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DIGITAL INNOVATION

A driving force of change

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content

EDITORIAL

Digital innovation – A driving force of change

Prof. Asoc. Dr. Teuta XHINDI
Editor in chief

In the contemporary landscape, the phrase "digital innovation" has become synonymous with transformation, revolutionizing the way individuals, businesses, and societies operate. The integration of digital technologies into various facets of our lives has not only accelerated the pace of change but has also emerged as a powerful driving force shaping the future.

Digital innovation, at its core, refers to the application of digital technologies to create new or significantly improved processes, products, or services. The relentless evolution of technologies such as artificial intelligence, the Internet of Things (IoT), blockchain, and data analytics has unleashed a wave of transformative possibilities across diverse sectors. One of the key attributes of digital innovation is its inherent ability to disrupt traditional models, fostering a dynamic environment that rewards adaptability and forward-thinking.

In recent years, innovation, especially innovation in technology has received great attention in business as a strategic way for resilience. Monge and Soriano (2023), after reviewing 119 articles published in the WOS over the period 2018-April 2022, provide the most complete and up-to-date review of digitalization from a global perspective, summarizing the current state of knowledge within an integrated framework. Ndesaulwa and Kikula (2016) have considered technological innovation as a major force in economic growth and are focused on some of the most distinctive features of innovation in the highly industrialized economies of the OECD area. Although the innovation is seen as a driver for economic growth, it is not certain if digitalization and other innovations will lead to full employment or to a long-term mass unemployment (Arsic, 2020). This author adds that "the employment will depend on the speed of adjustment of education system to

technological changes and labor market requirements, as well as on the possibilities for vocational education and change in qualifications".

The business landscape, in particular, has witnessed a paradigm shift with the advent of digital innovation. Organizations are compelled to rethink their strategies, embracing digitalization to stay competitive. From automated processes enhancing operational efficiency to data-driven insights guiding strategic decisions, digital innovation has become the cornerstone of success. Start-ups, unencumbered by legacy systems, have leveraged digital technologies to challenge established norms, giving rise to agile and disruptive business models.

In the realm of healthcare, digital innovation is transforming patient care, diagnosis, and treatment. Telemedicine, wearable devices, and health apps are revolutionizing the way healthcare services are delivered, making them more accessible and personalized. Moreover, the integration of big data analytics allows healthcare professionals to derive meaningful insights, enabling proactive and preventive healthcare strategies.

However, the impact of digital innovation extends beyond the confines of businesses and healthcare. Societies are experiencing profound changes in the way information is disseminated, communities are formed, and governments interact with their citizens. Social media, for instance, has become a catalyst for social movements, allowing people to connect, organize, and voice their opinions on a global scale. The democratization of information through digital channels has empowered individuals, reshaping the dynamics of power and influence.

Yet, with the promises of progress come challenges and considerations. The ethical implications of digital innovation, such as privacy concerns, algorithmic bias, and the digital divide, warrant careful examination. Striking a balance between harnessing the benefits of digital innovation and addressing its potential drawbacks is crucial for creating a sustainable and inclusive future.

In conclusion, digital innovation stands as a driving force of change, reshaping industries, societies, and the very fabric of our daily lives. Its transformative influence is undeniable, offering unprecedented opportunities for growth, efficiency, and connectivity. As we navigate this digital frontier, it is imperative to foster a culture of responsible innovation, ensuring that the benefits of digital advancements are equitably distributed and that the ethical considerations are given due diligence. The journey of digital innovation is ongoing, promising a future where change is not just inevitable but is driven by the limitless potential of the digital age.

Innovation in Healthcare through Technology and Artificial Intelligence – Case Study: VitalView Blood Pressure Monitoring System

Msc. Amanda KOTE

Abstract

The rising prevalence of chronic diseases and the advancement of artificial intelligence and machine learning are driving significant shifts in the healthcare industry. Chronic diseases pose an urgent threat to the world's healthcare systems due to the rising number of fatalities, making the demand for innovative approaches imperative. Applying VitalView, a blood pressure monitoring system, as a case study, this thesis explores the intersection of these fields. The system's main goal is to employ AI and machine learning to offer personalized treatment for chronic diseases, especially blood pressure. To accomplish this, the study commences by examining the challenges faced by Albania's healthcare system, in particular issues connected to access, costs, and service quality. The study then digs into the development of VitalView, an innovative solution that meets the needs of patients and healthcare professionals. The creation of an algorithm for data analysis and communication is at the core of this work. Autoregressive Integrated Moving Average (ARIMA), among other machine learning models, improves the platform's ability to forecast blood pressure trends and simplify doctor-patient communication. The system also provides advice and recommendations for the patient's general state of health. The case study methodology is employed with the objective of putting this system's applications into action in real-life situations. Its findings show the potential of AI and machine learning to boost communication, improve the management of chronic blood pressure diseases, and

boost patient outcomes. This thesis demonstrates how innovative technologies could cope with pressing concerns of our time and contributes to the discussion on artificial intelligence in the healthcare industry. The VitalView system serves as an example of how innovation, data analysis, and user-centered design function together. It highlights how AI and machine learning have the potential to improve healthcare.

Keywords: *artificial intelligence, machine learning, chronic diseases, blood pressure monitoring, personalized treatment, healthcare challenges, case study, VitalView, data analysis, communication.*

Introduction

In today's complex healthcare landscape, the emergence of modern technology and the assistance of artificial intelligence offer hope for medical innovation. The urgent need to solve healthcare issues and reduce expenses served as the motivation driving this study. Implementing technology and artificial intelligence is essential for improving patient care and healthcare efficiency in a time of growing healthcare demands and limited resources.

The aim of this study is to develop novel methods and strategies that not only improve the quality of healthcare services but also offer practical, economical responses to today's pressing healthcare issues. Additionally, the study aims to develop a model for healthcare innovation that is scalable and flexible, able to change in sync with new technological advancements and changing patient demands. It envisions a future where healthcare is not only more effective but also more cost-effective, empowering people to take control of their health and fostering healthier communities by fusing the power of cutting-edge technologies like Artificial Intelligence and data analytics with a patient-centered ethos.

The study addresses two key research questions:

Research Question 1: What impact can artificial intelligence and machine learning have, through personalized treatment of patients, in the management of chronic diseases?

Through this question, the thesis explores the ways personalized care for chronic diseases could be improved by machine learning and artificial intelligence. This investigation seeks to enhance individual patient treatment through user-centered design innovations.

Research Question 2: How can artificial intelligence and machine learning algorithms be used to reduce blood pressure fluctuations?

By analyzing this question, the study dives into the potential of AI and machine learning algorithms to decrease variations in blood pressure. The aim is to examine how modern technologies could ensure more consistent and controlled blood pressure levels.

This paper is guided by a clear hypothesis and objectives. The hypothesis posits that by applying artificial intelligence and machine learning in healthcare innovation would result in significant advancements. By facilitating quick communication with healthcare providers, personalized health tips and advice, and forecasting trends in systolic and diastolic blood pressure values, ultimately would lead to balanced blood pressure values, reduced medical costs and equitable high-quality healthcare services.

Hypothesis: Health innovation activities are improved significantly when the potential of artificial intelligence and machine learning is used.

By using the new technologies, blood pressure readings can be monitored and kept under control, medical costs can be reduced, and a comparable standard of care can be guaranteed through rapid interaction with the doctor, personalized advice, and analysis of coherent and recent information.

In pursuit of this hypothesis, the study outlines several key objectives:

1. To identify and analyze health problems in Albania.
2. To create an innovative solution to address these problems by developing a blood pressure monitoring system.
3. To create an algorithm that analyzes real data, identifies trends and realizes communication between the patient and the doctor.
4. To provide personalized recommendations and advice based on patients' personal data to improve the management of this chronic disease.

Together, these objectives form the foundation for an impactful research endeavor.

Literature Review

Artificial Intelligence in Healthcare

At the relationship of computer science and healthcare, artificial intelligence (AI) has emerged as an influential force in the area of healthcare. AI has the amazing ability to evaluate complex and multifaceted medical data, leading to quick and significant changes in the medical field. The conventional paradigms of disease management,

therapy, and diagnosis have all undergone major shifts as a result of its application. It is amazing how flexible AI is in healthcare. For instance, AI enhances surgeons' ability in the field of surgery by detecting high-risk or difficult areas that need to be treated, improving the accuracy and safety of surgical treatments. AI speeds up the search for novel therapeutic compounds in drug discovery and development, saving time and resources for pharmaceutical companies. Additionally, AI finds a promising application in telemedicine and health monitoring systems, enabling remote patient monitoring and enabling thorough health data analysis, ultimately improving the overall effectiveness of healthcare delivery. (Ramesh, Kambhampati, Monson, & Drew, 2004)

Telemedicine

In the present digital world, telemedicine has made impressive strides, resulting in a variety of uses that closely resemble the study's goals. To aid in the systematic documentation of medical data and the preservation of important healthcare information, including diagnoses, medications, and appointment information, such applications carefully use electronic formats that are always accessible. With the introduction of virtual contacts between patients and healthcare professionals and the facilitation of treatment delivery, telemedicine has advanced beyond geographic limits and successfully managed the flow of information. But it's important to remember that there are different levels of AI technology integration acceptance among medical professionals. (Nittari, et al., 2020)

Machine Learning

The use of machine learning algorithms is naturally prompted by the different levels of complexity, sophisticated human-machine interactions, and decision-making phases that these systems exhibit. In the context of radiotherapy, where the majority of cancer patients get ionizing radiation therapy, especially in advanced stages of the disease, machine learning has emerged as a vital asset. Radiotherapy is a broad term that refers to a variety of procedures that not only speed up the process of going from consultation to treatment but also guarantee accurate delivery of the required dose of ionizing radiation and customize the course of action for every patient. (Naqa & Murphy, 2015)

Predictive Analytics

The medical industry is being rapidly transformed by predictive analytics, which encourages innovation and improves patient outcomes. Predictive analytics sorts

through historical and real-time data using complex statistical algorithms, machine learning models, and data analytics tools to estimate upcoming medical events. This enables those who supply healthcare services to take well-informed decisions, improve patient care, and even forecast problematics. Predictive algorithms, for instance, have been created to identify high-risk patients who would need a hospital readmission, allowing healthcare institutions to put preventive measures into place. Predictive analytics also significantly influenced resource allocation during the COVID-19 epidemic, helping hospitals effectively manage the availability of beds, ventilators, and medical personnel. (Kankanhalli, Hahn, Tan, & Gao, 2016)

Augmented Dickey-Fuller Test

In this context, the Augmented Dickey-Fuller test (ADF test) is a statistical method used to identify the presence of unit roots in a time series. Non-stationary, in the majority of the cases, denotes the presence of a trend that makes analysis more difficult, whereas stationary denotes the absence of a discernible pattern that significantly changes the series' values over time. The ADF test begins by presenting the null hypothesis that the time series is non-stationary. This indicates that the autoregressive model has a unit root. If the time series has a unit root, this means that it has a stochastic trend. (Mushtaq, 2011). The starting point is the stochastic process:

$$\Delta y_t = \alpha y_{t-1} + \epsilon_t$$

where:

- Δy_t is the difference between y_t and y_{t-1}
- α is the tested parameter for the unit root
- ϵ_t is a white noise error term

If $\alpha=0$, then the series has a root of unity and is non-stationary. If $\alpha<0$, then the series is stationary. If the computed absolute value of the tau statistic exceeds the absolute DF or MacKinnon critical tau values, we reject the hypothesis that $\alpha=0$, in which case the time series is stationary. On the other hand, if the computed absolute value of the tau statistic does not exceed the absolute critical tau value, we do not reject the null hypothesis, in which case the time series is nonstationary.

ARIMA model

ARIMA(p,d,q) (Autoregressive Integrated Moving Average) is one of the most widely used methods for time series forecasting. The components of ARIMA are:

- AR part (Autoregressive) explains the relationship between an observation and its previous observations (lags). An AR term is commonly used to model the trend component of a time series. The parameter p is the order of the AR model, indicating the number of lags to be used as predictors. In mathematical form, the AR part is defined as:

$$\boldsymbol{\varphi_1 y_{t-1} + \varphi_2 y_{t-2} + \cdots + \varphi_p y_{t-p}}$$

- I (Integrated) is the order of differentiation applied to the time series data to make it stationary. A non-stationary series is one that has time-varying properties. The parameter d is the number of times that the time series has to be differenced before it becomes stationary.
- MA (Moving Average), this component models the relationship between an observation and the errors from previous observations. It helps to capture unexpected shocks or transient effects that cannot be modeled by trend and seasonality components. The parameter q is the order of the MA model, indicating the number of lagged forecast errors in the forecast equation. In mathematical form, MA is described as:

$$\boldsymbol{\theta_1 e_{t-1} + \theta_2 e_{t-2} + \cdots + \theta_q y_{t-q}}$$

(Fattah, Ezzine, Aman, Moussami, & Lachhab, 2018)

Differencing

The method of differencing is a common method used to make a non-stationary time series stationary. Basically, differentiation calculates the difference between consecutive observations. The more differentiation stages are completed, the more accurate the prediction is. In first-order differentiation, each value in the series is replaced by the difference between it and the previous value: $\Delta y_t = y_t - y_{t-1}$, where Δy_t is the difference between the value at time t, and the value at time t-1, y_{t-1} . Sometimes, first-order differentiation is not sufficient to make the series stationary. In these cases, it may be necessary to apply second-order differentiation, which is simply the first-order differentiation of data that has already been differentiated.

After differentiation, it is common to use statistical tests such as the Dickey-Fuller (ADF) test to confirm whether the series has become stationary. Stationarity is essential because many statistical modeling techniques assume or require the time series to be stationary to make reliable and valid inferences. (Abraham, Poole, & Poole, 1999)

VitalView – Blood Pressure Monitoring System

VitalView: this innovative blood pressure monitoring system, designed as part of this study, serves as a solution to address the needs of individuals suffering from chronic blood pressure issues. VitalView is a platform created to be used by both patients and healthcare providers.

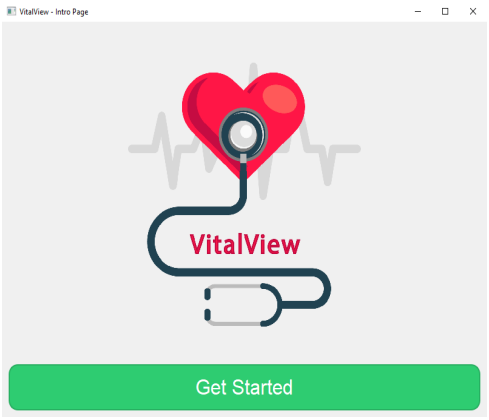

FIGURE 1 VitalView Blood Pressure Monitoring System

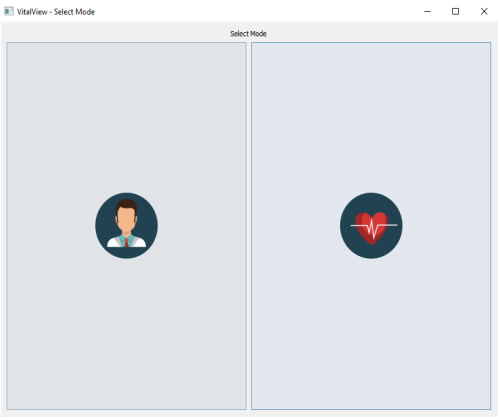

FIGURE 2 Doctor/Patient Portal Mode

It serves as a personalized health companion, providing support for people with chronic blood pressure issues. This method can be easily incorporated by patients into their everyday routines, becoming an essential element of their healthcare regimen. Patients may easily check their profile, add manually or watch their systolic and diastolic values, get important health information, and stay up to date with the help of this system. They may quickly visualize their data, including lowest, maximum, and average blood pressure measurements, providing a thorough insight of their progress, using graphical representations.

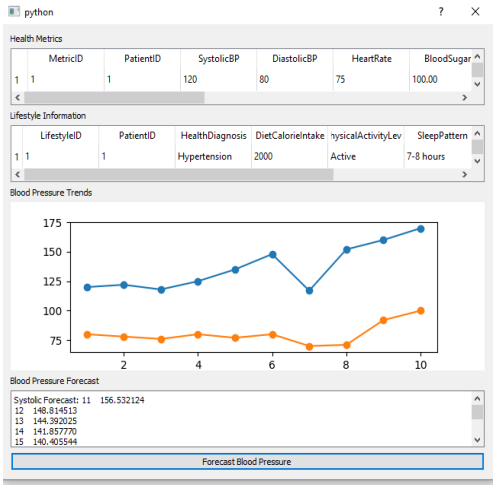

FIGURE 3 Doctor Portal - Patient Information &

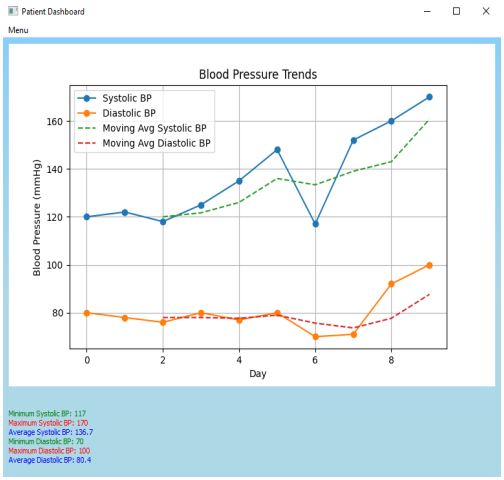

FIGURE 4 Patient Portal - Information Vizualization & Calculations

To improve health outcomes, VitalView collects real-time data in a cost-effective way, performs deep analysis by using machine learning algorithms (ADF test, differencing & ARIMA model), and can forecast trends in 5 upcoming days. By using this method, the system aims to actively involve patients and healthcare providers in the journey of this chronic disease. The technology updates end-users on the health trends in real-time and notifies all parties in case of emergency. Additionally, VitalView encourages better interaction and consultation between patients and their doctors, provides faster access to health services and reduces costs for patients. If offers a convenient, cost-free and efficient method for exchanging crucial health information by offering a channel of communication, as well as it empowers medical experts with all the information necessary to make informed decisions on the best course of action and modify treatment regimens. Doctors may rely on VitalView's real-time data to deliver accurate medical reccomendations and actions.

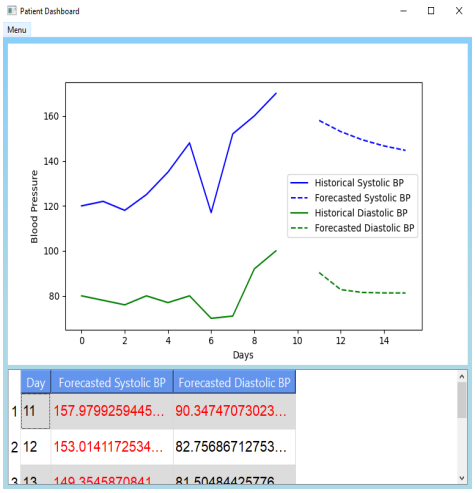

FIGURE 5 Patient's Forecasted Trend

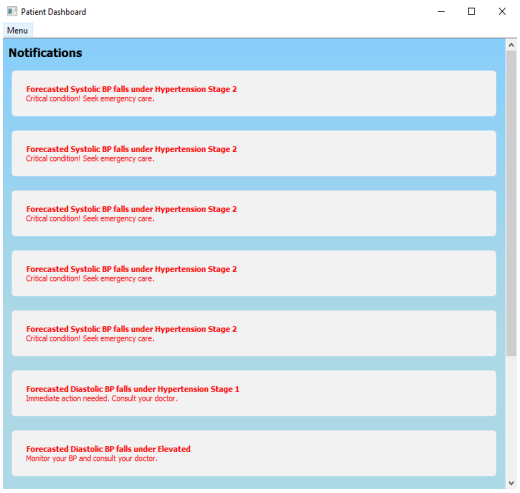

FIGURE 6 Patient's Emergency Notifications

The process for predicting future systolic and diastolic blood pressure values involves several steps. The initial step is to conduct an analysis using the forecasting capabilities of the ARIMA model. The Augmented Dickey-Fuller (ADF) test and first-order differences calculations are used to determine the stationarity of the time series data. If the data is determined to be stationary, the ARIMA analysis can use it right away. If not, a differencing procedure must be used until the data become stationary. The ADF test indicates the parameter that is not stationary, indicating that it fluctuates with time. On the other hand, the ADF test defines the stationary values, which means the readings are more constant and show a trend. For non-stationary values, differencing is performed until the data meets the criteria of stationarity after reapplying the ADF test. Once the stationarity requirement is met for the new values, an ARIMA forecasting model is used. The model needs the p, d, and q parameters to be determined, which often entails examining various lags or delays. Modern tools can, however, automatically determine these parameters, such as the auto ARIMA function. The ARIMA prediction function is used to calculate future systolic and diastolic blood pressure values for the following five days after determining the model's parameters.

Furthermore, this novel system raises the bar for healthcare by making food suggestions, improving sleep quality, sending reminders to stay hydrated, providing stress-reduction techniques, and encouraging physical exercise based on user data. In addition to being software, VitalView is a thoughtful partner who is concerned about the welfare of its end users. This system is a potent illustration of the potential for making well-informed judgements about an individual's well-

being that innovation and artificial intelligence create. Healthcare should no longer be difficult; rather, it should be an enjoyable journey towards a healthier and better life.

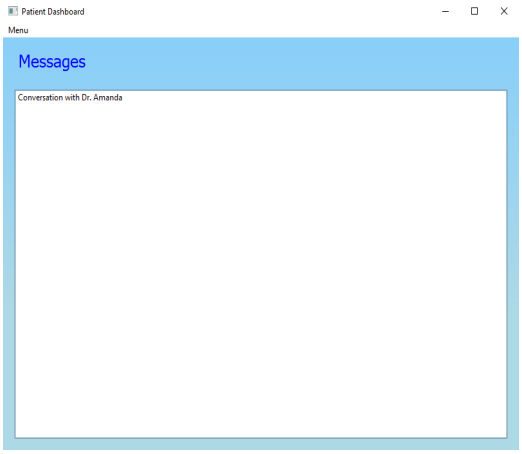

FIGURE 7 Doctor - Patient Communication

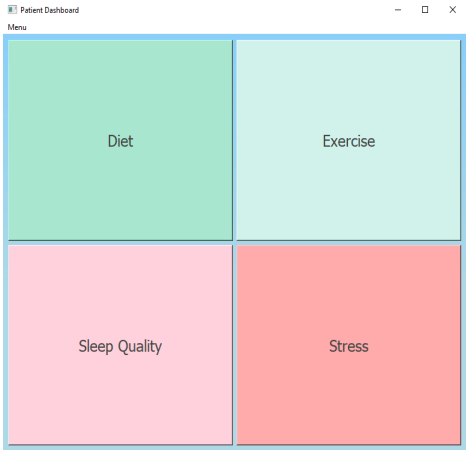

FIGURE 8 Patient General Healthcare Tips

VitalView plans to improve its technology in the future for improved healthcare. Predictions could be more accurate by considering lifestyle parameters like exercise, sleep patterns, stress and diet information. By integrating with health monitoring equipment, faster data collection and ongoing tracking could be made available, helping doctors make better decisions. An AI chatbot might provide support outside of business hours. It is also essential to create a network of specialists and healthcare workers for collaboration and patient support groups. Data security will be a top priority, with strict access controls, audits, encryption and privacy protection. Finally, VitalView would have the full capacity to deliver precise, customized, and cohesive healthcare advice.

Results & Conclusions

The study's findings suggest that the VitalView blood pressure monitoring system was successfully created, highlighting its potential to revolutionize healthcare in Albania. The system successfully tackles the issues of access, affordability, and service quality that present in the Albanian healthcare system by taking a user-centric approach. The VitalView prototype uses machine learning and AI algorithms to analyze patient data in real-time, spot trends in blood pressure, and promptly alert patients and medical professionals to any alarming numbers.

Machine learning's adaptability enables continual learning from patient data and adaptation, improving the system's accuracy over time. Additionally, giving patients information on improving their lifestyles provides a comprehensive approach to preserving good blood pressure levels. Patient health is prioritized thanks to VitalView's role in supporting constant patient-doctoral dialogue, which ensures prompt interventions. In summary, this thesis highlights how AI and machine learning have the potential to dramatically advance healthcare by providing a more individualized and responsive method of patient care. With the VitalView system, chronic disease management can be addressed, setting the groundwork for further advancements and advances in Albanian healthcare.

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The influence of brick masonry on the response of the b/a building in the phase of the seismic event

Msc. Eglis MURRANI

Abstract

The study will consist of the seismic reaction of a six-story building with a reinforced concrete structure, including the impact of brick masonry in the seismic event phase. Partition walls are part of the building's structure used to create separate spaces within the building and to limit the building from the exterior and other objects. Despite their intended functions, partition walls can be involved in transmitting seismic forces due to their stiffness and strength. Since partition walls are rigid, they tend to capture more seismic forces and transmit them to frame-type structures. This can cause damage to the structure. For this reason, it is important to analyse the effects of partition walls on the building's structure, especially in the context of seismic activity. The structure with masonry will be calculated in engineering software, and conclusions will be drawn about the way of connecting the masonry to the frame.

Key words: *Seismic activity, partition walls, load-bearing structure, cracks*

Introduction

Reinforced concrete frame structures dominate modern construction in Albania and other nations. Such frameworks consist of reinforced concrete beams and columns, forming the load-bearing skeleton. Alongside, buildings include partition walls, slabs, and stairs. Firm connections between beams and columns are crucial.

Three main features characterise these structures:

- Wide columns to withstand bending and shear forces, especially on lower floors.
- Proper beam dimensions respecting the beam-column hierarchy.
- Secure bonds between columns and beams.

Partition walls, though non-structural, support from below and above. This study focuses on analysing partition and perimeter walls, often overlooked as non-essential. Recent Albanian earthquakes have revealed stability risks if these elements lack proper connections. During seismic events, poorly connected partition walls can lead to significant issues. To prevent potential severe consequences, understanding and strengthening these walls is crucial. Through calculations and ETABS18 software analysis, we aim to identify optimal methods to attach walls to frames, bolstering structures against seismic forces.

The Aim of Study

Throughout history, numerous masonry structures have been created, many of which remain in use today, including residential buildings, hospitals, schools, and more, some of which hold historical significance. During this time, earthquakes of varying strengths have highlighted their vulnerability.

This study aims to theoretically analyse partition and perimeter walls and their integration with load-bearing structures, with the goal of enhancing their resilience against seismic forces.

Study Objectives

- Analysing partition walls based on their constituent materials (mortar and bricks).
- Exploring the response of the examined partition walls to seismic tremors.
- Should walls be connected to the main frame? If so, what recommendations from Eurocodes and KTP-89 exist for implementing such connections?

Research Questions

- Given the extensive use of partition walls, what challenges are associated with them?
- Why do these walls demand special analysis in seismic regions? What insights did recent earthquakes in Albania provide about walls in general?
- How do partition walls' seismic performance and influence impact overall structural stability?

Literature Review

The seismic response of load-bearing structures, particularly those with reinforced concrete frames, has garnered significant attention in the realm of structural engineering due to its implications for safety and resilience during seismic events. This literature review aims to synthesise key insights from various authors and studies, shedding light on the influence of brick masonry on the seismic behaviour of such structures.

"Eurocode 8 provides comprehensive guidelines for seismic design and behaviour, enabling engineers to ensure structures are equipped to withstand seismic forces," elucidates Eurocode 8's principles (European Commission, 1998). Additionally, KTP-N.2-89's guidelines (*KTP-N.2-89, 1989)* furnish an essential framework for understanding seismic response mechanisms and the structural implications.

Frashëri's seminal work on "Seismicity" delves into the seismicity of the region, setting the stage for a deeper examination of how structures respond to seismic forces (Aliaj et.al, 2020). Meanwhile, Dolsek's study (Dolsek, 2008) undertakes a deterministic assessment of masonry infills' effect on the seismic response of reinforced concrete frames, indicating that "the presence of masonry infills can significantly alter a structure's dynamic behaviour."

Doudoumis' research introduces a novel approach by incorporating "infill finite elements" with unilateral contact friction and various material laws (Doudoumis, 2006). Dukuze (2000), Fardis (1966), and Merabi (1994) collectively contribute by conducting static and dynamic analyses, with Dukuze highlighting the role of "infilled elements in influencing overall structural stability."

Santhi's work (2005) focusing on the seismic response of soft-story infilled frames underscores the importance of accounting for the unique behaviour of these structures during seismic events. Hima's study (2016) and Krasniqi's insights

(2016) emphasize that "seismic vulnerability is closely tied to the presence and characteristics of masonry infills, urging designers to consider their impact."

Bachman (2000) underscores the significance of understanding structural responses, stating that "analysing seismic effects contributes to designing buildings capable of withstanding varying seismic intensities." Additionally, Seranaj's work (2016) underscores the importance of studying "reinforced concrete structures under different seismic conditions to derive comprehensive insights."

Case Study

The chosen subject of analysis is a typical residential building with 6 above-ground floors and 1 basement level. (The basement floor serves as utility space, while the other floors are for living, and the underground level is for parking.) It is located in Zone X, bordered by Object A to the North within 6 metres, Object B to the South, Object C to the East, and "Durres" road to the West.

The selected construction system is a hybrid system combining masonry infill and frame construction. In this scenario, the structure's resistance to lateral seismic forces is ensured through the combined contribution of masonry walls and frames.

This section will focus on the two main axes, Axis A and Axis F, where masonry infill has been incorporated. The study of the object comprises three computational models:

- Without masonry infill,
- With masonry infill,
- With masonry infill and cracks.

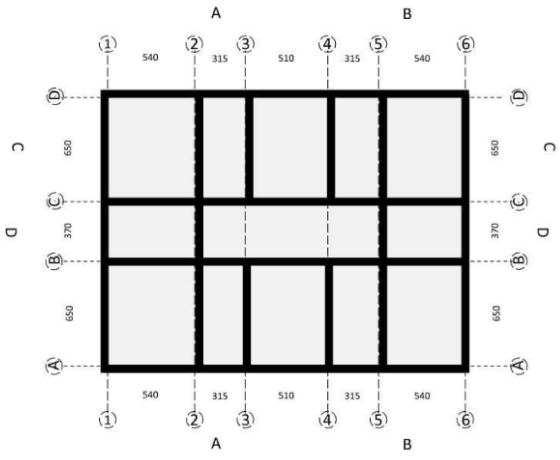

FIGURE 1 - Structure's plan

Computational Model

The structure has been modelled using the computer program CSI Etabs v.18. The frame portion is modelled using frame elements with concrete of class C 25/30. Columns of varying dimensions have been utilised, with their section decreasing as the height increases. This design choice is influenced by the decreasing weight carried by upper floors compared to lower ones. Four types of beams have been employed, two of which are tall beams (55 x 30; 60 x 30) placed along the perimeter, and the other two are short beams (30 x 55; 30 x 60) positioned within the building. Class B500 steel has been used for reinforcement.

For the structural elements' connection to the ground, "Frame" type elements are affixed with fixed base connections (the six degrees of freedom are restrained), while for walls, the connection to the base and column is considered a non-movable hinge. This is because the masonry rests on the foundation beams, and aside from contact, there is no reinforcement providing fixed base connection between these structural elements. The infill masonry is represented as a thin shell, with all brick parameters accounted for.

The selected brick type is perforated ceramic brick with dimensions of 250x140x120 mm. It should be emphasised that the brick parameters entered in the program represent average brick and mortar characteristics. This implies that an average parameter characterizing the masonry has been employed, rather than individual brick parameters.

Element	Foundation	Beam	Column	Wall
Concrete	C25/30	C25/30	C25/30	C25/30
Steel	B500	B500	B500	B500
Protective Layer				
Cmin	25mm	25mm	25mm	25mm
Cmin	25mm	25mm	25mm	25mm

TABLE 1 - Characteristics of the Building Construction.

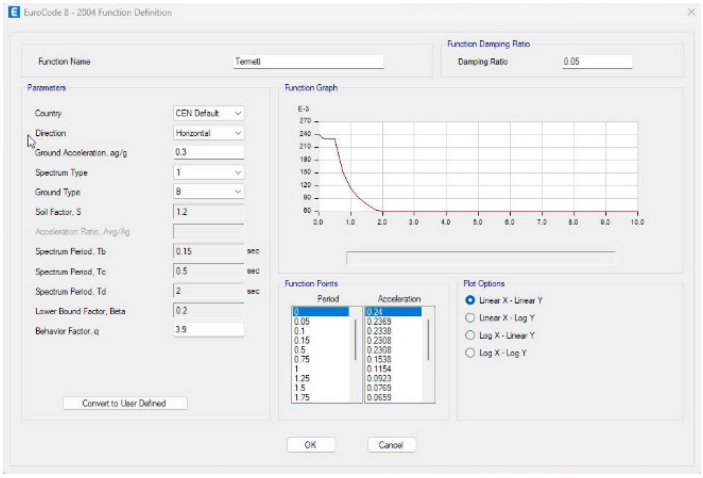

FIGURE 2 - Design spectrum.

	I rregullt në plan dhe në lartësi		I parregullt në plan		I parregullt në lartësi		I parregullt në plan dhe në lartësi	
SISTEMI STRUKTUROR	**DCM**	**DCH**	**DCM**	**DCH**	**DCM**	**DCH**	**DCM**	**DCH**
një-katësh (ramë ose ramë-ekuivalent)	3.30	4.95	3.15	4.73	2.64	3.96	2.52	3.78
rama shumëkatëshe, me një hapësirë	3.60	5.40	3.30	4.95	2.88	4.32	2.64	3.96
struktura ramash shumëkatëshe, me shumë hapësira ose duale ramë-ekuivalent	3.90	5.85	3.45	5.18	3.12	4.68	2.76	4.14
sisteme dual mur-ekuivalent, ose me mure të çiftuar	3.60	5.40	3.30	4.95	2.88	4.32	2.64	3.96
sisteme me mure me vetëm dy mure të palidhur për secilin drejtim horizontal	3.00	4.00	3.00	4.00	2.40	3.20	2.40	3.20
sisteme të tjera me mure të paçiftuar	3.00	4.40	3.00	4.20	2.40	3.52	2.40	3.36
sistem me fleksibilitet në përdredhje	-	-	2.00	3.00	1.60	2.40	1.60	2.40
sistem i tipit lavjerrës i përmbysur shënim α_0>2	1.50	2.00	1.50	2.00	1.20	1.60	1.20	1.60

TABLE 2 - Behavior factor values for concrete structural systems

From the photos obtained from the program, we can discern that we are dealing with the same mixed structure of reinforced concrete frames (columns + beams) and shear walls. By introducing infill walls and creating cracks within them, we will observe how the key parameters of the structure will be altered.

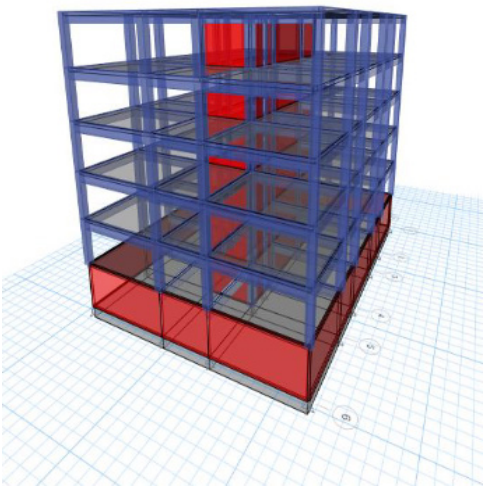

FIGURE 3 - Modeling of the structure without infill walls

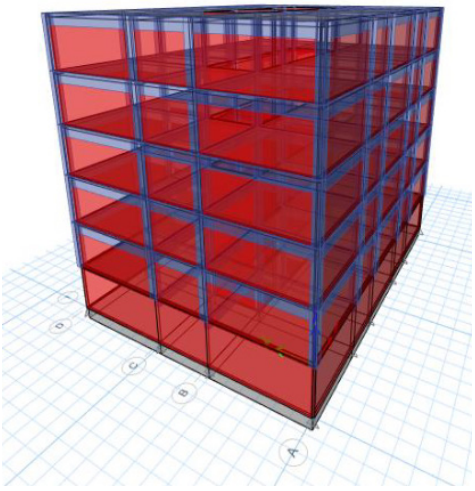

FIGURE 4 - Modeling of the structure with infill walls

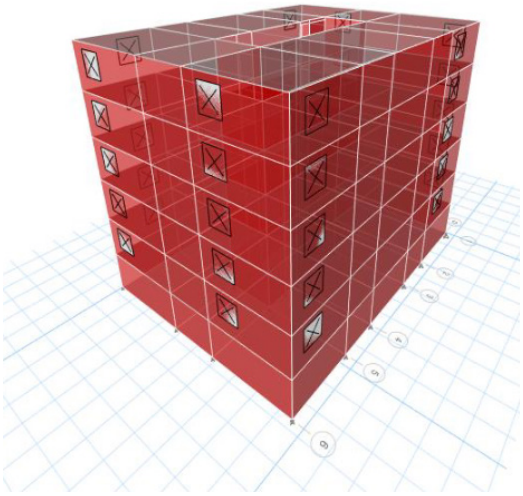

FIGURE 5 - Modeling of the structure with infill walls with cracks

In the program, we have considered the masonry material as "concrete," an isotropic material, and manually input the respective coefficients and modules of masonry. This considers that masonry consists of bricks and mortar, and for these inputs, an approximation of brick-and-mortar data has been utilised to derive a set of shared data points that approximate the behaviour of infill masonry.

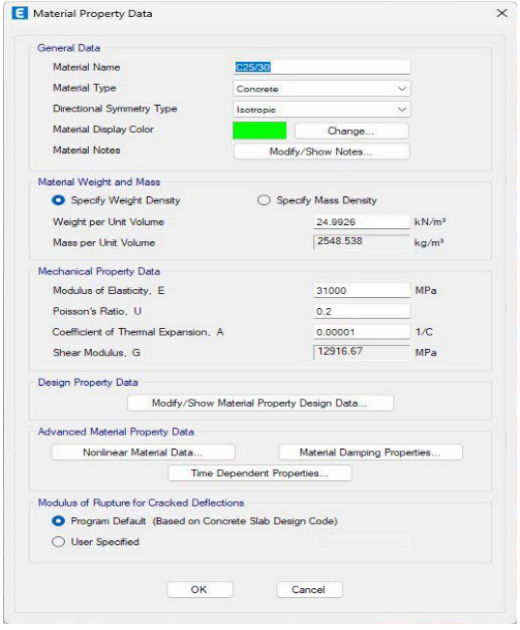

FIGURE 6 - The material on the program

Displacements of the Three Building Models

- Building without infill walls
- Building with infill walls
- Building with infill walls and cracks

TABLE: Story Response	Column1	Column2	Column3	Column4	Column5	Column6
Story	X-Dir	Y-Dir	X-Dir	Y-Dir	X-Dir	Y-Dir
	mm	mm	mm	mm	mm	mm
Story6	1.574	18.534	0.888	14.64	0.942	15.073
Story5	1.292	15.378	0.681	12.46	0.758	12.786
Story4	0.935	11.699	0.507	9.687	0.576	9.913
Story3	0.576	7.823	0.325	6.624	0.373	6.756
Story2	0.261	4.009	0.159	3.479	0.193	3.54
Story1	0.193	0.954	0.181	0.892	0.183	0.898
Base	0	0	0	0	0	0
	Pa mure		Me mure		Me mure me carje	

TABLE 3 - Comparison of displacements

From the tabular values obtained by the program we notice that there is a difference between the three models. Which means that the addition of infill masonry affects the displacement of the floors.

Maximum Floor Drifts

- Building without infill walls
- Building with infill walls
- Building with infill walls and cracks.

TABLE: Story Response	Column1	Column2	Column3	Column4	Column5	Column6
Story	X-Dir	Y-Dir	X-Dir	Y-Dir	X-Dir	Y-Dir
					mm	mm
Story6	0.00010065	0.0010535	7.1004E-05	0.00076466	0.94214437	15.0725188
Story5	0.00011891	0.00122674	6.0981E-05	0.00092572	0.75813647	12.7855829
Story4	0.00011969	0.00129275	6.3238E-05	0.00102222	0.57640453	9.91275469
Story3	0.00011708	0.00127141	6.9116E-05	0.00104858	0.3733093	6.75577818
Story2	0.00013594	0.00123914	9.5837E-05	0.00104465	0.19258449	3.54005078
Story1	6.4441E-05	0.00031792	6.0414E-05	0.00029744	0.18289681	0.89805947
Base	0	0	0	0	0	0
	Pa mure		Me mure		Me mure me carje	

TABLE 4 - Comparison of the Three Models for Floor Drifts

Shear Force at Each Floor

- Building without infill walls
- Building with infill walls
- Building with infill walls and cracks

TABLE: Story Response	Column1	Column2	Column3	Column4	Column5	Column6
Story	X-Dir	Y-Dir	X-Dir	Y-Dir	X-Dir	Y-Dir
	kN	kN	kN	kN	kN	kN
Story6	0	-2886.418	0	-2967.4152	0	-2926.3516
	0	-2886.418	0	-2967.4152	0	-2926.3516
Story5	0	-5553.2926	0	-6047.6202	0	-5948.7298
	0	-5553.2926	0	-6047.6202	0	-5948.7298
Story4	0	-7686.7923	0	-8511.7841	0	-8366.6324
	0	-7686.7923	0	-8511.7841	0	-8366.6324
Story3	0	-9286.9171	0	-10359.907	0	-10180.059
	0	-9286.9171	0	-10359.907	0	-10180.059
Story2	0	-10353.667	0	-11591.989	0	-11389.011
	0	-10353.667	0	-11591.989	0	-11389.011
Story1	0	-10846.2451	0	-12159.12	0	-11951.76
	0	-10846.2451	0	-12159.12	0	-11951.76
Base	0	0	0	0	0	0
	0	0	0	0	0	0
	Pa mure		Me mure		Me mure me carje	

TABLE 5 - Comparison Among the Three Models for Shear Force

On the floors where we have added infill masonry, we have an increase in shear force, this is because the masonry as a structural unit and bars absorbs more shear force. Also, on the other hand, we see that with the opening of cracks in the masonry, this shear force decreases slightly, but still does not exceed the level of the building without infill walls.

Overturning Moment

- Building without infill walls
- Building with infill walls
- Building with infill walls and cracks

Story	X-Dir	Y-Dir	X-Dir	Y-Dir	X-Dir	Y-Dir
Column1	kN-m	kN-m2	kN-m3	kN-m4	kN-m5	kN-m6
Story6	0	0	0	0	0	0
Story5	8659.2539	0	8902.2455	0	8779.0547	0
Story4	25319.1317	0	27045.106	0	26625.2442	0
Story3	48379.5088	5.987E-07	52580.4584	0	51725.1416	0
Story2	76240.2602	0.00000083	83660.1798	0	82265.3198	0
Story1	107301.261	0.000001074	118436.147	0	116432.352	0
Base	139839.996	0.000001307	154913.507	0	152287.632	0
	Pa mure		Me mure		Me mure me carje	

TABLE 6 - Comparison Among the Three Cases for Overturning Moment

When we add the masonry, we have an increase in the value of this moment, and after making the cracks we see that it decreases a little, although it is still at higher values than in the building without infill walls.

Respective Periods of the Buildings

	Case	Mode	Period sec
▶	Modal	1	0.296
	Modal	2	0.26
	Modal	3	0.156
	Modal	4	0.089
	Modal	5	0.082
	Modal	6	0.055
	Modal	7	0.049
	Modal	8	0.046
	Modal	9	0.043
	Modal	10	0.037
	Modal	11	0.035
	Modal	12	0.034

TABLE 7 - Building without infill walls

Case	Mode	Period sec
Modal	1	0.267
Modal	2	0.215
Modal	3	0.154
Modal	4	0.079
Modal	5	0.073
Modal	6	0.049
Modal	7	0.046
Modal	8	0.045
Modal	9	0.036
Modal	10	0.035
Modal	11	0.034
Modal	12	0.031

TABLE 8 - Building with infill walls.

Case	Mode	Period sec
Modal	1	0.27
Modal	2	0.218
Modal	3	0.154
Modal	4	0.079
Modal	5	0.074
Modal	6	0.049
Modal	7	0.046
Modal	8	0.045
Modal	9	0.036
Modal	10	0.035
Modal	11	0.034
Modal	12	0.032

TABLE 9 - Building with infill walls and cracks

From the tables in the program, we notice that with the addition of infill walls, there is a decrease in the oscillation periods. This happens because of the rigidity that is added to the structure of the building. Due to the increased rigidity, the change in the amount of movement of the structure during oscillations is reduced,

bringing a decrease in the period of oscillations. With the addition of cracks in the walls, it is observed that the period increases slightly, but the difference is not very large.

Displacements at the Extreme Points of the Building

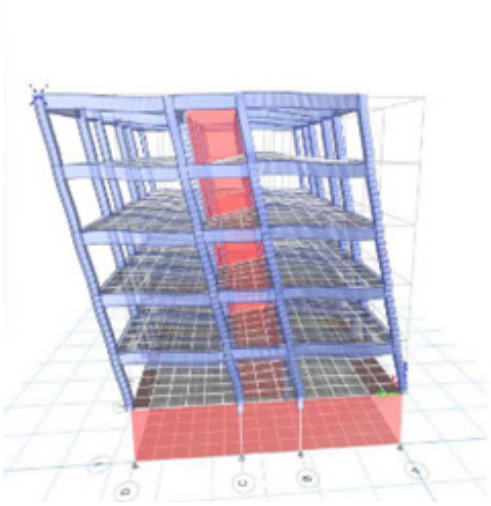

FIGURE. 7 - Building without infill walls

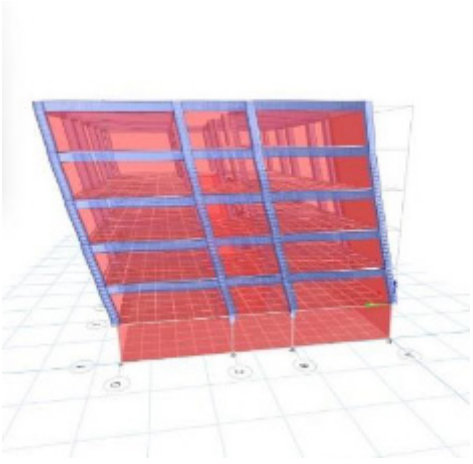

FIGURE. 8 - Building with infill walls

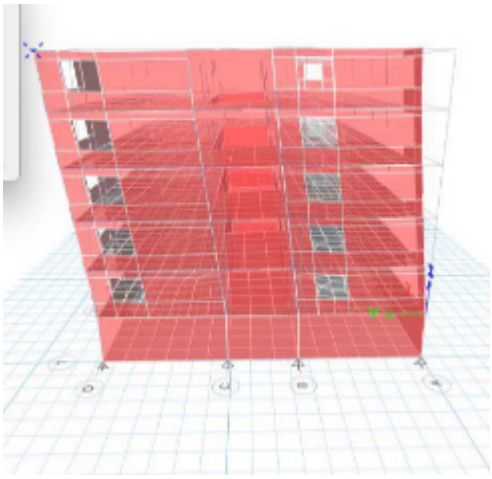

FIGURE. 9 - Building with infill walls and cracks

It is noticed that even in the displacements at the extreme points of the building, there is a small difference in the behaviour of the building with walls and without infill walls.

When walls are added, we have a decrease in displacement, and with the addition of cracks, we have a slight increase in displacement.

Discussions and Recommendations

Given that masonry is a vulnerable element, its behaviour needs to be carefully considered. Earthquakes pose the greatest threat to masonry and not just the masonry itself. Over the years, there have been numerous devastating earthquakes both in Albania and globally. Following the recent earthquakes in Albania, especially the one in November 2019, it was evident that a considerable number of buildings had issues arising from infill walls, which subsequently caused irreversible damage to the load-bearing structure in many cases.

There are several issues related to masonry that must be taken into consideration:

- Masonry cracking due to window or door openings
- Cracking of masonry near columns, leading to the short column effect
- Lack of infill walls in the lower floors, potentially causing soft-story effects, etc.
- It is advisable to consider infill walls for their significance and provide proper specifications and details for their placement and connection to the structure.

Conclusions

Several conclusions can be drawn from the case study and insights gathered from various researchers:

- The addition of infill walls increases the stiffness of the structure.
- Frame structures with infill walls on all floors can adequately withstand seismic forces due to the enhanced structural stiffness.
- Infill walls absorb more forces due to their stiffness and rigidity, subsequently transmitting them to the frame.
- If infill walls are considered in calculations, they should be well-connected to the frame to prevent stability loss.
- The absence of infill walls on the ground floor can lead to the "soft story" effect.
- Additionally, columns in the lower floors should be carefully considered as critical zones throughout the entire section due to the heightened vulnerability of the infill walls on the ground levels.

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Business benefits from the implementation of ERP systems especially in Navision

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Abstract

The business market nowadays is becoming increasingly dynamic day by day. From the smallest business up to the biggest one, each one needs to implement the system of automation. That's why ERP Systems are for. ERP stands for Enterprise Resource Planning and is a software user by organization to manage daily business activities such as: accounting, procurement, project management, risk management and compliance, and supply chain operations. Starting from the ancient ERP systems (MRP – Material Requirements Planning) and the latest version of Business Central, this technology is developing so quickly. Too much information is coming around and this study is focused on the relationship Customer – Vendor. A treatment on how we can deal with different use cases with debtor customers so we can go far away to aim what we want from our business. The purpose of the study is to analyze how Customer Experience processes can develop for being managed by automating certain processes in Dynamics Navision. What can we develop besides our analysis, to reduce the company's debt as much as possible? Throughout the study the literature review methodology is used by analytical research about the topic, analyzing the new tendencies, their impact on the business and summarizing academic research. Also, descriptive use cases in applied to analyze the use and impact of Debtor Customer Experience in daily economic activity in these companies. The study concludes that Customer Experience, although it is customer centric, is aligned directly with business' incomings and it is very important to improve debt management.

***Key words**: ERP System, Implementation, Business, Incoming, Customer, Debt, Dynamics Navision*

Introduction

ERP stands for Enterprise Resource Planning, translated into Albanian: Enterprise resource planning systems. ERP is software that serves different businesses in the automation and management of key processes with the main goal of optimal performance. Such software coordinates the flow of data between different business processes. Within this software, various business departments are connected, such as: finance, marketing, human resources, supplies, services, sales, etc. The ERP system, as mentioned above, is a type of software application designed and produced specifically for use by small, medium or large businesses. ERP systems support all aspects of financial management, human resources, supply chain management or production. The term ERP was first used in the 1990s by the Gartner Group, but enterprise resource planning systems have their roots deep in the manufacturing industry and can trace their history back to the 1960s. At this time, manufacturers needed a better way to manage, track, and control their inventory. Basic software solutions, known as MRPs or Material Requirements Planning systems were developed to meet their needs. These systems helped manufacturers monitor inventory, reconcile balances, as well as included very basic manufacturing, purchasing, and delivery functions. Through the 1970s more and more manufacturers started to adopt MRP systems, and the systems themselves got more sophisticated. By the 1980s MRP systems evolved into what became known as MRP II or Manufacturing Resource Planning systems. More manufacturing processes were added into the original MRP systems, and these MRP II systems had expanded capabilities and were better able to handle scheduling and production processes.

In the 1990s the first true ERP systems came into use. These systems further expanded beyond the basic inventory control and manufacturing processes of previous iterations to include other departments and functions, such as accounting, finance, and sales. These systems set the stage for ERP solutions as we've come to know them today, by integrating multiple processes and departments into one system.

Methodology

This study aims to give answers to the following research questions:

- What can we plan to develop to minimize the debt amount for the business?
- Why do we choose this way and how can we develop this?

The methodology that this study uses is literature review by semi-systematic review approach accompanied with a use-case on how will work our development.

Literature review

ERP Systems

As mentioned above, ERP systems are anything but basic and have little resemblance to the ERP of decades ago. They are now delivered via the cloud and use the latest technologies such as artificial intelligence (AI) and machine learning. Their aim is to provide intelligent automation, greater efficiency, and instant insight across the business. Modern cloud ERP software also connects internal operations with business partners and networks around the world, giving companies the collaboration, agility, and speed they need to be competitive today.

Pros and cons of ERP

Pro: Improves efficiency - Through an ERP system, businesses can simplify and facilitate many of their processes, reduce duplication of efforts for a certain task as well as to automate tasks or services/ certain needs.

Pro: Better decision making - Through an ERP system the business can get real-time information on each operation and what happens in it. This enables information at any time thus allowing the business to make decisions based on real data, react quickly to market changes as well as optimize its performance.

Pro: Increases collaboration - Given that ERP summarizes several departments company in a single software, this will gradually bring one better communication and cooperation through them for a certain purpose. This helps to eliminate individual work without cooperation, increases transparency at work and strongly promotes cooperation and teamwork.

Pro: Reduction of costs - By simplifying and automating processes, it is reduced the possibility of error during the work process as well as improved productivity I company. In this way a business can reduce many other costs by investing in an ERP system.

Cons: High costs - Implementing an ERP system is quite expensive. It requires a large investment with significant amounts upfront specifically in hardware, software, training, employees, and maintainers/developers.

Cons: Complex system - Today's ERP systems are complex and often sometimes difficult to implement and to understand the way they work. The job requires professionalism and a lot of very important configurations and fulfils every need and business requirement.

Cons: Integration challenge - Often the integration of the ERP system itself with existing systems business can be quite challenging. This can lead to inconsistencies in systems and errors in the processing of existing business data.

Cons: User's Adoption - Implementing an ERP system in a company normally requires and brings significant changes in business processes. Something like this can be difficult for employees to adapt to. If this situation lasts in time will lead to resistance and reduced productivity on the part of adaptation of the staff to the system.

Cost of ERP

According to a survey done by Mabert, Soni and Venkatamaran (Mabert, 2003) were given a snapshot of the experiences of small and large businesses among 497 respondents. From there

found that approximately 50% of businesses have annual revenues of less than $250 million per year and with less than 1000 workers included. Small businesses have up to 10 employees and up to 2 million in annual revenue. While the biggest business reaches up to 240,000 distributed employees and revenues of 100 billion dollars per year. The summary of the cost of implementing a typical ERP system was found as follows:

- Cost for Software (purchase of packages): 30% of total cost
- Hardware cost (servers, network, connections): 18% of the total cost
- Consulting (during implementation): 25% of the total cost
- Training (for project participants and users): 10% of the total cost
- Implementation team (full time/part time): 14% of total cost
- Others: 3.3%

Considering the millions of dollars needed to implement an ERP (of $150,000 to $750,000 for an average business) two components have figures relatively significant and account for most of the investment. Consultancy accounted for 25% of the total cost and the cost for the implementation team. Then as it is known and noticed, the highest costs are occupied by software and hardware, and then approximately 50% of other costs used for labor.

ERP Market

ERP is a market that has taken off a lot these days and in 2022 it is valued at $54.76 billion and expected to expand at an annual rate of consisting of 11.0% from 2023 to 2030. Some of the key factors listed which promote the growth of this market are the continuous increases in requests for decisions driven by data and information, transparency in various processes in business, need for operational growth, etc. However, some are also co-listed factors that can almost restrain the growth of the market starting from the high costs of investment and maintenance as well as the increasing availability of open-source applications source.

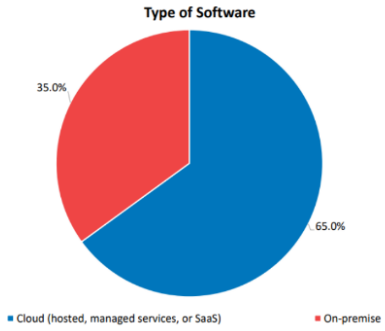

FIGURE 1: Type of software

Source: The 2022 ERP Report from Panorama Consulting Group(page.13), 2022

The list of major ERP vendors is as follows:

- Microsoft
- SAP
- Oracle ERP
- Sage
- Epicor
- Info

What is Navision?

Dynamics NAV is an enterprise resource planning application that assists business in different departments such as finance, production, relationship management with customers, analytics, and marketing of large and medium-sized companies as well as branches local of international organizations. This application uses language as programming language C/AL and is part of Microsoft Dynamics along with its smart applications business.

Designing Application Objects

Tables: Tables are used to store data. For example, a business application may contain a customer table that stores information about each customer, such as, name, address, telephone number, and contact person.

Reports: Reports are used to present data. We use filters and sorting to select the data that we want to present in a report.

XMLports: XMLports are used to import and export data in .xml, .txt, or .csv format.

Codeunits: A codeunit contains user-defined functions that are written in C/AL code. We can use the functions in a codeunit from the other objects in your application.

MenuSuites: A MenuSuite object contains the set of menus that are displayed in the navigation pane.

Pages: Pages display data from the database and allow users to enter new data into the database.

Queries: A query specifies a set of data from the database.

Case Study

Analysis

ERP systems provide several automated functions depending on the customer's requirement. What I have covered below is the automation of a process, which is intended to warn the company about debtor customers. Often it can happen that a company's large debts turn out to be fatal for them, so it is necessary to keep such situations under control. With the request of the finance department attached below, the development department should automate the checking of the value of the debt and the value of the customer's invoice at the moment that these

values equal each other. Knowing this fact, the business will pull back demanding payment of the loan from the customer and not adding the value of the debt to the company. The purpose of this automation is to help the finance department by keeping under control debtor customers.

Date: __/__/____

REQUEST FOR DEV/IT DEPARTMENT

Based on work practice, the business analysis manager sends this request to DEV/IT department:

- For debtor customers with an amount greater than the value of the current invoice, you are not giving the opportunity to make further sales/purchases until the settlement of obligation.
- For this, we want you to develop an option, an action/field within the interface users to make it possible to warn the company and block the customer invoice.
- This development is required to minimize the amount of debt in the company, automatically reducing the possibility of bankruptcy risk.

Business Analyst's Signature

Development

First, to have a working environment we need to download the Microsoft application Dynamics NAV by following the steps below. We make sure that the system is updated and that we have enough memory for it to download the application along with its components. We make sure to check all the Hardware and Software Requirements on the website Dynamics NAV. We go to the main page of Microsoft Dynamics NAV and to the download option and select W1 (Worldwide one version that is universal) to download (Figure 2).

Download UK-United Kingdom	Available in NAV 2018
Download US-United States	Available in NAV 2018
Download NA-North America	Available in NAV 2018
Download RU-Russia	Available in NAV 2018
Download W1	Available in NAV 2018

FIGURE 2: The first step to download Microsoft application dynamics NAV

Then we will see that a folder will be downloaded which we must extract (figure 3&4).

FIGURE 3: The downloaded folder

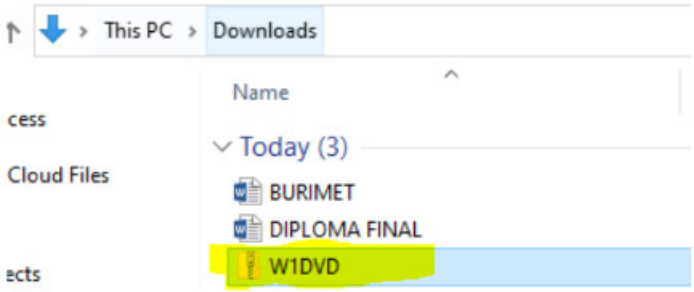

FIGURE 4: The folder to be extracted.

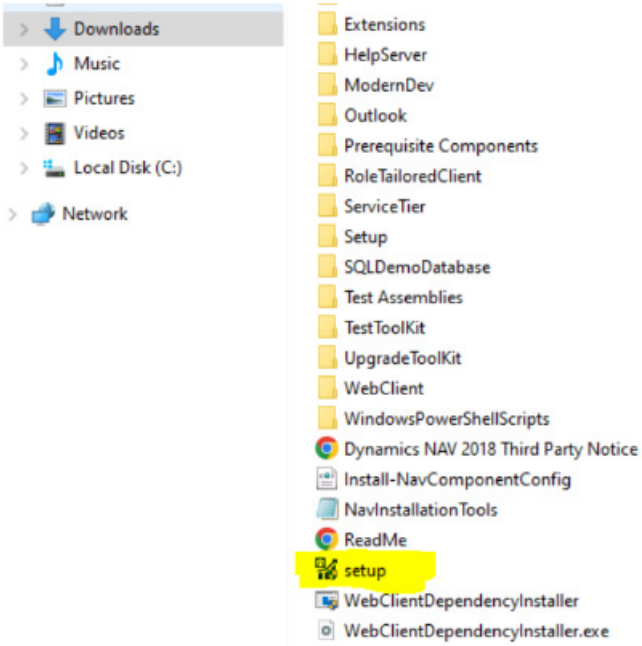

FIGURE 5: "Set up" option to download the program.

Choose an installation option → Custom and then choose all the options we need for the program as in the picture (figure 6&7).

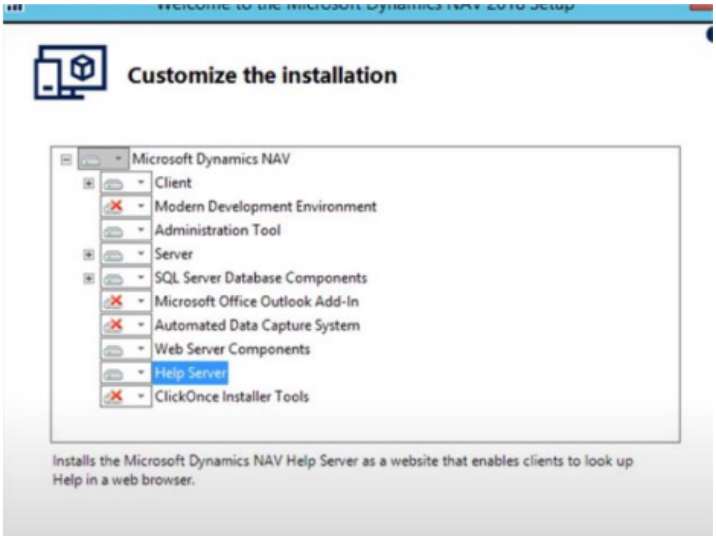

FIGURE 6: The customization of the installation

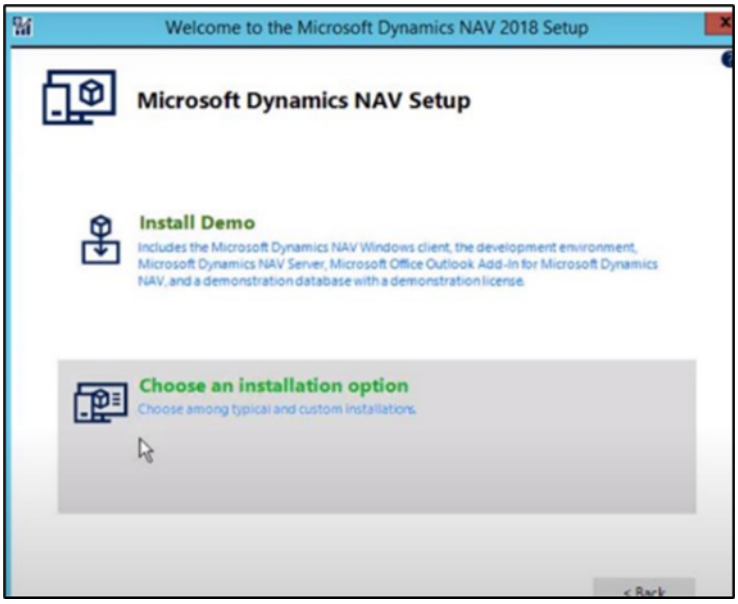

FIGURE 7: The choice of the installation option

After the full installation is completed on our computer, we have the NAV application that offers user services and the development environment where we can make changes regarding our client's requests. To implement the required changes, open the development environment (Figure 8).

FIGURE 8: The development environment

In File →Database →Open option we can open the downloaded database together with the application. In this way everything will be saved in the database (Figure 9&10).

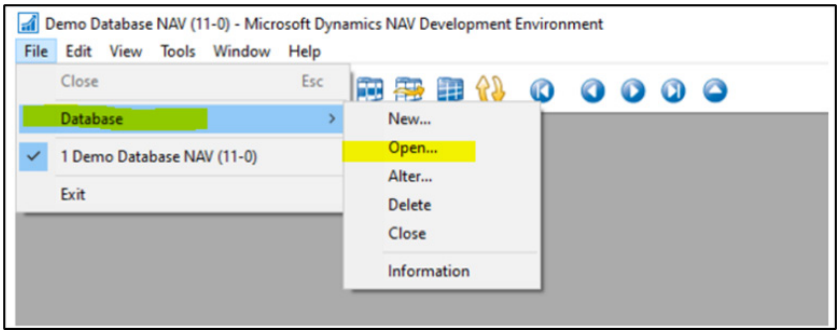

FIGURE 9: The opening of the downloaded database

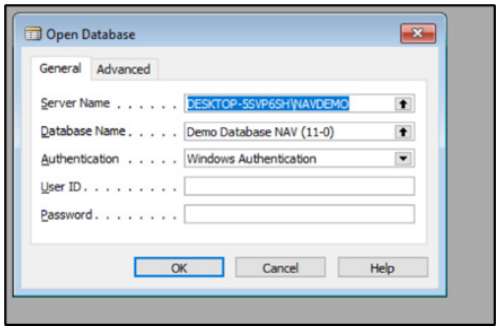

FIGURE 10:THE storage of the downloaded database and the aplication

Then in Tools → Object designer will open the development environment for the database that we have chosen to work with and will show us all the objects such as pay tables, reports, etc.

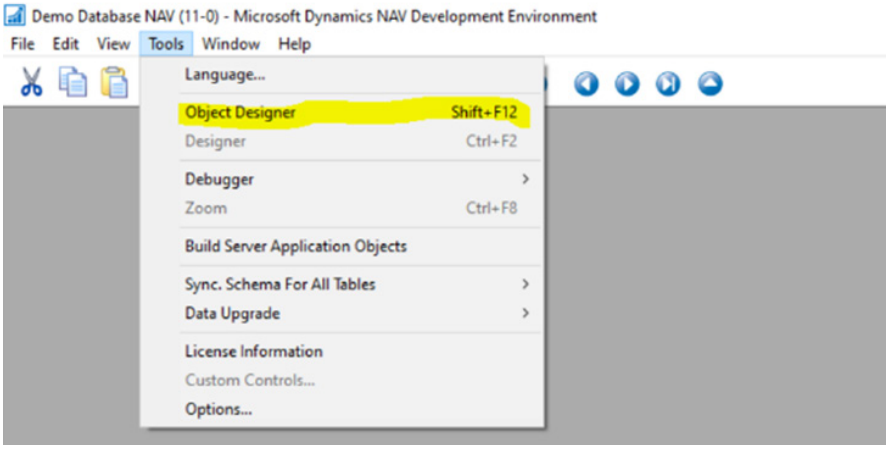

FIGURE 11: The opening of the development environment for the database

We go to the Customer table (Figure 12) and add a new field called "Credit Limit - UET DPL" which will present the amount of credit (debt that a certain customer has against the company) of type decimal because it will store a numeric value.

FIGURE 12: The customer table option

We have added other functionalities such as: editability, this field can be edited, is set the connection to the sales line table that will be seen later and some other options (Figure 13). The field will appear on the client's page together with other data referring to that client (Figure 14).

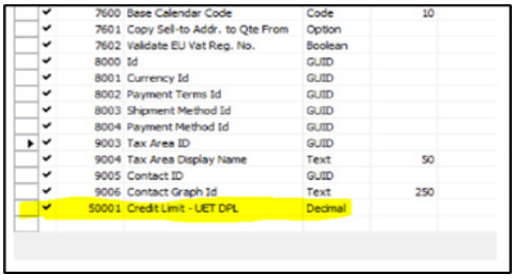

FIGURE 13: The functionalities that can be edited.

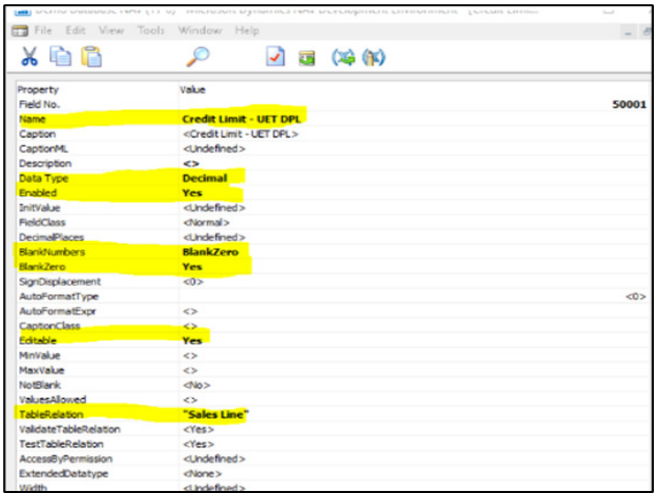

FIGURE 14: The appearance of data referring to the client.

To display this field to the user in his interface found on the "Customer Card" page, we add it to the General data (figure 15/16).

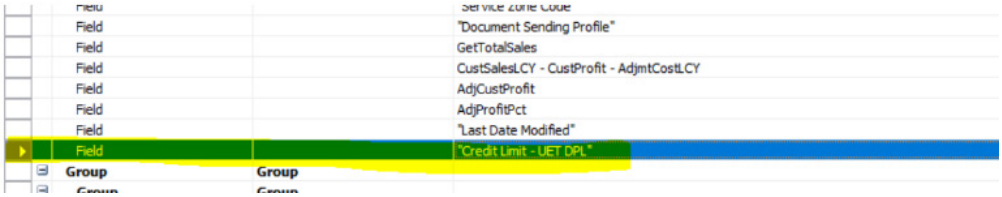

FIGURE 15: The added field to user interface

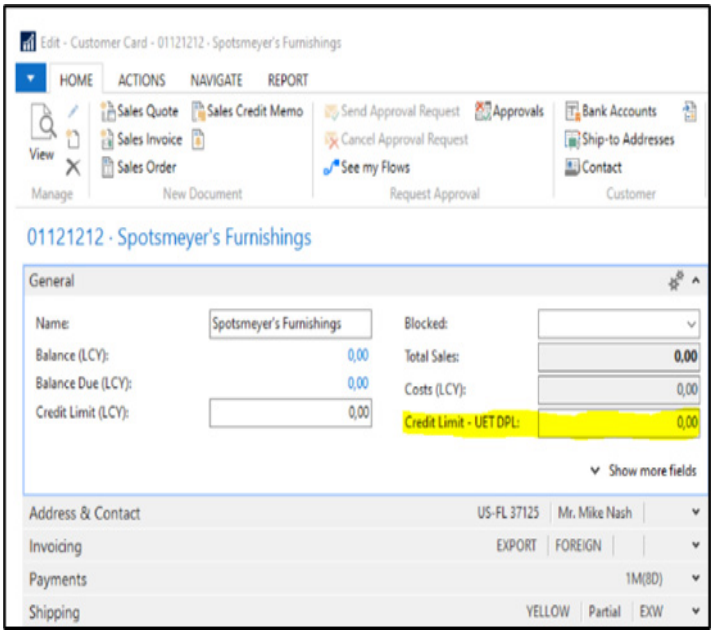

FIGURE 16: Customer Card page

We need all this from the moment a customer receives a sales invoice, we need to know if this customer has reached his limit or not. For this we need a trigger in the invoices part, so we need to work with the sales table named "Sales Line" where the needed data is given for this customer. For this we will need to add a code at the moment of validation of the quantity of products because at this moment the total amount of the bill changes automatically. This is the moment when the invoice total changes and the moment where the credit check will be done until the limit amount, so we can decide whether a purchase will be made to this customer or not.

The code will be added to the end of the standard NAV code.

For the code you need:

- To capture the customer by creating a new local variable that captures the table customer.
- Use "Sell-to-customer No" to identify specific clients.

So, at this moment we will have an invoice completion and a customer reaches the amount of his credit equal to the invoice, this invoice cannot proceed until the debt is paid off.

Example

1. We created the profile of a customer "European University of Tirana" (Figure 17) with all the data such as in the photo. The value of the credit amount he has is 1000.00 ALL. The deadline we have left for payments is 21 days.

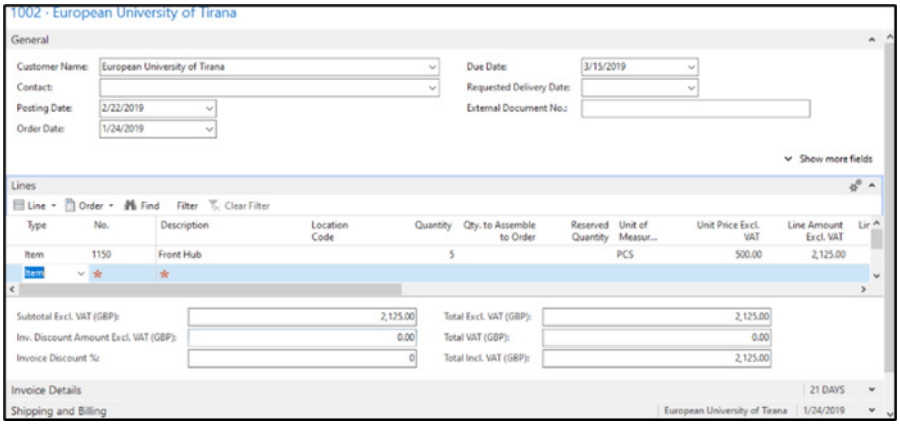

FIGURE 17: The profile of customer "European University of Tirana"

2. We created an invoice for our client (Figure 18).

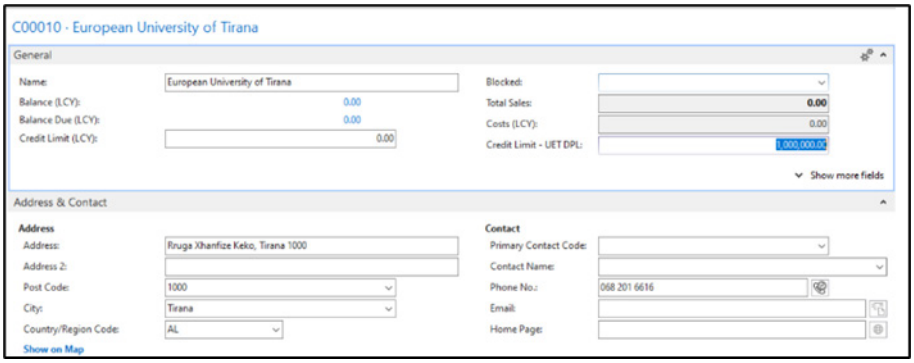

FIGURE 18: The invoice for the client European University of Tirana

Here we can avoid that when the total bill is less than the system credit value it works without issue. But, in the opposite case we will get the following error (Figure 19).

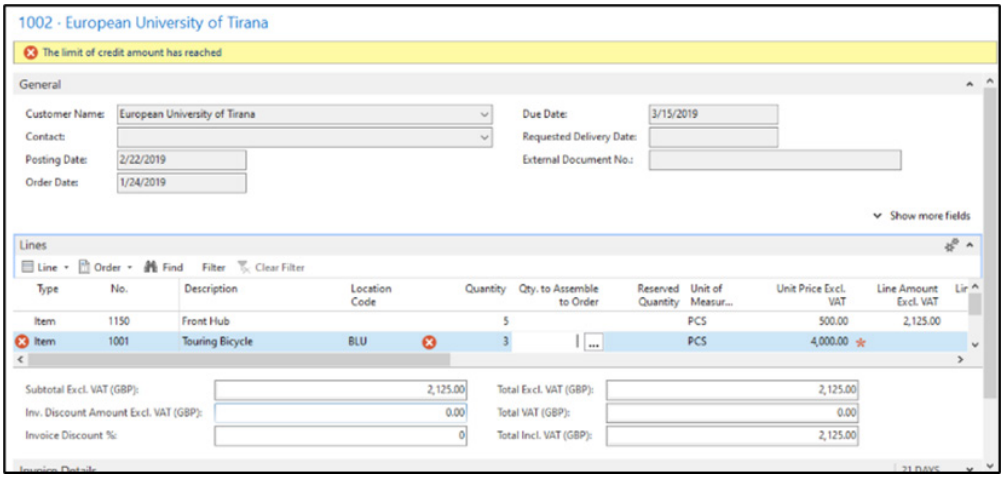

FIGURE 19: The error view when the total bill is greater than the system credit value.

Conclusions

This work itself is an attempt to provide a clear example of how automation works in ERP systems and how it directly impacts in developing the economic activity of a business. The main purpose of this work is to unfold a use-case of how a certain department through business analysis makes the request for change and then the development department and technology will be the one who has the

responsibility to finalize the request. ERP systems will continue to develop and easily adapt to customer requirements. With a user-friendly space for development and combining it directly with the client's environment, the work is simplified much more than going through stages of tests and presentations with clients. The dynamism of this application should be able to be tested and tried by everyone so that cost and obstacles won't matter despite small implementation's issue, and they should not be considerate as a reason for the elimination of automation in a business life. Automation has always been and always will be important in business life and is rapidly expanding its circle.

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Demographic dynamics and characteristics of urbanization in Albania in the third decade of transition: the determining steps in shaping the demographic-territorial model of transition

Dr. Urb. Gentian KAPRATA

Abstract

The third phase of urbanization of Albania in transition was shaped by: (i) external migration; (ii) decline in natural population growth; and (iii) internal migration. In the period 2014-2022, 178,094 more inhabitants left Albania than returned. This number has increased a lot in the last two years, which also shows the future trend of the phenomenon. Another contributor to this basic national phenomenon remains the level of natural population growth. During the years 2014-2022, Albania: (i) grew by 42,054 new inhabitants, as a result of natural growth (birth-death difference); and, this growth has generally come in a downward trend, where it is worth differentiating the year 2021 where the natural growth is negative. The phenomenon of population aging accompanied this transition decade. Internal migration led to large-scale urbanization of some areas and drastic depopulation of others. The internal migration scheme contributed to the further deepening of the demographic difference between the three main regions of the country: Greater Region Tirana-Durres; The Middle Region Fier-Vlora and the Abandoned Region that includes the other eight districts of the country. Internal migratory movements are also clearly visible at the

inter-county level. For the period 2014-2016, the districts of Tirana, Fier, Durrës and Vlora experienced growth and hold the main weight of the total population, which is expressed by about 58%. Internal demographic movements continued to contribute to the deepening of demographic differences between the three regions of the country, even in the 2017-2019 period. Large districts will continue to remain so and grow further, while small districts will continue to shrink. Even in the following three years, 2020-2022, internal demographic movements continued to contribute to the deepening of demographic differences between the three regions of the country. These demographic dynamics established the demographic-territorial model of the country and the dominance of the District of Tirana over the other 11 districts of the country.

***Keywords**: demography, external migration, internal migration, natural population growth, population aging, level of urbanization, demographic-territorial model, population concentration, population abandonment*

Presentation

This paper aims to present and analyze the demographic dynamics, the level of urbanization and the demographic-territorial model of Albania in the third decade of transition. It tries to put together all the information collected by other researchers regarding demography, external and internal migration, population distribution and inhabited centers throughout the National territory. The paper aims to analyze these data, to understand and present the level of urbanization of the country and the characteristics of the urban-spatial structure, in the period studied.

In the absence of a general census of the population and housing, for this decade we have referred to INSTAT studies published in the annual periodical report *'Population of Albania*'. Unlike the first two periods of urbanization, when the population level refers to empirical measurements on the ground through the General Population and Housing Censuses, this figure should be taken with suspicion because INSTAT does not measure it empirically but calculates this indicator (INSTAT, 2020: 8).

This fact has affected two dimensions: (i) the paper has limitations in the accuracy of its analysis and findings, because the INSTAT data are not measured empirically; and, (ii) the structure of the paper is adapted to the way the data that INSTAT presents in the periodic annual reports are collected and produced.

The paper starts with an overview of the population level in the country (2022). What stands out is that the third phase of transitioning Albania's urbanization was shaped by the same demographic dynamics as the first two decades of transition. They expressed the same forms, including: (i) external migration; (ii) the decline in

natural population growth; and (iii) internal migration (Vulnetari, 2012; INSTAT, 2014-2022; RM, 2015, 2018).

It is followed by an overview of external migration (2011-2021), which is one of the two formative components of the level of demography in the country (INSTAT, 2014, 2015-2023; RM, 2017). In total, it can be said that in the period 2014-2023, 178,094 more residents left Albania than returned. What stands out, too, is that this number has increased greatly in the last two years, which also indicates the future trend of the phenomenon.

Another contributor to this basic national phenomenon remains the level of natural population growth (INSTAT, 2004, 2014, 2015-2022; RM, 2015-2022), therefore the paper continues with an overview of it (2011-2021). In general, natural growth is expressed in the difference between births and deaths. Its main factor is the Fertility Index, which in 2018 set a historical record in the average number of children born to a woman. The fertility index was only 1.37 children per woman from 1.48 children in 2017 and from 1.73 children per woman which was this index in 2014 (RM, 2020).

What stands out from demographic figures is the fact that during the years 2014-2022, Albania: (i) grew by 42,054 new inhabitants, as a result of natural growth (birth-death difference); and, this growth has generally come in a downward trend, where it is worth differentiating the year 2021 where the natural growth is negative. Another very negative demographic phenomenon that accompanied this decade was the aging of the population (INSTAT, 2015-2021; RM, 2016-2022).

These figures and demographic analysis show that in this decade the population has suffered a significant decrease as a result of external migration, but also due to the level of natural population growth.

Further in this paper we will present and analyze the distribution of this demographic level in the national territory, in order to understand the level of urbanization and its characteristics as a shaper of the demographic-territorial model of the country. We will do this by presenting and analyzing the internal movements of the population (internal migration), as the only shaper of these urban indicators, starting from a quick look at the internal migration in the post-Census moment (2010-2011) and the perspective of following general.

Internal migratory movements in the time period 2011-2021 (INSTAT, 2014, 2016-2020; RM, 2015-2022) follow the trends of two previous periods, 1991-2001 and 2001-2011 (IHS Alumni, et al., 1998; Misja and Misja, 2004; Faja, 2008; Aliaj, 2008; Imami et al, 2008). Internal migration brought a large-scale urbanization of some areas and a drastic depopulation of some others (INSTAT, 2014: 12).

The internal migration scheme relies on the four main lines of population displacement (INSTAT, 2014: 53; Vullnetari 2007, 2012), which contributed to the further deepening of the demographic difference between the three main regions of the country: Greater Region Tirana-Durres; The Middle Region Fier-Vlora

and the Abandoned Region that includes the other eight regions of the country (INSTAT, 2014, 2015-2022). Internal migratory movements and their results in relation to the level of population and urbanization are clearly visible even at the inter-county level (INSTAT, 2014).

The paper then continues with a detailed look at internal migration and the demographic-territorial model for the years 2014-2016. For this period it can be said that, excluding Elbasan, which remains large for historical reasons (Kaprata, 2022; Kaprata and Lubonja, 2022), the districts of Tirana, Fier, Durres and Vlora, experienced growth and hold the main weight of the population in general, which is expressed by about 58% of the national population. This means that the two 'concentrated' regions of the territorial model of the concentration-abandonment of the territory by the population have densified, while the districts of the Abandoned Region have lost population (INSTAT, 2015-2017, RM, 2015-2017).

A detailed view of internal migration and the demographic-territorial model for the period 2017-2019, I will outline in the paper. Internal demographic movements continued to contribute to the deepening of demographic differences between the three regions of the country, even in the following three years. Large districts will continue to remain so and grow further, while small districts will continue to shrink further.

The panorama of the weight ratio between the two 'concentrating' regions of the territorial model is further clarified, with a clear dominance of the Tirana-Durres Region with an increase about 40 times higher than that of the Fier-Vlora Region (INSTAT, 2018).

The paper continues with a detailed look at internal migration and the demographic-territorial model for the period 2020-2022. Even in the following three years, internal demographic movements continued to contribute to the deepening of demographic differences between the three regions of the country.

This demographic dynamic will further differentiate the population level ratios between the constitutive districts of the same region, especially between the districts of the two regions that are experiencing population concentration. This difference establishes the demographic-territorial model of the country and the dominance of the District of Tirana over the other 11 districts of the country.

The paper closes with some modest findings and conclusions.

The purpose and methodology of the work

The first aim of this paper is to collect data regarding the population level (demography), internal demographic movements during the period 2011-2022, and the level of urbanization (the third decade of transition). In this sense, the

study aims to contribute first to the expansion of knowledge on these demographic and urban/territorial aspects, which is also its first contribution.

The purpose of the paper is to analyze these data to understand the development of the country, throughout the period under study, in the aspects of: (i) external migratory movements; (ii) natural population growth, and other demographic characteristics; (iii) internal migratory movements; (iv) of the urban-spatial structure of the country and its characteristics; (v) the demographic-territorial model of the country. The conclusions of this analysis, within the scope of this paper, will contribute to a wider understanding of the urban phenomena of the period under study and the contextual reasons of the subsequent urban-territorial development.

The methodology of this work is based on the analytical one, which is foreseen as the most suitable in this work, as it explains in a systematic and detailed way the phenomenon taken in the study, throughout the time that the study includes.

The methods used in this paper are qualitative. This paper theoretically evaluates demography, the level of urbanization, the urban-spatial structure, the characteristics of the urban-spatial structure of the country, and the characteristics of the Albanian city in the period studied. This is done using secondary sources of authors who spoke on these topics and Albanian institutions that have produced empirical measurements and theoretical analyzes on demographic and migration issues.

Overview of the population level in the country (2022)

The third phase of urbanization of Albania in transition was shaped by the same demographic dynamics as the first two decades of transition. They expressed the same forms, including: (i) external migration; (ii) internal migration; and (iii) the decline in natural population growth (Vulnetari, 2012; INSTAT, 2014-2022; RM, 2015, 2018).

External migration was one of the main reasons for the decrease in the number of the population. In the same direction, the decrease in the level of natural population growth, which is measured by the difference between the number of births and the number of deaths, contributed (INSTAT, 2014-2022; RM, 2015, 2016, 2017, 2019, 2021, 2022).

The population of Albania, according to the report *'Population of Albania'*, on January 1, 2022 is 2,793,592 inhabitants, suffering a decrease of 1.3%, compared to January 1, 2021 (INSTAT, 2022: 1). While in 2011, the population of Albania was 2,831,741 inhabitants (INSTAT, 2014: 15), the measurements of 2022 show that the population has decreased by 38,149 inhabitants in these years.

Unlike the first two periods of urbanization, when the population level refers to empirical measurements on the ground through the *'General Population and Housing Censuses'*, this figure should be taken with suspicion because INSTAT does not measure empirically but calculates this indicator. For its calculation, INSTAT is based "on the generation component method", which according to it is a standard demographic method that "uses a variety of data sources for the basic components of population change" (INSTAT, 2020: 8).

If we refer to INSTAT, these sources also include data predicted by the authors of the study themselves, such as the "coefficients of population projections 2011-2031". This means that INSTAT, using the 2011 census data, has made its own predictions of how the population dynamics will be presented in the next 20 years (INSTAT, 2014), and then uses these predictions to calculate the number of the population of the corresponding year (INSTAT, 2020).

The problem of the inaccuracy of INSTAT data has been presented by many authors, such as Vullnetari, Fuga, the World Bank, but also the author of this paper (Vullnetari, 2007, 2012; Fuga 2012, 2019; BB, 2007; Kaprata, 2021). However, INSTAT itself acknowledges the problem when it underlines that "Given that resident Albanians are not systematically registered when they leave the country and, since there are few incentives for them to register their departure with the local authorities, there is no reliable measurement of the number of individuals who have left Albania." (INSTAT, 2014: 31).

The inaccuracies of INSTAT data are more apparent when it comes to matters more complicated than demographics. While presenting an analysis regarding employment, in the 2014 'Economic Characteristics' Report, INSTAT would admit that "The main conclusion from this analysis is that there are large differences between employment data from the population census and those from the census of agriculture and labor force survey of 2011 (third quarter)" (INSTAT, 2014: 47).

However, according to INSTAT, the population of the country compared to a year ago: (i) on January 1, 2015, it reached 2,893,005 inhabitants, suffering a decrease of 2,942 inhabitants (INSTAT, 2015: 1); on January 1, 2016, it was 2,886,026 inhabitants, suffering a decrease of 6,276 inhabitants (INSTAT, 2016: 1); on January 1, 2017, 2,876,591 inhabitants are estimated, suffering a decrease of 9,435 inhabitants (INSTAT, 2017: 1).

The population of Albania continued to decline progressively in the following years. Expressed as a percentage compared to the previous year, it resulted: on January 1, 2018, 2,870,324 inhabitants, suffering a decrease of 0.2% (INSTAT, 2018: 1); on January 1, 2019, 2,862,427 inhabitants, suffering a decrease of 0.3% (INSTAT, 2019: 1); on January 1, 2020, 2,845,955 inhabitants suffering a decrease of 0.6% (INSTAT, 2020: 1); on January 1, 2021, 2,829,741 inhabitants, suffering a decrease of 0.6% (INSTAT, 2021: 1); on January 1, 2022, 2,793,592 inhabitants, suffering

a decrease of 1.3% (INSTAT, 2022: 1); on January 1, 2023, 2,761,785 inhabitants, suffering a decrease of 1.1% (INSTAT, 2023: 1).

As can be clearly seen from these figures, beyond the real impossibility of INSTAT to collect accurate empirical data on the number of residents in the country, referring to its annual calculations, we can say that Albania has not only lost population in the third decade of transition (2011-2022), but this loss has been annual and in an increasing progression from year to year.

According to the Monitor Magazine, referring to the new projections of the Department of Population at the United Nations Organization, the century in which we live will end with fatal results for the country's population. Taking into consideration the progress of the population only in gross birth rates (fertility rate) according to all scenarios, Albania will have a decrease in its population. But "Even according to national data (INSTAT), the country's population is shrinking faster than the population projections 2011 - 2031. On January 1, 2018, the population was 18 thousand people less than the official INSTAT projection (RM, 2019).

Overview of external migration (2011-2021)

One of the two components forming the level of demography in the country is net external migration, which is expressed in the difference between: (i) emigration (outbound migration); and, (ii) immigration (incoming external migration) (INSTAT, 2004, 2013, 2014, 2015-2022; RM, 2015, 2016, 2017).

The population of Albania has been decreasing since 2001, and if we refer to the Monitor Magazine "In this decrease in the population, net migration has a significant impact and less natural increase of the population. While the first component continues to remain negative, the second, although positive, has declined during the period in question" (RM, 2017).

In 2014, it was estimated that 46,413 people left the country, while in the same year the number of immigrants in Albania was estimated to be 28,367 people. Referring to these INSTAT figures, it can be said that "the net external migration during 2014 was in the amount of 18,046 individuals" (INSTAT, 2015: 1). For this reason, "Since 2014, the trend of emigration abroad has deepened" (RM, 2015). This figure does not match the decrease of the country's resident population, of 2,942 people, for the reason that the natural increase of the population of 15,104 people has a positive effect here (INSTAT, 2015: 1).

During 2014, net migration in Albania compared to 2013 decreased by 245 people (INSTAT, 2015: 1). Although the indicator is down from a year ago, if we refer to the Monitor Magazine we can say that "With this progress, Albania ranks second in Europe after Moldova for the high level of immigration. Both countries are ranked first for the level of addiction in Europe" (RM, 2015).

Similarly, in 2015, it was estimated that 42,922 people left the country, while the number of immigrants (returnees) in Albania was estimated to be 25,846 people (INSTAT, 2016: 1). If we compare it with a year ago, we can say that "During 2015, net migration in Albania, compared to 2014, decreased by about 1000 people" (RM, 2016).

While, during 2015-2016, net migration (the difference between immigrants and emigrants), suffered a contraction as a result of the decrease in the number of immigrants from about 41 thousand to about 33 thousand and the increase in the number of immigrants from about 21 thousand to about 23 thousand (INSTAT, 2017: 3). However, Monitor Magazine thinks that this data is not real, according to it "Albania's population recorded a minimal increase of 0.03 percent during 2016, for the first time since 2001, ..., but this increase came as a result of changing the methodology with which INSTAT measures migratory flows in the country" (RM, 2017).

The country's population shrank faster than expected, as a result of the drop in birth rate, but also the return of the emigration cycle. At the beginning of 2017, there were 8 thousand people less than the population projections of the medium variant that INSTAT issued for the period 2011-2031 (RM, 2017). Net migration in 2017 was 14,902 inhabitants, and results as the difference between the number of immigrants (outgoing) of 39,905 people and the number of immigrants (incoming) of 25,003 people (INSTAT, 2018: 1, 3).

This figure of net external migration, a year later will mark a decrease of 0.9%, because it will be only 15,030 inhabitants (INSTAT, 2019: 1). In this year, the number of immigrants (outgoing) was 38,703 people, suffering a decrease of 3.0%, compared to the previous year, while the number of immigrants (incoming) was 23,673 people, suffering a decrease of 5.3 %, compared to a year ago (INSTAT, 2019: 3).

In 2019, the number of immigrants (outgoing) was 43,835 people, experiencing an increase of 13.3%, compared to 2018; whereas the number of immigrants (incoming) would be 20,753 people, suffering a decrease of 12.3%, compared to 2018, which would bring a net migration to the indicator of 23,082 inhabitants (INSTAT, 2020: 3). Referred to Monitor Magazine "Albania is experiencing a new increase in the phenomenon of immigration. Asylum applications alone, in the last five years, have reached about 200 thousand, according to official data from Eurostat, while there are many others who run away with work contracts, or who simply leave and never return" (RM, 2020) .

Even in 2020, Albanians showed the highest percentage of the desire to live and work abroad, compared to other countries in the Region, according to the Survey of the Regional Cooperation Council (RCC) in the Balkan Barometer 2021 (RM, 2021). This is also distinguished from the indicators published by INSTAT.

In 2020, the number of immigrants (outgoing) was 23,854 people, in 2020; while the number of immigrants (incoming) was 7,170 people. Net migration, the difference between immigrants and emigrants, suffered a contraction, compared to the previous year: from 23,082 residents lost in 2019; in 16,684 lost inhabitants in 2020. (INSTAT, 2021: 1, 3).

During 2021, a significant increase in emigration was observed, while the number of returnees remains low (RM, 2022). The number of immigrants in 2021 was 9,195 people and the number of immigrants was 42,048 people. Net migration experienced an increase in absolute value, compared to the previous year: from 16,684 people lost in 2020; in 32,853 lost inhabitants in 2021 (INSTAT, 2022: 1).

These figures and demographic analysis from INSTAT and Monitor Magazine show that in this decade the population has suffered a significant decline, especially as a result of external migration. Another contributor to this basic national phenomenon remains the level of natural population growth (INSTAT, 2004, 2011, 2013, 2014, 2015-2022; RM, 2015-2022), which we will address below.

Overview of the level of natural growth (2011-2021)

Monitor magazine in the article *'INSTAT: 2012-2017 Albania decreased by 26 thousand inhabitants'*, underlines that "Changes in the population [demographic decline] come as a result of two components: the natural addition of the population and net migration" (RM, 2017). The natural increase of the population is expressed in the difference between births and deaths, and has been declining year after year.

Referring to the article *'The UN revises the projections of the Albanian population with a 30-40% decrease; In the pessimistic scenario, we remain only 512 thousand people in the year 2100'*, from the Monitor Magazine "The latest INSTAT data showed that women living in Albania year after year are giving up motherhood, drastically reducing the number of babies born in life" (RM, 2020). According to her, "In 2018, this phenomenon was emphasized even more when the average number of children born to a woman set a historical record. The fertility index was only 1.37 children per woman from 1.48 children in 2017 and from 1.73 children per woman which was this index in 2014" (RM, 2020).

INSTAT statistics show us that during 2014 only 10 more births and 214 deaths were registered than in 2013. Albania has increased with 35,760 new inhabitants during this year (INSTAT, 2015: 1). This demographic indicator will decline in the coming years. According to Monitor Magazine "The number of children will continue to decline by a quarter and the number of elderly will increase by four fifths by 2031. This will lead to an advanced aging of the population, with more dependence on elderly compared to children" (RM, 2015).

The forecast of the Monitor Magazine will be confirmed every year by the statistics brought by INSTAT in its annual publication "Population in Albania", starting from 2015, in which the number of births in Albania was 33,221, and 22,422 deaths occurred, resulted in a natural increase in 10,799 people (INSTAT, 2016: 1).

During 2016, about 32 thousand babies were born, while about 21 thousand people died. The natural addition of the population was positive with about 11 thousand people. Referred to INSTAT "For the first time since 2001, the natural increase exceeded the net migration, resulting in a slight increase in the number of the resident population on January 1, 2017" (INSTAT, 2017: 1). But, if we refer to the Monitor Magazine, in a comparison between these actual figures and INSTAT forecasts for the period 2011-2031, we can say that "The country's population is shrinking at a faster rate than the forecasts" and "The number of births was 8% below expectations" (RM, 2017).

A decrease of 16.5% compared to the previous year would occur during 2017, the natural increase of the population (birth-death), which was 8,637 inhabitants (INSTAT, 2018: 1). During this year, 30,869 babies were born, while the number of deaths was 22,232 people (INSTAT, 2018: 2). Similarly, if we refer to the article "The scary forecast of the UN: The Albanian population risks reaching 860 thousand inhabitants by the year 2100", from the Monitor Magazine, we can underline that "Albania is one of the few countries in Europe that will experience a sad population transition" (RM, 2018).

Even during 2018, the natural increase of the population will suffer a further decrease, of 17.4%, compared to the previous year (INSTAT, 2019: 1). During this year, 28,934 babies were born, suffering a decrease of 6.3%, while the number of deaths was 21,804 people, suffering a decrease of 1.9% (INSTAT, 2019: 2).

The natural increase in 2019 was only 6624 people, a year ago, the natural increase was 7130 people, while in 1990 it was 64 thousand people per year, or almost 12 times higher than in 2019 (RM, 2020). In percentage, this comparative statistic is provided by INSTAT, according to which this annual decrease is 7.1% compared to the previous year (INSTAT, 2020: 1). According to INSTAT, during 2019, 28,561 babies were born, and 21,937 people died (INSTAT, 2020: 2).

During 2020, the natural increase of the population was 470 inhabitants, suffering a decrease of 92.9%, compared to the previous year (INSTAT, 2021: 1). This addition is expressed in the difference between 28,075 babies born and 27,605 lives lost (INSTAT, 2021: 3). Even the Monitor Magazine would notice that "... fertility rates (expressing the number of children a woman can have during her lifetime) are falling rapidly year after year, signaling irreversible population decline. The fertility rate has dropped to about 1.3 births per woman (below the replacement rate)" (RM, 2022) dropping significantly from 6 in the 1960s (King

and Vullnetari, 2003; Vullnetari 2007, 2012; Hoxha, 2017) and over 2 in the early 90s (WB, 2007; INSTAT, 2004, 2014).

During 2021, 27,284 babies were born, suffering a decrease of 2.8%, compared to the previous year. The number of deaths in 2021 was 30,580 people, having an increase of 10.8%, compared to the previous year (INSTAT, 2022: 3). The same phenomenon is also distinguished by the Monitor Magazine, according to which "During 2021, the natural increase of the population (birth-death) was -3,296 inhabitants, marking for the first time a negative natural increase" (RM, 2022).

Another very negative demographic phenomenon that accompanied this decade was the aging of the population (INSTAT, 2015-2021; RM, 2016-2022). The median age indicator increased from 34 years in 2015: to 35 years in 2016 (INSTAT, 2017: 2); to 35.0 years old in 2017 (INSTAT, 2018: 2); at 35.4 years old in 2018 (INSTAT, 2019: 2); to 36.7 in 2019 (INSTAT, 2020); to 37.2 years old in 2020 (INSTAT, 2020: 2); to 37.6 years in 2021 (INSTAT, 2021: 2); to 38.2 years in 2022 (INSTAT, 2022: 2); and to 38.8 years in 2023 (INSTAT, 2023: 2).

These figures and demographic analysis from INSTAT and Monitor Magazine show that in this decade the population has suffered a significant decrease as a result of external migration, but also due to the level of natural population growth. The statistics of INSTAT and the analyzes of Reviste Monitor talk about a progressive aging of the population which affects many sectors of the social, political and economic development of the country, but especially in the natural growth of the population (INSTAT, 2004, 2014, 2015-2022; RM , 2015-2022).

Both indicators: (i) net external migration; and, (ii) the reduction of natural population growth will determine the level of population (demographic) of the country. Further in this paper we will present and analyze the distribution of this demographic level in the national territory, in order to understand the level of urbanization of the country and its characteristics as a shaper of the demographic-territorial model of the country. We will achieve this by presenting and analyzing the internal movements of the population (internal migration), as the only shaper of these urban indicators.

Quick view of internal migration in the post-Census moment (2010-2011) and the general perspective going forward

External migration together with natural population growth shape the resident population of the country, which, observed in the way it is distributed across the national territory, produces the level of urbanization and the demographic-territorial model of the country. This is the first reason why we presented and analyzed: (i) external migration; and, (ii) natural population growth. But also

because "As in other countries in transition, in Albania both phenomena [internal and international migration] are closely related" (INSTAT, 2014: 12). This phenomenon would be more clearly distinguished by Vullnetari in 2012, in the paper *'Albanian on the Move: Links between Internal and International Migration'* (Vullnetari, 2012).

Internal migratory movements in the time period 2011-2021 (INSTAT, 2014, 2016-2020; RM, 2015-2022) follow the trends of two previous periods, 1991-2001 and 2001-2011 (IHS Alumni, et al., 1998; Misja and Misja, 2004; Faja, 2008; Aliaj, 2008; Imami et al, 2008). What is clearly distinguished in INSTAT's annual *'Population of Albania'* reports, but also in Monitor Magazine's analysis, is the fact that internal migratory movements are presented in very high values even in this third decade of transition (INSTAT, 2014, 2016 -2020; RM, 2015-2022).

A clear argument of this dynamic is the fact that even the statistics of internal migration change rapidly in just one year, which requires updating the data on this social phenomenon even for this short period. Referring to INSTAT, it can be said that "In particular, internal migration brought a large-scale urbanization of some areas and a drastic depopulation of some others." (INSTAT, 2014: 12).

All counties of Albania experience internal migration from other counties, but the most favored counties remain those of the central region. This phenomenon can be observed in detail in table 5 *'Residential population that has changed the usual place of residence, 2010-2011'* of the *'Migration in Albania'* report of INSTAT. In this table, it is clear that all counties have been affected by internal migration throughout this year (INSTAT, 2014: 53).

If we analyze the figures presented in this table in more detail, we will notice that internal movements shape an inter-regional migration scheme. This scheme is based on the four main lines of population displacement, where the first three are destined for the Tirana-Durrës Region, while the fourth line is for the Fier-Vlorë Region (INSTAT, 2014: 53; Vullnetari 2012). What further emphasizes the two main characteristics of the territorial transition model, the 'concentration' of the population in the central region of the country and the 'abandonment' of the northern and southern regions by the population.

The first three lines attract migrants who come: (i) from the north-east of the country and are generally from Kukës and Dibër districts (INSTAT, 2004: 25); (ii) from the internal regions of the country and include the districts of Berat, Korçë, Elbasan, Gjirokastër and Shkodër (INSTAT, 2004: 24; Vullnetari, 2012); and from the secondary centers located on the coast that include the districts of Vlorë, Fier and Lezhë (INSTAT, 2004: 24; Vullnetari 2012). While the fourth line of population displacement consists of migrants who come "from the interior areas [Berat, Korçë, Elbasan, Gjirokastër and Shkodër counties] who head to the secondary centers of the country's coast [Fier-Vlorë]" (INSTAT, 2004 : 24).

These four lines remained the same throughout the years 2014-2021, as we will see below, and contributed to the further deepening of the demographic difference between the three main regions of the country: Greater Tirana-Durres Region; The Middle Fier-Vlora Region and the Abandoned Region that includes the other eight regions of the country (INSTAT, 2014, 2015-2022).

To be emphasized is the Tirana region, which, as INSTAT would say, "Even though internal movements are multidimensional, it is obvious that the vast majority of internal migration flows are concentrated towards Tirana." (INSTAT, 2014: 12). For the opposite reason, the district of Gjirokastra is also to be distinguished. Referring to the article *'Population of Albania 120 thousand people less until 2031'* of the Monitor Magazine "The district which records the highest population decline during the years 2010-2014 is that of Gjirokastra with a decrease of 2.7 percent or 2 thousand residents every year" (RM, 2015).

Internal migratory movements and their results in relation to the level of population and urbanization are clearly visible even at the inter-districts level (INSTAT, 2014). In this dimension we will focus more, referring to each year, for two main reasons.

First, there are no statistics for the decade as a whole because the census of this time period has not been developed, so we will refer to the annual estimates of INSTAT *'Population of Albania'*, and the analyzes of the Monitor Magazine, where we found the information of necessary. And secondly, what is more important, for this phase of urbanization we are more focused on understanding what happened to the dynamics of internal population movements and urbanization at the level of the forming districts of the three components of the territorial model.

Detailed view of internal migration and demographic-territorial model (2014-2016)

We will start the observation of internal migration and its products at the level of urbanization with the year 2014, given that many statistics from the years 2012-2013 are not organized together in a dedicated INSTAT report (as for the years 2014-2022). Moreover, part of the demographic measurements of this period were used in INSTAT thematic studies in 2014 (INSTAT, 2014).

In this year (2014), internal migration continued emphasizing the fact that the district with the highest population in Albania is Tirana. It includes 800,986 inhabitants, followed by Fieri with 315,012 inhabitants and Elbasan with 301,397 inhabitants. Whereas the districts with the lowest population in the country for 2015 are Gjirokastra with 72,202 inhabitants, Kukësi with 85,461 inhabitants and Dibra with 136,476 inhabitants, which shows that the growth of other districts comes as a result of their decline (INSTAT, 2015; RM, 2015).

The fact that the district of Elbasan is presented with a high level of population is not a result of its mechanical growth in this year or in previous years, but as a result of the fact that it includes the city of Elbasan, which has historically been a large city (Misja and Misja, 2004; Faja, 2008). We can also understand this fact from the Monitor Magazine, which does not mention Elbasan as a city or as a county that has grown in this year. According to her, "Of all the counties, only Tirana, Durres and Vlora have seen an increase in population, while the others have suffered a decrease in the tax population" (RM, 2015).

As in the first and second phase of urbanization (1991-2001 and 2001-2011), this year too, the internal dynamics of the components of the territorial model will be identified. Thus, in the Tirana-Durrësi Region, the district of Tirana "with an increase of 1.61%" is the district that grew the most this year (INSTAT, 2015; RM, 2015), creating a further difference from the district of Durrës.

While the district with the highest decrease in population "is Gjirokastra with an annual decrease of 1.84%" (INSTAT, 2015). It contributed to the further growth of Tirana because "internal migration from Gjirokastra is oriented towards the central districts [Tirana and Durrës]" (INSTAT, 2014: 19). The same dynamic can be seen in the Fier-Vlora Region, where the district of Vlora dominates in growth as it is presented as the district that has experienced the highest growth after the regions of Tirana and Durrës (INSTAT, 2015; RM, 2015).

These dynamics continued for 2015, as the district with the highest population in Albania, in relation to the total number of the national population, remains Tirana with 811,649 inhabitants or 28.1%, followed by Fieri with 312,488 inhabitants or 10.8% and Elbasan with 298,913 inhabitants or 10.4% (INSTAT, 2016: RM, 2016).

As can be seen, almost half of the country's population is concentrated in these three counties, two of which (Tirana and Fier) are the main counties of the concentrated regions according to the territorial model of transition, while the third (Elbasan) remains historically populated, although is experiencing population loss. The phenomenon of differentiation between the three constituent regions of the country's territorial structure can also be distinguished if we observe the districts of the Abandoned Region. The counties with the lowest population remain Gjirokastra with 70,331 inhabitants, Kukësi with 84,035 inhabitants and Dibra with 134,153 inhabitants (INSTAT, 2016).

We can also observe the dynamics of strengthening inequality between regions in relation to the annual growth of their constituent districts. If we refer to INSTAT, we can say that "The district with the largest annual increase remains Tirana with an increase of 1.36% per year, while the district with the largest decrease remains Gjirokastra with an annual decrease of 2.57%" (INSTAT, 2016; RM, 2016).

This statistic shows that the country's largest district (Tirana), not only continued to be overpopulated, but its annual growth is greater than that of any other district.

Apart from Tirana, the biggest increase this year benefited from Durrës and Vlora. In fact, the indicators measured by INSTAT and the analyzes presented by Monitor Magazine show that in 2015 only these three counties received internal migration, while other counties of the country lost population (INSTAT, 2016; RM, 2016).

Demographic Albania continues to accumulate massively in the Tirana-Durres Region, and less so in the Fier-Vlora Region. But it can also be distinguished that Tirana was the district that experienced the highest growth, and Vlora, apart from Tirana and Durrës, was the only district that experienced growth (INSTAT, 2016; RM, 2016). This means that the internal dynamics in the two regions that represent the 'concentration' characteristic of the territorial model have continued to reinforce the main tears of each of them (Tirana and Vlora).

Tirana included about 30% of the population, continuing to be the most populated county in the country, followed by Fieri with 11%, Durrës and Elbasani with 10% and Vlora with 7% of the total national population, in 2016 (INSTAT, 2017: RM, 2017). These figures show that the counties of Tirana, Fier, Durrës and Vlora remain this year to hold the main weight of the general population, which is expressed by about 58% of the national population. This means that the two "concentrated" regions of the territorial model of the concentration-abandonment of the territory by the population have been further densified throughout the year 2016.

The strengthening of imbalances in the territorial model is also noticeable in its 'abandonment' characteristic, because other counties, such as Gjirokastra, Kukësi, Dibra, Lezha and Berati, include something around 2% - 5% of the population, while Shkodra and Korça occupy 7 % of the population each (INSTAT, 2017: 4).

As Elbasan, Shkodra and Korça keep this relatively high weight of the population because they have historically dominated the hierarchical structure of Albanian cities (Konica, 1993; Kolevica, 2004; Faja, 2008; Kaprata, 2019, 2021, 2022). The fact found by INSTAT that "only in three districts of the country there was an increase in the population compared to the previous year, while nine of them recorded a decrease" (INSTAT, 2017: 4), proves the further emphasis of the main characteristics of the territorial model of concentration-abandonment. This dynamic is also supported by the fact that the region of Gjirokastra experienced the largest decrease in population with 30.6 per 1000 inhabitants, Dibre with 26.9 per 1000 inhabitants, Berat with 25.8 per 1000 inhabitants and Kukës with 21.3 for 1000 inhabitants (INSTAT, 2017: 4).

The phenomenon of population densification is distinguished this year as well, through the dynamics between the two regions with "concentrated" population of the model, because if the Greater Region (Tirana-Durres) grew by 39.5 new inhabitants per 1000 inhabitants, the Medium Region (Vlorë-Fier) increases by only 4.15 per 1000 inhabitants (INSTAT, 2017: 4).

The internal dynamics in these two regions did not escape this phenomenon either, because while "The biggest increase was observed in Tirana with 23.0 per 1000 inhabitants", Durrës grew with only "16.5 per 1000 inhabitants", and while Durrës continues to include about 10% of the national population, Tirana has increased from 28.2% to 30% this year. The same situation is presented in the Middle Region (Fier-Vlorë), while "Vlora [has grown] by 4.15 per 1000 inhabitants" Fieri did not present an increase this year (INSTAT, 2017: 5).

Detailed view of internal migration and demographic-territorial model (2017-2019)

Internal demographic movements continued to contribute to the deepening of demographic differences between the three regions of the country, even in the following three years. Large counties will continue to remain so and grow further, while small counties will continue to decrease further, as a result of internal emigration.

In 2017, "it turns out that only three districts of the country experienced an increase in population compared to the previous year, while nine of them recorded a decrease" (INSTAT, 2018: 3). The biggest increase, as for many years in a row, was observed in Tirana with 25.1 per 1000 inhabitants, followed by Durrës with 16.9 per 1000 inhabitants and Vlora with 2.15 per 1000 inhabitants. The largest decrease in population, as in the following years, was experienced by the district of Gjirokastra with 45.3 per 1000 inhabitants, followed by Dibra with 36.3 per 1000 inhabitants and Berat with 34.2 per 1000 inhabitants (INSTAT, 2018 : 3-4).

As can be easily identified, even in 2017, the emphasis on the Tirana-Durrë Region and the Fier-Vlora Region continues, where three of the four districts of these two regions continue to have population growth, while the district of Fier, although not there is growth for historical reasons (INSTAT, 2001, 2004, 2011, 2014) it remains a county with a high population including about 10% of the country's population (RM, 2018). The panorama of the weight ratio between the two 'concentrating' regions of the territorial model is further clarified, with a clear dominance of the Tirana-Durra Region with an increase of 42 per 1000 inhabitants, which is about 40 times higher than that of the Region Fier-Vlora, for this year (INSTAT, 2018).

While the differences are also highlighted within the Greater Region, where while Durrës continues to include about 10% of the national population, Tirana surpasses itself from a year ago with an additional 1%, reaching the level of 31% of the national population. Referring to the data presented in figure 5 *'Population of Albania by regions, January 1, 2018'* but also to the data of figure 6 *'Total change*

of population and regions, January 1, 2017- January 1, 2018' of the assessment '*Population of Albania*' in in 2018, the other eight counties that are included in the territories that are being abandoned, lost their tax population for this year as well (INSTAT, 2018: 4).

Even during 2018, Tirana, Fieri and Durres have the highest weight in the total national population (INSTAT, 2019: 4). The dynamics of the growth of these counties also determined the internal dynamics of each component of the territorial model characterized by the "concentration" of the population, and in relation to each other. Expressed as a percentage, Tirana ranks first in the country with 31.3% with an increase of 1.3% compared to a year ago, followed by Fieri with 10.3% with an increase of 0.3% with a year ago and Durrës 10.2% with an increase of 0.2% from a year ago (INSTAT, 2019: 4).

The Great Region of Tirana-Durrës deepened the difference to the Middle Region of Fier-Vlora with 1.4% of the total national population, likewise the region of Tirana emphasized its dominance in the Great Region, while the region of Fier in the Middle Region. Referring to figure 5 *'The proportion of the population of each district in the total population, January 1, 2019'* of the 'Population of Albania' assessment in 2019, this year brings the decline of Elbasan from 10% to 9.6% of the total population (INSTAT, 2019) .

As for the other counties, with slight fluctuations, they present a slight decrease in weight in the general population, where five of them include 2-4.4% each (INSTAT, 2019: 4). As in all previous years, this year too, the population increased in three districts of the country, while the other nine districts suffered a decline. Tirana continued to have the biggest increase with 12.6 per 1000 inhabitants, followed by Durrës with 1.7 per 100 inhabitants and Vlora with 0.2 per 1000 inhabitants. In contrast, the largest population decrease was recorded by Gjirokastra with 24.3 per 1000 inhabitants, Berat with 17.8 per 1000 inhabitants and Dibra with 16.8 per 100 inhabitants (INSTAT, 2019).

2019 is the time when only the Greater Region of the concentration-abandonment territorial pattern continues to experience growth, which further emphasizes the difference between the Greater Region and the Middle Region. Referring to INSTAT "The biggest increase [in the period January 1, 2019-January 1, 2020] was recorded in Tirana with 1.2%, followed by Durrës with 0.2%" (INSTAT, 2020: 4), which means that the difference between them deepened to the extent of 1.4% of the national population.

These statistics show that the difference between the two counties of the Greater Region has deepened to the extent of 1% of the total population. Figure 5 'The proportion of the population of each district in the total population, January 1, 2020' of the 'Population of Albania' assessment in 2020 shows that Tirana occupies about 31.8% of the total population, continuing to be the most populated district of

country, and three times as big as the counties of Durrës and Fier, which follow in terms of size, each of which includes 10.2% of the total population each (INSTAT, 2020: 3-4).

As for the other districts, five of them account for 2% to 4.3% of the total population (INSTAT, 2020), suffering continuous loss of tax population. Although they include a higher percentage of the country's population, the districts of Elbasan, Korça and Shkodra also suffered further losses, while the largest decreases in population were recorded in the districts of: Gjirokastër with 3.3%, Dibër with 2.6 % and Berat with 2.5% (INSTAT, 2020: 3-4).

Detailed view of internal migration and the demographic-territorial model (2020-2022)

Even in the following three years, the internal demographic movements continued to contribute to the deepening of the demographic differences between the three regions of the country: the Greater Tirana-Durres Region; Middle Fier-Vlora Region; and the Abandoned Region. This demographic dynamic will further differentiate the population level ratios between the constitutive counties of the same region, especially between the counties of the two regions that are experiencing population concentration.

As in previous years, also in 2020 "Tirana, Durres and Fieri have the highest weight in the total population" (INSTAT, 2021: 3). Expressed as a percentage of the total number of residents, Tirana occupies about 32.2%, continuing to be the most populated region of the country, followed by Durrës and Fieri with respectively 10.3% and 10.1% (INSTAT, 2021).

In contrast, the other eight districts of the country belonging to the Abandoned Region continue to lose population, with five of them each accounting for 2% to 5% of the total population (INSTAT, 2021). This dynamic can be distinguished more clearly if we refer to figure 5 'The share of the population of each district in the total population on January 1, 2021' of the periodic report of INSTAT for the year 2020 (INSTAT, 2021: 4).

The difference between this year and the other years included in the study is the fact that, if in previous years the counties that experienced demographic growth as a result of internal migration were three; in this year the population increased only in two regions of the country. If we refer to figure 6 'Annual rate of population change by district, January 1, 2021 vs January 1, 2020' of this year's INSTAT report, we can say that the biggest increase was recorded in Tirana with 0.7%, followed by from Durres with 0.5% (INSTAT, 2021: 5).

This statistic testifies to a further deepening of the demographic gap: (i) between the two counties of Tirana and Durrës of the Greater Region, where Tirana dominates with an annual growth of 0.2% more than Durrës; (ii) between the Great Region of Tirana-Durres to the Medium Region of Fier-Vlora, where the Great Region experienced an increase of 12% while the Medium Region suffered a decline. Referring to INSTAT "The population estimates on January 1, 2021 show that only two regions of the country recorded an increase in population, compared to the previous year, while the other ten regions recorded a decrease in population." (INSTAT, 2012: 5).

Demographic differences as a result of internal immigration further damaged the homogeneity of population distribution across the national territory, which was a legacy of socialist urbanism 1945-1989 (Misja and Misja, 2004; Kotmilo and Kotmilo, 2017; Faja, 2008, Imami, et al, 2008). This can also be distinguished in terms of the demographic ratio between the shaping components of the model ('concentrated' vs. 'abandoned'). Referring to INSTAT, not only did the districts of Tirana and Durrës of the Greater Region increase, but at the same time the largest decreases in population were recorded in the districts of the Abandoned Region, such as Gjirokastër with -2.3%, Berat with -2, 1% and Dibër with - 1.9% (INSTAT 2021: 5).

Referring to figure 5 'The share of the population of each district in the total population on January 1, 2022' of the annual periodical report 'Population of Albania' of 2022, it can be said that Tirana, Durrës and Fieri have the highest weight in the total population (INSTAT, 2022: 4), following the deepening of the demographic gap between the two formative components of the demographic-territorial model, even for this year. According to this Report "On January 1, 2022, Tirana occupies about 32.9% of the total population, continuing to be one of the most populated counties in the country, followed by Durrës and Fieri with 10.4% and 10.0% respectively" (INSTAT 2022).

This dynamic is further deepened, but we refer to the demographic statistics of the districts of the Abandoned Region, in both parameters. Both in terms of the resident population of these districts, where five of them occupy respectively from 2% to 5% of the total population, also in terms of annual growth, where the largest decreases in the population were recorded in the districts of Gjirokastër with - 4.7 %, Berat with - 3.7% and Dibër with - 3.6%. This is easily recognizable even if we refer to figure 6 'Annual rate of population change by district, January 1, 2022 vs January 1, 2021' of the same Annual Report (INSTAT, 2022: 5).

The forming structure of the demographic-territorial model was further unbalanced due to the fact that "The population estimates on January 1, 2022 show that only one region of the country recorded an increase in population, compared to the previous year, while the other eleven regions recorded a decrease in

population population" (INSTAT, 2022: 5). If for many years during the transition there were three regions that experienced growth (INSTAT, 2001, 2004, 2011, 2014, 2015-2020; RM, 2016-2022; Kaprata, 2021, 2022) and in 2020 there were only two regions that experienced growth, the year 2021 is the first year where only the region of Tirana experiences growth (INSTAT, 2022: 5).

The phenomenon of the growth of only one district (Tirana) continues in 2022, but in this year another dynamic within the same phenomenon begins and stabilizes. The annual growth of the district of Tirana over the years has undergone a downward trend from: an increase of 1.61% in 2014 (INSTAT, 2015; RM, 2015), to an increase of 1.36% in 2015 (INSTAT, 2016; RM, 2016), in an increase of 1.2% in the year (INSTAT, 2020), in an increase of 0.7% in 2020 (INSTAT, 2021: 5), to be covered in an increase of 0.6% in this year (INSTAT, 2023). In short, the growth rate of the only county that benefits from internal inward migration falls.

Referring to figure 5 'The share of the population of each district in the total population on January 1, 2023' of this year's INSTAT Report "Tirana occupies about 33.5% of the total population, continuing to be one of the most populated districts of the country, followed by Durrës and Fieri with 10.5% and 9.8% respectively", while "As for the other districts, five of them occupy respectively from 1.9% to 4.1% of the total population" (INSTAT, 2023: 4), which further deepens the demographic differences, both between regions and between districts.

This difference establishes the demographic-territorial model of the country with two main characteristics: (i) the dominance of the Greater Tirana-Durra Region over the Middle Fier-Vlora Region and especially over the Abandoned Region; and the dominance of the district of Tirana over the other 11 districts of the country. This is distinguished not only by the demographic level that each district has, but also in relation to the annual growth level of each of them, which is easily identified if we refer to figure 6 'Annual rate of population change by district, January 1, 2023 vs January 1 2022' of the aforementioned Report (INSTAT, 2023: 5).

As we presented, internal migration has continued with high growth even in this third decade of transition, which constitutes the third phase of urbanism in Albania. This has emphasized the distinctive characteristics of the territorial model of concentration-abandonment of the territory by the population, whose forms began to be sketched in the first phase, and to be carved in the second phase of the country's urbanization along the transition.

Findings and conclusions

The third phase of urbanization of Albania in transition was shaped by the same demographic dynamics as the first two decades of transition. They expressed the

same forms, including: (i) external migration; (ii) the decline in natural population growth; and (iii) internal migration.

External migration (2011-2021) is one of the two components forming the level of demography in the country. Expressed in numbers, external migration resulted in: 18,046 individuals in 2014; about 17 thousand in 2015; about 8 thousand in 2016; 14,902 in 2017; 15,030 inhabitants in 2018; 23,082 in 2019; 16,684 in 2020; 32,853 in 2021; and, 32,497 in 2022.

In total, referring to the figures and demographic analysis from INSTAT and Monitor Magazine, we can say that in the period 2014-2023, 178,094 more inhabitants left Albania than returned. What stands out, too, is that this number has increased greatly in the last two years, which also indicates the future trend of the phenomenon.

Another contributor to this basic national phenomenon remains the level of natural population growth, which is expressed in the difference between births and deaths. Its main factor is the Fertility Index, which in 2018 the average number of children born to a woman set a historical record, with only 1.37 children per woman from 1.48 children in 2017 and from 1.73 children per woman that was this index in in 2014.

In quantitative terms, the natural growth of Albania's population was: 35,760 in 2014; 10,799 in 2015; about 11 thousand in 2016; 8,637 in 2017; 7,130 in 2018; 6,624 in 2019; 470 inhabitants in 2020; -3.296 in 2021 where for the first time natural growth was negative; and 690 in 2022.

What stands out from these demographic figures is the fact that during the years 2014-2022, Albania: (i) grew by 42,054 new inhabitants, as a result of natural growth (birth-death difference); and, this growth has generally come in a downward trend, where it is worth differentiating the year 2021 where the natural growth is negative.

Another very negative demographic phenomenon that accompanied this decade was the aging of the population. The median age indicator increased from 34 years in 2015: to 35 years in 2016; to 35.0 years in 2017; to 35.4 years in 2018; to 36.7 in 2019; to 37.2 years in 2020; to 37.6 years in 2021; to 38.2 years in 2022. These figures and demographic analysis show that in this decade the population has suffered a significant decrease as a result of external migration, but also due to the decrease in the level of natural population growth.

Internal migratory movements in the time period 2011-2021 follow the trends of the two previous periods, 1991-2001 and 2001-2011. Internal migration led to large-scale urbanization of some areas and drastic depopulation of others.

The internal migration scheme is based on the four main lines of population displacement, which contributed to the further deepening of the demographic difference between the three main regions of the country: Greater Tirana-Durres

Region; The Middle Fier-Vlora Region and the Abandoned Region that includes the other eight districts of the country. Internal migratory movements and their result in relation to the level of population and urbanization are clearly visible even at the inter-county level.

For the period 2014-2016 it can be said that, excluding Elbasan, the districts of Tirana, Fier, Durrës and Vlora, experienced growth and hold the main weight of the total population, which is expressed by about 58% of the national population. This means that the two "concentrated" regions of the territorial model of concentration-abandonment of the territory by the population have densified, while the districts of the Abandoned Region have lost population.

Expressed as a percentage, at the end of this period: Tirana included about 30% of the population, continuing to be the most populated district in the country, followed by Fieri with 11%, Durrës and Elbasani with 10% and Vlora with 7% of the general national people. On the other hand: Gjirokastra included 2% of the population, continuing to be the district with the lowest population level, followed by Kukësi with 3%, Dibra and Lezha with 4%, and Berat with 5% of the total national population.

Internal demographic movements continued to contribute to the deepening of demographic differences between the three regions of the country, even in the 2017-2019 period. Large districts will continue to remain so and grow further, while small districts will continue to shrink.

The panorama of the weight ratio between the two 'concentrating' regions of the territorial model is further clarified, with a clear dominance of the Tirana-Durra Region with an increase about 40 times higher than that of the Fier-Vlora Region, only in 2018. Expressed as a percentage, for this three-year period: Tirana increased from 30% to 31.8%, Durrës from 10% to 10.2%, Fieri from 11% fell to 10.2%, Vlora from 7% fell to 6.5%, Elbasan fell from 10% to 9.5%. As for the other counties, five of them occupy 2% to 4.3% of the total population, where: Berat falls from 5% to 4.3% and Kukësi from 3% to 2.7%.

Even in the following three years, 2020-2022, internal demographic movements continued to contribute to the deepening of demographic differences between the three regions of the country. Expressed as a percentage; Tirana increased from 31.8% to about 33.5%, Durres from 10.2% to 10.5%, Fieri from 10.2% fell to 9.85, Elbasan fell from 9.5% to 9.2%. As for other districts, five of them lost population from 2% to 4.3% to 1.9% to 4.1% of the total population.

This demographic dynamic will further differentiate the population level ratios between the constitutive districts of the same region, especially between the districts of the two regions that are experiencing population concentration. As can be seen, Tirana has grown by 1.7% while Durrës by only 0.3%; Vlora has grown by 0.1% while Fieri has fallen by 0.35%. The most evident dynamic was the fact that

if in the previous periods, three main districts grew, during this period: in 2020, only two districts grew (Tirana and Durrës); whereas, in 2022, only one district (Tirana) has increased. This difference establishes the demographic-territorial model of the country and the dominance of the District of Tirana over the other 11 districts of the country.

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Electricity supply of an industrial building

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Abstract

*Electricity is one of the greatest gifts that human beings possess. The era in which we live has a high level of development and as a result the use of electricity is very necessary. One of the main sources of electricity production in our country are hydropower plants, which make it possible to convert water energy by means of a turbine into mechanical energy, where the mechanical energy is then transformed by the generator into electrical energy. Electricity is produced by the movement of particles, which we know as electrons. It can also be defined as the energy which is transferred when the electric current passes through the conductor. Electricity is measured in kW (kilowatt hours 1kW*h= 3.6MJ). It can also be produced from a variety of energy sources and different types of technology. The supply of electricity to the consumer is carried out by the Electric Power System, where its constituent parts are Generation, Transmission and Distribution of electricity. Recently, an increase in electricity costs has been observed, so this will bring more consumers who are interested in reducing energy costs.*

In this topic, the way Albania is supplied with electricity is examined, taking a specific case of a fashion factory. The topic includes the following aspects:

- *The method of electricity production in Albania.*
- *Supplying a factory with electricity.*
- *Solar energy production and photovoltaic plants.*
- *Assessment of the possibility of reducing energy consumption in an industrial facility.*

Key words: *Direct Current, Alternative Current, Photovoltaic, Kilo Watt hour (unit of energy spent in one hour), Kilo Volt Ampere(kVA), Mega Watt, On-Grid, Off-Grid, Hybrid, V (volt), Kilo volts (Kv)*

Introduction

The way of electricity production in Albania and the main hydropower plants

Electricity is a mysterious power, without its life would not be so easy. Some of the greatest and most unique inventions have been made using electricity. In our country, electricity is dominated by hydropower plants; Fierze, Koman and Vau i Deja with a capacity of 1,350 MW. On the other hand, power plants balance the transmission of electricity. Solar energy is renewable energy and mainly in recent years its use is being noticed. It can be used directly. The use of Renewable Energy Sources can contribute to the reduction of primary energy consumption. All consumers think that a single device that is set to work does not consume much electricity, but when several of them are in working condition, consumption will be a real problem. Every consumer should be informed not only about the ways of using electricity but also about managing or reducing its losses. (Ravi) (Wikipedia, 2022) (Shivane)

Electricity can be produced from different sources. Renewable energy is the buzzword of today's times. Renewable energy in our country varies from solar, wind, geothermal, biomass and hydroelectric energy. Albania is a small country which has as its source the energy produced by hydropower plants, which have a determining role, where they have provided more than 90% of the country's annual production. Hydroelectric energy may not be effective enough when the water level is low, because as a result problems will be encountered in the production of electricity. Since Albania offers a Mediterranean climate, solar energy can also be seen as a good alternative. Albania's transition from the system of the concentrated economy to the free-market economy largely changed the structure of consumption and, therefore, of the energy supply to the consumer. The previous ratio through the use in industry and family and public use of energy, changed because of the closure of many businesses and the massive growth of the services market (restaurants, bars, industrial units, etc.) as well as the change in the direction of growth household use of electricity. The construction of hydropower works requires a relatively long time, therefore both optimal utilization and the re-commissioning of existing power works of any capacity should be evaluated and encouraged.

In Albania, hydropower plants have started to be built since 1936, its capacity has been 386 kW. The small hydropower plant was in the village of Vithkuq in Korcë. In 1951, the first real hydropower plant was built in Lanabregas in Tirana, with a power of 5MW. Electricity through power lines will travel to our homes. As mentioned above, the source of electricity in Albania is hydropower plants. Some of the main hydropower plants in Albania are:

Ulza, Shkopet, Bistric 1 & 2, Vau i Deja, Koman, Fierza, Banja and Kaskada over Devoll hydropower plants. Some of the problems that are neglected during the control of HPPs are those of protection from direct atmospheric shocks but also those from the damaging action of other high voltage waves. A good knowledge of the physical side of the action of lightning helps us to realize an effective protection from lightning strikes on the electromechanical equipment of a hydropower plant. It is also important to know the area where the hydropower plant is being built (Paloka, 2006).

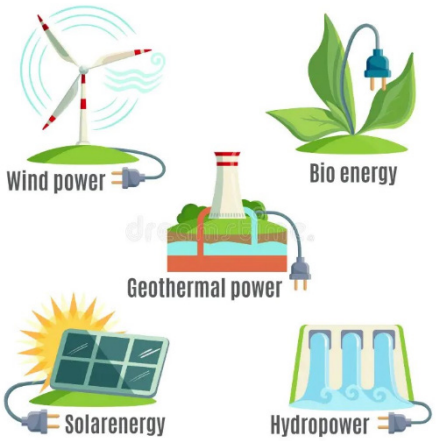

FIGURE 1: Alternative energy sources (Illustration of windmills, bio energy, solar energy, hydropower plants, thermal sources)

The aim, objectives, and hypothesis

Aim

The main goal is the analysis of an industrial building in terms of electricity supply, considering an industrial building in Albania.

Objectives

The objective is to show the way of production and distribution of electricity. Research efforts are aimed at the possibility of reducing electricity costs in an industrial facility by providing recognition of solar panels and their use.

Hypothesis

The use of photovoltaic plants is a good opportunity for reducing electrical energy.

The use of solar energy

The sun's energy is vital to life on Earth. It determines the temperature on the Earth's surface, and supplies all the energy that drives the global natural system and cycles. Every second the sun releases a large amount of radiant energy into the solar system. The solar energy system is a source of energy without pollution and is known as renewable energy. In recent years, it has been noticed that the solar energy system is being seen as the main and primary source of energy that is converted into electricity. Solar energy has as its main benefit the fact that it is free of cost and anywhere on Earth, it is also known as the technology that harnesses the sun to harness solar energy and use it in other forms. Some of them are known as photovoltaic cells or solar panels. There are always several solar cells that are connected and form a solar module. Electrons are stripped from atoms when sunlight hits cells. As electrons move through the cell, they generate electricity. (national geographic) (Gary Cook) (Electrical4U, 2023) (BoxWell)

- Solar energy can be used to heat buildings. In this case, the solar wall is used, where it is more cost-effective in northern countries. Sunlight is reflected by snow to improve solar gain. Solar water heaters work in the same way. They collect solar energy for heating water, which is then used according to internal use such as washing, cooking, etc.
- Passive solar systems. This system uses solar radiation through materials that absorb, reflect and store solar radiation in order to regulate temperatures inside the building. Important factors for evaluating the feasibility of renewable energy technology we will consider the number of hours of sun on a daily basis and the intensity of solar radiation.

Power supply of a factory and reduction of electricity consumption by means of solar panels

Electricity reaches the consumer through three stages. These three stages are production (generation), transmission and distribution.

First, to get electricity, we need to produce it. The place where electricity is produced is known as the production station or thermal power plant, hydropower plant, nuclear power plant, etc. So, everyone has the task of producing a high amount of energy. As we know, in thermal power plants, electricity is produced from the heat produced by burning oil, coal or natural gas. While in hydropower plants, the energy of moving water is converted into electricity by means of large hydraulic turbines, coupled with generators. On the other hand, in nuclear power plants, electricity is produced from the heat released by the nuclear reaction. Solar energy, wind energy, biomass and hydro are all known as green sources. This is because they do not cause pollution.

The transmission system makes the transmission of high voltage for the conductor to have economic parameters, as the currents and losses are small.

So, the second stage is the transmission of energy to the consumer. Once the energy is produced, it will be transmitted to urban and rural areas. Power stations generate electricity at low voltage, but when transmission occurs the voltage will be increased using a step-up transformer, because high voltage power supply has more priority than low voltage power supply.

About 30,000 km of high-voltage transmission lines connect power plants or generating hydropower plants with transmission stations. An example of an energy system can be the electrical network, which provides energy for homes or industrial buildings within an extended area. The transmission voltage depends on the amount of power to be transmitted. The surge resistance load is a parameter that determines the voltage level of the system for the transmission of an amount of energy.

The electricity supply of the industrial building for tailor's building is expected to be at Medium Voltage, from the electricity connection point, after approval by OSHEE, Lezhe area, a point discussed in advance with the electrical specialist on the ground, which is Shtylla b/ a of the 10KV Medium Voltage overhead line, which is located on the highway near the investor's property. From this point, it is envisaged to extend the incoming line for TM-20KV and the outgoing line for TM-20KV, directly underground according to the relevant section approved by OSHEE, this proposed to serve in the perspective, in the distribution implementation phase of TM-20KV, also in Lezhë Municipality.

The installed electrical power, in all the premises of the industrial building, for normal work is expected to be 471.6 kW, divided into consumer groups:

- 29.0 kW for lighting
- 4.0 kW for surrounding lighting
- 153.7 kW for plugs and electrical equipment
- 2237.2 kW for the aspiration and air conditioning system
- 34.7 kW for sanitary water and fire extinguishing pumps
- 4.4 kW for emergency lighting from UPS,
- 6.0 kW for the elevator system.

Considering the simultaneity coefficient in these industrial environments approximately 0.63, the required power is calculated around 300.0 kW.

Electricity experts have predicted an increase in prices, not only in Albania but also in many other European countries. Currently, some states are aiming to build some packages that help to save electricity. The moment electricity management is achieved, crises will begin to be faced, costs and restrictions will be reduced. There are several ways that can contribute to reducing electricity costs. These methods can be used at home or in industrial buildings. To make a connection with the case study, one of the best ways to save electricity, thus reducing costs, would be to install photovoltaic panels.

Solar panels are mechanisms that make it possible to transform the sun's rays into electrical and thermal energy. As we know, solar energy is a clean source of energy production. The types of solar panels are:

- Hybrid solar panel
- Thermal solar panel
- Photovoltaic solar panel

Hybrid solar panel

Thanks to solar energy, hybrid panels can be able to generate electricity and hot water. For this there is a hydraulic system that heats the water and photovoltaic cells that produce energy. Thus, photovoltaic production is maximized, and losses are minimized. Hybrid solar systems use special batteries and inverters to store energy for later use.

FIGURE 2 : View of a house that uses solar systems.

Solar thermal panel

For the first time in 1910, the installation of solar thermal energy equipment was done in the Sahara. This technology makes it possible to turn the sun's rays into heat. These panels help to reduce the savings on monthly bills by using a renewable energy source thus covering the heating needs.

Photovoltaic energy systems are classified according to their component configurations, their operational and functional requirements, and how the equipment is connected to electrical loads and other energy sources (Murty, 2017)

- **On-Grid System** An on-grid system is a photovoltaic system that generates electricity. It is this solar energy that will be fed into an existing public grid.
- **Off-Grid System**
  An off-grid system is an island system. This photovoltaic system is not connected to a public power grid. If it produces more energy than needed, then the excess energy is stored in the battery. It only works with energy storage.
- **Hybrid system (HYBRID)**
  In the hybrid system, in addition to the integration with the network, batteries are also integrated. So, a special inverter is needed for it. This system is programmed according to the options, but the special thing is that after the batteries are charged, the excess energy produced by the panels will be injected into the network. This system normally works like the On-Grid system, but the only difference is that this system does not shut down when there is no electricity but continues to produce energy or consume what has been accumulated in the battery.

Calculation of the photovoltaic plant in Albania

Knowing that the power required in the appliance is up to 300 kW, we will calculate how much the price of the electricity bill will vary in a month, considering the building of an Tailor.

150 kWh (daily) - **Required energy**
For 6 hours of work per day – 900 kWh
In 20 working days (5 days a week) – 18000 kWh
Monthly energy consumption = 18,000 kWh × 11.4 ALL = 205200 Lekë
Based on consumption, you need: **90 Kw panels**
The minimum area must be: **540 m²**

Kwh/ production month. Money that you can save in months.

4680 kwh	101,088 Lekë
7110 kwh	153,576 Lekë
9630 kwh	208,008 Lekë
11340 kwh	244,944 Lekë
13320 kwh	287,712 Lekë
14400 kwh	311,040 Lekë
15300 kwh	**330,480 Lekë**
14310 kwh	309,096 Lekë
11250 kwh	243,000 Lekë
8280 kwh	178,848 Lekë
5940 kwh	128,304 Lekë
4680 kwh	101,088 Lekë
120240 kwh	**2,597,184 Lekë**

At the end of the year, the amount that can be saved is: 20,200,320 Leke. So, it is obvious that the benefit that this tailor's building will have if it installs photovoltaic plants.

Conclusions

This thesis shows us the way of electricity supply in Albania. Within this paper, information is presented on how a hydropower plant works and some of the main hydropower plants in Albania. The case study was intended to show, in a simple way, the electricity supply of a factory. Referring to the issues discussed above, even though in our country electricity production is mainly done by hydropower plants, another good alternative is the use of renewable energies. Favored by a high number of sunny days, Albania seems to be a suitable place for the installation of solar panels for energy production.

Special importance has been given to solar panels, through which solar energy is obtained. These are dealt with in detail starting from the history when they were used for the first time. Continuing thus to the different types of photovoltaic plants. All the components of a photovoltaic system are also presented and treated. Photovoltaic systems are somewhat complex to understand. The demand for solar

energy is constantly increasing. Consequently, the number of installed systems using renewable energy is increasing.

Normally this paper encourages to increase the use of alternative energies. Clean electricity produced by solar energy can help light our future.

Recommendations

The use of solar panels is a technique that can be used not only by families but also by businesses or industrial buildings.

Albania, as a connecting part with Europe, using its geographical position, should use the production of solar energy.

It is recommended that not only in the family economy, but also in various businesses, the use of alternative energies, specifically solar energy, be widely used. This means that after the initial investment, the energy produced for at least the next 25 years will be at zero cost.

The use of photovoltaic plants will not only be a good opportunity for reducing electrical energy costs, but it will also be an even better opportunity for reducing environmental pollution. Unlike hydropower plants, photovoltaic plants do not have any negative impact on the environment.

Another recommendation that can be made regarding the case study is the installation of photovoltaic plants. The surface of the terrace can be used very well, knowing that 1 kW at the end of the year will give 1300 - 1500 kW/h. They also have a limited energy warranty of 10 years at 91.2% of the minimum rated energy output. Cost is one of the main factors that people notice. Starting from this factor, the investment in photovoltaic plants is an investment that will return within a few years.

So solar energy is cheap and affordable, and photovoltaic systems work as autonomous systems and do not have access to the electricity grid.

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Geotechnical and petrographic properties of carbonate sedimentary rocks from Sasaj region (Ionian Zone) and their use as aggregates for road pavement

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Abstract

This paper is a part of the master's thesis with the title "Geotechnical and petrographic properties of carbonate sedimentary rocks from different zones of Albania regarding their use as aggregates for road pavement" where this topic presents a particular method of study of limestones and dolomite aggregates from the point of view of their petrographic characteristics, the petrography being an important working tool which proves to be indispensable alongside the classical geotechnical study currently used in Albania.

Our work was born from the need to demonstrate that the studies carried out by engineering, geotechnics and geomechanics should not lack synthetic reports on the different types of aggregates used in Albania, especially those of carbonate origin.

Moreover, our goal was to take a step forward to fill this gap by accurately correlating the general geological knowledge and the lithological and petrographic characteristics of carbonate rocks with the engineering properties of the aggregates produced from these types of rocks.

It is well known that petrography is focusing on details invisible to the naked eye, and therefore, for rock materials selected for the production of aggregates, this microscopic analysis is also necessary, as well as other laboratory analyses, if necessary to verify the stability of these aggregates.

Concretely, in this paper we will present a part of our results which show the methods which we used in the analysis of materials from samples of carbonate rocks coming from Sasaj region, one of the four carbonate rock formations that we studied in our master thesis, these formations belonging to four different geological tectonic zones of Albania: Mirdita, Albanian Alpes, Kruja and the Ionian zones.

The complete material will be the subject of a more detailed paper for a high-impact international journal.

Keywords: *aggregates, road pavement, petrography, carbonate rocks, geotechnical properties, optical microscope, binocular, Ionian, Sasaj.*

Introduction

Industrial limestones constitute a particular sub-category of geomaterials widely used in the construction industry as well as road pavement aggregates. The selection of these rocks as construction materials is done on the basis of their quality, with the most viable ones being chosen mainly on the basis of their chemical properties, and after that they are analyzed from a geotechnical and petrographic point of view.

The use of these aggregates in road pavements depends on the shape, classification and lithological composition of the rock material, as well as their physical, mechanical and chemical properties, and for this, an in-depth study of these rock aggregaates is necessary on the basis of The mechanical behavior of rock aggregates is particularly influenced by their textural and mineralogical characteristics as well as their geotechnical characteristics. The latter are related to their resistance, i.e. the resistance they present to the requirements based on which it is recommended or not to use it as a raw material for construction.European International Standards.

The results of various international specialized studies regarding the problem of carbonate aggregates show that the lithology and petrography are the main factors that influence the physical and mechanical properties of these rocks. So, based on this fact, it can be said that the methods of their study from the geotechnical point of view should be closely related to the petrographic study of these rocks.

Carbonate rocks are included in the group of sedimentary rocks together with marls, siliceous rocks, gypsum, clays, siltstones, sandstones, conglomerates, gravels, sands, etc. The limestones and dolomites are classified as carbonate rocks.

These sedimentary rocks are used as building stones, so they are natural materials widely used in the construction of foundations and walls of houses, for the construction of roads, bridges, dams, for squares pavement, sidewalks, as well as decorative materials, sculpture, for interior and exterior design of buildings, floors and artistic works.

The origin of carbonate rocks is chemical, biochemical and organic. In Albania, these rocks represent about 60% of the all sedimentary rocks. According to the studies conducted by the Albanian Geological Service, more than 100 sources of carbonate rocks have been identified throughout the country, with a total of about 800 million cubic meters of reserves. These sources are mainly represented by limestones with a high level of purity (CaO content greater-than 53.5%) and high physic-mechanical indicators (fig. 1).

FIGURE 1. Schematic map of the distribution of carbonate rocks in our country.

But the of carbonate rocks as aggregates in road paving has not found the right use in Albania. However, the importance of the reserves and above all, the damage caused to the environment by the use of river gravels underline the need for using the aggregates of carbonate origin as a qualitative alternative to river gravels.

The geographical position and geological setting of the region under study

From geographical point of view, the studied samples presented in this paper were taken from the carbonate rock formations located near the village of Sasaj, which administratively belongs to the Prefecture of Vlora, municipality of Himara, administrative unit of Lukovë (fig. 2).

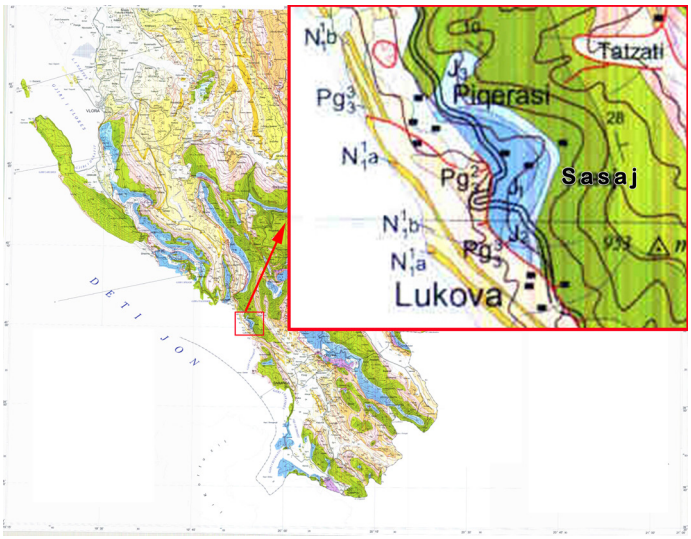

FIGURE 2. Geological map of the study area and its position on the geological map of Albania (South)

From geological point of view, the region belongs to the Ionian tectonic zone (fig. 3), which is part of the western zone of the external Albanides. Within this zone are included the next subzones: the western or Çika subzone (including the Dukat syncline belt and the Çika anticlinal belt), the central or Kurvelesi subzone (including the Shushica syncline belt, the Kurvelesi anticline belt and the Memaliaj syncline belt) and the Eastern subzone or Berat (including the Berat anticline belt and the Përmet syncline).

The carbonate rock formations of Sasaj are part of Kurveleshi subzone and their geological ages are Cretaceous and Paleogene. The samples taken for our

study belong to the Lower Eocene (Middle Paleogene, Pg2) which according to the geological map of Albania consists of biomicritic and turbiditic limestones (Xhomo et al. 2002, 2010).

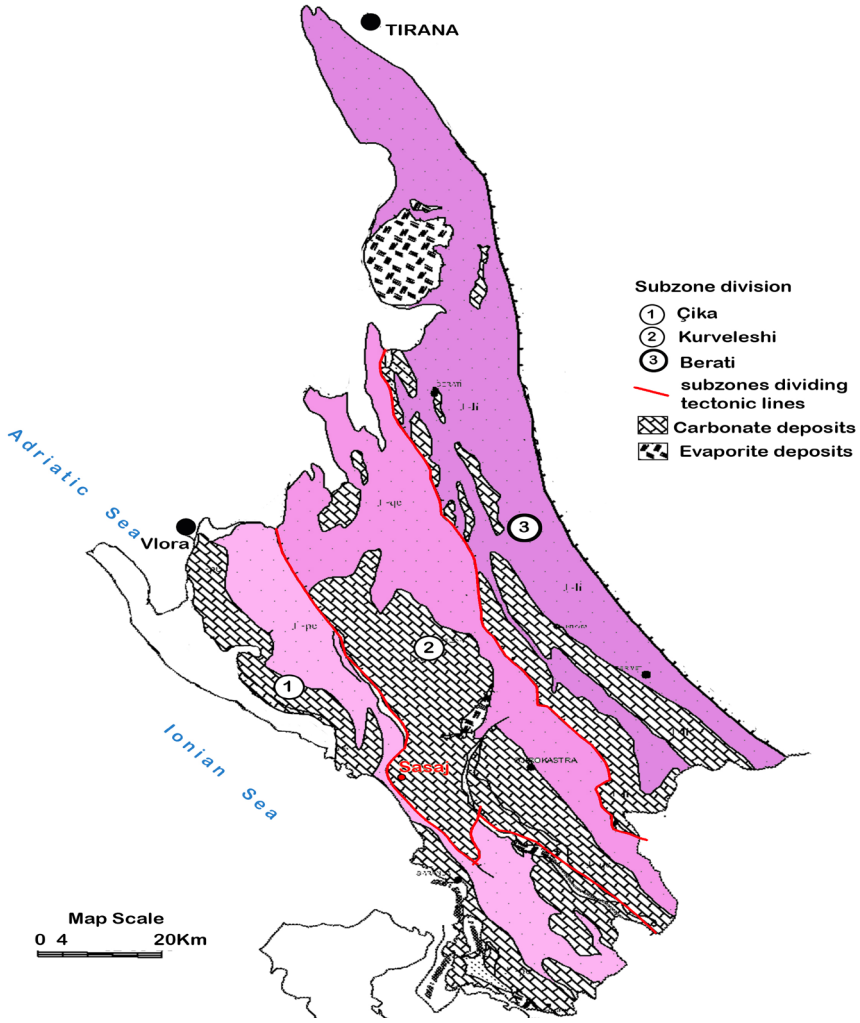

FIGURE 3. The position of the Ionian zone and its divisions into tectonic subzones (belts).

Literature review

The invention of cement and concrete in the 19th century greatly increased the demand for natural aggregates, and with the development of the construction industry, their widespread use increased exponentially. Currently, large volumes

of aggregates are used, where for example, the average consumption of aggregates in the European Union in 2007 was 24 million USD. Thus, 1.4 km of two-lane highway requires 75,000 tons of aggregates, while a two-floors building requires 400 tons.

Aggregates are extracted from the crushing of various rocks such as limestone, basalt or granite (fig. 4) and are divided into two categories:

- **natural aggregates** - which are obtained from the fragmentation of massive rocks (sedimentary, igneous and metamorphic) and unconsolidated sediments (accumulated in rivers, lakes and seas) which are created by natural weathering and/or of alteration.
- **recycled aggregates** - which are produced by recovering certain materials from demolition, road paving and other industries.

FIGURE 4. Aggregates of different rocks. Limestone (a), basalt (b), granite (c)

To carry out quality work, the rocks from which the natural aggregates are derived must fulfill the following qualities:

- homogeneous, uniform and compact structure;
- homogeneous color and petro-mineralogical composition;
- low water absorption and low modification of characteristics under the action of water;
- minimal brittleness to withstand traffic load and maintain the angular shape without rounding;
- lack of decomposable minerals (pyrite, limonite or soluble salts);
- they do not contain microcrystalline or amorphous siliceous which reacts with cement alkalis (if used in the presence of cement);

Limestone aggregates are commonly used in road construction and roadside ditches to drain the runoff water. There they are an ideal alternative to gravel for use as stable layers on the surface of secondary roads, sidewalks, cycle paths and car parks Recognized for being strong and durable, limestone aggregates greatly

facilitate water drainage and also have a fairly low cost compared to other non-porous surfaces such as asphalt or concrete.

In the classification of carbonate rocks are included (1) **Limestone**, a sedimentary rock mainly composed of calcium carbonate (CaCO3), which can be of mainly organic origin, but also of chemical origin; (2) **Dolomite, a** rock with similar sedimentary characteristics to limestone, in which the mineral called dolomite [CaMg(CO3)2] predominates and is mainly formed by the early replacement of the carbonate fraction under the action of magnesium-rich waters; (3) **Chalk** which is a very fine limestone, of organic origin. It is the dominant carbonate of the Cretaceous of Europe and North America, from which comes the name of the Cretaceous period (Kreide – chalk *germ.*).

Other rocks with a carbonate composition are **marls** (with a carbonate composition of 35-65%) and **travertines** (formed by the chemical precipitation of calcium carbonate minerals from fresh waters).

Limestones are classified in two categories: Folk classification and Dunham classification where Folk (1959) proposes a classification based on the type and size of the grains (fig. 5), while Dunham (1962) is taking into account the depositional texture of rocks as the basis for classification (fig. 6).

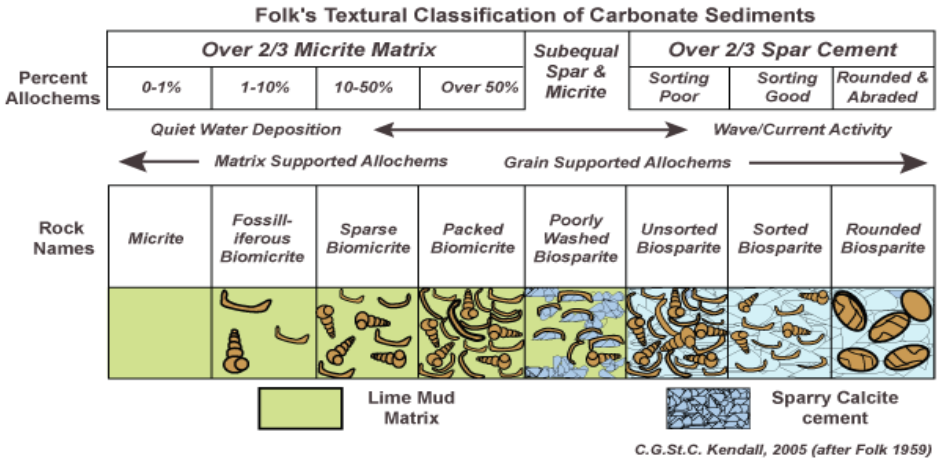

FIGURE 5. Limestone classification according to Folk, (1959)

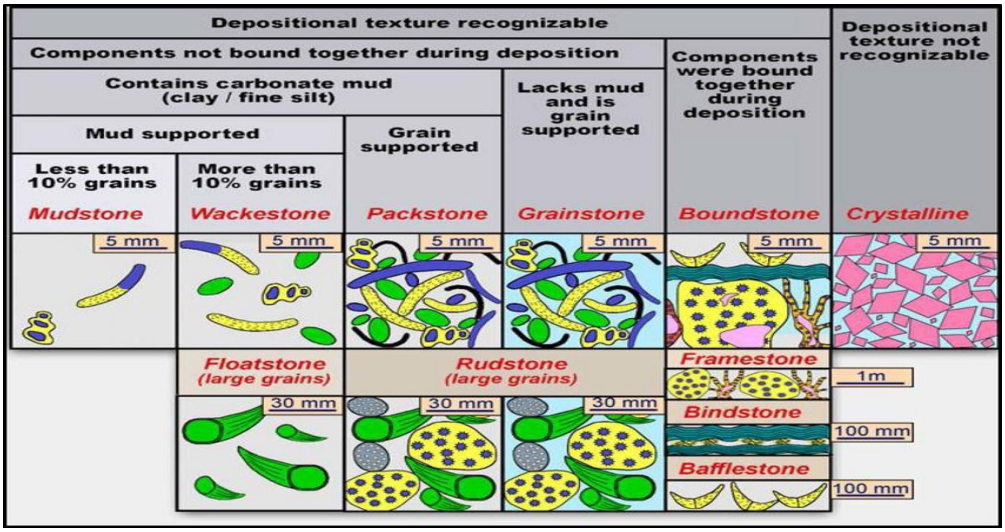

FIGURE 6. Limestone classification according to Dunham, (1962)

Road construction in history has gone through several stages, from the Roman road network to the present day. Granular material (rock aggregate) was first included in the construction of road pavements by John Loudon McAdam, in 1815, in England. He noticed that the small crushed stones were more resistant to the passage of chariots than the large stone slabs, and so he radically changed the foundations of the roads, which had previously been built with large stones which had a high cost. His techniques were applied from 1820 in Australia and the United States and from 1830 in continental Europe. In 1909, the German company AVUS (Automobile Verkehrs und Übungs Strasse GmbH) built a two-lane test road 10 km west of Berlin. In 1945, Germany had approximately 3,800 km of motorways. Later, highways "conquered" the world.

Known collectively as aggregates, these materials are essential for the construction, maintenance and rehabilitation of roads and bridges. Aggregates affect the durability, strength, modulus, thermal properties and important safety properties of running surfaces: friction and traction. To be useful to road agencies, aggregates must first be of sufficient quality to meet initial design needs and long-term life cycle performance objectives.

Ensuring a constant supply of aggregates requires advance planning and balancing a complex matrix of technical, geographic and geological variables and community interests.

Given the above considerations, the topic of our master thesis wants to propose the study of these aggregates from a petrographic point of view.

The used methods and the obtained results

The petrographic examination method was used as a research method in our work. Petrography is a geoscientific branch that aims to provide a description of rocks of different natures by analyzing their structural, mineralogical and chemical characteristics, in order to obtain a classification based on the identified minerals.

The petrographic as well as petrological examination of rock materials used in construction engineering, particularly in the road construction industry, makes it possible to identify the harmful elements or unfavorable characteristics and, in general, to evaluate the suitability for a certain use, in addition to petrophysical and mechanical tests.

Our rock samples were processed in the form of petrographic thin sections and analyzed by using a polarized light optical microscope (fig. 7).

A complete petrographic description includes:

- the description of the (micro-)texture: the size and shape of elements and voids or pores, their orientation, arrangement, etc.;
- identification and description of minerals, the presence or absence of crystallized phases, the presence of pores and micro-pores, cracks and micro-fissures (their opening), organic elements.

In engineering geology, the petrological and petrographic descriptions of a rocky material have specific objectives, the main ones being:

- Identify the presence of harmful components such as: chlorides, sulphates such as gypsum or anhydrite, poorly crystallized phases (silica of flint, for example), sulphides such as pyrite, altered clays, fibrous minerals, etc.
- Highlight the factors affecting the mechanical behavior and/or the stability of the material or of the rock composition: micro-fractures, structural changes, corrosive minerals, soluble minerals, freezing…;
- To place the rock in a classification: generic classifications are important because they provide a common language, a common nomenclature for all earth science professionals.

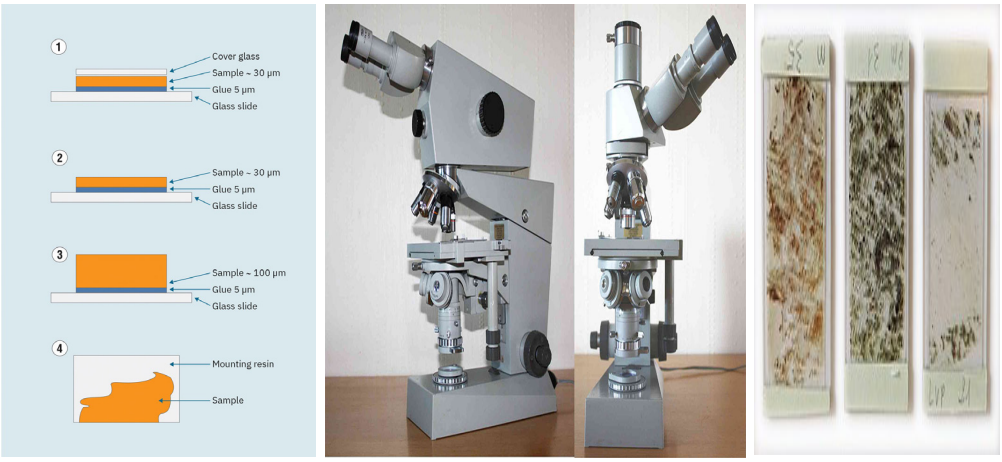

FIGURE 7. The preparation of the thin sections
and the Zeiss microscope with reflected light, used in this study.

For the presented study, thin sections were prepared from rock samples of carbonate rocks of Lower Eocene age, sampled near the village of Sasaj (sample P and sample N). The data are briefly presented below.

Based on the classification according to Dunham (1962), the two thin sections are classified as packestone - bioclastic floatstones (fig. 8.). The microfacies are characterized by a microfauna mainly composed of larger benthic foraminifers: alveolinids, rotaliids such as *Rotalia aff trochidiformis*, discocyclinids, nummulites, miliolids and also planktonic foraminifera. Fragments of echinoderms and micritized bioclasts are also found.

From a morphometric point of view, the components are generally rounded and present different sphercity with sizes between 0.2 mm and 2 cm for the largest grains represented by the larger benthic foraminifera, while the smallest grains are represented by unidentified micritised fragments. In terms of roundness, they have different sphericities: subangular, rounded and well rounded.

The microfaunistic association is typical for the Lower Eocene, more precisely for Cuisian\Ypresian, based on alveolinid foraminifera and *Rotalia aff trochidiformis.*

The rock has no cracks and is quite compact. Both samples are microfacies with a granular support (bioclastic packstone. Therefore, considering the petrographic and petrological characteristics of the rock in terms of microfacies, quite good petrophysical parameters are expected.

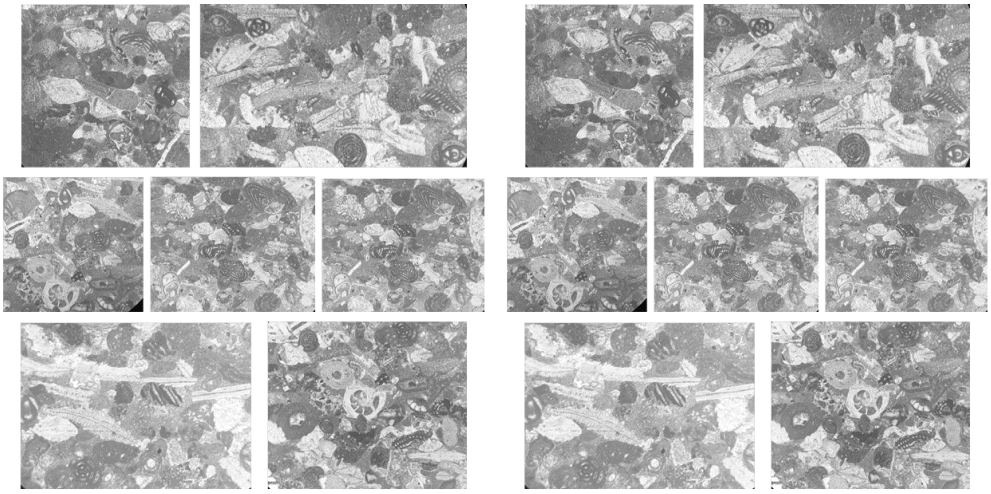

FIGURE 8. Microscopic views of thin sections of sample P (left) and sample N (left), Location, Sasaj (photo source Sokol Marku, personal collection)

Discussion of results and conclusions

The most important physical properties for the industrial use of carbonate rocks include textural composition, porosity, permeability, surface area and pore opening diameter distribution, water absorption and bulk density, hardness; compressive, tensile and shear strength; stiffness and elasticity, refractive properties and thermal conductivity (Harben and Purdy 1991; Bellanger et al. 1993; Winkler 1994). The physical and chemical properties are controlled at least in part by the nature of the microfacies. There are specific correlations between depositional microfacies of the rocks, rock color and amount of non-carbonate content and help differentiate the purity of limestone rocks (Dimke 1997). The relationships between depositional microfacies, diagenesis and porosity explain the types of alteration.

The limestones of Sasaj region are characterized by microfacies of grain-supported type, i.e. with granular support (grainstone or bioclastic packstone) which compared to those with micritic or mud support, i.e. with micritic matrix, are showing optimal petrographic and petrological characteristics, so we could expect better petrophysical parameters than the limestones with micritic support from Lura and Staveci, Mirdita geological zone. In the case of Lura and Staveci, the presence of clay minerals and Fe-Mn minerals has the opposite effect, that is, it causes a decrease in the strength of these rocks, so they are less performant compared to our samples from Sasaj region, Ionian geological zone.

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