DIGITAL TRANSFORMATION OF PUBLIC PENSIONS: A CASE STUDY OF FOUR EUROPEAN COUNTRIES

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ABSTRACT

This paper delves into the pension systems of four European nations – Lithuania, Latvia, Estonia and Romania – offering a comprehensive analysis of their respective structures, digitalization efforts and potential for harnessing artificial intelligence (AI) for public benefit. It paints a vivid portrait of the various approaches to pension systems and digitalization strategies in these four European countries. It illuminates the potential of AI and technology to drive progress in the public sector, ultimately improving citizen well-being and government efficiency. The comparison of the four national systems is made in order to understand Romania's situation in the Eastern European landscape. In Romania, the National Public Pension House is in a complex process of evolution in terms of improving access to electronic services, increasing the quality of information and communication technology so that all institutions have the possibility of multiple interactions both with the citizen and with the business environment and with other central and local public institutions, being in fact optimization and de-bureaucratization measures. Within the National Recovery and Resilience Plan, the Reform of the pension system was foreseen, a major and complex reform, which also includes the milestone – Operational efficiency and advanced electronic services for the national pension system through digitization – with a deadline of completion by the date of December 31, 2024, with several directions of development.

KEYWORDS: *artificial intelligence, digitization, public pension system.*

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1. INTRODUCTION

Since the 1950s, with a distinct revolution in the 1990s thanks to the occurrence of the Web, digitization has changed the way we work, shop, bank, travel, educate, govern, manage our health and enjoy life. Digitization technologies allow the conversion of traditional forms of information storage, such as paper and photographs, into the binary (one and zero) coding of computer storage. A subset is the process of converting analogue signals into digital signals, but much bigger than the translation of any media into bits and bytes, it is the digital transformation of economic transactions and human interactions. Digital transformation has been one of the most persistent and notable large-scale trends shaping the modern era – and it shows no signs of slowing down. Recent improvements in OCR technology (Optical Character Recognition), ICR (Intelligent Character Recognition), IDR (Intelligent Document Recognition) and machine learning have made transforming paper documents into fully digital assets faster and easier than ever before, with an increasing degree of accuracy. The development of real-time payment options is set to revolutionize peer-to-peer transactions. A lot of other improvements are being made and they will continue to expand our digital abilities (Foote, 2021; Tarpey, 2020).

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2. DIGITALIZATION, DIGITIZATION AND DIGITAL TRANSFORMATION – A BRIEF LITERATURE REVIEW

2.1 The concepts of digitization and digitalization

Digitization refers to the conversion of data and documents from analogue to digital. Khan (2016) clearly explains that digitization is a transformation of information into its digital analogue. It is a process in which images, sounds and texts in a physical format are converted into a digital binary format. Digitalization, on the other hand, is one step further and is the actual implementation of digital information. Terms such as big data, mobile apps and IoT are examples of digitization. Digital transformation is a sophisticated outcome of digitization: the advances gained through the implementation of technical systems (Khan, 2016). Therefore, digitization, digitalization and digital transformation can be described as sequential phases that follow each other in the given order. Digitization is the transformation of physical information, (such as documents, photos, reports, invoices, contracts etc.) into a format that can be stored and accessed from a computer, phone, tablet, USB stick, smart watch and other similar devices.

The term *digitalization* was first used in 1971, published by the North American Review as "the digitalization of society". It was about the context and potential of "computer-assisted humanities research" (Şükranli, 2020). Digitalization brings a wide range of technologies that are accessible to all, so it is implicated in the most important changes, including cultural, behavioral, demographic and lifecycle issues. As a result of digitization, e-commerce, e-banking, e-books, e-news, e-learning terms have emerged and the term knowledge society has emerged (Şükranli, 2020). On the other hand, digitalization has a broader meaning, encompassing within its scope also digitization methods.

Digitization is the process by which analogue processes and physical objects are converted into digital format. In other words, digitization is the procedure by which certain operations can begin to be carried out via digital media, such as computers or smartphones, usually with the help of an internet connection. Stolterman and Fors (2004) were among the first scholars to study the theoretical aspects of the new concept of digital transformation. They offered a precise and simple definition of digital transformation: a process towards "a world where everything is connected" through information technologies. They framed digital transformation as a general trend in our daily lives, so their definition is not necessarily business-oriented (Stolterman & Fors, 2004). Today, from a business perspective, digital transformation is an innovation in how a company generates and delivers value and generates revenue through the implementation of technology systems and structures (Tiersky, 2017).

Digitalization describes the phenomenon of adopting digital technologies in business and society. In addition, the term also covers affiliated changes in the connectivity of individuals, organizations and objects (Cijan et al., 2019). Digitalization is creating powerful changes in the working world. It all started in 1969, when the internet was dislocated. Cijan et al. (2019) argued that the key characteristic of wireless communication is not mobility, but perpetual connectivity. Digitalization has created many challenges as well as excellent opportunities in the workplace and in life in general. The world is concerned with the risk of technological unemployment, quality and working conditions, risk, even economic inequality. On the other hand, there are many new opportunities with the growth of new jobs and new markets, increased environmental sustainability, improved ergonomics and safety in the production processes.

2.2 Digitization and digitalization: what is the difference?

At the core is the argument that digitization cannot happen without digitalization. Digitization is the conversion of analogue technologies to digital, while digitalization is the use of digital technologies and digitized data to influence the way work is done, to transform the way customers and companies engage and interact, creating new (digital) revenue streams.

Digitization is about internal process optimization (e.g. automating work, minimising paper) and leads to cost savings. Conversely, digitalization is a strategy or process that goes beyond the implementation of technology to involve a deep, underlying change to the entire business model and evolution of work.

Digital transformation is a concept that has altered the ways in which we interact with both our social environment and the routines of everyday life in recent decades (Bloomberg, 2018; Fusaro, 2023; Vial, 2019). Digital technology fulfils a packaged role as both facilitator (operand) and initiator (operant) in the digital transformation journey (Lusch & Nambisan, 2015).

Despite being a relatively new concept, digital transformation has a long history. It can be traced back to the late 1970s, when computer-aided design and manufacturing were first used in business. This was followed by the introduction of enterprise resource planning in the 1980s and customer relationship management in the early 1990s.

Each of these technologies aims to improve efficiency and productivity by digitizing manual processes. In the late 1990s, we saw the rise of e-commerce and online banking. These activities were initially conducted offline, but later moved online as internet speeds increased. This was followed by the introduction of social networking in the mid-2000s, which revolutionized the way we communicate and share information.

Over the past decade, we have seen a renewed focus on digital transformation as businesses and public institutions strive to remain competitive in a global marketplace. While the concept is not new, it has taken on a new value in recent years.

2.3 How digitalization is changing the workplace

Digitalization has increased the pace of daily life. We live in a 'fast-paced society', with a faster pace throughout the day, fewer breaks, more tasks and more time pressure. Most of it is directly connected with information and communication technology (ICT). ICT actually allows us to do tasks and activities easier and faster, but nowadays people have more and more to do. If there are more activities, less time can be spent on each of them, so people feel more pressured (Cijan et al., 2019). One of the biggest impacts of digitalization on organizations is that information has become more accessible and transparent, which allows organizations to share more information with all employees – even the lowest levels of the hierarchy (Cijan et al., 2019). This easy accessibility has led to increased work productivity and higher demands both at work and at home (Cijan et al., 2019)

We conducted researches on this topic and found that while many studies have investigated this topic, most have focused on the impact of digitization on business performance and worker productivity For example, some studies on worker autonomy and its link to digitalization are divergent. Cijan et al. (2019) found that digitalization actually allows employers to monitor employees even more, whereas Aral and Weill (2007) argued that digitalization provides more worker autonomy.

2.4 Artificial intelligence and its impact in the current world

Artificial intelligence (AI) has been transforming both our intelligence and society. Many sectors, including the public pension system, can benefit from AI. There is no clear definition of AI, but some define it as a digital computer system that can solve complex problems or take optimal action to achieve real-life goals and it refers to the creation of computer systems capable of performing tasks that only a human could do, such as reasoning, decision making or problem solving.

Today, the term *AI* describes a wide range of technologies that power many of the services and goods we use every day – from apps that recommend TV shows to chatbots that provide customer support.

AI is the theory and development of computer systems capable of performing tasks that have historically required human intelligence, such as speech recognition, decision making and pattern identification. AI is an umbrella term encompassing a wide range of technologies, including machine learning, deep learning and natural language processing (NLP).

Although the term is commonly used to describe a number of different technologies in use today, many disagree as to whether they actually constitute artificial intelligence. Instead, some argue that much of the technology used in the real world today actually represents highly advanced machine learning, which is simply a first step towards true artificial intelligence or artificial general intelligence (AGI).

However, despite many philosophical disagreements about whether "true" artificial intelligence really exists, while most people use the term AI today, they are referring to a suite of machine learning-based technologies, such as Chat GPT or computer vision, capable of enabling machines to perform tasks that previously only humans could do, such as generating written content, driving a car, or analyzing data (Coursera Staff, 2023).

The artificial aspect of AI is quite simple: it refers to any phenomenon that is not natural but, in this case, man-made. It can also be represented by the use of terms such as machines, computers or systems. Intelligence is a much more disputed concept, explaining why there is still no consensus on how to define AI, even among experts.

John McCarthy, considered to be the father of artificial intelligence, defined artificial intelligence in 1956 as "the science and engineering of making intelligent machines". Some industry experts have argued that the term artificial intelligence is too closely tied to popular culture, which has caused the general public to have improbable expectations about how AI will change the workplace and life in general. They suggested using the term augmented intelligence to differentiate between AI systems that act autonomously – popular culture examples include Hal 9000 and The Terminator – and AI tools that support humans.

The rapid adoption of ChatGPT and Bard in the industry indicates a desire to use AI to support human decision making.

True artificial intelligence, or AGI, is closely associated with the concept of the technological singularity – a future governed by an artificial superintelligence that far surpasses the human brain's ability to understand it or the way it shapes our reality. This remains in the realm of science fiction, though some developers are working on it. Many believe that technologies such as quantum computing could play an important role in turning AGI into reality and that we should reserve the use of the term AI for this type of general intelligence.

Robots are becoming increasingly efficient, flexible and autonomous as AI, machine learning and sensor technologies advance. They are expected to play an increasingly critical role in a variety of industries and applications in the future. A study by Spherical Insights and Consulting estimated that the size of the global robotics market will grow from $25.82 billion in 2022 to $115.88 billion by 2032.

2.5 The chatbot concept

AI chatbot ChatGPT has taken over the internet and people are enjoying its interactive nature and detailed responses. A chatbot (or virtual assistant) is an algorithm that conducts a textual or oral conversation. The first chatbot was already programmed in 1966 to figure out whether people could tell if they were talking to a person or a machine. The potential of chatbots is now considerably greater thanks to advances in AI technologies and ever-changing communication patterns (Misuraca & Van Noordt, 2020).

A virtual assistant is an Artificial Intelligence-based software that uses the most advanced techniques to help users with everyday tasks. Specifically, a virtual assistant has the ability to understand users' intent and provide accurate solutions to their questions, eliminating any trace of ambiguity. The virtual assistant is able to interact with people in an intuitive way and, over time, learn their habits and preferences, giving them only personalized information. In the field of human resources, virtual assistants are becoming essential in an HR department that wants to automate repetitive and time-consuming processes, as well as increase productivity. ChatGPT is an "Artificial Intelligence Chatbot" developed by OpenAI, a research lab conducting research in the field of "AI". It uses the OpenAI GPT 3.5 model as its code base enhances it by using an optimized "big language model" with supervised reinforcement-based training. GPT stands for "Generative Pre-trained Transformer", providing detailed answers to user questions.

The ongoing debate regarding the benefits of artificial intelligence and the question of whether intelligent machines should possess cognitive abilities remains relevant. Starting from the genius of Alan Turing to the fathers of deep learning using neural networks for voice recognition, computer vision or natural language processing - Joshua Bengio, Geoffrey Hinton and Yann Lecun to the successors of GPT-3, Switch Transformer, chatbot generation, Mum (search engine brain), Wu Dao 2.0 (1750 billion parameters), GPT 4. If the GPT-4 chatbot scared you then you should meet Wu Dao 2.0: a monster with 1.75 trillion parameters being 10 times bigger than GPT-3. These are exciting times in AI. OpenAI shocked the world a year ago with GPT-3. In 2022, Google introduced LaMDA and Mum0, two AIs that will revolutionize chatbots and the search engine respectively. On 1 June 2021, the Beijing Academy of Artificial Intelligence (BAAI) conference presented Wu Dao 2.0. Wu Dao 2.0 is now the largest neural network ever created and probably the most powerful. Its potential and limitations have not yet been fully revealed, but expectations are high and rightly so. In this article, I wanted to point out the information available about Wu Dao 2.0:, AI and Chat GPT. According to some assumptions, by the end of 2022, on average, people will talk to bots more often than they talk to their own spouses (Comes, Schatsky and Chauhan, 2021). Ultimately, chatbots bring new legal and ethical concerns to social security institutions (Henman, 2020) and will become an integral part of social security institutions' overall customer communication strategy. Chatbots Onem in Belgium, Kela in Finland, DRV-Bund in Germany, EPFin Malaysia demonstrate that chatbots are visibly improving, AI is becoming more sophisticated and they can reduce traffic to other channels, something that needs to be taken into account in planning and allocating human resources.

The following section is a comprehensive overview of the smart development and digitalization initiatives within the public systems of three countries (Lithuania, Latvia and Estonia), with the overarching objective to derive key insights applicable to a fourth country, Romania. The focus is on encapsulating the multifaceted aspects associated with recent smart-level advancements and digital transformation in all these four countries.

3. DIGITAL TRANSFORMATION OF PUBLIC PENSIONS IN FOUR EUROPEAN COUNTRIES

3.1 Lithuania

Characterizing the pension system in Lithuania involves referencing authoritative sources such as OECD (2021), and Eriksonas (2021).

3.1.1 Old-age pension

The institution in charge of public pensions in Lithuania is called "Sodra". This old-age pension benefit is appointed and paid to the following persons who have declared their domicile and are included in the accounts of persons, who have not declared their domicile: citizens of the Republic of Lithuania (hereinafter – RL); citizens of the European Union (EU) or Member States or European Free Trade Association, Member States belonging to the European Economic Area and their family members with documents proving or granting the right of residence in the Republic of Lithuania; foreigners holding a long-term residence permit in the RL; foreigners who have been granted asylum in the RL, citizens of Australia, Japan, the United States of America, Canada, New Zealand, South Korea and their family members with a temporary residence permit in the Republic of Lithuania (Eriksonas, 2021).

The old-age pension scheme is compulsory for employees and self-employed persons if they declare their income as occupational. It is funded by contributions, covers the working population and provides pensions consisting of a basic (flat-rate) and a supplementary (income-related) part.

3.1.2 State pensions

State pensions of the first and second degree in the Republic of Lithuania are granted to citizens of the Republic of Lithuania who have reached the age limit for old-age pension as provided by the Law on State Social Insurance Pensions and have been recognised as incapable or partially capable of work or have lost 60% or more of their ability to work.

State pensions of the first degree shall be granted by the Government upon submission to the Ministry of Social Security and Labour for participants in the resistance, army – volunteer soldiers – according to the lists of volunteer soldiers provided by the Research Centre for Genocide and Resistance of Lithuania; persons with such status, including senior state officials, upon submission to the highest governmental and administrative authorities of the Republic of Lithuania, with the consent of the Republic of Lithuania.

State second-degree pensions are granted by the Commission to participants in the resistance - freedom fighters by submitting to the Research Centre for Genocide and Resistance in Lithuania; mothers who have given birth and raised children or fathers who have raised children up to the age of 8 and have raised five or more children.

A state pension of first degree has a value of more than EUR 273.16, while a state pension of second degree has a value of more than EUR 136.58. These state pensions are granted and paid by the territorial units of the State Social Insurance Fund Council.

3.1.3 Pensions for scientists

The granting and payment of state pensions to scientists is regulated by the Temporary Law on State Pensions for Scientists. State pensions for scientists are granted to persons with an academic degree or diploma and a career of at least 10 years as a doctor or university professor at the age of retirement or who have lost 60-100% of their working capacity.

3.1.4 State pensions for victims

The granting and payment of state pensions to victims are regulated by the Law of the Republic of Lithuania on State Pensions (OECD, 2021).

The following citizens of the Republic of Lithuania are entitled to a state pension for victims: a person recognised as incapable or partially capable of work as a result of the aggression committed on 11-13 January 1991 and subsequent events, as well as defenders of the independence of the Republic of Lithuania who were injured on 11-13 January 1991 but were not recognised as incapable or partially capable of work as a result; political prisoners, deportees and former abandoned children, provided that documents proving the restoration of the rights of political prisoners and deportees or documents proving the legal status of the political prisoner, deportee or former abandoned child are presented; participants in the resistance to the occupations of 1940-1990 – freedom fighters who have been recognised as such in accordance with the procedure laid down by law; persons who, during the Second World War, were deported for forced labour or held in ghettos, concentration camps or other isolation camps; persons who, during the Second World War, served in the active armies, guerrilla squads or combined units of the anti-Hitler coalition states.

On the death of the beneficiary of a state pension for victims, the victims' survivors' and orphans' pensions are awarded. These pensions are awarded and paid if the persons entitled to them have reached retirement age or are qualified as incapable or partially capable of work.

3.1.5 Pensions for officers and soldiers

The granting and payment of state pensions to officers and soldiers is regulated by the Law on State Pensions for Officers and Soldiers. State pensions for officers and soldiers may be of the following types: for service; for loss of working capacity; for widows and orphans.

3.1.6 Pensions for judges

The award and payment of state pensions to judges are regulated by the Law on State Pensions for Judges. State pensions for judges were introduced on 1 January 2003.

State pensions for judges are granted to persons who have served as judges of the Constitutional Court, the Supreme Court of Lithuania, the Court of Appeal of Lithuania, the Supreme Administrative Court of Lithuania and other Lithuanian courts of general and specialised jurisdiction, as well as judges of any international court elected or delegated by Lithuania.

3.1.7 Social assistance pensions

Social assistance pensions are as follows: to parents (foster parents), guardians or guardians who have cared at home for at least 15 years for disabled persons who have special needs for permanent care or attendance with permanent assistance. From 1 January 2022, it is granted 1 basic social assistance pension amounts to EUR 150 (in 2021 - EUR 143).

3.1.8 Pension fund

Individuals can claim a state pension and retire from work if they have reached a certain age and have spent enough years working. In addition, different factors such as health status, type of housing, marital status and gender influence, financial deprivation of retirees. Women are more likely to have lower pensions than men because raising children has led to career breaks. During career breaks, the number of assets in women's pensions did not increase. The most notable difference between the number of assets held by each gender was observed in the 55-to 64- age group. In that age group, men on average have €65,000 in pension plans, while women have only €40,000, creating quite a difference of 35% to the average asset value. To reduce the number of retirees living in poverty and increase their incomes, different pension schemes have evolved,

which can be classified into three pillars. The first pillar is a state pension scheme that focuses on poverty prevention; the second pillar consists of occupational pension schemes that involve employer contributions and aim to provide an adequate income.
The third pillar is made up of voluntarily funded plans that supplement the income from the first two pillars. The pension fund's accrual also depends on the trustees providing the pension fund's investments. The manager creates investment portfolios with different assets and equities to keep investments within a specified risk range. In addition, the manager adjusts the portfolio over time based on how many years remain until retirement and the economic situation.

3.1.9 Digitization of the public system in Lithuania

Lithuania ranks 14 out of 27 EU Member States in the 2022 edition of the Digital Economy and Society Index (DESI). In digital public services Lithuania performs very well, in human capital, digital technology is on the EU average, but performs poorly in connectivity, especially in 5G. Being close to average in many indicators, the country's progress has slowed down over the last five years, while catching up with the most digitised EU countries has not been so fast.
Lithuania still has room to improve the digital skills of its population and to invest in reskilling and upskilling the workforce, as it currently ranks 20 in the DESI dimension.
Remarkably, Lithuania continues to perform above the EU average in terms of ICT (Information and Communication Technology) professionals. Lithuania, together with other Member States, is implementing the EU project. The aim of the project is to provide cyber threat support while it is needed for the participation of EU countries, EU Institutions, missions and other partners. Currently, the participating countries are Croatia, Estonia, Lithuania, the Netherlands, Poland and Romania, while Belgium, Finland, France, Greece, Italy, Slovenia, Spain have observer status. Lithuania runs the Kaunas Regional Cyber Defence Centre (RCDC) which monitors and analyses threats in the region, including partners in Ukraine and Georgia.
The National Progress Strategy 2030, including the Roadmap for the Digitization of Lithuanian Industry 2020-2030 and the National Cyber Security Strategy 2018-2023 are extremely important in Lithuania's digital catalogue.
The ongoing roll-out of Next Generation Access (NGA) internet connectivity in Lithuania will ensure data transmission speeds of 30 Mbps and even higher. In order to achieve the NGA target and to be available throughout Lithuania, the RAIN3 NGA internet access infrastructure development project (initiated in 2018) is underway and currently 1 015 km (compared to 778 km in 2020) of fibre cable lines have been deployed (out of a total of 1 200 km planned) and 290 telecommunication facilities have been connected as well. None of the telecom towers (out of 25 planned) have been built. New towers that are planned should be built by the end of 2023. In areas where the installation of communication towers is not possible, Gigabit Passive, Optical Network Compression Infrastructure (GPON) is planned with about 8 500 connection points. The Ministry of Transport and Communications has foreseen the measure "Step to 5G. Innovation in Mobility" in Lithuania's Recovery and Resilience Plan (RRL). The main goal is to create a sandbox regime (financial, legal, regulatory environment) for testing and implementing innovative 5G-based solutions in various sectors. The Digital Decade 2030 states that all European households should be covered by a Gigabit network. While it is positive and encouraging that Lithuania is using RRF funding to test 5G technologies, addressing the low level of 5G award is essential to boost 5G deployment, thus increasing the possibility of achieving the targets set for the Gigabit Society and the Digital Decade 2030 (Eriksonas, 2021).

3.1.10 Artificial intelligence in Lithuania in the pension system and public administration

Artificial intelligence systems promise a unique set of benefits for the public sector. The creative use of AI can elevate citizen welfare in Lithuania. Some examples of public-oriented projects include:

- Crime prediction: AI models can be used to discover or cover high-risk areas with high crime in cities.
- Better services for citizens: intelligent virtual assistants can serve citizens better.
- AI for public institutions: internal government workflow can be optimised using intelligent digital systems. The biggest barriers to greater deployment of AI systems in public sectors are barriers to innovation. Public institutions are slower to adopt new technologies, either due to lack of funding or procedures. To ensure the best quality of life for citizens in the digital age, the public sector will need to adopt a culture of innovation, especially in AI.

3.2 Latvia

3.2.1 Characteristics of the public pension system - General aspects

In Latvia, social insurance is administered by the State Social Insurance Agency. Pensions are granted according to the Latvian State Pension Law. Since July 2001, a three-pillar pension system has been implemented in Latvia, with the first pillar being a compulsory state pension system, the second comprising state pension schemes and the third pillar comprising voluntary private pension schemes. Participants in the second pension pillar can choose an investment manager to invest their contributions in the financial markets in order to ensure an increase in their pension savings.

3.2.2 Old-age pension/ early retirement pension

People living in Latvia who have at least ten years of social insurance at the time of retirement and have reached retirement age are entitled to receive the old-age pension. In 2022, the retirement age for both men and women is 64 years and 3 months and the minimum period for the social insurance contributions to be made is 15 years. The retirement age gradually increases by 3 months each year, reaching 65 on 1 January 2025. From 1 January 2025 the minimum insurance record required to receive an old-age pension will be 20 years. It should be mentioned that men cannot claim early retirement before they reach the age of 60. The early pension can be paid if the retiree is not working. The minimum contribution period in Latvia is of 15 years according to the pension law.

3.2.3 Private pension funds

A private pension fund is a joint-stock company that is registered in the Commercial Register in accordance with the Act on Private Pension Funds and Pension Schemes, accumulates and invests contributions from money assets paid by members of pension schemes. For the pension fund, it is offered a defined contribution scheme with guaranteed profitability or a defined payment scheme that provides cover for biometric risks in the pension scheme, the minimum equity size is EUR 3 000 000 of biometric risks, but it is not provided for in this plan.

3.2.4 Digitalization of the pension system in Latvia

Digitization can further improve the coordination of social security systems and support fair labour mobility. Old-age pension can be claimed by completing a form in person at the Insurance Agency Branch Office (SSIA) or by sending the completed form signed with an e-signature to the SSIA or by electronic application (Rupeika-Apoga et al., 2020).

E-service information on social insurance, payments and the value of benefits, pensions and maintenance payments that can be requested using Internet banking or electronic signature.

All three industrial revolutions in Latvia produced radical changes in production conditions that affected society as a whole.

AI will be the leading technology that, along with technologies such as 4D printing, genetic engineering, materials science, Internet of Things, 5G communications, blockchain, quantum computing, nano-engineering, virtual reality and others, will underpin the fourth industry for a revolution that will change not only the global economy but also Latvian society.
Work is currently underway on the "Roadmap for the Development of Latvia's Industrial Digitalization" and the strategy for the implementation of the "Industrials 4.0" platform to promote the digital transformation for Latvian companies and institutions. The platform determines the exchange of current information between stakeholders, promoting cross-sector cooperation in the implementation of various development projects, application of digital solutions. Taking into account that interdisciplinary cooperation is one of the favourable conditions for the development of the national economy, the platform envisages mutual interaction between the scientific sector, the state and industry.

3.2.5 Use of artificial intelligence
The development of AI will be an important component for the development of all the above priorities as well as for the overall successful implementation of the whole Latvian Government Action Plan.
AI technologies are already successfully used in Latvia. Virtual assistants have been developed and used also in public institutions. The Business Register has started to use the virtual assistant "Una" for customer service.
In the Enterprise Registry, the workload of employee-consultants has not decreased significantly, but the quantity and speed of the answers provided has increased and employees are able to focus on more complex issues, leaving the simpler ones to the virtual assistant. The Rural Support Service (hereafter – LAD) uses the virtual assistant "Varis".
"Varis" analyzes all support requesters in the LAD database, then attains information about the responsible persons of the company from the Lursoft database. "Varis" checks if the beneficiary has been convicted or has committed any criminal offence. "Varis places the information obtained in the LAD database. The direct management institution "Cultural Information Systems Centre" (KISC) under the authority of the Minister of Culture has started the unified development of the virtual assistant platform of the state administration. KISC has been created and continues to improve the technological platform in the state administration language Hugo.lv.
The Hugo.lv website offers machine translation, speech recognition and summarisation. Public administrations will face challenges when they start using a virtual assistant, as they will have to learn to adapt it to their needs. It should be noted that this regulatory framework changes frequently and institutions will need to maintain an up-to-date knowledge base of virtual assistants. It is expected that both specific virtual assistants performing specific functions and universal assistants (e.g. Google Assistant, Siri, Cortana etc.), which can be connected to various knowledge bases, can be developed in parallel.
Currently, there is no unified international methodology for assessing and comparing the performance neither in different countries concerning the AI, nor in Latvia. Experts have brought up this issue at OECD and EU level, which suggests that the outcome (methodology) could be in the next year. The OECD working paper "Measuring Digital Transformation" looks at three components – AI-related scientific publications, AI use in open-source software and AI patents.
Some examples of evaluation indicators in Latvia include:

1. Capgemini's AI Readiness Benchmark. In this index, Latvia ranks among the least developed countries, also lagging behind neighbouring countries. Of the 19 indicators, only customer relationship management (CRM) tools apply AI. Everything else is more related to ICT development and not specifically to AI.

2. Capgemini's AI Performance Benchmark. The Capgemini MI Rating Index is only calculated for relatively large countries. The best MI performance indicators are for the US, the worst for Russia. Of the 31 indicators in this index, 16 indicators are directly related to MI. The remaining 15 indicators relate to ICT, a section on innovation, environment and general economic development.
3. The Economist's Automation Index. Pretty close to the topic of AI is The Economist's Automation Index. Two indicators apply specifically to AI. The other indicators reflect the business, educational, scientific, ICT and institutional environment.

Latvia is the country with the lowest number of AI participants among EU countries, but the ratio of the value added of AI companies to the total national GDP is at the EU average level. Artificial Intelligence in Eastern Europe and the presentation of the AI industry landscape in 2018 is shown in the report including Russia, Belarus, Kazakhstan, Armenia, Georgia, Romania, Lithuania, Latvia, Estonia, Ukraine, Poland where, according to it, there are 26 companies operating in the field of AI and 11 investors in Latvia (29 and 5 in Lithuania, 46 and 27 in Estonia, respectively). This represents 5.2% of Eastern European companies in the AI sector and 4.8% of investors in the AI sector (5.8% and 2.2% in Lithuania, 9.2% and 11.7% in Estonia respectively). As a region, Latvia is ahead of other countries in proportion to the size of its economy and population, but lags behind Estonia and Lithuania.

3.2.6 Latvian E-index

The "Electronic Index of Latvia" contains two measurements – the electronic index of state institutions (developed by VARAM) and the electronic index of municipalities (developed by "Lattelecom") (eGovernment, 2015).

The expansion of the e-government index of Latvian public institutions is based on a survey carried out by VARAM to develop an e-government index of central state institutions in order to assess and highlight the activities implemented on the use of modern technology. The survey includes a questionnaire of 102 initially selected state institutions.

The e-Index of Municipalities in Latvia analyses practices in the fields of e-government and e-environment carried out by municipalities. In connection with Lattelecom's social responsibility initiative, "Connect, Latvia!", which provides computer-based training for seniors, Lattelecom has extended the project's focus by initiating an annual measurement for e-environment development of Latvian municipalities.

The information report of 6 February 2018 identified VARAM as the state institution responsible for Open Data. Since 2015, VARAM has promoted the implementation of Open Data policy and initiatives in the state administration by organizing educational seminars for those employed in the public system.

Latvia may not be able to compete with the US or China in research or information data, but Latvia can be a leader in specific AI solutions. Latvia's main advantage is the ability to implement faster solutions in both the private sector and public administration. Therefore, AI skills should be acquired not only by ICT specialists but also by a wider range of users and managers.

3.3 Estonia

3.3.1 Social security system

In Estonia, the social security system is subordinated to the Ministry of Social Affairs and the Social Insurance Board. In order to participate in the Estonian social insurance system, social insurance contributions are compulsory. Social insurance contributions are a financial obligation imposed on taxpayers in order to obtain the necessary funds for pension insurance and national health insurance.

Estonia's social insurance system covers pensions, family benefits, health insurance, unemployment insurance, benefits for the disabled, repression benefits (for people who suffered repression during the previous regime), death benefits.

3.3.2 The pensions system in Estonia

A pension is a benefit paid as soon as it is reached an old age. The purpose of the public pension system is to provide the retiree with a monthly income and to help maintain the standard of living. To receive a minimum pension for the age limit, there are needed 15 years of contributions to the public pension system.

3.3.3 The flexible pension

It is a new type of pension that came into force in 2021, thus replacing early retirement or partial early retirement. This pension time helps citizens if they retire five years earlier but the pension amount will be lower. In Estonia, citizens have the possibility to retire earlier if they have 1 or more children. Persons who have not accumulated sufficient time, but who have reached the age of 63 and have been resident in Estonia for at least five years at the time of application are entitled to a national pension paid at the national pension rate.

3.3.4 Digitization in Estonia

New technologies are adopted by the Estonian digital government: Estonia is a pioneer in the world when it comes to implementing new solutions (Tkacz, 2021; Divald, 2021).

Service delivery in public institutions where paper was used has been replaced by digital services in Estonia. Basic infrastructure including broadband and blockchain networks and the towers connected to them provide a good basis for the necessary investment in additional infrastructure and services and help the development of communications. KSI is a blockchain technology designed in Estonia and used globally to ensure that networks, systems and data are not compromised, while maintaining 100% data privacy.

Estonia has become a global leader in digitization and has co-opted the private sector in this process by successfully implementing online voting or blockchain for data protection. 99.9% of public services are digitized, missing only marriage and divorce, but even in this respect Estonia is trying to implement online solutions for most of the steps. In 2000, Estonia became the first country to implement parking payment by SMS, which can be considered the first step towards smart cities.

In Estonia, blockchain is used to certify the clarity of data. The data itself is not stored on the blockchain, only the hashes associated with it, so that its accuracy can be verified. It is a solution implemented by a private company formed by Estonian university cryptography experts and the company does not need access to citizens' data to implement it.

Estonia has become the first country to back up all data managed by digital public services to the cloud. Digitization experts have created a "data embassy" in Luxembourg, while full and regularly updated backups of databases are stored there. So, if the ones in Estonia are lost or no longer accessible, the ones in Luxembourg can be restored (Divald, 2021).

One of Estonia's success factors in digital government is developing and is based on strong platforms, i.e. component and service centric infrastructure. This has accelerated the development and introduction of digital services across the country. Existing platforms have constantly adapted to the development of technology and user needs. Estonians have a state-issued digital identity. Estonia has the most developed national ID card system in the world. Much more than a legal photo ID, the mandatory national card also provides digital access to all of Estonia's electronic services.

Estonian citizens access and use the government services they need with the personal digital assistant of their choice, the latest project of the Estonian government.

This year, the Estonian government will take its digital services strategy to the next level by creating a network of public sector software bots that, through a virtual assistant of the citizen's choice, can be accessed to complete government service application processes.
As the Estonian government makes all its services available online, the system will be able to access all the information an Estonian citizen needs to facilitate the processing of documents such as applications for a new passport or other official papers.

3.3.5 The use of AI in Estonia
In the future, citizens could ask Siri to pay their taxes, with artificial intelligence (AI) apps in different departments interacting in order to complete the citizen's request.
KrattAI, at the conceptual stage will allow citizens, if they wish, to interact with the government as they interact with Alexa to play certain types of music or order food. KrattAI will not be a chatbot, it will manage all interactions and activities it has in the memory through an app.
The objective of the Action Plan for "kratts" in the Estonian Public Sector is to bring the e-state up to the high level of performance. Siim Sikkut of the Estonian government says Artificial Intelligence is described as a system that exhibits intelligent behaviour, analyses the environment and makes autonomous decisions to a certain extent in order to achieve goals.
In May 2019, an expert group led by the Estonian Ministry of Economic Affairs and Communications (MKM) and the Government Office presented proposals to encourage the adoption of artificial intelligence (AI) in Estonia, aka Estonia's National AI Strategy. This current strategy has been prepared based on these proposals, as a plan on how to implement the expert group's recommendations. The strategy is a sum of actions that the Estonian government will take to promote the adoption of AI in both the private and public sectors. This strategy also includes Estonia's National AI Strategy in the Coordinated Context of the European Union's AI Action Plan. The Estonian government has invested at least €20 million between 2019-2023 in the implementation of the AI strategy in various sectors and KrattAI solves the problem of digital public services. There are at least 100 AI use cases implemented by 2022.
The national AI strategy is based on four pillars: boosting AI in government, AI in the economy, skills along with research and development in the legal environment.
As part of the national AI plan, Estonia is bringing a government-wide approach as a platform to drive AI endorsement in both the public sector and the economy. The Estonian Information System Authority uses machine learning for the detection of traffic anomalies and incidents. Estonia's data exchange – X-Road. Predictive analytics is used to decide where to send the police for traffic regulation. The system is well used in cities. Estonian unemployment insurance fund matches jobs, open positions compatible with citizens using AI. The current job matching algorithm is further developed with the job seeker profiling algorithm. Agricultural registers and information in Estonia use AI. Board uses machine learning to detect mown land. Satellite images are analysed to detect whether agricultural land has been mown, ploughed or not. This is necessary because mown land is one of the requirements for receiving government subsidies.
What are the benefits of implementing AI? Implementing artificial intelligence could have various benefits for Estonia. In the public sector, it allows to increase the performance of services, improve the data analysis process and the country to operate more efficiently by achieving the goals of e-government development.
In Estonia, the digital system in the medical field is highly developed. Every person who has ever visited a doctor has an online E-Health Record (EHR) that can be tracked and accessed with the electronic ID card. The EHR system allows doctors to access a patient's records and read the results of tests, medical analyses, including image files such as X-rays, even from remote locations.
There is a project in Estonia that wants to implement a "robot judge" and it could settle disputes over small claims of less than €7,000 (about $8,000). Officials hope the system can eliminate a

backlog of cases for judges and clerks. The project is in its early stages; this pilot began in 2019, focusing on contract disputes. In concept, the two parties will upload documents and other relevant information and the IA will issue a decision that can be appealed to a human judge. The Estonian Ministry of Justice, in collaboration with Estonia's Chief Data Officer Ott Velsberg, developed and piloted this AI software. Ultimately, Velsberg wants to eliminate the human element. AI judges also have the potential to be fairer than human judges. A joint study between Australia's Swinburne University Law School and Queensland University of Technology found that status quo courts were influenced by arbitrary factors such as race or socioeconomic status. Moreover, because the judiciary, as a collective body, is made up of thousands of different judges, lawyers and legal professionals, judgments have been inconsistent across courts. The study found that a court in Victoria, Australia, was three times more likely to jail offenders than other courts in the state.

3.4 Romania

3.4.1 The public pensions system in Romania

In Romania, the old-age pension is allocated to persons who meet, at the date of retirement, the conditions regarding the standard retirement age and the minimum contribution period provided for by law. The standard retirement age for women and men is determined in relation to the month and year of birth (Annex No. 5 to Law No. 263/2010 on the unified public pension system). The standard retirement age is 63 for women and 65 for men, the minimum contribution period is 15 years and the full contribution period is 35 years for both women and men.

3.4.2 Digitization and AI in Romania in the public system

The National Public Pension House is undergoing a complex process of evolution in terms of improving access to electronic services, increasing the quality of information and communication technology so that all institutions have the possibility of multiple interaction with the citizen, the business environment and other central and local public institutions, which are in fact optimization and de-bureaucratization measures. Artificial intelligence is still at an early stage in many public sectors but it is developing fast.

Romania ranks last in the DESI 2022 on this dimension with a score of 21%, well behind the second last ranked Greece (39.4%), the European average (67.3%) or the first ranked Estonia (91.2%). The ranking on this dimension is as follows: Digitization of public services is still a challenge for Romania. It lags behind the European average for the availability of digital public services for citizens (a score of 44 compared to the EU average of 75) and for businesses (a score of 42 compared to the EU average of 82). For digital interaction between public authorities and the general public, only 17% of internet users use e-government services.

Ever since 2014, the European Commission has been analyzing, based on strategic information, the progress of the member states in the digital field with the help of the Digital Economy and Society Index (DESI) reports. Starting in 2023 in conjunction with the Digital Decade 2030 programme, DESI is now used in the Digital Decade status report and is used to monitor progress towards digital goals in member countries.

Using this data for research, the main findings were neatly summed up in table 1.

Table 1. The place occupied by the following countries in the EU according to the following indicators

EU country	The place occupied in the EU according to DESI in 2022 for - Digital public services	The place occupied in the EU according to DESI in 2022 for - Digital technology	The place occupied in the EU according to DESI in 2022	The place occupied in the EU according to DESI in 2022 for - Digital skills by using AI through chatbots or virtual assistants
Estonia	5th place in EU	2nd place in EU	7th place in EU	6th place in EU / use only chatbots
Lithuania	10th place in EU	13th place in EU	14th place in EU	23rd place in EU / use only virtual assistants
Latvia	7th place in EU	24th place in EU	18th place in EU	18th place in EU / use virtual assistants
Romania	27th place in EU	27th place in EU	27th place in EU	27th place in UE

Source: adapted from The Digital Economy and Society Index (DESI), 2022

4. CONCLUSIONS

This paper aims to analyze by comparison the three countries and Romania, analyzing the development of the national public pension system in relation to digital technologies and the use of artificial intelligence.

Lithuania's state old-age pension, as it is called in Lithuania's public pension system, is paid starting from the age of 65 to people who have contributed to Lithuania's pension system according to the country's laws. Lithuania ranks 14 out of 27 EU Member States in the 2022 edition of the Digital Economy and Society Index (DESI). A good information and digital technology infrastructure is one of Lithuania's basic principles. Artificial intelligence systems promise a unique set of benefits for Lithuania's public sector and the creative use of AI can raise citizen welfare in the country.

In Latvia, social insurance for public pensions is managed by the State Social Insurance Agency. Digitization can further improve the coordination of social security systems and support fair labour mobility in Latvia. AI technologies are already successfully used in Latvia. Virtual assistants have been developed and used also in public institutions. The Business Register has started to use the virtual assistant "Una" (Future Entrepreneurs Support) for customer service.

In Estonia, the social security system is subordinated to the Ministry of Social Affairs and the Social Insurance Board. In order to participate in the Estonian social insurance system, social insurance contributions are compulsory. New technologies are adopted by the Estonian digital government: Estonia is a pioneer in the world when it comes to implementing new solutions. Estonia has become a global leader in digitization and has co-opted the private sector into the process by successfully implementing online voting or blockchain for data protection.

In Romania, the National House of Public Pensions is in a complex process of evolution in terms of improving access to electronic services, increasing the quality of information and communication technology so that all institutions have the possibility of multiple interactions both with the citizen and with the business environment and other central or local public institutions, which are in fact means of optimization and de-bureaucratization.

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