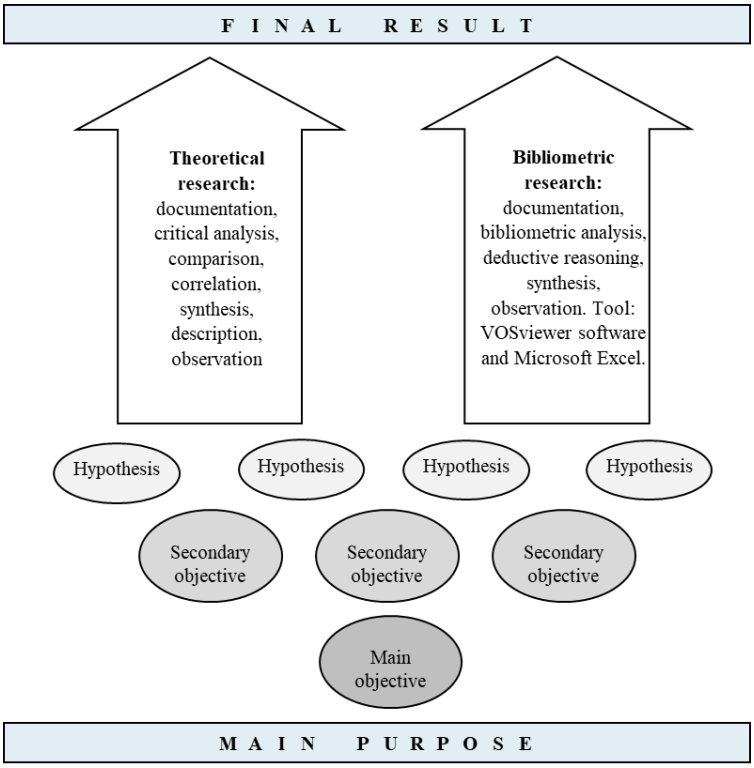


Source: Own processing

The scientific approach denotes the obligation of an appropriate methodological approach, combining fundamental and quantitative research through modern and classic

research tools. According to the following graphic, the methodological framework is built on the basis of two components and they are arranged schematically:

Figure 2. Methodological framework



Source: Own processing

According to some researchers (Wang et al., 2022) to comprehensively understand the broad scope of a certain research field, bibliometric analysis is one of the most suitable approaches to reveal the key topics and emerging research directions visually and is an effective way to present the evolution and relationships of articles in a topic or journal by analyzing the relevant literature.

A unique feature used in the performance analysis in this study is the citation count, which is provided by WoS and represents the relative importance and influence of publications, authors, journals, institutions, and countries. We also calculated the average of citations per article and displayed in the tables. Scientific mapping is used to explore the structure and evolution of a focal research area (Bota-Avram C., 2022).

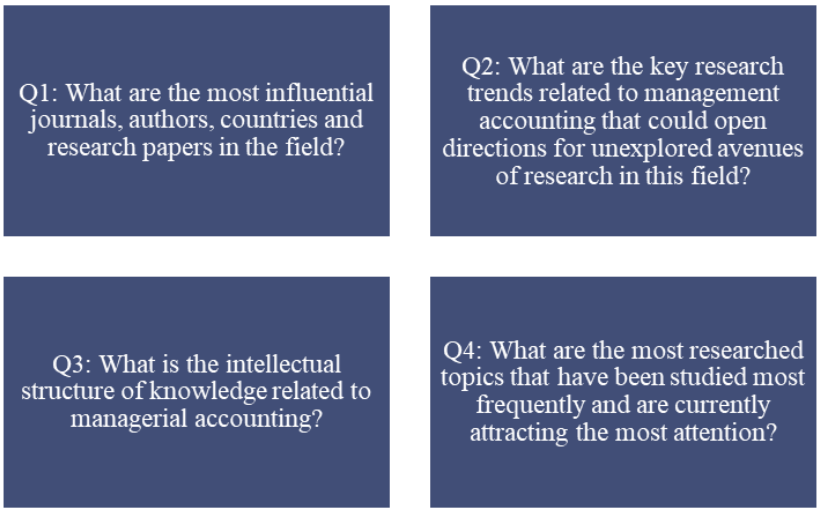
2. ANALYSIS OF THE CURRENT STATE OF KNOWLEDGE REGARDING MANAGEMENT ACCOUNTING

This theme focuses on the concept of management accounting and presents different approaches to its performance, strategy, providing a comprehensive holistic perspective on the research area studied.

This study aims to map the field of management accounting by providing data on the intellectual structure of knowledge and enabling the most influential articles, institutions, source titles, countries and authors. The findings of this bibliometric analysis can provide a solid basis for positioning real contributions in this field and detecting emerging trends and directions for future research.

This study addresses the following research questions using appropriate bibliometric methods:

Figure 3. Research questions

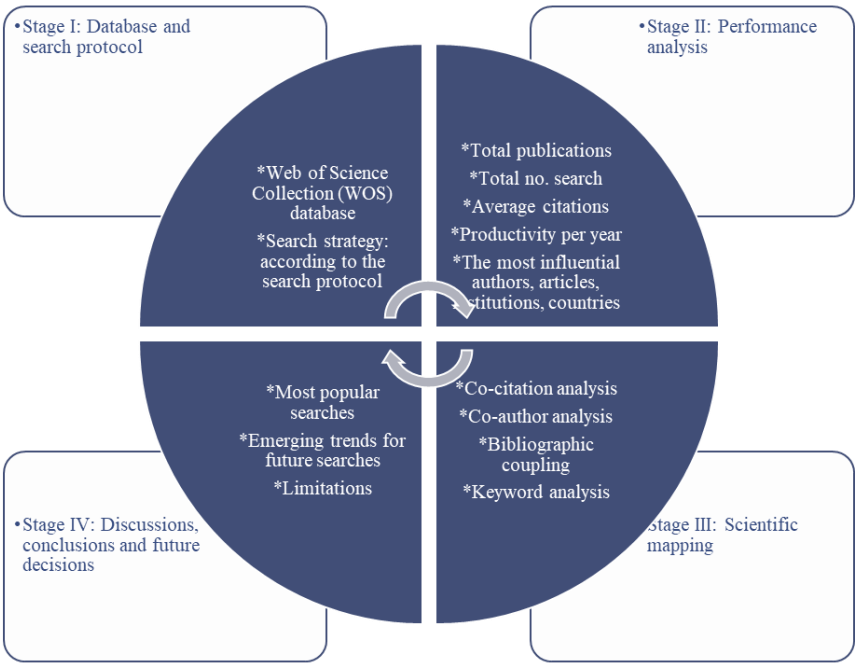


Source: Own processing according to Bota-Avram C., 2022

The purpose of this study is to provide a comprehensive overview of existing publications through an extensive bibliometric analysis of the field of management accounting research, based on a sample of 593 papers on the Web of Science for the period 1975–2022, using the bibliometric software tool VosViewer.

To provide a comprehensive mapping of the state of knowledge in the field of management accounting through the lens of recent developments in bibliometric research, we adopted a systematization of search steps that followed one of the most well-known systematic review protocols.

Figure 4. Systematization of search stages



Source: Own processing

In the following lines, we will present the results of the descriptive statistics, the map and the analysis related to the publications, authors, institutions and countries in the field of platform research. In addition, we will also provide the results of co-citation analysis on cited references, cited authors, and cited journals. In order to gain an overview of research developments in management accounting, we perform a keyword co-occurrence analysis.

The sample in this study consisted of a total of 593 publications by 987 authors affiliated to 591 institutions from 75 countries/regions, of which 538 of the articles were published in 174 journals and 55 were published in 30 magazines and referred to 13,543 cited references.

Our study analyzed publications from 1975 to 2022, since the first publication on the platform containing complete information was in 1975. Using "management accounting" in the title field, we obtained a total of 1181 publications:

Table 1. Sample study

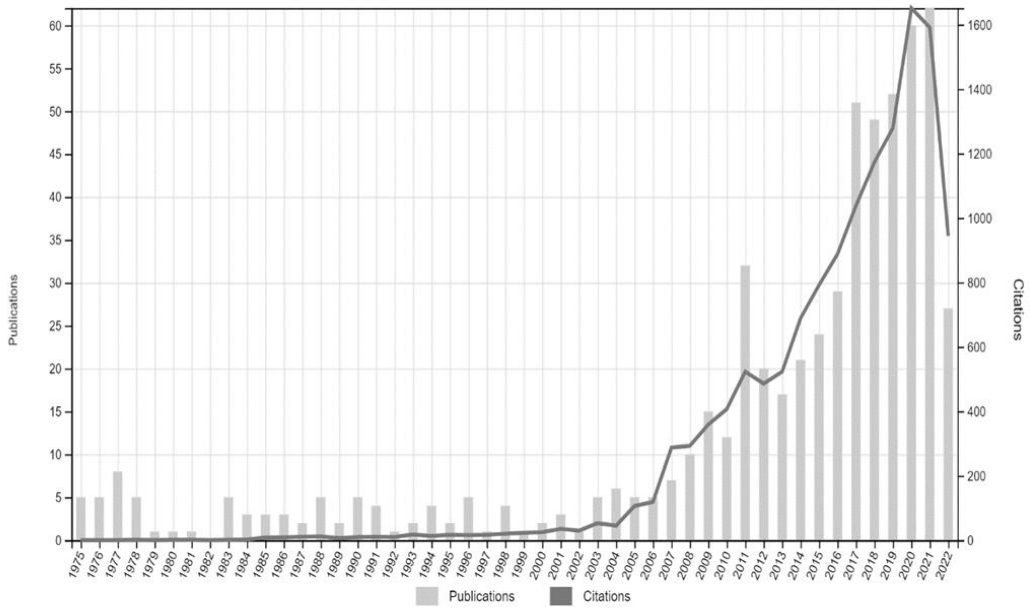
Criteria	Quantity
Publications	593
Citations	13.543
Journals	174
Magazines	30
Author	987
Institutions	591
Countries/Regions	75

Source: Own processing

After limiting the search to the fields of "management", "business finance", "business", "economics", we obtained a total of 933 results. The database was then filtered by "document types 'articles' or reviews", ultimately generating a unique database including 593 publications of which 564 were articles and 29 were reviews.

The following figure shows the chronological distribution of publications in the field of management accounting research:

Figure 5. Chronological distribution of publications



Source: Own processing

The first traceable article was published in 1975, and since then, the number of publications was increasing until 1978, followed by a period of stagnation between 1979 and 1982 (with only one publication per year and no publication in 1982), then having an increasing rate until now. From 1983 to 2002, an average of three articles were published each year, showing that it is an embryonic stage. In the subsequent stage, the number of works published from 2003 to 2007 reaches an average of twice as many publications - six publications - compared to the previous stage, indicating the seeding chronology. In the next stage, from 2008 to 2010, an average of 12 articles were published per year. Since 2010, there has been considerable growth, reaching an average of thirty-seven publications per year. The year with the most publications was 2020 (with 61 publications), followed by 2021 (with 60 publications).

This study discovers the most cited publications in WoS. The top 10 most cited publications are shown as follows:

Table 2. Top 10 most cited publications

	Titlu	Sursă	An	Citări
1	Doing qualitative field research in management accounting: Positioning data to contribute to theory	Accounting Organizations and Society	2006	396
2	The impact of structure, environment, and interdependence on the perceived usefulness of management accounting systems	Accounting Review	1986	356
3	Management accounting as practice	Accounting Organizations and Society	2007	289
4	The relationship between strategic priorities, management techniques and management accounting: An empirical investigation using a systems approach	Accounting Organizations and Society	1998	287
5	The role of actor-networks and boundary objects in management accounting change: a field study of an implementation of activity-based costing	Accounting Organizations and Society	2001	286
6	Management accounting systems, perceived environmental uncertainty and organization structure - an empirical-investigation	Accounting Organizations and Society	1984	284
7	Mapping management accounting: graphics and guidelines for theory-consistent empirical research	Accounting Organizations and Society	2003	272
8	A hybrid profession - the acquisition of management accounting expertise by medical professionals	Accounting Organizations and Society	2004	254
9	The evolution of management accounting	Accounting Review	1984	252
10	An exploratory investigation of an integrated contingency model of strategic management accounting	Accounting Organizations and Society	2008	234

Source: Own processing

The first most cited article, "Doing qualitative field research in management accounting: Positioning data to contribute to theory," (Athens T. et al, 2006) has in total 396 citations, traces the ways in which conducting qualitative research brings discipline to the researcher, allowing us to assess the credibility of their accounts with the intention of to develop a more adequate basis for judging the plausibility of qualitative studies.

The second most cited article totaling 356 citations, "The impact of structure, environment, and interdependence on the perceived usefulness of management accounting systems" (Chenhall R. et al, 1986), analyzes the effect of structural decentralization, perceived environmental uncertainty, and organizational interdependence on design management accounting systems. Findings indicated that decentralization was associated with a preference for aggregated and integrated information; perceived environmental uncertainty with a wide range of information and timely information; organizational interdependence with a wide range of information, aggregated and integrated, and the effects of perceived environmental

uncertainty and organizational interdependence were, in part, indirect through their association with decentralization.

The third article in our ranking, totaling 289 citations, "Management accounting as practice" (Athens T. et al, 2007) outlines a distinct practice theory approach to consider the role of management accounting in the constitution of organizations. By tracing the skillful practices by which social actors in a restaurant chain understand and mobilize accounting to contribute in specific ways to what they consider to be the goals of the organizational unit. By situating the interrelationships between technical and interpretive accounting processes within the broader field of organizational practices the authors elaborate the ways in which management control systems as structures of intentionality shape and are shaped by shared norms and understandings.

Top 10 publications reflect the most classic works on management accounting research, while Top 10 authors show the most influential scholars in this field:

Table 3. Top 10 most influential authors

	Autori	Publicații	Interese
1	Chenhall RH	8	Decision processes; Accounting; Strategy and statistics, Management accounting
2	Hiebl MRW	8	Management accounting; Resource-basedview; Internationalization
3	Endenich C	7	Budgeting; Controller; Ethics; Management accounting; Management control system
4	Modell S	7	Management accounting-innovations; Regulation
5	Lukka K	6	Cost implications, Management accounting research; Paradigms; Contingency theory
6	Oyewo B	6	Global management accounting principles; management accounting function
7	Scapens RW	6	History of management accounting; Practice-research gap, Management accounting change
8	Schaltegger S	6	Management accounting research; Supply chain costing; Research-practice gap
9	Spraakman G	6	Management accounting; Qualitative research methodology; IT and accounting
10	Trapp R	6	Budgeting; Controller; Ethics; Management accounting; Germany

Source: Own processing

Robert Chenhall and Hiebl Martin are the most productive authors who published 8 articles during our search period. Robert Chenhall has focused mainly on managerial accounting, the managerial accounting system, perceived environmental uncertainty, performance measurement systems, contingency hypothesis testing, budgeting and organizational culture. His current research activities involve investigating how strategic management accounting systems can be designed to help Australian business organizations develop internationally competitive strategies. In 2007, the author studied a potential issue of concern in management accounting research, namely the extent to which endogeneity limits the validity of empirical model testing. In his study, he explains what endogeneity is, its causes and consequences, and potential ways to manage the problem. Specifically, the paper argues that an econometric definition of endogeneity clarifies its meaning in empirical research.

Hiebl Martin's research focuses on managerial accounting and control, strategic management, risk management, small firms and family firms, and is primarily based on field research such as surveys and qualitative research methods. For example, in a 2018 study on management accounting survey response rates, the author concludes that in recent years, management accounting survey response rates have experienced a downward trend. They also find that the size of the survey population, the region in which the surveys are conducted, the scale of the surveys, the hierarchical level of the respondents, the research topics examined, the random sampling techniques, and the establishment of contact with the survey population

before sending out the questionnaires are all significantly associated with the response rate. answer.

Endenich Christoph is interested in studying managerial accounting, management control system; performance measurement system, thus publishing 7 articles during the period of our study. As the third most active author, he focused in particular on examining the link between outsourcing and performance: the leverage effect of the interactive use of management accounting and control systems.

According to Dzikowski (2018), a journal has a greater impact the greater the number of published papers and the greater the number of citations it possesses. Therefore, this study analyzes the number of publications and citations and the average citation per publication of all journals. The Table 4 presents the Top 10 important journals in the field of managerial accounting, sorted by the number of publications.

Table 4. Top 10 most cited sources

	Sursă	Publicații	Citări	Media publicații/ citări
1	Accounting Organizations And Society	55	5886	107.02
2	Management Accounting Research	42	1857	44.21
3	Accounting Auditing & Accountability Journal	28	649	23.18
4	Journal of Accounting and Organizational Change	26	93	3.58
5	European Accounting Review	13	708	54.46
6	Journal of Asian Finance Economics and Business	13	55	4.23
7	British Accounting Review	12	225	18.75
8	Journal of Management Accounting Research	12	136	11.33
9	Qualitative Research in Accounting and Management	11	38	3.45
10	Accounting and Business Research	9	302	33.56

Source: Own processing

The top five journals according to the number of publications are: Accounting Organizations and Society (55 publications), Management Accounting Research (42 publications), Accounting Auditing & Accountability Journal (28 publications), Journal of Accounting and Organizational Change (28 publications) and European Accounting Review (13 publications). This reflects that these five journals are more interested in management accounting studies.

According to the "average citations/publication" indicator, the first journal is: Accounting Organizations and Society (107 citations per publication), European Accounting Review (54 citations per publication), Management Accounting Research (44 citations per publication), Accounting and Business Research (34 citations per publication) and Accounting Auditing & Accountability Journal (23 citations per publication), thus gaining more attention in our research field.

Similarly, the number of publications and the average number of citations per publication of each institution reflect the influence of an institution. The sample used in this study contains 589 institutions from 73 countries or regions. The Table 5 presents the top 10 institutions that have researched in the field of managerial accounting:

According to the number of publications, the University of Manchester was ranked 1st with 10 publications and 610 citations, followed by the University of Essex which published 9 papers thus obtaining 124 citations to date. 3rd place is occupied by Monash University, which has published 8 articles in the field of management accounting, but totals 1023 citations.

Table 5. Top 10 most cited sources

	Instituție	Publicații	Citări	Medie citări/publicații
1	UNIVERSITY OF MANCHESTER	10	610	61.00
2	UNIVERSITY OF ESSEX	9	124	13.78
3	MONASH UNIVERSITY	8	1023	127.88
4	UNIVERSITY OF GRONINGEN	8	237	29.63
5	UNIVERSITAT SIEGEN	8	118	14.75
6	UNIVERSITY OF SOUTHAMPTON	8	112	14.00
7	UNIVERSITY OF TURKU	8	239	29.88
8	QUEENSLAND UNIVERSITY	7	75	10.71
9	DORTMUND UNIVERSITY	7	63	9.00
10	UNIVERSITY OF EDINBURGH	7	176	25.14

Source: Own processing

Based on the "average citations/publication" indicator, the top is led by Monash University in Australia with an average of 128 citations/publication, followed by the University of Manchester (average of 61 citations/publication) in the United Kingdom, and then the University of Turku in Finland, recording an average of 30 citations per publication.

By analyzing the data presented above, we can observe that the universities with the highest degree of influence in the field of management accounting research are: Monash University in Australia, Turku University in Finland and Manchester and Essex Universities in the United Kingdom. To understand which country is the most outstanding in the field of management accounting research, we also performed a country analysis. The following Table shows the top 10 countries in this field:

Table 6. Top 10 most influential countries

	Țări/ regiuni	Publicații	Citări	Medie citări/ publicații
1	England	77	3102	40.29
2	Australia	62	3234	52.16
3	USA	53	1813	34.21
4	Germany	46	527	11.46
5	France	30	491	16.37
6	Netherlands	29	1169	40.31
7	Canada	28	292	10.43
8	Finland	27	937	34.70
9	Italy	27	281	10.41
10	Brazil	23	89	3.87

Source: Own processing

From the data previous presented, Australia, the Netherlands and the United Kingdom are the countries with the greatest impact in the area of management accounting.

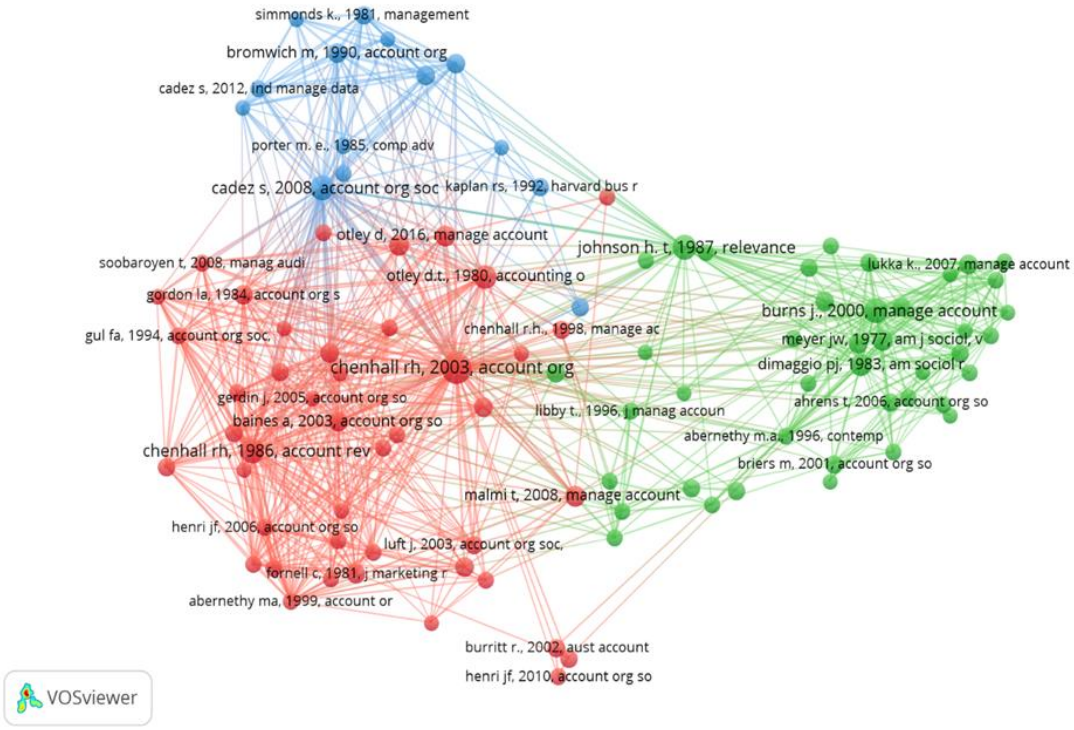
In terms of average citations/publications, Australia ranks first (62 publications and 3234, with an average of 52), followed by the Netherlands (29 publications and 1169 citations, with an average of 40), the United Kingdom (77 publications and 3102, having an average of 40), Finland (27 publications, 937 citations and an average of 35 citations per publication), and in 5th place is the USA (53 publications, 1813 citations, obtaining an average of citations per publication of 34).

In order to clearly understand the structure of the cited references in the field of management accounting, according to the bibliometric analysis studies, we performed a co-citation of the cited references, obtaining a set of 23,846 cited references. By using the threshold of 20, which reflects the minimum number of citations of a cited reference should be 20, we obtain a set of 100 references that are used for co-citation analysis of cited references. Based on these 100 most cited references, this study constructed the management accounting research network through co-citation analysis. The result shows that the 100 references are

divided into three clusters, and each color represents a cluster. The most frequently cited references are Chenhall Rh. (2003) (115 citations), Burns J. (2000) (67 citations), Johnson H. (1987) (67 citations), Chenhall Rh. (1986) (65 citations), Cadez S. (2008) (65 citations), Otley D. (1980) (59 citations), Dimaggio P. (1983) (46 citations), Otley D. (2016) (43 citations), Abdel-Kader M. (2008) (40 citations) and Malmi T. (2008) (38 citations).

Cluster 1 presents a holistic view of management accounting and management control systems. In the study of management control systems, contingency research has a long tradition and researchers have attempted to explain the effectiveness of management control systems by examining models that best fit the nature of the environment, technology, size, structure, strategy and national culture. We believe that in recent years, this theme has maintained its popularity through studies that include the previously mentioned variables, being redefined in contemporary terms. Cluster 2 focuses on research into the understanding of management accounting practices, given that in recent years there has been much debate about the business-oriented role of management accountants. Cluster 3 provides a review of strategic management accounting.

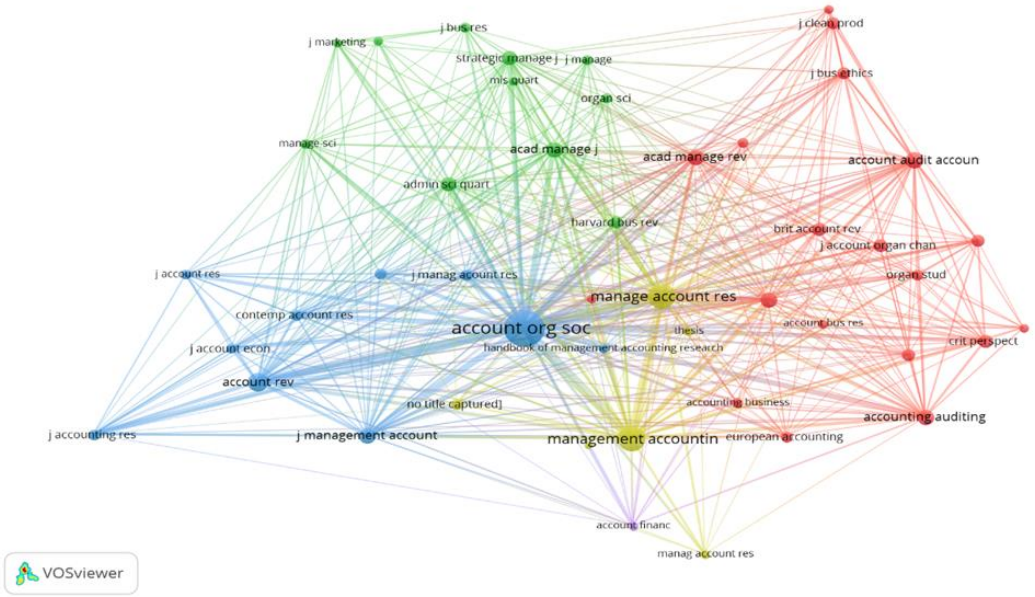
Figure 6. Clusters of the most frequently quoted references



Source: Own processing

Through bibliometric analysis of cited journals, this study obtained a set of 8769 cited sources that were cited by the 593 publications. By using the threshold at 100 citations, we obtained a set of 47 sources that were used for the co-citation analysis of cited sources, and finally we obtained a network consisting of four clusters related to accounting issues, auditing and accountability and their impact on policy, practice and society; management, decision-making and performance measurement; organizational and institutional structures and processes; high-quality applied and theoretical research publications.

Figure 7. Co-citation of cited sources



Source: Own processing

It should be noted that ACCOUNTING ORGANIZATIONS AND SOCIETY (3997 citations) is by far the most influential source compared to other sources in this research area.

The next four most cited sources are: MANAGEMENT ACCOUNTING RESEARCH (1585 citations) and JOURNAL OF MANAGEMENT ACCOUNTING RESEARCH (1574 citations), ACCOUNTING REVIEW (714 citations) and ACCOUNTING AUDITING ACCOUNTABILITY JOURNAL (564 citations).

The 'management' cluster includes journals that aim to publish papers that help answer important and interesting questions in strategic management, develop and/or test theory, replicate previous studies, explore interesting phenomena, review and synthesize existing research and evaluate the many methodologies used in our field (STRATEGIC MANAGEMENT JOURNAL), examine a wide variety of business decisions, processes and activities in the actual business setting (JOURNAL OF BUSINESS RESEARCH), scientific research on management practice, focusing on the problems , the interest and concerns of managers. Within their scope are all aspects of management related to strategy, entrepreneurship, innovation, information technology and organizations, as well as all functional areas of business such as accounting, finance, marketing and operations (MANAGEMENT SCIENCE JOURNAL).

The 'structures and processes' cluster comprises leading international interdisciplinary journals concerned with the relationships between accounting and human behavior, organizational and institutional structures and processes and the wider socio-political environment of the enterprise (ACCOUNTING ORGANIZATIONS AND SOCIETY), articles reporting the results of accounting research and explains and illustrates related research methodology (ACCOUNTING REVIEW), publishes research that contributes to the collective understanding of the role of accounting within organizations, markets or society (CONTEMPORARY ACCOUNTING RESEARCH).

The 'research' cluster consists of sources that focus on original research papers using archival, case, experimental, field, survey or any other relevant empirical method, as well as analytical modelling, framework or thought papers, review articles by substantive and shorter papers such as commentaries or peer-reviewed research notes (MANAGEMENT ACCOUNTING RESEARCH).

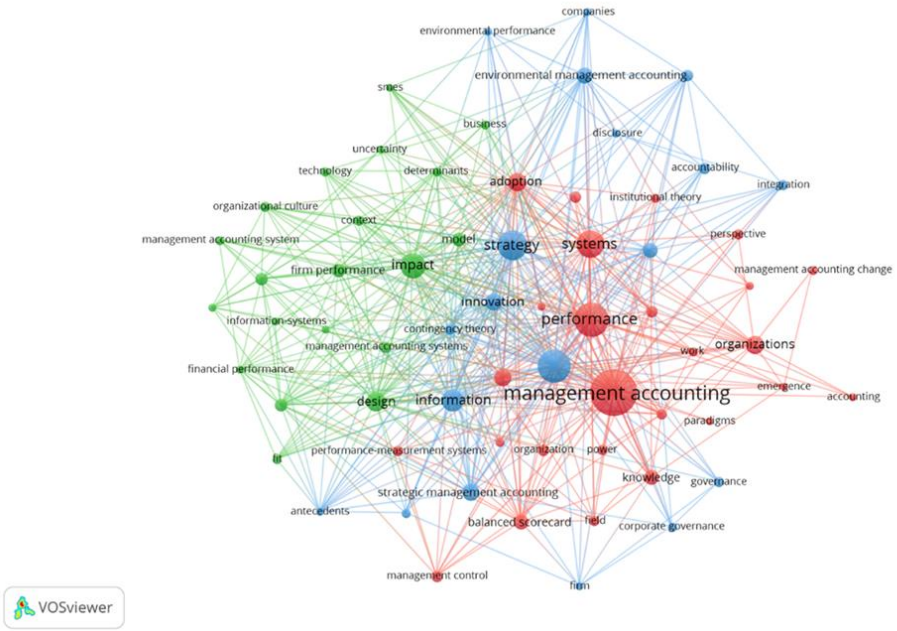
The main purpose of keyword co-occurrence analysis is to provide a form of content analysis that allows the identification of connections between keywords in a selected sample of publications (Bota Avram Cristina, 2022).

To further explore potential future topics, we performed a keyword co-occurrence analysis using VOSViewer. We obtained 1983 keywords by analyzing the selected publications and also listed 65 keywords with a frequency of more than 10 times, keywords with higher frequency networks more popular in the field of management accounting research. By performing a co-occurrence analysis on the keywords, we obtained a network consisting of three clusters: performance, strategy and impact of management accounting.

The first cluster consists of 26 terms such as: managerial accounting, performance, systems, organizations, implementation, managerial control. The author Vale Jose, (2022) believes that in recent decades, accounting has ceased to have as its sole purpose the simple recording of financial transactions, becoming a powerful tool for evaluating the performance of organizations and maximizing their profitability.

The second cluster consists of 20 terms as follows: design, impact, business, organizational culture, uncertainty, technology. Research by authors Hoozee Sophie and Mitchell Falcone (2018) 'Who Influences the Design of Management Accounting Systems? An Exploratory Study' presents the results of an exploratory, survey-based study of the relative influence of managers on management accounting system design. The findings show that, on average, corporate management has a stronger influence on management accounting system design. However, the strength of their influence varies both between companies and between management accounting sub-fields, and in a significant number of cases, the influence of management accountants is even greater. The results therefore suggest that the processes by which management accounting systems evolve differ between companies due to the variation that exists in the influence exerted by these two parties in the design of the management accounting system. The authors explore the nature, antecedents and impact of managers' influence on management accounting system design and conclude that the degree of managerial influence can vary in strength and focus and is affected by the involvement of third parties (parent companies and consultants).

Figure 8. Co-occurrence of keywords



Source: Own processing

The third cluster comprises in 19 terms such as: information, strategy, innovations, contingency theory, performance measurement, integration, environmental managerial accounting. Through their study "Integrated Performance Measurement as a Strategic Management Accounting Approach: A Case of Beverage Businesses in Thailand", authors Phornlaphatrachakorn Kornchai and Peemanee Jindarat (2020) set out to examine the effects of integrated performance measurement on company success, business study of beverages from Thailand. Integrated performance measurement, organizational commitment, organizational citizenship behavior and company success are the main variables of the study.

Of the completed and returned surveys, 159 responses were usable and the results show that integrated performance measurement as a strategic approach to management accounting is a key driver of companies' business results. They must support their resources and capabilities in developing, implementing, using and maintaining integrated performance measurement.

We can observe that terms such as managerial accounting, performance, management, strategy, impact, systems represent high frequency keywords.

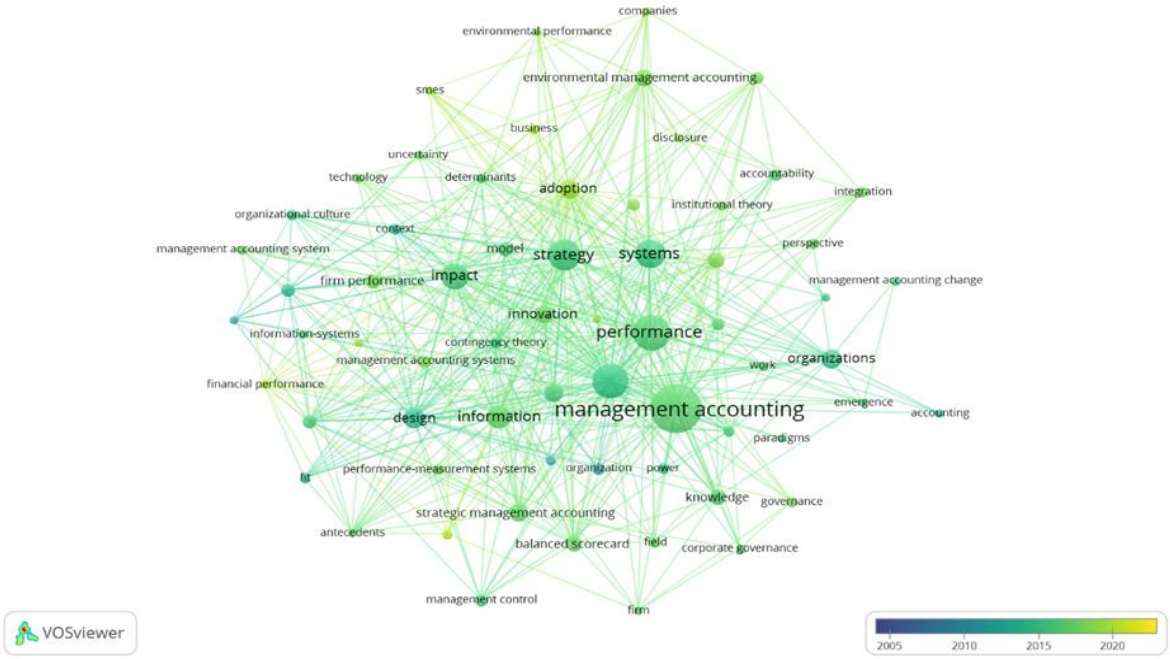
Table 7. Top 30 most common keywords

Cuvânt cheie	Ocurență	Putere	Cuvânt cheie	Ocurență	Putere
management accounting	149	336	performance-measurement	27	111
performance	94	320	knowledge	25	90
control-systems	87	339	model	24	92
strategy	76	325	firm performance	22	99
systems	65	196	perceived environmental uncertainty	21	107
impact	59	239	managerial performance	20	92
information	47	197	accountability	19	49
design	41	193	diffusion	19	59
organizations	36	110	management accounting systems	19	52
adoption	35	165	sustainability	18	77
implementation	32	132	management accounting practices	17	46
innovation	32	146	management control	17	61
strategic management accounting	31	114	organization	17	55
environmental management accounting	29	100	contingency theory	16	87
balanced scorecard	27	108	governance	16	53

Source: Own processing

Another useful chart is the overlay view, which allows identifying the temporal distribution of keywords in each cluster. In the overlay view, keywords are colored according to a score that is calculated based on the average year a keyword appeared. Thus, the colors range from blue (oldest year) to yellow (newest years).

Figure 9. Keyword overlay view



Source: Own processing

3. CONCLUSIONS

The originality of this paper lies in the fact that it helps to understand the evolution of research in the field of managerial accounting from the perspective of bibliometric analysis and challenges researchers to proceed with explorations from multiple aspects in this field. Using bibliometric software (VosViewer), this study provides a more comprehensive holistic view of management accounting, while emerging research trends are identified and a synthesis of directions for future studies in this area is provided.

Analyzing the specialized literature, we can conclude that starting from 1975, the number of publications was increasing until 1978, followed by a period of stagnation between 1979 and 1982 (with only one publication per year and no publication in 1982). , then having an increasing rate until now.

From 1983 to 2002, an average of three articles were published each year, showing that it is an embryonic stage. In the subsequent stage, the number of works published from 2003 to 2007 reaches an average of twice as many publications - six publications - compared to the previous stage, indicating the seeding chronology. In the next stage, from 2008 to 2010, an average of 12 articles were published per year. Since 2010, there has been considerable growth, reaching an average of thirty-seven publications per year.

In recent years, management accounting has become more relevant to the needs of modern corporations. To accommodate these changes in management accounting practice, teaching and research in the field have similarly changed. Traditional approaches, developed for the large corporations that emerged in the early part of the 20th century, have proven inadequate for today's global and technological environment. Academics have turned to field research to discover the new techniques developed and implemented by successful organizations. New approaches focus on improving the information provided to managers and

employees about their organizations and paying more attention to the design of information and control systems.

New approaches focus on improving the information provided to managers and employees about their organizations and paying more attention to the design of information and control systems. Different authors have looked at responsibility accounting from different perspectives, but they have agreed on a common concept: controllability with authority and responsibility.

Based on the literature review, some studies focused on cost controllability, responsibility centers, the budgeting process and the relationship of responsibility accounting and analyzed the relationship of responsibility accounting with cost accounting and managerial accounting, focusing on the relationships between responsibility centers. cost that are used in all business functions of a company.

Budgeting issues are certainly a primary purpose of managerial accounting. Managers share the same worries about how to deal with their budgets. They should be aware of how much each enterprise project costs, how much cash is available, and how to manage expenses in their budgets. Their management accounting goals involve monitoring current accounting information as well as projecting expenditures and revenues for future endeavors.

Managerial accounting has been greatly affected by the remarkable improvements in the computer technology sector. Today's technology allows management to track overall performance information that builds on the cost-based information of traditional general ledger systems. The main concepts of managerial accounting include monitoring as well as predicting costs. These consist of cost collection, analysis and evaluation. As a proposition, we believe that future research in this area would certainly be beneficial to increase our understanding of how management accounting is managed by entities.

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