

# #ICITTB2022

SHAPING THE FUTURE: DIGITAL ECONOMY AND RECENT TECHNOLOGY TRENDS

INTERNATIONAL CONFERENCE ON  
INTELLIGENCE-BASED TRANSFORMATIONS OF  
TECHNOLOGY AND BUSINESS

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## **Opening Remarks**

**by Prof. Dr. Sokol Abazi,  
Rector Canadian Institute  
of Technology (CIT)**

***Ladies and gentlemen,  
Distinguished participants,  
Honorable guests,***

I take this special opportunity to welcome you all to the second International Scientific Conference entitled International Conference on Intelligence based Transformations of Technology and Business (ICITTB) “SHAPING THE FUTURE: DIGITAL ECONOMY AND RECENT TECHNOLOGY TRENDS”.

It is a great pleasure for me to declare open the Conference and to welcome the participants from all over the world, 20 different countries, more than 100 researchers and 60 full papers, who are here to exchange experience and work together on this day on the exciting fields of economy and technology.

The recent crises have uncovered the vulnerabilities of societies, individuals, businesses, and economies, demanding for a reshaping of how social, economic, and technological activities are organized. This crunch calls for reactions based on responsibility, solidarity, and co-operation. Given this background, Canadian Institute of Technology in co-operation with other universities and main actors is organizing the International Conference on Intelligence based Transformations of Technology and Business (ICITTB): “Shaping the Future: Digital Economy and Recent Technology Trends”.

This scientific event aims to welcome international partners in the field of economy and technology through their work to highlight and analyze the main challenges and trends in various fields of technology and economy. Enhancement and proper utilization of resources to build a better and safer society is a responsibility we must all endeavor to embrace.

At the CIT, we are conscious of the ever-changing technological environment in which we thrive and strive to align science and technology

in the faculties of Engineering and Economy with the current socio-economic and legal developments. For instance, one of the goals committing CIT to its mission is to develop and advance knowledge through teaching, and academic activities carried out within the country and abroad. This means that CIT is committed to cooperation with various institutions both in the private and public sector, at home and abroad, for the betterment of society.

The vision of and mission of CIT Cooperation is necessary for the creation and application of knowledge in the social, economic, and technology fields.

Therefore, I call on all participants to maximize this opportunity by devising ways of greater cooperation in different aspects. We should also endeavor to develop modalities of cooperation between the academic fraternity inter-governmental and non-governmental organizations to enhance efficient policy development in economic and technological development, especially after having learned much from the disruptions triggered by the Covid-19 pandemic.

CIT takes this conference as an excellent opportunity to enhance our collaboration with participating institutions and as a platform for making strides towards the attainment of our mission of developing students' skills and abilities while promoting competition and improving education. In addition, as an opportunity for the realization of our vision geared towards preparing students to shape their lives, careers, and society at large.

The Canadian Institute of Technology understands the value of peer reviewed research and the importance of the dissemination of this knowledge. With this ethos in mind, it has organised over 20 international conferences and 50 round tables over the last decade. This has resulted in the publication of 1,500 papers from the 1,800 international and national scientific participants. As I conclude my remarks, I would like to thank you again for working hard to ensure success for this conference. I call upon all participants to do everything possible to make this conference memorable and profitable for all of us. To our distinguished guests, thank you for being part of this conference.

At the same time, I'd like to express my gratitude to the Organizing Committee and to those who worked hard to make this wonderful conference happened.



## Concluding Remarks and Prospects

**by Prof. Dimitrios A. Karras,  
General ICITTB 2022 Chair  
Canadian Institute of  
Technology (CIT)**

The International Conference on Intelligence based Transformations of Technology and Business (ICITTB) “SHAPING THE FUTURE: DIGITAL ECONOMY AND RECENT TECHNOLOGY TRENDS” 2022 is now a history. It has been a great opportunity for CIT to organize such a successful scientific event bringing together researchers from many different fields dealing with the Digital Transformation of our societies. The statistics of the conference have been very satisfactory, interconnecting researchers from more than 20 different countries worldwide from nearly all continents. More than 55 interesting papers presentations have been organized in face to face or virtual mode, spanning some of the most important aspects of Digital Transformations, including Artificial Intelligence impact on Digitalization, Cybersecurity, Theoretical aspects and methodologies in Digitalization, Financial and Business Digitalization Transformations as well as Digitalization in Education. Moreover, more than 10 keynote speakers covered a wide range of topics in Digital Transformation of our Societies, contributing immensely to this success. One of the most important aspects of this conference has been that nearly all works have been presented, fostering discussions and contributing to a very lively scientific event. We would like to Thank you all for attending this conference and being a part of this enlightening experience. We hope that the insights and knowledge gained over the past few days have been valuable to you, and that you will take away practical learnings and actionable insights from the presentations and discussions. We would like to express our gratitude to our distinguished speakers, panelists, and moderators, whose expertise and contribution have made this conference a great success. Their valuable insights have certainly enriched the discussions and provided food for thought.

We hope that this conference has provided a platform for networking and forging new partnerships, and that it has helped to build bridges between different disciplines and sectors. We look forward to seeing you at future events and continuing the conversation.

In conclusion, we believe that the proceedings you now herein hold reflect all the above facts and present good quality of scientific research in the aforementioned fields. We would like to express our gratitude to our reviewers and the editorial team without the help of whom this conference and these proceedings would be impossible. We have to remind that these ISBN proceedings is the first only publication step of the works presented. ICITTB is envisioned to be a high quality scientific event and the participating herein authors have been already encouraged to submit extended versions of their papers for further indexed publication processes and opportunities. Finally, we would like to express our gratitude to CIT that hosted this event, with all its resources, without the support of which nothing would be possible. We envision this conference to be a real attractive platform for all researchers and a focal point for research results announcements and publications in Western Balkans

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# **KEYNOTE SESSIONS PAPERS**



# Transhumanism

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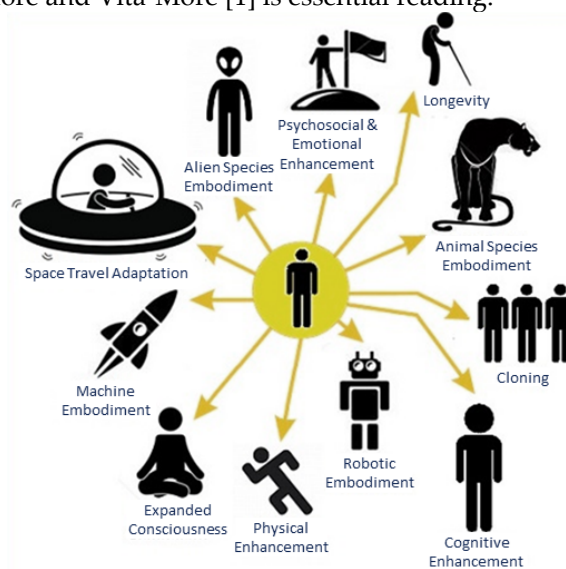
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**Abstract:** The concept of transhumanism, its purpose and its implementation using bio-transformative technologies is introduced. The applications of transhumanism are illustrated leading to the so-called second evolution of mankind (Human 2.0) covering life extension technologies. The conclusion lists seven ways the world will change by 2030 [body augmentation; thought transference; behavioural science and gamification; empathetic interaction; extreme personalisation; business paradigm shifts and greater conformance to societal values] and the comparison of futurist ideas and positions.

**Keywords:** *Transhumanism; Bio-transformation; Longevity; Posthumanism; Humans 2.0*

## 1. Introduction to Transhumanism

Transhumanism is generally understood as the concept that the human race can evolve beyond its current biological, physical and mental limitations by utilising science and technology “to augment human capabilities”<sup>1</sup>. Fig. 1, below, illustrates 11 transhuman adaptivity. The core of transhumanism is to use “bio-transformative technologies” in order to “enhance” the human organism, the aim being to overcome human limitations<sup>2</sup>. For a “comprehensive survey of the origins, [key thinkers] and current state of transhumanist thinking”, the book edited by More and Vita-More [1] is essential reading.



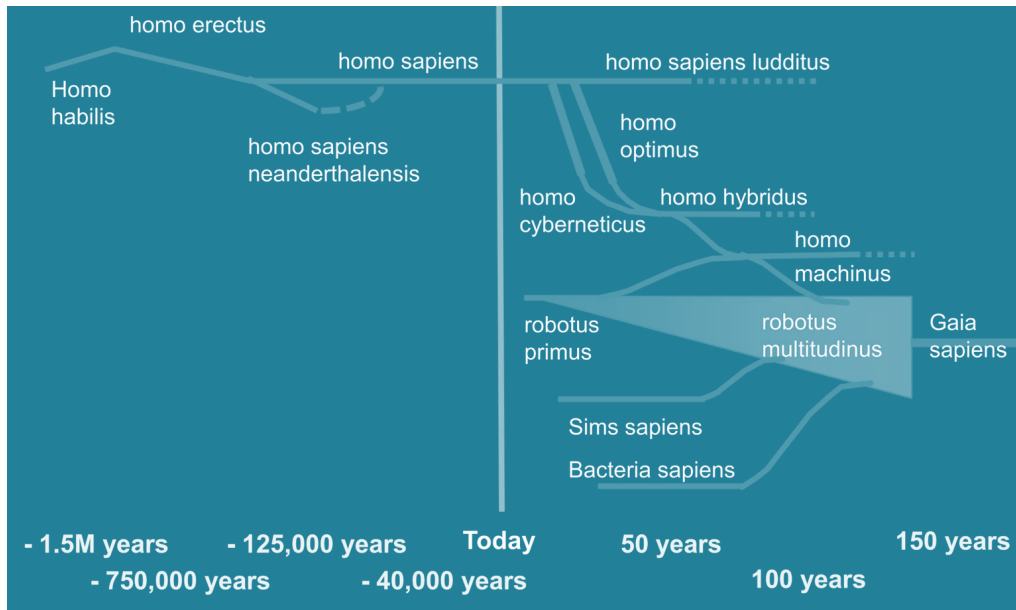
**Figure 1.** Application of Transhumanism [2].

Prof. Kevin Warwick is considered to be the world’s first cyborg. He formed a symbiotic connection with a robotic hand linking his nervous system to a computer, controlled with his brain signals in 1998 [3].

<sup>1</sup> <https://www.britannica.com/topic/transhumanism> [Accessed: 13 March, 2023].

<sup>2</sup> Transhumanist FAQ. Available: <https://www.humanityplus.org/transhumanist-faq> [Accessed: 12 March, 2023].

The ultimate goal of some ardent transhumanists is the complete fusion of human and machine through human-machine convergence. As Fig. 2 show, the eventual trajectory is the merging of *homo hybridus* with *robotus primus* to produce the novel species of *homo machinus*.



**Figure 2.** Human-machine Convergence [4].

Current Artificial Intelligence (AI) is classified as “narrow” as they still have imperfections and have not reached the same level of intelligence as humans, known as “Artificial General Intelligence”. Artificial General Intelligence is necessary in order to achieve human-machine convergence. This technological singularity is often labelled “Human 2.0”. With singularity it is expected AI to continue to evolve to “Artificial Super Intelligence”. The curve of technological evolution is shown in Fig. 3, below.



**Figure 3.** The Path to Artificial Super Intelligence<sup>3</sup>.

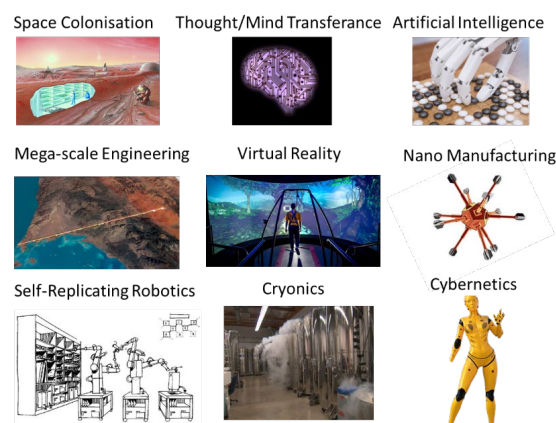
<sup>3</sup><https://cmte.ieee.org/futuredirections/wp-content/uploads/sites/44/2018/09/future-scenarios.png> [Accessed: 12 March 2023].



Transhuman technologies has already been applied in human history starting with using artificial prosthetic limbs. The initial application was for a long time simply repairing or making it possible to lead a normal life as possible. Only in recent times has application of technology being used for lifestyle adjusting and now for augmenting the human senses. This trend has accelerated with applications that cover boosting and embellishing of human capabilities. More controversial augmentation is still to be applied, such as replacing limbs and organs with synthetic ones by choice or the addition of additional sensors. Once the trend starts, it is likely to expand to altering, redefining and restructuring of the human body by choice and not just for the repairing of accident damage nor to help with disabilities.

## 2. Applications of Transhumanism

Fig. 4, below, categorises nine broad application domains for transhumanism. Already applications include AI, molecular manufacturing, cybernetics, VR (virtual reality) and the commencement of the Neom<sup>4</sup> mega-scale building engineering project in Saudi Arabia.



**Figure 4.** Applications of Transhumanism.

The application of transhumanism to the eventual Human 2.0 goal will be achieved in stages with the creation of transgenic humans, designer babies, postgendered humans, eco-humans (engineered humans to fit in a particular eco-habitat), continuing to space humans and finally sentient robots. Life extension technologies of transhumanism has already started with: gene therapy, fooling of genes, cryonics and nanotechnology. More advanced research includes cloning and body part replacement with the possibility of mind transfer.

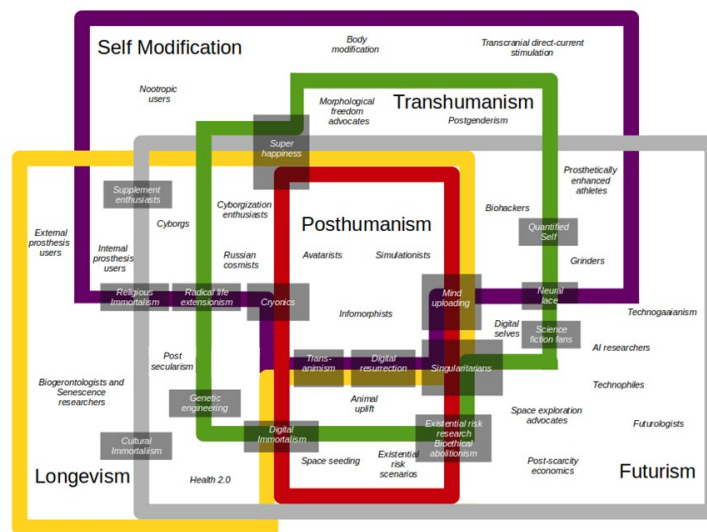
## 4. Transhumanism and the Future of Humanity

Seven ways that the world will change by 2030 is listed below [5]:

- I. Our bodies will be augmented.
- II. Our thought processes will be faster and more transferable.
- III. Gamification and behavioural science will increase human productivity.
- IV. We will be more empathetic.
- V. We will see the emergence of extreme personalisation and customisation.
- VI. Business practices will shift significantly.
- VII. Conversations focused on our societal values will gain a great deal of attention.

Fig. 5, below, summarises the interrelationship between the various domains and application of transhumanism. It is interesting to note, that the red square, termed "Posthumanism", encompasses all the broad categories of transhumanism.

<sup>4</sup> <https://www.neom.com/en-us/regions/theline> [Accessed: 12 March, 2023].



**Figure 5.** Comparison of Futurist Ideas and Positions by Chris Monteiro<sup>5</sup>.

## 5. Conclusion

This is a very controversial and contested topic, however, the application of transhumanism may be argued as being as old as the existence of humans. The widespread application and speed of transhumanism has been made easier with the acceleration of technologies. There is the danger of the divergence of the human species – between those who are enhanced versus those who are non-enhanced (i.e. natural). This could see the emergence of transhumans and AI Sentient beings with their new laws of ethics.

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<sup>5</sup> [https://hpluspedia.org/wiki/Comparison\\_of\\_futurist\\_related\\_ideas\\_and\\_positions](https://hpluspedia.org/wiki/Comparison_of_futurist_related_ideas_and_positions) [Accessed: 12 March, 2023].

**PARALLEL SESSIONS  
PAPERS PRESENTATION**

**SESSION 1**

**CYBERSECURITY AND CLOUD COMPUTING  
SESSION CHAIR: DR. ADISA DABERDINI**



# Implementation of IDSS in Albanian Businesses

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**Abstract:** Most companies have no problem gathering data but analyzing it and creating a Business Model is the most crucial and time-consuming part. Smart business decisions are the trend for the moment, and the gap between data analytics and decisions is where a decision support system (DSS) comes in. A DSS gathers and analyzes data and then incorporates it into comprehensive reports. This methodology can be carried out by Artificial Intelligence (AI), human decision-makers (DM), or a mix of both, leading to intelligent decision support systems (IDSS). AI algorithms are very efficient for businesses to use for decision-making. This study aims to investigate the most effective and trending applications of IDSS and analyze through questionnaires the current situation in their implementation in Albanian businesses. The study shows the Albanian businesses' digital transformation and the new perspectives coming through with the support and infinite possibilities that digitalization offers.

**Keywords:** DSS; AI; Albanian Businesses; Digitalization; Implementation.

## 1. Introduction

Nowadays, life is technologically dynamic and rapidly changing in all facets. It has been significantly impacted by modern technological advancements and trends, meaning that most of our decisions are driven by these changes. With the growing impact of these trends, COVID-19, and the continuous need for improvement, comes the need for efficient choices, especially related to business. Additionally, there have been significant modifications to the decision-making process. A decision support system (DSS) aids in the decision-making process to get the best results. The area of information systems (IS), known as DSS, is dedicated to assisting and enhancing managerial decision-making. Decisions of this nature are frequently complex and unclear [1]. Gaining a competitive advantage and efficiency are the primary motivations for creating and using information systems to support decision-making processes. Combining them with Artificial Intelligence (AI) results in even more accurate and automated results. The main goal of this paper is to analyze the adoption of such systems in Albania and highlight the main issues businesses are facing. An online survey was conducted, and the results were analyzed to identify the elements that influence how managers of business organizations in Albania use DSS.

## 2. Intelligent Decision Support System

An effective IDSS is primarily meant to aid the decision makers' efforts and ensure that essential details are not overlooked. Tariq & Rafi [2] said that DSS does not supervise the decision and never replaces human decision-makers, but they support them and help them make better and consistent decisions.

An IDSS might examine the following sorts of data: Data sources, Documents, Business models, Employee knowledge, Client knowledge, Sales predictions, Electronic records.

Because Decision Support Systems perform a wide range of tasks and have a wide variety of software platforms, design and development are essential. The selection of an acceptable approach or technique for developing DSS has been a fiercely debated subject in the information systems (IS) literature. One group of DSS experts bases their suggestions for creating Decision Support Systems on the established literature on systems analysis and design [3]. Another group has recommended and described an iterative, prototyping, or "quick-hit" method for creating DSS [4]. Some authors note both techniques without explicitly articulating the

benefits and disadvantages or other circumstances that could favor a specific strategy or a particular combination of approaches. Allowing managers to create their own customized DSS is the third method for creating DSS. The empirical study of design and development methods is minimal. An effective IDSS should: assist decision-makers with available new and verified relevant data, provide access to a knowledge repository, provide an infrastructure for interpretation and classification of new knowledge, have the ability to distinguish between verified and unverified data [3].

According to Simon [4], there are four primary stages in the decision-making process:

-Intelligence: gathering information, detecting issues and opportunities, collecting, analyzing, and exploring data;

- Design: create a model, specify selection criteria, and conduct an alternatives analysis, modeling, and simulation;
- Selection: evaluation of alternatives, sensitivity analysis, selection of the best options, and implementation strategy;
- Application: Implementation of the selected alternative.

Based on the above, there are a lot of possible applications for an IDSS, especially after the impact of Covid-19 on the online development of most businesses. Retail experts can use an IDSS to carry out several crucial tasks for a store environment and choose pricing strategies. Think of a software program that runs on a store's cash registers and can simultaneously review data like purchase history, inventory costs, and spending plans. Store managers can use this tool to plan strategies to boost sales, such as which products to mark down and when to advertise goods. Banking organizations may use an IDSS to examine financial data, such as asset reports and revenue statements. An autonomous DSS procedure commonly functions as artificial intelligence when software developers create digital products for clients. When performing simple tasks daily, people may use these tools. For instance, GPS software frequently uses this kind of DSS to assist in mapping a precise route between two points.

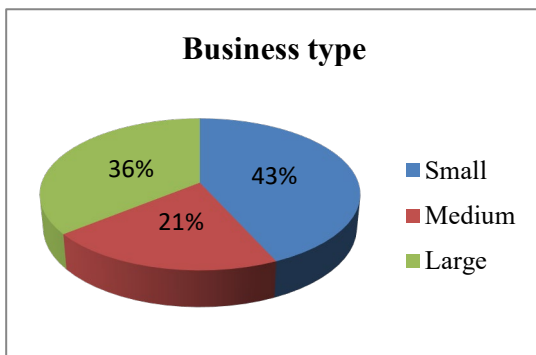
### 3. Research Results

Before analyzing the results is essential to specify that except the usage or not of IDSS from businesses is as necessary to consider the success of such a system [5]. As seen from different studies [6], there are six sets of variables:

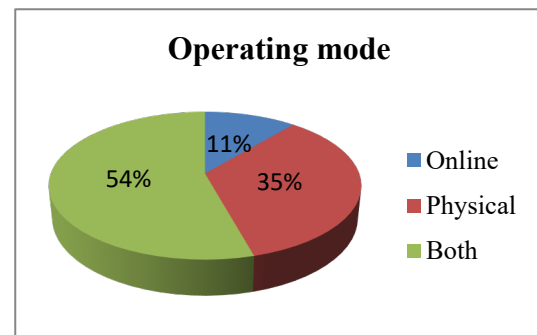
1. Features of the application procedure (top management support, user training, and user involvement);
2. The nature of the commercial task (task structure and certainty, task difficulty, task variability, and task independence);
3. Knowledge about the decision-makers (organizational level and IDSS experience);
4. Details on the IDSS (the supported phase, level of managerial activity, and source of information);
5. The IDSS's user satisfaction rating;
6. User opinions regarding the advantages of IDSS.

The questionnaire was addressed to all businesses without distinction. The main goals were, of course, to identify the degree of use of IDSS systems by companies in Albania; secondly, the success of implementation as a significant factor for these systems; thirdly, the market tendency towards the use of these systems; and finally, the possible reason for non-use.

43.2% of the survey participants are small businesses, 21% are medium-sized businesses, and 35.8% are large businesses. These companies work in many sectors, typically have physical locations, and provide online services.



**Figure 1.** Statistics according to business type



**Figure 2.** Statistics according to operating mode

As expected, small businesses are almost unfamiliar with these systems, while medium and large businesses, apart from implementation, are regular users of these systems. The organization and continuity of the work process are integrated with the work and suggestions of the system, but none of the users has complete confidence in the system. In any case, the interviewed managers periodically check the work process and the plan. Something interesting that came to light is that most of the companies that use an IDSS system operate with franchising. Their contract allows them to use the system and periodic staff training, so using it is not difficult. Companies that had implemented the system through the internal group had chosen to buy the software and make the adaptations according to their needs. In these cases, the difficulties of the staff in adapting to the system appeared, even though most of them accepted the facilitation of the work and did not question its success. Subjects in the adaptation phase found it more difficult to express themselves and were not completely convinced of the system's success. External subjects (Albanian or otherwise) offering software development services were also an option, even though most had no idea where to look for such systems.

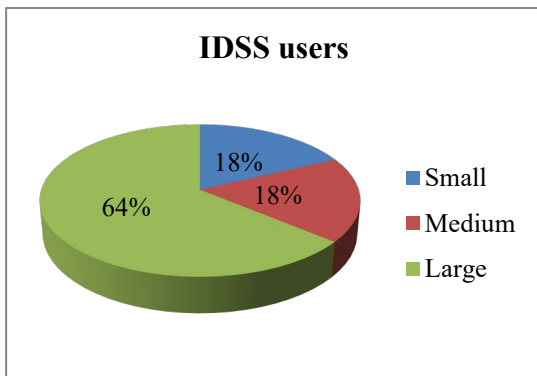


Figure 3. IDSS users classified by business type

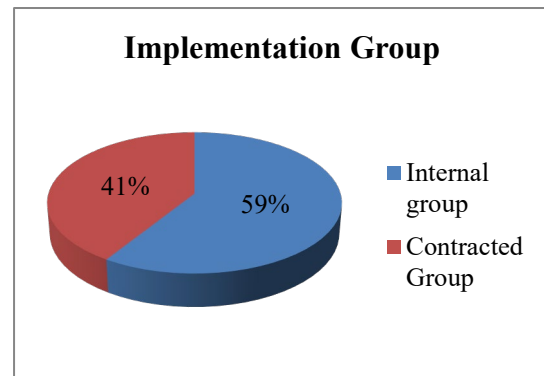


Figure 4. IDSS users classified by implementation type

Small businesses typically struggle with adopting these systems, as observed in earlier research [7], primarily due to the cost but also because well-prepared human resources are needed, which is a requirement for these systems. IDSS systems are expensive, which means they are substantially more expensive for the Albanian business. Although there are companies that develop and sell software that offers decision support, employees with the necessary training are required for its application. The fact that small businesses hardly ever use the phrase and prefer to carry on utilizing the fiscal systems that the Albanian state has included in its laws and the traditional operating methods is worrying. Another issue in these businesses is a lack of understanding and trust in technology, as their plans do not call for further investment in these technologies. In the next two years, costs may rise because of the new regulations about tagging and tracing the European Union is putting in place for products, particularly for companies that sell consumer products, retail and automotive [8]. Alternatively, we will continue to pay the same price for a product that is of lesser quality and does not meet EU criteria.

4. Conclusion

Artificial intelligence is currently an essential element of every technological development, but according to the research subjects, it is not a dependable source. In addition to increasing the efficiency of decision-making processes, intelligent DSS can be used to provide decisions that are realistic and reliable. IDSS uses various methods and strategies for decision support activities, ranging from straightforward data reporting tools to sophisticated AI systems. Combining human expertise with modeling technologies supports decision-makers throughout high-level decision-making stages. These systems continue to be a resource that can give businesses a long-term competitive advantage.

With the incoming and growing need for digitalization, all will feel the need to upgrade and rely on the internet and technology, whether we are talking about developed or developing countries or without distinction of industry and income. Things are changing very fast in each direction, and the only way to be in the line is to follow the rhythm and invest in growing and staying in the market. As expected, Albanian businesses are still very behind with technology integration in the managerial part. What can be seen as a bigger problem is the lack of confidence in this technology.

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# Security Applications in Linux Operating Systems and Practices for their Protection

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**Abstract:** Linux is an operating system which is considered one of the most protected this day and is being used massively for building information technology systems, it is open source but for organization and institution there are licensed versions. Considering the security and ease that offers to IT professionals and more, more and more people are using it for a variety of tasks. In this study, we will make an evaluation of the security of Linux, starting from the evaluation of the attacks that we have encountered in our systems, Linux attacks are presented in different ways and attackers have several ways to attack a server. Security should be one of the main thoughts we have in all stages of configuring a computer or a Linux server. To implement a good security policy on servers and systems Linux on a computer, a good knowledge of the basics of Linux is required, as well as some of the main applications and protocols used in these systems. The main security requirements presented for Linux systems and beyond are: Authenticity, Authorization, Privacy and Confidentiality, Integrity and Availability. Linux has a security model built into its system by default. Necessary changes should be made to it and adjusted or customized according to the needs and requirements of the technology system where it will be used and that can help to make the system more secure. Linux is one of the most difficult operating systems to manage, but it is also a system that offers more flexibility and options during its configuration. Methods that can be used to protect or ensure greater privacy in Linux system are: Update the server you have configured, Create new privileged user account from time to time, Upload your SSH key, Secure SSH, Enable a firewall and Remove unused network facing services etc. Methods that can be used to protect or ensure greater privacy in Linux system are: Update the server you have configured, Create new privileged user account from time to time, Upload your SSH key, Secure SSH, Enable a firewall, Install Fail2ban and Remove unused network facing services. It also examines the general security that is used in the technology system where Linux is configured as a server and offers some possible solutions that can be used to increase security in these systems. In this study, we have identified some of the main attacks that have been encountered in systems built with Linux, what are some of the main risks of these systems, the methods that have been used to protect systems built with Linux and how they will be used in practice for their protection in institutions. In conclusion, we can say that Linux systems are among the most secure systems that can be used today in the servers of various organizations and institutions, but also in private sector companies.

**Keywords:** *Security; Linux Systems; Confidentiality; Linux Attacks; Technology System.*

## 1. Introduction

In this article, we will discuss many threats that plague Linux operating systems, both for end users and servers. These systems have always been the most targeted by attackers, considering the security they have offered so far. Servers and computers that use Linux systems have been considered and continue to be considered the safest from cyber threats. [1] Despite the security that Linux offers, it is always attacked by various threats and dangers. We have presented some of them in this article. According to the data we received for the distribution of Linux, we can say that more than 90% of the main servers and services offered in the cloud are installed on Linux platforms. These are also made by the security that Linux offers as a platform.

Like all other software and Linux is not free from threats and all games of risks related to security. Although, it has shown greater stability and durability against these risks compared to other operating systems. [2]

In this article we will take into consideration the threats of Linux as an operating system and also starting from the fact that the most important systems and services have been built there. [3] For this reason, regardless of its strength as an operating system, Linux is prone to many risks and threats. In this article we will also mention some of the weaknesses that include in some cases the configurations that can be wrong in Linux or even any problem that can be created and encountered in Linux security.

The Linux operating system we have considered is red hat 7.0, in which we have included some security elements and installed an antivirus. The system is expected to provide the logs of the attacks that will occur and to see if the system we have configured will have any problem of breaking into the attacks that will be made.

## 1.1. Vulnerabilities in different Linux platforms

The systems that are built for public services are the most threatened and the first target for cyber threats. One of the problems that are often noticed is that these systems have a pronounced lack of vulnerability tracking and then procedures for adjusting the system. This can leave public systems very exposed when vulnerability is found or an exploit of these systems is made public. From the recent publications of such events, it is noted that at least there is no procedure for reading attacks and threats in such systems in most organizations. Another concern that comes from security in Linux systems is that most of the code that works in these systems is open source. [3]

### 1.1.1. Vulnerabilities in the Applications

Weaknesses in the applications that will be used is one of the reasons that there have been problems in the past in Linux systems. [4]

Depend of the type of what are you using a Linux server /client we have encountered some vulnerabilities. -in clients Linux OS:

- 1- open only SSL communication between it and server
- 2- certificate installation (SSL)
- 3- SMTP Authentication required (in outlook clients)
- 4- controlled access of internet (not everything is allowed), this you can do it with NGFW
- 5- USB and CD/DVD device blocked
- 6- Email (phishing,) instruct clients and remind them time to time what kind of emails he can open ore other that are suspected.
- 7- Antivirus
- 8- Discipline-in Linux servers OS [5]:
  - 1- Access
    - a) one person can have the Super-user password
    - b) never login with super user on server, locally and remote
    - c) restrict remote access (allow only system administration with username and ip to login )
    - d) restrict SSH access (no root allowed login)
  - 2- SeLinux active and rules for rwx in certain files
  - 3- Declare only the app that you have installed, in SeLinux
  - 4- PKI, SSL \$ TLS communication
  - 5- Password policy restriction
  - 6- using different ports (not default) for remote login
  - 7- Antivirus customized application (example mail server how many emails you can send, time, email capacity, in how many users you can sent in the meantime)
  - 8- Controlled internet (with NGFW)

9- Save-in logs (system and application) for minimum one year.[6]

10- Frequently updates of the system.

Some of the main vulnerabilities are also listed in web application vulnerabilities, SQL interventions, external XML entities, XSS page scripts, etc. Interventions from the web have become one of the main points in the attacks that we can encounter in many systems. [7]

### 1.1.2. Cloud security gaps and misconfigurations

The bad configuration of systems is very common and is also one of the biggest concerns that has brought criticism in the field of security. [8] Companies, organizations and institutions that switched to new systems in the IT field and building applications in Linux operating systems cause some of the configurations to be wrong. These were mainly placed in cloud environments; databases and they do not have a server for filtering and protecting them from external attacks.

Below we have presented some of the bad configurations in LINUX environments:

- Using a default or a weak password
- Services Exposed on the internet (open ports)
- open shared files
- APIs unprotected and exposed [9]

## 2.Security in Linux

The security offered by a Linux system is one of the most important topics. Compared to many other systems, the security in these operating systems continues to be more developed. [10]

### 2.1 Security based on the design of the operating system

Linux in many ways compared to other systems has security built into its core design. As an open source operating system such as Linux systems, it offers great flexibility, is configurable and has variety in its use and configurations [11]. It as an operating system offers the choice of integrated kernel protection, and also a strict model of user privileges. Being a system with transparency in the source code, this means that its weaknesses, which are the weaknesses of many operating systems, will be short-lived. We have seen this from the development that Linux has had over the years, but also from the modifications made to the code of this operating system.

### 2.2 Advantages of open source systems

Since Linux is an open source system, it has the opportunity to have its code content reviewed frequently by many members of the community of these systems. [12] Weaknesses in this way are identified more quickly and can therefore be fixed more quickly. This is different from Microsoft systems which, being closed systems, do not offer this possibility. They can be identified as problems and fixed only by the designers of this system.[8]

### 2.3 A Super\_user in Linux

Unlike other systems, Linux offers the possibility of only one person being the super user who has the right to see the system's roots. Other users of the Linux system can only make changes, but not look inside the system's packages. This makes this system much more protected, it is more difficult to spread malware and rootkits on a Linux system. Whereas the Administrators in Windows have equal rights in the system and can make changes.

## 2.4 Kernel security protection

The Linux kernel has a series of built-in security protections including firewall, packet filters in kernel, UEFI secure Boot firmware, Lockdown configuration option of the Linux kernel, SeLinux etc. By configuring these options and activating them, we have activated the self-protection of the Linux kernel. In the Linux systems if you gain control of the kernel you have control in overall system.[9]

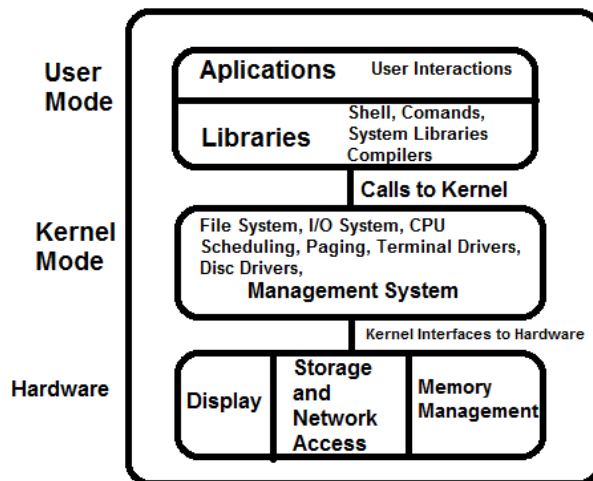


Figure 1. Construction of Linux System

Kernel vulnerabilities occur for two reasons in general: incorrect system configuration and coding errors. Some of the vulnerabilities that have been detected earlier were: Heart bleeding (CVE-2014-0160-due to failure of Open SSL allow the extraction of information), Meltdown and Spectre (CVE-2017-5753, CVE-2017-5715, CVE-2017-5754- reading of the memory), SACK Panic and Slowness (CVE-2019-11477, CVE-2019-11478-denial of services from kernel). We will see if some of these vulnerabilities will be present in our system. [2]

When Linux have a right configuration than the system is free from any risk. Some of the steps to configure e Linux system are:

- shutting down all the unused services and ports that have access in the network,
- managing penetration test result
- data encryption
- network segmentation
- test code and review
- communication secure
- locking or removing default passwords
- limiting servers to a single function
- removing all unnecessary utilities and software
- auditing and managing privilege account access

## 3. Material and Methods

Before we install LMD, there are some dependencies that must be installed, *epel-release*, *inotify-tools* must be installed so that LMD has access to the *inotify wait* command *after installing LMD (maldetect)* we must create a symbolic link to the *LMD executable*. [13]

This is the way that the *av* looks in logs directory after installed.

Name	Size	Owner	Mode	Modified
..				
clamscan_log	523.98 KIB	root:root	0640	2022/10/10 - 15:41:38
event_log	1.47 MiB	root:root	0644	2022/10/10 - 15:41:44
inotify_log	8.18 MiB	root:root	0640	2022/10/07 - 13:30:18

Figure 2. Logs directory

With LMD installed, we have changed a few configuration options, to enable clam scan and quarantine scan from 0 to 1. Then we have installed of ClamAV. We have put the LMD to monitor mode, so we have customized the monitoring folder with detection, depend of what type of server we have implemented. [14] At the and the creation of a cronjob to generate a hourly report because by default maldet is set to generate only one report a day.

### 3.1. Antivirus for Linux Security

Now days with the increase of use of technology and needs for communication and sharing information all around the world, the new application and platform applied in system and client the Linux serves could be susceptible to malware and viruses, so the best way to manage that is to install an antivirus. in this study we have tested in our Linux server the LMD (Linux Malware Detect), and Clam AV antivirus. We have chosen this AV because we have two type of prevention and detection method. [15]: The first one is a malware scanner for Linux released under the GNU GPLv2 license, that is designed around the threats faced in shared hosted environments. <sup>6</sup> The landscape of threat in shared hosted environments is unique from that of the standard AV products detection suite, they are detecting primarily OS level Trojans, rootkits and traditional file-infecting viruses but missing the ever-increasing variety of malware on the user account level which serves as an attack platform. [3] The second, for increasing the performance, standards, multi-threaded scanner daemon, command-line utilities for on-demand file scanning and automatic signature updates of our system we have installed Clam AV.[12]

### 4. Analyzing the Data collected

In order to ensure this is working, we need to download a few malicious files to our server. To do this, go to the terminal window and issue the following commands:

```
cd /var/www/html
wget http://www.eicar.org/download/eicar.com.txt
wget http://www.eicar.org/download/eicar_com.zip
wget http://www.eicar.org/download/eicarcom2.zip
```

Back at the terminal, issue the command `maldet -a /var/www/html`. When this command runs, it will find the malware, quarantine it, and report it.

At the end of the scan, maldet will instruct you on the command to run to view the report.

<sup>6</sup> <https://www.rfxn.com/projects/linux-malware-detect/>

```

aldet(18576): (mon) scanned 0 new/changed files with clamav engine
aldet(18576): (mon) warning clamd service not running; force-set monitor mode file scanning to every 120s
aldet(18576): (hit) malware hit (YARA)SafeOver_Shell_Safe_Mod_Bypass_By_Evilc0der_php found for /usr/share/clamav/rfxn.hdb
aldet(18576): (quar) malware quarantined from '/usr/share/clamav/rfxn.hdb' to '/usr/local/maldetect/quarantine/rfxn.hdb.156647543'
aldet(18576): (clean) could not find clean rule for hit SafeOver_Shell_Safe_Mod_Bypass_By_Evilc0der_php or file /usr/local/maldetect/quarantine/rfxn.hdb.156647543 no
aldet(18576): (hit) malware hit (YARA)SafeOver_Shell_Safe_Mod_Bypass_By_Evilc0der_php found for /usr/share/clamav/rfxn.ndb
aldet(18576): (quar) malware quarantined from '/usr/share/clamav/rfxn.ndb' to '/usr/local/maldetect/quarantine/rfxn.ndb.1184524572'
aldet(18576): (clean) could not find clean rule for hit SafeOver_Shell_Safe_Mod_Bypass_By_Evilc0der_php or file /usr/local/maldetect/quarantine/rfxn.ndb.1184524572 no
aldet(18576): (hit) malware hit (HEX)php.gzbase64.inject.452 found for /usr/share/clamav/rfxn.yara
aldet(18576): (quar) malware quarantined from '/usr/share/clamav/rfxn.yara' to '/usr/local/maldetect/quarantine/rfxn.yara.1783624193'
aldet(18576): (clean) could not find clean rule for hit php.gzbase64.inject or file /usr/local/maldetect/quarantine/rfxn.yara.1783624193 no longer exists.
aldet(18576): (mon) scanned 16 new/changed files with clamav engine
aldet(18576): (mon) warning clamd service not running; force-set monitor mode file scanning to every 120s
aldet(18576): (hit) malware hit (YARA)SafeOver_Shell_Safe_Mod_Bypass_By_Evilc0der_php found for /usr/share/clamav/rfxn.hdb
aldet(18576): (quar) malware quarantined from '/usr/share/clamav/rfxn.hdb' to '/usr/local/maldetect/quarantine/rfxn.hdb.1282322698'
aldet(18576): (clean) could not find clean rule for hit SafeOver_Shell_Safe_Mod_Bypass_By_Evilc0der_php or file /usr/local/maldetect/quarantine/rfxn.hdb.1282322698 no
aldet(18576): (hit) malware hit (YARA)SafeOver_Shell_Safe_Mod_Bypass_By_Evilc0der_php found for /usr/share/clamav/rfxn.ndb
aldet(18576): (quar) malware quarantined from '/usr/share/clamav/rfxn.ndb' to '/usr/local/maldetect/quarantine/rfxn.ndb.220277173'
aldet(18576): (clean) could not find clean rule for hit SafeOver_Shell_Safe_Mod_Bypass_By_Evilc0der_php or file /usr/local/maldetect/quarantine/rfxn.ndb.220277173 no
aldet(18576): (hit) malware hit (HEX)php.gzbase64.inject.452 found for /usr/share/clamav/rfxn.yara
aldet(18576): (quar) malware quarantined from '/usr/share/clamav/rfxn.yara' to '/usr/local/maldetect/quarantine/rfxn.yara.26858221'
aldet(18576): (clean) could not find clean rule for hit php.gzbase64.inject or file /usr/local/maldetect/quarantine/rfxn.yara.26858221 no longer exists.
aldet(18576): (mon) scanned 20 new/changed files with clamav engine
aldet(18576): (mon) warning clamd service not running; force-set monitor mode file scanning to every 120s
aldet(18576): (hit) malware hit (YARA)SafeOver_Shell_Safe_Mod_Bypass_By_Evilc0der_php found for /usr/share/clamav/rfxn.hdb

```

Figure 3. Installation of malicious files

After the installation every day we monitor the logs of the running AV scan in clam scan, event log if its working and monitoring every hour.

```

event_log (/usr/local/maldetect/logs)
15643 Oct 12 14:01:16 ns1 maldet(1220): (mon) scanned 0 new/changed files with clamav engine
15644 Oct 12 14:01:16 ns1 maldet(1220): (mon) warning clamd service not running; force-set monitor mode file scanning to every 120s
15645 Oct 12 14:01:43 ns1 maldet(1220): (mon) scanned 0 new/changed files with clamav engine
15646 Oct 12 14:03:44 ns1 maldet(1220): (mon) warning clamd service not running; force-set monitor mode file scanning to every 120s
15647 Oct 12 14:04:11 ns1 maldet(1220): (mon) scanned 0 new/changed files with clamav engine
15648 Oct 12 14:06:11 ns1 maldet(1220): (mon) warning clamd service not running; force-set monitor mode file scanning to every 120s
15649 Oct 12 14:06:39 ns1 maldet(1220): (mon) scanned 0 new/changed files with clamav engine
15650 Oct 12 14:08:39 ns1 maldet(1220): (mon) warning clamd service not running; force-set monitor mode file scanning to every 120s
15651 Oct 12 14:09:06 ns1 maldet(1220): (mon) scanned 0 new/changed files with clamav engine
15652 Oct 12 14:11:07 ns1 maldet(1220): (mon) warning clamd service not running; force-set monitor mode file scanning to every 120s
15653 Oct 12 14:11:34 ns1 maldet(1220): (mon) scanned 0 new/changed files with clamav engine
15654 Oct 12 14:13:34 ns1 maldet(1220): (mon) warning clamd service not running; force-set monitor mode file scanning to every 120s
15655 Oct 12 14:14:02 ns1 maldet(1220): (mon) scanned 0 new/changed files with clamav engine
15656 Oct 12 14:16:02 ns1 maldet(1220): (mon) warning clamd service not running; force-set monitor mode file scanning to every 120s
15657 Oct 12 14:16:29 ns1 maldet(1220): (mon) scanned 0 new/changed files with clamav engine
15658 Oct 12 14:18:29 ns1 maldet(1220): (mon) warning clamd service not running; force-set monitor mode file scanning to every 120s
15659 Oct 12 14:18:57 ns1 maldet(1220): (mon) scanned 0 new/changed files with clamav engine
15660 Oct 12 14:20:57 ns1 maldet(1220): (mon) warning clamd service not running; force-set monitor mode file scanning to every 120s
15661 Oct 12 14:21:24 ns1 maldet(1220): (mon) scanned 0 new/changed files with clamav engine
15662 Oct 12 14:23:25 ns1 maldet(1220): (mon) warning clamd service not running; force-set monitor mode file scanning to every 120s
15663 Oct 12 14:23:52 ns1 maldet(1220): (mon) scanned 0 new/changed files with clamav engine
15664 Oct 12 14:25:52 ns1 maldet(1220): (mon) warning clamd service not running; force-set monitor mode file scanning to every 120s
15665 Oct 12 14:26:20 ns1 maldet(1220): (mon) scanned 0 new/changed files with clamav engine

```

Figure 4. Monitoring the logs

This are all the files installed on server.

Name	Size	Owner	Mode	Modified
clean		root:root	0755	2022/10/12 - 03:26:58
cron		root:root	0755	2016/05/10 - 14:26:52
internals		root:root	0755	2022/04/30 - 03:51:25
logs		root:root	0755	2022/10/11 - 14:33:23
pub		root:root	0755	2022/04/29 - 09:58:02
quarantine		root:root	0750	2022/05/22 - 03:07:01
service		root:root	0755	2019/03/16 - 05:11:27
sess		root:root	0750	2022/05/23 - 03:20:01
sig		root:root	0755	2022/10/12 - 14:50:29
sig.old		root:root	0755	2022/10/12 - 03:26:58
tmp		root:root	0755	2022/10/12 - 14:50:57
CHANGELOG	45.31 KIB	root:root	0644	2022/04/29 - 09:58:02
conf.maldet	12.33 KIB	root:root	0644	2022/04/29 - 10:01:44
conf.maldet.cron		root:root	0777	2016/05/10 - 14:26:59
COPYING.GPL	17.66 KIB	root:root	0644	2022/04/29 - 09:58:02
event_log		root:root	0777	2022/04/29 - 09:58:03
hookscan.sh	702 bytes	root:root	0755	2017/02/17 - 19:31:49
ignore_file_ext	0 bytes	root:root	0644	2022/10/12 - 14:50:01
ignore_notify	201 bytes	root:root	0644	2022/10/12 - 14:50:01
ignore_paths	44 bytes	root:root	0644	2022/10/12 - 14:50:01
ignore_sig	0 bytes	root:root	0644	2022/10/12 - 14:50:01
maldet	7.2 KIB	root:root	0755	2019/07/06 - 04:46:04
maldet.1	9.9 KIB	root:root	0644	2019/03/16 - 05:11:27
modsec.sh		root:root	0777	2015/09/26 - 20:12:34
monitor_paths	0 bytes	root:root	0644	2015/02/05 - 05:25:39
README	23.62 KIB	root:root	0644	2022/04/29 - 09:58:02
uninstall.sh	1.54 KIB	root:root	0755	2018/08/08 - 19:15:57
VERSION	6 bytes	root:root	0644	2022/10/12 - 14:50:01
VERSION.hash	65 bytes	root:root	0644	2019/07/06 - 04:46:04

Figure 5. Files installed on server

Until now in our servers all is clean, we have implemented this for 6 months.

## 5. Conclusions

Linux is a reasonably secure operating system, but it is not perfect.

- Implementing the controls as suggested in this article and additional safeguards in Linux, like configuring all the options and installing two different antiviruses to protect the system made it very safe.
- Until now in our servers all is clean, we have implemented this for 6 months. We had some attacks and added some malicious file to see if the system works well, and finally we can say that the system reacted to them.

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# Cyber Security in Forticlient Institutions and Organizations

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**Abstract:** In this paper, we will present some of the security policy rules that recently are implemented in organization and institutions for data protection of the administrative personnel. One of the security appliances that is being tested and used for data protection in main and endpoint user is Next Generation FW (NGFW) Forti OS with the extension of Forticlient in enduser, connected with each other. This technology can be used in different ways with EMS and FortiGate. FortiGate is installed on a Linux server as it is one of the most suitable systems for such programs considering the protection they offer against various type of viruses. The analysis of the data was done based on the attacks that were recorded mainly on the server. The management of an organization and the creation of cloud systems, the mobile uses that are numerous today, as well as offering very good and necessary services, are also very vulnerable, since expanding to every user, then not everything can be controlled by IT. Today, governmental and non-governmental organizations in Albania and the world are moving towards a digital accelerator, an expansion and increase in the surface and complexity of the network, which automatically increases the tendency for cyber-attacks. From this arises the need for a new approach to provide a secure connection as well as high performance from the client to the application.

**Keywords:** *Cyber-Crime; Security; Automated Systems; Protection; Cyber-Attacks.*

## 1. Introduction of Cyber Security Application in Albanian Organizations

The only solution to secure the systems is the application of the principle of the secure network: "Wide. Integrated. Automated" [1], which means the creation of a central system that unites the concepts of a convergent development, i.e. towards a certain point similar to one another, consolidated, the use of robust software that provides security and stability in the work they perform as well as providing protection comprehensive cyber security for all; "users, devices and applications" and at all ends of the network [2]. Taking this into consideration, these organizations must create a cyber-security network, architecture (RSK) as part of their ecosystem. (general data for cyber protection, which are the software we used and what results are expected to come out) [3].

## 2. Construction of Architecture (RSK)

First, the central security devices must have an operating system that offers coded (encrypted) traffic, stability, security, high performance, and ensures interoperability with other hybrid systems, tools and applications that can be integrated into network [4]. Since the last 10 years the method for encryption of traffic and packages has been applied precisely in this field, hackers are also working to break this aspect of security, then to ensure that viruses, malware, command and control of traffic and exfiltration of data (data extraction)



not to let us slip and in this encrypted traffic, these devices must ensure a deep and detailed inspection of the packages (deep inspection) and high performance.

But how can the detailed inspection of an encrypted package be done? Only by decrypting it, the process of encryption and decryption of information packets by security devices (SSL deep inspection). If we combine other algorithm options such as "application control", antivirus, ips (intrusion prevention) which are included in threat protection, it requires a hardware with high parameters to ensure high performance in a fast time.

The central device must necessarily be a "Next generation" device, offer application control, ips, antivirus, antisipam profile, dlp (data leak) sensor, waf (web application firewall), SSL dip inspection, SSH, dns filter, black and white list.

To inspect protocols http, https, imap, imaps, ftp, ftps, MAPI, POP3.POP3s. APT protection includes mobile malware protection. For the end customer, a preferred and tested solution is:

- central device antivirus & vpn client
- is a fabricated agent that serves as the next generation of end-client protection, which communicates with the central security fabric device to provide information, visibility and control for that device, also enables secure connection (VPN), remotely with Security Factory.
- End clients send telemetry data to the central device. Agent means a set of end software that work on end devices such as laptop, desktop or (mobile device) phone/tablet.

### 2.1. Real time protection

The application had to secure some protections such as real time – protection against file base malware and attack communication channels: AntiExploit, Prevents vulnerability exploits and zero-day attacks or removable Media Access: Realtime-protection against removable media.

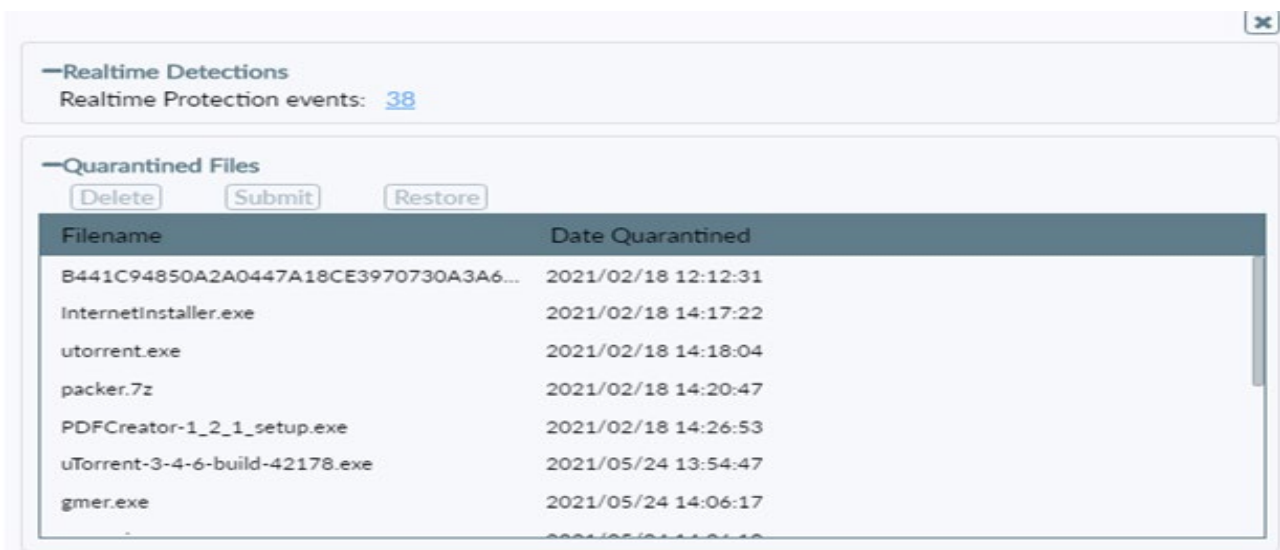


Figure 1. Real time detections

### 3. Material and methods

In this study, we considered for client 6.0 installed on some client computers and also FortiGate with foes 6.0, which support FortiClient with free licenses. FortiClient is a software that offers remote filtering of the web of institutions, offering more security on the web and filtering of the content of information that can be accessed from the web. The Web Application Firewall provides botnet protection and granular traffic control of applications used by employees in the respective institutions, including some applications, web-based applications and also software as a service (SaaS). FortiClient is a Fabric agent that provides external threat protection, compliance and secure access in a single, lightweight, modular client. A Fabric Agent is a

piece of endpoint software that runs on an endpoint, such as laptop or mobile device, which communicates with the Fortinet Security Fabric to provide information, visibility and control for that device. It also enables secure, remote connection to the Security Factory.

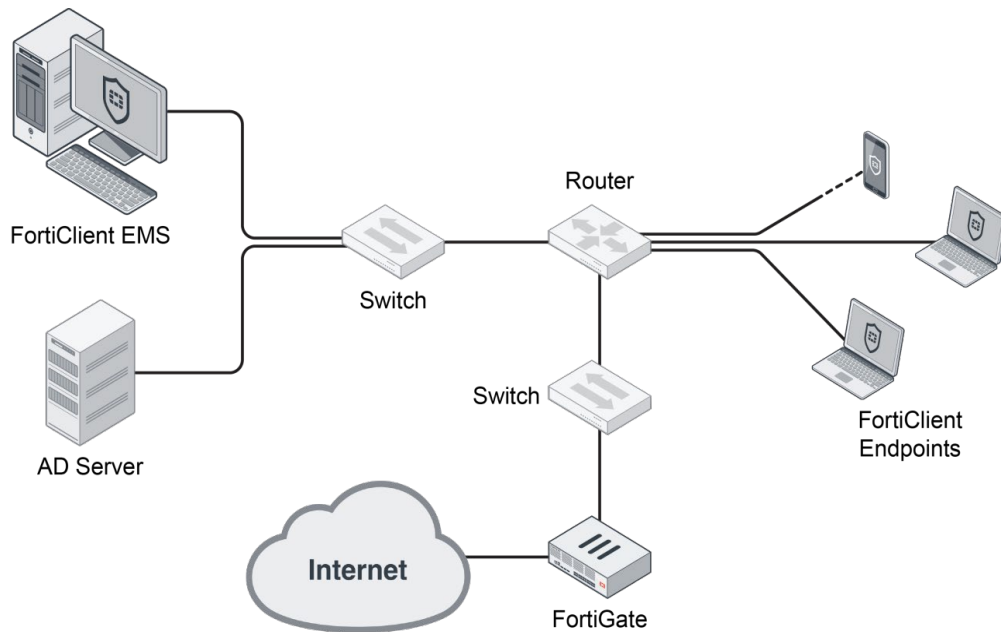


Figure 2. Schema systems with forticlient [7]

#### 4. Vulnerabilities

Helps detect and remediate application vulnerabilities that can be exploited by known and unknown threats. The FortiClient 6.0 that we have installed includes a vulnerability scanning component that the system can display to check the endpoints of the security system and for known vulnerabilities. The possible results of the vulnerability scan may include these elements that we have presented:

- The list of vulnerabilities detected in the system and in the endpoints of the system.
- How many detected vulnerabilities should be evaluated as critical system threats, as high, medium or low system threats.
- If we need more information, we will contact the FortiGuard Center.
- One-click connection to install system troubleshooting and resolve as many identified vulnerabilities as possible.
- Some elements of these solutions require manual installation to resolve vulnerabilities.
- FortiClient has the ability to detect and recognize vulnerabilities for many software.

Then you can update the databases obtained from Fortinet, notifies you in real time of any change and scans all system files as below. The application can also serve as a vpn if configured in the firewall by opening a username and password and a preshared key for authentication [5].

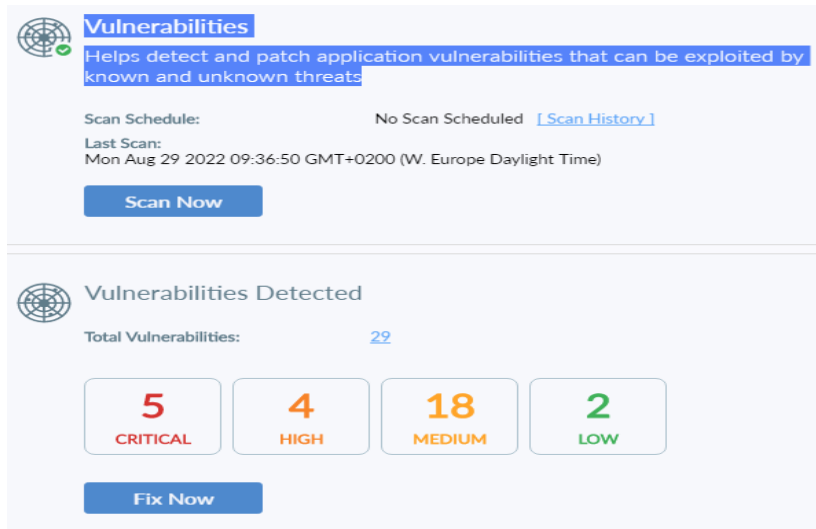


Figure 3. Vulnerabilities in forticlient

For the safest protection of the system, perform the following actions by checking the following components:



Figure 4. The Component checked in the following data to increase the security of the system

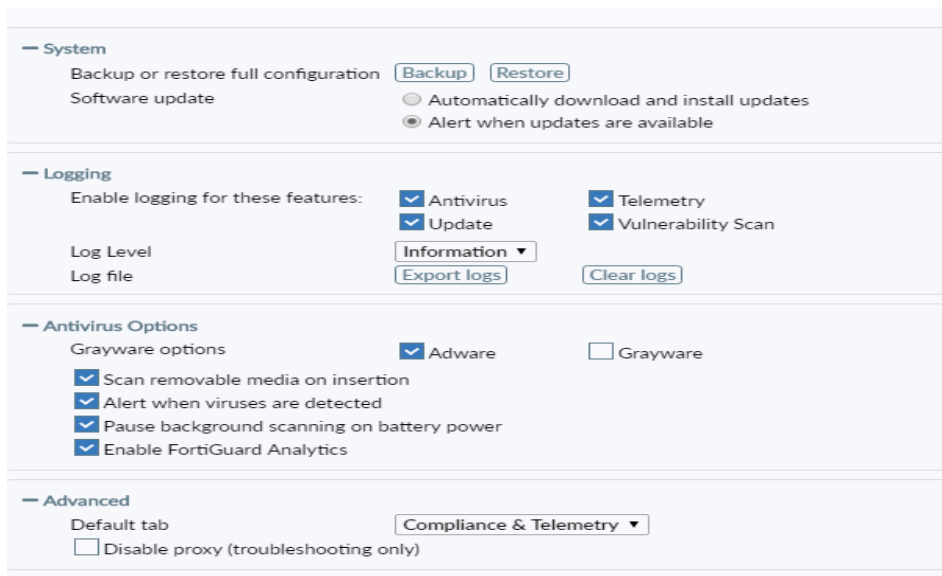
Then you can update the databases obtained from Fortinet, notifies you in real time of any change and scans all system files as below. In the picture below are some of the notification of the updates that are reported from the system.

Notifications		
Time	Source	Alert
Recent Alerts		
8/29/2022 9:36:51 AM	Update	Update successful
8/29/2022 8:37:35 AM	Update	A network error prevented updates from being downloaded.
8/29/2022 8:18:05 AM	Update	A network error prevented updates from being downloaded.
8/29/2022 8:06:05 AM	Update	A network error prevented updates from being downloaded.
8/26/2022 1:36:13 PM	Update	No updates available
8/26/2022 12:36:12 PM	Update	No updates available
8/26/2022 12:00:01 PM	Update	Update successful
8/26/2022 11:59:16 AM	Antivirus	Total files scanned 28107, infected 0. Total boot blocks scanned 0, infected 0.
8/26/2022 10:36:58 AM	Update	Update successful
8/26/2022 10:30:37 AM	Antivirus	Total files scanned 5, infected 0. Total boot blocks scanned 0, infected 0.
8/26/2022 10:30:25 AM	Antivirus	Total files scanned 10, infected 0. Total boot blocks scanned 0, infected 0.
8/26/2022 9:36:28 AM	Update	No updates available

**Figure 4.** Notification of updates

The application can also serve as a vpn if configured in the firewall by opening a username and password and a preshared key for authentication. [5]

This free FortiClient VPN application that we can enable and as shown in the figure below allows you to create a secure Virtual Private Network (VPN) connection using the IPSec or SSL VPN "Tunnel Mode"[6] application establishes connections between the device and the FortiGate Firewall. [1]. The connection that we will create for you will be fully encrypted and all the traffic that will be generated will be sent through the secure tunnel.



**Figure 5.** Options for systems logs used in this application

5. Analysis of data detected

One of the points where the analysis of this application will be adapted is the data security analysis, which we call one of the most important points for this application and for its further development in the relevant institutions.

5.1. Data security

Security starts with understanding how the developers who are building and distributing the app collect and share your data with others. The practices that apply to the privacy and security of the data that are in use may vary based on their use and the region where they are being developed as applications. The developer has provided some of this information and it can be used and updated over time.

- There is no data that you can declare with third parties.
- The points related to the sharing of data and their protection in the applications that you will develop in the future must be carefully considered.
- The data used is encrypted during its transit.

5.2 Attacks registered in the system from the logs

Below we have presented some logs that have been recorded by the system in the form of attacks. These attacks are recorded in the system and are collected to see the weaknesses of the system. Also, below we have presented only some of them.

```
*****
The following intrusion was observed: "ZGrab.Scanner".
date=2022-08-29 time=09:46:49 devname***** devid=***** logid=***** type="utm" subtype="ips"
eventtype="signature" level="alert" vd="***** " eventtime=1661759209 severity="low" srcip=192.241.____
*****
```

```
Message meets Alert condition
date=2022-08-29 time=10:00:28 devname=***** devid=***** logid="*****" type="utm"
subtype="webfilter" eventtype="ftgd_blk" level="warning" vd="***** " eventtime=***** policyid=5
sessionid=31648689 srcip=192.____.____ service="HTTPS" hostname="www.shkabaj.net"
profile="Restricted_Web" action="blocked" reqtype="direct" url="/" sentbyte=517 rcvdbyte=0
direction="outgoing" fctuid="*****" unauthuser="user " unauthusersource="-----" msg="URL belongs to a
denied category in policy" method="domain" cat=75 catdesc="Internet Radio and TV" crscore=30
crlevel="high"
*****
```

```
Message meets Alert condition
date=2022-08-29 time=10:08:28 devname=***** devid=***** logid="*****" type="utm"
subtype="webfilter" eventtype="ftgd_blk" level="warning" vd="***** " eventtime=***** policyid=5
sessionid=31648689 srcip=192.____.____ service="HTTPS" hostname="ads1.medium.al" profile="
Restricted_Web" action="blocked" reqtype="direct" url="/" sentbyte=517 rcvdbyte=0 direction="outgoing"
fctuid="*****" unauthuser="user " unauthusersource="____t" msg="URL belongs to a denied category in
policy" method="domain" cat=75 catdesc="Internet Radio and TV" crscore=30 crlevel="high"
*****
```

6. Conclusions

At the end of this study, which was also a practical development of an application for the protection of information security, we can conclude that during the implementation and installation of such a system, we must be well informed about the security points offered by this application and such similar. If all security

policies are correctly implemented, the application provides protection of security information and safe transfer of information.

We have managed to record some of the logs that have been captured and so far, we have not been able to see a breach of its security. We recommend for IT specialists who work as administrators and developers of networks and information systems to take into consideration the use of FortiClient and FortiGate and its more advanced versions so that they can be used in their systems.

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# Youth Violence Driven by Cyberspace

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**Extended Abstract:** An expression of the Albanian people says that "*Language leaves bones, but bones break*". This is one of the oldest expressions of our people, which emphasises the great importance of language, communication and freedom of speech. Freedom of expression is one of the fundamental rights guaranteed by national and international legal instruments. Article no. 22 of the Constitution of the Republic of Albania, Article no. 10 of the European Convention on Human Rights, clearly expresses one of the basic human rights, that of freedom of expression, and I quote "*Everyone has the right to freedom of expression. This right includes freedom of opinion and freedom to receive or impart information and ideas without interference by public authorities and regardless of frontiers.*" (Republic of Albania, n.d.,) (European Convention on Human Rights, n.d.,).

But, the concept of freedom of expression has evolved, adapting to time, technology, generations, globalisation, etc. This adaptation, in addition to the positive aspects of the evolution and improvement of the concept and the society, has also brought negative consequences that we are facing nowadays.

People's ever-increasing access to cyberspace and its resources affects our daily lives and has a significant impact on our society. It has already profoundly transformed the way we live, work and interact. Cyberspace offers countless opportunities for economic development, social interaction, and political exchange. It has provided the means to conduct illegal surveillance, collect personal data, influence democratic processes, commit crimes, and change the means and methods of warfare.

Information and communication technologies (ICT) have transformed modern lifestyles. They have provided real-time communications, borderless access and almost unlimited information, and a wide range of innovative services. At the same time, they have also created new opportunities for exploitation and abuse. Without adequate protection, people, and more specifically children and young people - among the largest users of the Internet - are at risk of unwanted sexual favours, harassment and unwanted exposure to violent, sexual and disturbing content.

The word cyberbullying didn't even exist a decade ago, yet the problem has become widespread today. Cyberbullies don't have to be strong or fast, they just need access to a cell phone or computer and a desire to terrorise. The dual nature of modern technology, constantly balancing risks and opportunities, is clearly manifested in an emerging social problem known as cyberbullying. More than 97% of youth are connected to the Internet in some way. The number of children and teens using the Internet at home is growing rapidly, with over 66% of fourth through ninth graders able to browse the Internet from the comfort of their bedrooms. Children can engage in many Internet-based activities, such as playing games, searching for information, and chatting with friends and non-friends. All this interaction has increased the communication between people, but also communication between unknown people, and this has brought increased levels of online violence, hate speeches reaching even more frightening levels of violence among young people.

The purpose of selecting this topic is to highlight the issues related to the violence among young people as a result of the excessive and unsupervised use of the Internet and all cyberspace. The specific weight of criminal offences of cybercrime in the total number of criminal proceedings registered nationwide for 2021 is 0.81%, while in 2020 it was 0.56. The crime coefficient per 100,000 inhabitants for this group of offences in 2021 is 8.16, while in 2020 it was lower at 5.48%. These increased values, as a result of the increased use of ICT by individuals, children and teens, makes us reflect on the safety of children while surfing on the internet, as the most vulnerable category of the society. In Albania the statistical data shows that internet addiction is a

growing problem among teens, and the number of violence and fights among young people, as a result of insults and inappropriate communications made online in various social media, is increasing.

For this problem, there is not just one solution - in technology, education, legislation or government policy - that can respond to the complex challenges of children's online safety. Current efforts and collaboration in all of these areas – along with strong parental involvement, supervision and guidance – are needed to help ensure that the Internet remains a positive and healthy environment for children and adolescents. We must all be committed to helping protect children online. We must have a comprehensive approach to online safety that includes the development of family safety technologies, education for families and children, and partnerships with industry, non-governmental organisations and law enforcement to help fight online crime.

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## **SESSION 2**

**FINANCIAL ANALYSIS & TRANSFORMATIONS  
IN ECONOMY-1 SESSION CHAIR:  
DR. DENIS VELIU**



# Impact of COVID-19 on Business Digitalization in Albania

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**Abstract:** Inevitably, the Covid-19 pandemic negatively impacted the global economy leading to an economic recession, but on the other side, Covid-19 has caused an immense impact on business digitalization worldwide. In this perspective, there is a need in businesses for digitalization. The situation in Albania, given the delayed implementation of technology and Information Systems, is expected to be of interest to the development of Albanian businesses. Covid-19 seems to be the "catalyst" for the adoption and increasing use of digitalization in business activities. This paper will present an overview of the current situation on the impact of Covid-19 on the digitalization of small and medium-sized businesses in Albania and if they will support their digital transformation. An *online* questionnaire will be proposed and distributed to obtain this information. The collected data will be elaborated on and analyzed.

**Keywords:** *Covid-19; Digital Transformations; Internet; Business Strategy.*

## 1. Introduction

Like other countries in the world, the Covid-19 pandemic negatively affected the Albanian economy. Thus, Covid-19 had a major impact on businesses, society, and the economy in general and has significantly accelerated the need for the digital transformation of companies. Among other things, Covid-19 has built a new narrative of how to do business considering the changes caused to companies in all sectors. Digital technologies have changed the way companies do business, and the way they communicate and exchange information between people, but also the interactions in the public and private sectors. Therefore, the purpose of this paper is to present the digital changes that have occurred in Albanian businesses as a direct consequence of the pandemic. The impact of technology on the company can be great, but in addition to technology, it depends on the specific needs and the team of employees who implement these changes [1-2]

## 2. Methodology

The research was conducted through an online questionnaire. The main target of the questionnaire was 75 businesses from different industries. The companies that we targeted are in several cities in Albania. The questionnaire was created in the Google Forms application and consists of 6 questions. The questions were simple to answer and sought to highlight the current situation on the impact of Covid-19 on the digitalization of small and medium-sized businesses in Albania and whether they will support their digital transformation. Through the questionnaire, reliable results were obtained that are important for the development of further steps in support of the digitalization of the businesses in Albania.

## 3. Analysis of the Results

The potential of digital transformation for businesses has been highlighted especially after the outbreak of the Covid-19 pandemic and as a result of the imposition of restrictive measures to prevent its spread. Albanian businesses, whether small or medium, have faced many changes in the way of doing business and have found

themselves in an unprecedented situation that necessarily requires reaction and change. Businesses, found in this unusual position, are looking for ways to improve productivity, have better customer service, facilitate communication, and access to customers through new sales channels. Among other things, they must work to optimize the work process as well as simply be innovative and create a competitive advantage, as the only way to stay relevant in business [3].

#### 4. Survey Results

##### **Question 1. What was the perception of the level of digitization activity before the Covid-19 pandemic in your company?**

Albanian businesses, starting from the concepts inherited from the past, but also the lack of faith in the importance of digitization, had a low level of implementation of digital technologies before the pandemic.

**Table 1.** Digitalization Level Perception

Perception	Percentage (%)
Medium	47.30
Low	20.27
High	18.92
Very High	6.76
Very Low	6.76

As can be seen in Table 1, **47.30%** of businesses had a medium level of perception of the level of digitization activity before the Covid-19 pandemic in their business, and **20.27%** of businesses a low level.

##### **Question 2. What was the perception of the level of digitization activity after the Covid-19 pandemic in your company?**

Almost all aspects of our lives have changed in recent years. **37.84%** and **36.49%** of the surveyed businesses were respectively at the high and medium level of perception of the level of digitization activity after the Covid-19 pandemic. The practice then showed which of these solutions are practical and workable and which are not. The strategic importance of technology as a critical component of business, and not just as a source of cost efficiency, has been recognized [4].

##### **Question 3. What digital technology investment have you implemented due to Covid-19 in your business?**

Most companies have invested in Internet access to data for remote work at 39.73%, followed by Internet Infrastructure improvement at 23.29%. The pandemic was an encouragement to implement ERP systems for 4.11% of participants, while only 6.85% have invested in digital software. Only 2.74% have invested in the implementation of sensors and cloud computing.

##### **Question 4. Digitization continues to be a hot topic, the focus of the events of the Covid-19 pandemic.**

Results show that 4, 71.6 % of businesses agree and 28% partially agree that digitization is a hot topic, especially after the outbreak of the Covid-19 pandemic. Only 5.4 % of them do not agree at all.

##### **Question 5. Who drove digital transformation in your company in the last 5 years?**

Undoubtedly, the Covid-19 pandemic has accelerated the digital transformation process of companies. The Covid-19 pandemic forced companies to treat digitization not only as a possibility but as a realistic solution for business survival. The answers to the question indicate the situation. Considering digitization as a means

of survival for business, it has not been treated as a process of acquiring new technology, but rather as a transformation process and a good opportunity to reduce operating costs. Among other things, digitization has been used to prepare companies to be more competitive in domestic and foreign markets [5].

**Question 6. Covid-19, among other things, has changed the vision and orientation of companies' management.**

COVID-19 has not only changed daily life, but among other things, it has changed the vision and orientation of companies' management. About 66.2% of the surveyed businesses affirm this, while 33.8% of them partially agree.

As Albanian companies move from the immediate response phase to the mitigation phase of the pandemic, strategies are needed to help businesses compete and some strategies to ensure market survival. Digital transformation has helped many Albanian businesses to survive the consequences of the pandemic. Covid-19, among other things, has changed the vision and orientation of management companies. Recent research shows that the main barriers for companies that hinder the digitalization process are the lack of digital skills in the workforce and the lack of technical knowledge to advance the digitalization process. continually adapt the way they design, communicate, and build customer value [6-7].

### 5. Conclusions and Recommendations

The results showed a small difference between the global research and the current situation of Albanian businesses. Most Albanian businesses have not been aware of the existence and importance of using digital technologies in their work environment. The local government provided financial support to most businesses, but not many of them used it for digital transformation, which shows that most companies still do not have a digital strategy or digital production. Resistance to digitization is in most cases the result of underestimation and unawareness of its benefits. It is therefore very important to increase the training of workers at every level of the organization. Businesses' perception of future digital development has not been researched, so the correlation between ambitions for the level of competition in the market and their future development path cannot be predicted but can be studied in the future as a continuation of this paper.

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# Challenges of Political Elections in Albania

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**Extended Abstract:** Fair elections are one of the cornerstones of the rule of law. Equal access to the voting process is a condition which is stipulated in the modern constitutions and lays down the foundation of political rights of the individuals of the society.<sup>7</sup> The legitimacy of the incumbent originates from the ballot box of the citizens either during local or political elections.<sup>8</sup> Therefore, the level of the accountability of the public servant to the public is tight to the standards of the voting process. If this relationship is hampered from undue influence, corruption, or organized crime than the constitutional architecture of the checks and balance will not work and the system of the rule of law can risk returning to a system of the rule of the powerful ruling the weakest. This paper focuses on the some of the drawback of elections in Albania with focus on political financing regime and the involvement of individuals from the underworld. This paper assesses the forms of political finance mainly from the legal perspective and highlights how politics has managed to channel informal financial assets to 'deviate' the political will of society and undermine the role of the voting process in Albania. It notes that the misuse of political finance is an instrument which has been used by main political parties and when the process has been distorted has been instrumentalized as the justification of the weak (i.e., the loosing political party). The paper also highlights that improvements of the legal framework has come into play after an international pressure and as a condition to the EU accession. Therefore, the paper concludes, that while legally speaking, the standards of political finance have increased, they are not politically 'organic' or because of a public discourse but rather artificial'. As the result, in practice, these standards are undermined and have not yielded any significant result in the quality of the rule of law in Albania.

## 1. Legal Framework

The election process in Albania is regulated by several important laws. According to Article 9 of the Constitution everyone is free to create a political party with the condition that they should comply with democratic principles. Political parties should not include in their programs which incite and support racial, religious, regional, or ethnic hatred, which use violence to gain power or to influence the politics. Political parties with a secretive nature or organization are prohibited. What is also important is that Constitution allows political parties to be financed, but their sources and expenses should always be public. Therefore, forming a political party is a constitutional right but on the other hand, it is also a constitutional requirement that financial sources of political parties should be transparent.

Another important legislation is Law no. 8580, date 17.2.2000, 'On Political Parties'. This is the first law to regulate the establishment of political parties. Considering that the standard of behavior of political parties during the election in Albania has been a concern this is reflected in the several subsequent amendments of this law. For instance, the Law on Political Parties is amended 5 times (i.e., amended with Law no. 9452, date 2.2.2006; Law no.10 374, date 10.2.2011; Law no.17/2014 and Law no. 90/2017, date 22.5.2017, nr. 135/2020, date 16.11.2020). Article 19 of the law stipulates the formula of the distribution of the public budget allocated by the government to political finance. Another important law is the Election Code which regulates the whole election process. It also stipulates the institutions which monitor and supervise the election process. Among

<sup>7</sup> Anne Philips (1998). Political Equality and Fair Representation' at *The Politics of Presence*, online edn, Oxford Academic, 1 Nov. 2003).

<sup>8</sup> Karen Dawisha and Stephen Deets (2006). Political Learning in Post-Communist Elections, *East European Politics and Societies*, 20(4), 691–728.



others, the Code is founded on the premise that all political parties should be transparent and provide all required information on financial source to Central Election Commission (CEC), offer all necessary data to persons in charge of auditing and monitoring as well as to the public (Article 3 .5/1). Political parties therefore can benefit from public and non-public funding in support of their campaign with the condition of transparency. The main law which deals with preventing and purging political parties from individuals with criminal records is Law no. 138/2015 'On the Guarantee of Integrity of the Persons who are Elected and Appointed in Public Functions', otherwise known as the Law on Decriminalization. This law aims to impede the candidacy of individual with criminal records in and out of Albania. The ban applies to every person who has been sentenced with a final court decision for an offence which is punishable with no less than 6 months of imprisonment (Article 2/1.ç).

## 2. Challenges

As mentioned earlier, while the legal standards of election process have improved, there are still problems regarding the politicization of the process and misuse of political financing. The politicization of the public administration is one of the main concerns of elections in Albania. While the law is clear that public institution and administration cannot be misused during political campaign, even in the 2021 political elections there were concerns about the **exploitation of people and assets of public institutions**. Another phenomenon which continues to be persistent is **the vote buying**. This is when candidates offer money and favors in the exchange for votes. This phenomenon was evidenced in several elections' campaigns in the last 10 years, including the 2021 elections. Referring to KRIIK for the 2021 elections, "*The issues of voter intimidation and vote buying were the most debated topics of this election campaign. The statements of the main political actors and also the media coverage created tension before the beginning of the campaign*".<sup>9</sup> The number of allegations regarding the violation of the electoral law including claims of vote buying were filed to the Special Prosecution Office. There were around 91 cases filed to SPAK. Around 32 of them were accepted and investigation continued further. The number of those claims which were sent to the court was very small, only two as of 2021.<sup>10</sup> This shows however, that many political parties misuse the right to sue for vote buying as a propaganda tool rather than providing strong evidences to support their cases. The issue of **high level of individuals with criminal past** has been concerning before the implementation of the 2015 law above. Therefore in 2015, two members of parliament were arrested allegedly for giving a false testimony for a dispute between them and the speaker of parliament.<sup>11</sup> By 2020 around 100 candidates were forced to withdraw from the election process as the result of their criminal past.<sup>12</sup>

## 3. Conclusion

This short study showed that while the quality of legislation is important, this is not sufficient to improve the standards of the rule of law in post-communist societies. As the case of Albania shows, the election process still suffered and is undermined by political parties. Vote buying, misuse of public assets and involvement of individuals with links with organized crime in politics remain some of the main challenges of the elections. The implementation of the Decriminalization legislation brought some improvements but still the influence

<sup>9</sup> See the findings of KRIIK Albania 'Elections for the Assembly of Albania, 25 April 2021, Interim Monitoring Report-II, 26 March -23 April 2021', p.23, available at: [https://kriik.al/home/wp-content/uploads/2021/05/KRIIK\\_InterimReport-II-ParliamentaryElection2021\\_210424.pdf](https://kriik.al/home/wp-content/uploads/2021/05/KRIIK_InterimReport-II-ParliamentaryElection2021_210424.pdf)

<sup>10</sup> Sajmira Shapku, Krimet Zgjedhore, SPAK nga 76 kallzime cuam ne gjykate 2 raste, *Krimizgjedhor.com*, 24.12.2021,, available at: <https://www.krimizgjedhor.com/index.php/2021/12/24/krimet-zgjedhore-spak-nga-76-kallezime-cuam-ne-gjykate-2-raste/>

<sup>11</sup> Albania: 2 MPs arrested on false murder plot claim," *Daily Mail*, 26 March 2015, accessed at: <https://www.dailymail.co.uk/wires/ap/article-3012842/Albania-Immunity-lifted-2-MPs-murder-plot-claim.html>

<sup>12</sup> Ola Mitre, Suksesi I Pjesshem i Dekriminalizimit ne luften per Pasrtimin e Parave, *Reporter*, 03 February 2020, available at: <https://www.reporter.al/2020/02/03/suksesi-i-pjesshem-i-dekriminalizimit-ne-luften-per-pastrimin-e-politikes/>

of powerful individuals with strong connections with organized crime continues and it is vivid. The state apparatus continues to be misused by the governing political parties and the level of pressure and politicization of public administration is disturbing. In sum, even after 33 years democracy, the election process in Albania is not ensuring a fair voting process and is still in a transition process.

# Portfolio Optimization in the Cryptocurrency Market: a Case with no Expected Return

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**Abstract:** In this paper we apply different models of portfolio selection into the new cryptocurrencies market. We study their performance out of sample and riskiness without relying on expected returns, to have a fair condition on the comparison. We treat the cryptocurrencies as common stock or other assets and show that portfolio diversification can significantly improve the investment performance. The performance of the portfolios is compared in an out of sample rolling window, with a high frequency observation data. Due to the nature of the models selected, choose models with a small number of cryptocurrencies. The novice in this paper are the Risk parity models, used with different risk we can achieve a very good result, from the point of view of performance and diversification.

**Keywords:** *Cryptocurrency; Risk Parity; Optimization; Asset Allocation.*

## 1. State of the Art and Contribution

In the recent years, the cryptocurrencies market has gained a lot of attention from the point of view of the investments, although they are not typical assets, i.e. they are not regulated from any government or the sensitivity of their fluctuation from any news made from the market. Recent papers have tried to study and to mitigate the risk coming from this new non-classic investment, and to have a good performance and diversifications. In this paper we apply different models of portfolio selection into the new cryptocurrencies market. The trading with Cryptocurrencies, as a non-regulated market, have achieved a lot of focus from the point of view of the view of the speculation and also from the research point of view. The most famous cryptocurrency build using blockchain technology is the Bitcoin with high volatility, per coin and a very big market capitalization.

The target is to understand which model is more suitable for different clients, the minimum risk? Or the Maximum diversification? We study their performance out of sample and riskiness without relying on expected returns, to have a fair condition on the comparison between them. We treat the cryptocurrencies as common stock or other assets and show that portfolio diversification can significantly improve the investment performance. The performance of the portfolios is compared in an out of sample rolling window, with a high frequency observation data. Due to the nature of the models selected, choose models with a small number of cryptocurrencies (ten in total). We did not create any mix portfolio with other assets, since the cryptocurrency market have different timing of negotiation (can be bought and sold any time).

We collect ten cryptocurrencies with a market capitalization larger than half billion. To avoid any currency fluctuation, all the prices are in dollars as they are listed on yahoo finance. Since the Mean Variance model have some requirements on the distribution of the returns, we first describe the data to see the characteristics of each of the ten Cryptocurrencies that compose our portfolio. Also, an important description is the of

correlation matrix of the returns of the crypto currencies in order to understand the connection between the cryptocurrencies, and if they move in the same direction.

The portfolio models considered in this article are:

- 1/N equal weighted rule (Naive Portfolio),
- minimum variance (MV),
- minimum CVaR,
- Risk Parity with standard deviation as risk measure (RP-std),
- Risk Parity with conditional value at risk measure CVaR (RP-CVaR),

Naive Risk Parity CVaR (RP-CVaR naive).

The last one, is a special case in which we have the worst-case scenario (highest CVaR, useful as an upper bound [1])

In all these methods, we do not use expected returns, so at the minimum variance i.e. we don't have the constrain of the return of the portfolio, in order to have the smallest possible variance. In all the cases we do not allow short selling, so the weights allocated at each cryptocurrency can assume only positive values or zero if not assigned.

The novice in this paper are the Risk parity models, used with different risk we can achieve a very good result, from the point of view of performance and diversification. We introduce the Risk Budgeting Approach starting from the work of Maillard, Teiletche and Roncalli. We introduce Risk Parity approach to another risk measure, the CVaR. For a comparative method, we introduce Risk Parity with diversification, and we call it Risk Parity CVaR Naive. Starting from the continuous case, we also give the conditions for applying the Law of Large Numbers in the numerical approximation for the discrete case. In the last part we describe some of the performance and diversifications measures.

The portfolio created with cryptocurrencies using the Risk Parity criteria presented a better diversification (tested with Herfindal and Bera Park indexes), less concentration in high weights compared to Conditional Value at Risk and Mean Variance. For this, there are less cost to recalibrate the portfolio.

In all these cases, the Risk Parity strategies are a good trade of between the traditional CVaR and Mean Variance and the Naïve, from the point of view of performance and riskiness.

## 2. Conclusions and prospects

Considering cryptocurrencies as an asset class we will face a problem on high volatility, for that there is a need to consider different methods to allocate the amount of the investment in cryptocurrencies in financial portfolio. The traditional models, such as the Markowitz model, focuses only in the riskless assets in we find the global minimum of riskiness. Thus, this high concentration will have also high transaction costs if the investor will try recalibrate the portfolio. Also, relying the in the expected returns during a negative trend of the economy, will bring unrealistic and pessimistic allocation of the assets. Some particular investor may collect significant amounts of cryptocurrencies in their financial portfolio, for different purposes, especially for speculations. The portfolio created with cryptocurrencies using the Risk Parity criteria presented a better diversification (tested with Herfindal and Bera Park indexes), less concentration in high weights compared to Conditional Value at Risk and Mean Variance. For this, there are less cost to recalibrate the portfolio. In all these cases, the Risk Parity strategies are a good trade of between the traditional CVaR and Mean Variance and the Naïve, from the point of view of performance and riskiness.

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# Application of EU Competition Law in a Digital Technology: Need for New Rules?

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**Abstract:** Nowadays, everyone uses products or online services from big technologies products. The digitalization has become an opportunity for new forms of innovation, societal and economic opportunities. Digital services have contributed to the internal market by opening new business opportunities and facilitating cross border trading. Covering wide activities including online intermediation services, digital services have increased consumer choice and competitiveness of industry. At the same time, these digital 'gatekeepers', which control a large market combined with the features of gatekeeper is likely to lead to unfair practices and conditions for business users as well as for end. This paper briefly discusses the why the DMA regulation was needed and why is important to regulate the behavior of Big Tech companies in the digital market. The paper concludes that DMA will have impact on the business model in the digital market.

**Keywords:** *Digital Market Act; EU Competition Rules; Digital Platforms; Online Platforms*

## 1. Introduction

Nowadays, everyone uses products or online services from big technologies products. The digitalization has become an opportunity for new forms of innovation, societal and economic opportunities. Digital services have contributed to the market by opening new business opportunities and facilitating cross border trading. According to UNCTAD 2019 Report, the digital economy is estimated to account for between 4.5% to 15.5% of global Gross Domestic Product [1]. In the same vein, Oxford Economics estimates the value of the digital economy around 15.5% of world GDP or USD 11.5 trillion globally [2]. The top 50 online platforms represent an average of over 60% of traffic share across the Member States. By covering wide activities including online intermediation services, digital services have increased consumer choice and competitiveness of industry. In 2018, these online platforms have achieved worldwide revenues of almost EUR 276 billion and employed almost 600 000 people [3].

According to the Commission, there are over 10 000 online platforms operating in the Europe's digital economy. Most of these online platforms are SMEs; whereas only a small number of online platforms "capture the biggest share of the overall value generated" [4]. These large platforms have benefitted from the characteristics of the sector and currently are part of the today's digital economy. Only a few large platforms act as gateways or gatekeepers between business users and end users. The rise of big technology companies, such as Google, Amazon, Apple, Microsoft, and Facebook have raised concerns about potential economic harms brought by the concentrated structure of the digital economy [5]. Firstly, these large platforms lead to dependency of many business users on these gatekeepers and, in certain cases, gatekeepers may lead to unfair behaviour vis-à-vis these business users. Main characteristics of the core platform services are as follows: i) nearly zero marginal costs to add business users or end users; ii) very strong network effects; iii) an ability to connect many business users with many end users through the multi-sidedness of these services; iv) a significant degree of dependence of both business users and end users; v) lock-in effects, a lack of multi-homing for the same purpose by end users, vi) vertical integration, and vi) data driven-advantages [6].

Secondly, as gatekeepers have created a conglomerate ecosystem around their core platform services, it is difficult for the other online platforms to enter into the market. Thirdly, typically, gatekeepers operate at a global scale. At the EU level, EU MS have different regulatory framework. Such fragmentation increases compliance costs for these large market players and hampers the functioning of the internal market.

While digital services are present in our daily life, an ongoing debate has raised the question whether traditional EU competition law concepts fits within the digital technology development or the current EU competition legal framework may have to be reassessed to meet the challenges posed by digital markets. Some authors believe that competition authorities should refrain from intervening in a fast-moving technology sector. On the contrary, others argue that digitalization have significantly shaped the competitive landscape as well the nature of the competition [7]. Uses of the algorithm and artificial intelligence by the business increases the chance to facilitate both explicit and tacit collusion. Therefore, a 'muscular' intervention is needed to restore competition in the digital market.

### 2. The EU Proposal for new rules in Digital Market

In the EU landscape, rapid development of digital technology has confronted European Commission with new challenges in application of EU competition law. Upon a request of Competition Commissioner Margrethe Vestager, in February 2020, Commission published a communication "Shaping Europe's Digital Future", prepared by a group of experts [8]. In an interview given in December of 2019, Competition Commissioner Margrethe Vestager admitted that her fines have been unable to restore competition between Big Tech and smaller rivals because companies had "already won the market" [9]. Despite positive track of the Commission on fining Microsoft [10], digital technology become a priority of the new Commission. Its goal was ensuring the proper functioning of the internal market by promoting effective competition in digital markets and in particular a fair and contestable online platform environment.

To pursue this goal, Commission started a wide consultation on a broad range of online platform-related issues [11]. As a first step, between 2 June and 8 September 2020, Commission held two separate open public consultations on two separate Inception Impact Assessments for (i) the Digital Services Act package: ex-ante regulatory instrument for large online platforms with significant network effects acting as gate-keepers in the European Union's internal market; and (ii) the New Competition Tool [12]. Secondly, Commission held another open public consultation with the stakeholders on the interim reports by the Observatory for the Online Platform Economy, supporting the initiative. Thirdly, workshops, conferences or research activities were held to identify the problems and preliminary policy options. Finally, the Member States through the e-Commerce expert group were involved in the public discussion [13].

To address these identified problems, on December 2020, Commission proposed a Regulation instead of a directive [14]. The Regulation was chosen as the only a legislative instrument that can establishes the same level of rights and obligations for private parties at the EU level. Furthermore, as the Regulation is directly applicable in the EU MS [15], it enables the uniform application of the rules in the inherently cross-border online intermediated trade generated in the online platform economy.

The legal basis of the DMA is Article 114 (1) TFEU which confers onto the European Union the competence to adopt measures that are designed to harmonise national rules.

### 3. The Digital Market Act: A legal Appraisal

On 24 March 2022, the landmark proposed EU Digital Markets Act (DMA) has officially been agreed by Parliament and Council negotiators [16] and signed into law in 14 September 2022, by Parliament and Council under ordinary legislative procedure. The DMA entered into force on 1 November 2022 and will become applicable, for the most part, on 2 May 2023 [17]. As stipulated in the title, the DMA amends Directive (EU) 2019/1937 [18] and Directive (EU) 2020/1828 [19].

The DMA is very detailed. Structured in VI Chapters, DMA contains 109 recitals and 54 articles. Chapter I sets out the general provisions, including the subject matter, aim and scope of the Regulation (Article 1), and

the definitions of the terms used in, as well as the objectives of the proposal (Article 2). The DMA has two general objectives to ensure the proper functioning of the internal market by promoting effective competition in digital markets, in particular: i) a fair and ii) contestable online platform environment across the EU [20]. The DMA scope is on the regulation of “core platform services” provided or offered by gatekeepers to business users established in the Union or end users established or located in the Union. As defined in Article 2 (2), ‘core platform service’ includes: i) online intermediation services; ii) online search engines; iii) online social networking services; iv) video-sharing platform services; v) number-independent interpersonal communications services; vi) operating systems; vii) web browsers; viii) virtual assistants; ix) cloud computing services; and x) online advertising services. As can be seen, the DMA laid down an exhaustive list of what should be considered as core platform services. While this precise list increases legal certainty to target only those platforms or services, it does not foresee the services that might change in the future and distort competition in the digital market [21]. Chapter II contains the provisions concerning the designation of gatekeepers. It should be noted that not every provider of the core platform services is considered a gatekeeper and vice versa. Article 3 establishes the conditions under which providers of core platform services should be designated as gatekeepers either based on the quantitative criteria or following a case-by-case assessment during a market investigation (qualitative criteria). The qualitative criteria for an undertaking to be considered as gatekeeper are if: i) it has significant impact over the internal market; ii) it provides a core platform service that is an important gateway to the end customer; and iii) it enjoys an entrenched and durable position in its operations or it is foreseeable to have one in near future [22]. Whereas the quantitative criteria for an undertaking to be considered as gatekeeper are: i) turnover; ii) monthly active end users, and /or iii) active business users, and finally, if the latter criteria were met in the each of the last three financial years [23]. If the undertaking meets all the quantitative criteria, it informs the Commission which afterwards designates the undertaking as a gatekeeper within 45 working days [24]. Article 4 stipulates the conditions under which a designation of a gatekeeper may be reconsidered and an obligation to regularly review such a designation.

Chapter III sets out the practices of gatekeepers that limit contestability and that are unfair. In particular, this chapter lays down obligations for gatekeepers (Article 5) and obligations that are susceptible to specification (Article 6). Article 7 stipulates the obligation for gatekeepers on interoperability of number-independent interpersonal communications services. Article 8 lays down the obligation of the gatekeepers to comply with the obligations laid down in Articles 5, 6 and 7 of this Regulation. Article 9 foresees the conditions under which the obligations for an individual core platform service may be suspended in exceptional circumstances or an exemption can be granted on grounds of public interest (Article 10). Additional provisions in this Chapter establish a mechanism for reporting the implementation (article 11); updating the list of obligations (Article 12); anti-circumvention (article 13); obligation to inform about concentrations (Article 14) and obligation of an audit (Article 15).

Chapter IV provides rules for carrying out market investigations. This chapter contains procedural requirements for the opening of a market investigation (Article 16) and rules for carrying out different types of market investigations: (i) designation of a gatekeeper (Article 17), (ii) investigation of systematic non-compliance (Article 18) and (iii) investigation of new core platform services and new practices (Article 19).

Chapter V contains the provisions concerning the implementation, enforcement and monitoring powers. It provides procedural requirements for the opening of proceedings (Article 20). Then, the regulation foresees different rules for implementation and enforcement in the context of the market investigations or procedures such as: i) Commission right to request information (Article 21); ii) Commission power to carry out interviews and take statements (Article 22); iii) power to conduct inspections (Article 23); iv) Commission power to adopt interim measures or commitment (Articles 24 and 25); v) Commission power to monitor the obligations (Article 26); vi) fines, periodic penalty payment and limitation period for imposition and enforcement of fines (Articles 30-33). Also, DMA contains rules about cooperation with national authorities (Articles 38 and 39) and with national courts (Article 40). Chapter VI contains final provisions. It contains rules on: i) the obligation of the Commission the decisions (Article 44); unlimited jurisdiction of the Court of Justice of the European Union in respect of fines and penalty payments (Article 45); the Commission possibility to adopt implementing act and guidelines (Articles 46-47).



#### 4. The Digital Market Act and its impact of competition law

The DMA is heavily inspired and closely aligned with the overall aims of EU competition law and policy. The DMA aims to complement the enforcement of competition law and is applied without prejudice to EU competition provisions (Articles 101 and 102 TFEU) and national competition rules. The DMA seeks to address the deficits and shortcomings of competition policy to effectively deal with the challenges of digital competition. There is a widespread perception that competition law enforcement in the digital sphere has been too complex and too slow over [25]. Recital (5) of the DMA addresses the question of the articulation between competition law and ex ante regulation.

Thus, the DMA introduces an ex-ante regulatory system, instead ex-post used by competition law enforcement to disincentivise excessive market power. According to Cappai and Colangelo, the ex-ante regulatory system intends to ensure fairness, contestability, transparency and innovation, as well as to safeguard public interests before any bad behaviour can be materialized [26]. These notions appear to be the leitmotif of the DMA.

The DMA has two general objectives to ensure the proper functioning of the internal market by promoting effective competition in digital markets, in particular: i) a fair and ii) contestable online platform environment across the EU. Based on Article 3(3) of the DMA, companies that fulfil qualitative and quantitative requirements notify the Commission to designate such firm as a gatekeeper. The adoption of the DMA has major implications in business models of big tech companies operating in the EU.

#### 5. Conclusion

The DMA creates a novel ex ante regulatory regime for large digital companies, complementing the enforcement regime of EU competition law. Inspired by Regulation 1/2003, the DMA empowers Commission as the sole enforcers to request all relevant information in order to carry out its duties, regardless of ownership, location, format or storage medium. The Commission also has the power to conduct inspections (dawn raids), interviews and impose fines. The DMA is likely to have two positive outcomes. Firstly, the Digital Markets Act is a new regulatory initiative part of the strategic course set out in the Communication 'Shaping Europe's digital future'. It aims to regulate an area which previously was under-regulated and introduce uniform rules for the digital 'gatekeepers' across the EU. Thus, the adoption of the DMA is likely to increase legal certainty regarding the operation of the tech giants in the market.

Secondly, under the DMA, the gatekeepers will have basic guidelines in order to modify their mechanisms and business practices. The DMA might have a positive impact by imposing direct restriction on the behaviour of tech giants. As noted by Anderson and Mariniello, "the DMA would evolve alongside markets and adapt to individual business models" [27].

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## **SESSION 3**

**DIGITALIZATION AND EDUCATION SESSION  
CHAIR: PROF.DR. HABIB HAMAM**



# Towards Pedagogical Continuity in Remote Education

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**Abstract:** According to the French philosopher, specialist in education, Philippe Meirieu, the biggest drawback of remote education, including on-line education, is the lack of pedagogical continuity. Physical distancing imposed a discontinuity with the teacher and classmates. It is important to innovate and create a balance between physical distancing and active social and cultural life. Virtual reality is one of the tools to do so, if it is adapted in a way to integrate a social dimension and to make the learner responsible. The objective is to create motivation for the learner and to make him/her reach satisfaction during the learning process. The learner, especially the child, needs to socialize with classmates, to see around him/her, to enjoy the break, to have the sense of time, to face challenges, to assume responsibilities, to concentrate during the learning process, to attain a personal satisfaction. This work provides some solutions. A development of a prototype is ongoing.

**Keywords:** *Pedagogical Continuity; COVID-19; Education.*

## 1. Introduction

COVID-19 was behind closing universities and schools across the planet. Over 1.2 billion children stayed out of the classroom for several months. Education has taken a turn because of this pandemic. Education policy makers, parents and learners have turned to on-line learning. Teaching is provided remotely on digital platforms. There is one opinion that is gaining interest and seeing that the changes caused by the coronavirus could be here to stay. The attitudes of governments towards COVID-19 are varied. However, for most of them if on-line education is not the A plan, then it is the B plan, depending on the behavior of the pandemic. Progress in education technology started well before COVID-19. In the last decade, there has been high growth and adoption in education technology. By 2025, on-line education market is expected to reach US\$ 350 billion, mainly because of the introduction of flexible learning technologies in the corporate and education sectors [1-4]. COVID-19 accelerated research and development in education technologies.

Because of COVID-19 and in response to significant demand, many on-line learning platforms are offering access to their services. Most of them are offering free access.

## 2. Synchronous and asynchronous education

While synchronous learning is on-line education, also called distance education, that occurs in real time (video conf., ...), asynchronous learning proceeds through on-line channels without face-to-face or on-line real-time interaction. Besides, some hybrid learning techniques exist. They include a blend of both synchronous and asynchronous online methods. Pure synchronous and pure asynchronous learning approaches have some distinctly different features.

### 2.1. Synchronous education

Synchronous education has features including: Synchronous learning proceeds in real time; the learners and the instructor interact in a virtual space, through a communication platform (Zoom, Microsoft Teams, ...), at an agreed time; the feature “Anywhere, anyhow, anytime” does not apply; the content may be delivered through for example live chatting, audio conferencing, video conferencing. This kind of education show advantages including: Classroom Engagement; Dynamic Learning; Instructional Depth. However, there are some drawbacks inherent to synchronous education, such as: Rigid Schedule; Technical difficulties; Instructor should be trained.

### 2.2. Asynchronous education

Asynchronous education has features including: Asynchronous education is available on the learner’s schedule; Documents for reading, exercises for practicing, lectures for viewing, videos for watching, assignments for completing, and midterms and final exams for evaluation are prepared by instructors; the learner has total flexibility, in terms of time and location, to tackle the required tasks and to satisfy all success and graduation requirements; part of the content or all of it may be delivered in a self-guided way This kind of education show advantages including: Flexibility; Pacing: The learner may read at his/her pace, view the material on his/her time and may complete the duties based on his/her understanding. There is no pressure to hit a deadline. Affordability: minimal expense.

However, there are some drawbacks inherent to asynchronous education, such as: Isolation: The learner is alone; there is no social life. Online virtual tools are not of nature to deliver the same kind of intellectual energy as face-to-face or on-line real-time interaction; risk of apathy: It is difficult for the learner to remain passionate and enthusiastic during the learner process without interaction with classmates or instructors.

### 3. School values entrusted to parents

Ostensive face-to-face teaching is based on the application of a rule or the reproduction of a model. According to Jean Houssaye, nothing guarantees that the pupils will be able to mobilize by themselves, in another situation, the knowledge which they seemed to master at the end of the teaching situation [5]. When assigning the supervision of the process of teaching to parents, Jean Houssaye sees a fundamental issue. He sees an opposition between the values of the school, *such as individual and teamwork, diversity, equality and secularism*, and those of the consumer society including parents, *such as seduction, immediacy and ease*. Within this current situation of confinement imposed by COVID-19, the question is, how can we entrust the values of school to a part of the consumer society without fear of misguiding?

### 4. Urgent measures

Since the announcement of the closure of schools, many teachers have been very invested and trying to do the best they can in an emergency way. Many teachers decided to assign work according to the usual school timetable and to collect all the students’ work as usual. They tried to maintain “the existing” by warding off the anguish of the crisis. However, this mode of operation quickly attained its limits because the conditions of the pupils are different and thus are not always met by all of them to complete the required work (lack of space to work, books, insufficient internet connection, etc.). There is also a tendency to forget that the student is a complete human being and not just a brain. Teachers and parents forgot that the student has emotions, worries, feeling of loneliness, illness, etc.

## 5. Revision and progressing in the program

Revision is not as complex as progressing in the program. Autonomy in education implies facilitating training, revision, but not the achievement of new learning content which would be a factor of inequality between students. In the exam classes, however, it is the new content that will have to be addressed because it is necessary to move forward in the program, especially in the countries where the authority of education decided that the official program should be maintained as usual. The main issue is how students would assimilate new notions and aspects usually delivered and explained through ostensive learning. Another difficulty lies in the fact that students could not cope with so many assignments in so many subjects.

## 6. Main challenges during COVID-19

COVID-19 imposed on each teacher to ask oneself how the courses should be redesigned to cope with the new situation. Regulations should be adapted to the new situation. Pedagogical continuity leads us to think about satisfying the most favourable conditions for “the stay in school” (opposite to school dropout) where in face-to-face motivation is a prerequisite for the learning process. Teachers should think about alternatives replacing the gestures and postures that are the motors of the link with their students, promoting their autonomy and their commitment.

Autonomy is today conceived as a transversal skill in primary school [6]. It is also frequently mentioned in connection with fundamental school learning (independent reading, independent production of texts, etc.) [7]. According to Bernard Lahire [8], autonomy is fundamentally based on three essential elements: Transparency; Objectification; Publicization: The pupil must be able to refer to visible elements (knowledge, common rules, exercise instructions).

In the context of COVID-19, it is hardy to fully meet these conditions by families who do not have the school codes. Autonomy at school often requires a culture of the writing instructions. Families have been inundated with written instructions, guidelines for use, advices ... This requires reading skills which can be discriminating.

## 7. Results

A team of developers and pedagogical specialists/educators has been setup, and a first demo has been implemented. The ongoing project is planned for three years, where an operational platform is planned for the next year. Then, the platform will be improved in light of the first experiment. The platform is conceived in a modular and parametrable way, so that it could be continuously improved. The flow of data is optimized so that a high-speed connection is not required from the student. The platform could be used by governments to be offered publicly. The platform is not conceived for the elite and rich population. It could be used by poor populations, especially if public internet connection is offered. For example, high speed internet routers are placed in governmental buildings (municipalities, police stations, ...). The platform could be used during disasters where regions are isolated. Here again, high speed internet routers should be placed in governmental buildings. Ostensive teaching is also possible. Ostensive teaching or language conveys the meaning of a term by pointing out examples. Very often, the term is difficult to define verbally, either because the words will not be understood easily or because of the nature of the term. Gesture pointing out the object or qualification (street, orange, blue color, big, beautiful, hard, sad, grandfather, ...) is used. It assumes that the learner has sufficient understanding to recognize the type of information being given.

## 8. Conclusion

Physical distancing imposed a discontinuity with the teacher and classmates. This presents an obstacle towards pedagogical continuity. We advanced a solution by innovating and creating a balance between physical distancing and active social and cultural life. We used virtual reality in an adapted way to integrate

a social dimension and to make the learner responsible. The objective was to create motivation for the learner and to make him/her reach satisfaction during the learning process. We offer to the learner, especially the child, the opportunity of ostensive language, and also to socialize with classmates, to see around him/her, to enjoy the break, to have the sense of time, to face challenges, to assume responsibilities, to concentrate during the learning process, to attain a personal satisfaction, ...

We progressed in the development of a prototype by involving specialists in pedagogy. The project is conceived for three years, where an operational platform is planned for the next year. Then the platform will be improved. The platform is not conceived for the elite and rich population. It could be used by poor populations, especially if internet connection is offered publicly. The platform could be used during disasters where regions are isolated.

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# An Overview of the Factors that Impede Oral Communication in EFL Classes: The Case of BES Students at SEEU

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**Abstract:** The four language skills are mutually dependent on each other and in order to become an effective communicator you need proficiency of every skill. However, the most effective way of communicating is through speaking and therefore oral communication is an important way of revealing and reflecting your thoughts and opinions. Good oral communication skills can be achieved in classroom settings and teachers should first find out what problems they have when it comes to orally expressing their opinions and then try to apply different strategies beneficial to developing students' oral communication in EFL classes. Teachers should provide students with a variety of speaking activities and instruct them appropriately so they can enjoy their classes and therefore achieve the outcomes of the lesson. In addition, speaking activities are an inseparable part of daily life activities that cannot be underestimated [1]. Furthermore, [2] state that: "English language instructors should help students with the most outstanding abilities to achieve the speaking goal". It is assumed that teachers ignore speaking as a skill and instead focus more on teaching grammar and vocabulary and other tasks included in the books such as reading and writing since the curriculum does not include in particular tasks which are intended and designed for the oral communication of students but instead they receive it from their reading or writing texts. The aim of this paper is to analyze the factors that obstruct students' oral communication in EFL classes as well as exploring the possible solutions from both students' and teachers' perspectives.

**Keywords:** *Communication; Classes; Factors; Obstruction.*

## 1. Introduction

Every day we communicate with other human beings around us, this includes our friends, peers, family, co-workers and colleagues and if we don't know how to communicate and interact with them in a way that is mutually satisfying then our lives become restricted. In fact, with an emphasis on oral communication as an important tool of revealing our thoughts and as a way of proper communication speaking is a productive skill. Furthermore, notwithstanding the technology- driven society that has hold up the youth, oral communication still continues to be a crucial ability required at university level for students who want to study at different study programs. Conversely, most of students are not confident when it comes to accurately and fluently expressing their ideas in although they start learning English in primary school. This failure is often connected to the narrow time that is available for practicing this skill in their classes. Moreover, in authentic communicative situations, language learners are often unable to retrieve a word, to use or comprehend an idiomatic expression, or to grasp a topic; consequently, communication breaks down [3]. In addition to this, [4] states that "some academic speaking skills such as giving an oral presentation or participating in classroom discussion require a much broader range of vocabulary knowledge, grammatical sophistication and discourse competence than is the case with typical daily life conversation". Alternatively, [5] points out that "there are several factors which affect students' performance in speaking English fluently; such as, lack of adequate and appropriate vocabulary, shyness, nervous, fearful to speak, and lack of confidence".

This study aims to find out what are the causes that obstruct the oral communication between students in an EFL class and also explore the possible solutions from both students' and teachers' point of view. The results of this study can help to reveal the reasons why BES students face difficulties when it comes to expressing their ideas orally in their classes.

## 2. Literature Review

There is no doubt that a good communication skill signifies good mastering of a certain language, in this case English since it is considered a Lingua Franca and as a result it is necessary to develop this skill. The importance of this skill is supported by [6-7] who point out that “it has become an aphorism in EFL contexts that a graduate with a good command of oral English communication skills has a better opportunity in their professional life than one who does not.” Correspondingly, [8] states that “speaking is the ability to express opinion, ideas, or thoughts orally; it consists of producing systematic verbal utterances to convey meaning in order to be understood by the people we are speaking with”. The ability to speak clearly and effectively is crucial to how we build relationships, exchange information, also clear messages that we produce through speaking do not confuse others. Any unclear message may lead to misunderstanding and/or communication barrier.

With this in mind, both teachers and students see oral communication as one of the most challenging features to be considered in the process of obtaining the target language. When one party is not able to get the message conveyed by another party accurately, clearly and intendedly this difficulty indicates a communication barrier. Mostly, students of EFL face problems in developing fluency in speaking because of difficulties related to their motivation, low self-esteem, anxiety, first language interference, and the learning environment. Similarly, [9] has reported that students are often reluctant to speak because they are shy and are not predisposed to expressing themselves in front of other people, especially when they are being asked to give personal information or opinions. Moreover, [10] states that “anxiety and unwillingness during the English-speaking process are considered two of the biggest obstacles for EFL learners. Anxiety and unwillingness are caused by the fear of being negatively evaluated when making mistakes, particularly in front of their friends”. Identically, [11] highlights that feelings of anxiety, apprehension and nervousness are commonly expressed by foreign language learners in learning to speak a foreign language in public.

Learner inhibition is seen as a major problem encountered by students who learn a foreign language, therefore, their speaking performance is affected. In this situation, [12] point out that the first problem that the students often encounter is “inhibition”. Coupled with this, [13] reports that “inhibit to speak come together with fear of mistakes that will become the primary reason that students are afraid of looking unwise in front of other people that they are disturbed about how other will see them”. Moreover, [14] conclude that “inhibition is considered as a negative factor that hinders students from their natural performance and makes them act in a reluctant, hesitant or anxious way”.

In order to get the success, we want with our students their involvement in speaking activities that we assign to them is crucial. Participating in classroom activities requires an active interaction student- student and student- teacher which mean expressing individual thoughts and feelings.

## 3. Significance of the Study

Although many educators are aware of the problems that their students face when communicating in English little know what the factors that lead to these problems are. Therefore, the purpose of this study was to reveal the most common factors that obstruct oral communication of students at SEE University Basic English Skills. In particular, this study first intended to find the most common problems that students face when communicating their opinions orally and then find out what activities/strategies could be applied in order to achieve the best from students’ oral communication.

## 4. Methodology

A statistical analysis of quantitative data was used in this paper in order to collect the necessary information. The study was carried out at South East European University, Language Centre with Basic English Skills students. 55 students from different faculties participated in this study. The instruments used to collect data were one questionnaire for students and one for teachers and in order to check their agreement or disagreement with the statements a Likert scale was used. The students who were involved in the study belong to different levels of English, starting from beginner to advanced. Similarly, teachers who participated in administering the questionnaire also teach different levels of Basic English Skills.

## 5. Results and discussion

The following analysis describes the instrument used to collect data about the factors that impede students' oral communication in their English classes. As far as the first question is concerned "I feel anxious and I don't enjoy when I need to speak in my classes" 75% of students completely agree that they feel uneasiness when they are requested to communicate in English, 4% agree, 7% of them are neutral, 15% disagree and none of them disagrees. With regard to the second question "My thoughts will be expressed and articulated much better if I am allowed to use my mother tongue" 69% of students think that if they were allowed to use their mother tongue their ideas will be more clearly illustrated, 5% of them agree, 9% of them are neutral, 15% disagree and none of them completely disagrees. Concerning the third question "I can not act in a relaxed and natural way when topics which are inappropriate or irrelevant to my interests are given" 96% of students completely agree that topics should carefully be selected when it comes to speaking activities as they feel more relaxed, none of them agrees, 2% are neutral, none disagrees and 2% completely disagree with this statement. As far as the fourth question is concerned "I feel shy because of the mistakes I make while talking" 64% of students completely agree that they have the fear of making mistakes when speaking, 13% agree, 2% are neutral, 15% disagree and 7% completely disagree. With regard to the fifth question "The lexis I need to express my thoughts is not enough, therefore, I try to state my thoughts with a limited number of vocabulary" 58% of students completely agree with this statement, 9% agree, 4% of them are neutral, 2% disagree and 27% completely disagree. Concerning the sixth question "I need to be more motivated in order to participate more actively in speaking activities given by the teacher" 71% of students completely agree that they need to be motivated to perform better in their communication tasks, 16% agree, 2% are neutral, 2% disagree and 9% completely disagree. As far as the seventh question is concerned "When it comes to using the target language outside the class I am very limited because the social environment doesn't provide me with such an opportunity" 85% of students completely agree with this statement and 15% agree, there are no neutral, disagreeing and completely disagreeing students. With regard to the eighth question "The textbook does not provide me with enough practice of speaking" 60% of students completely agree, 7% agree, 7% are neutral, 15% disagree and 11% completely disagree. Concerning the ninth question "In some situations I have difficulties in applying correctly the linguistic competence, such as grammar and vocabulary" 65% of students completely agree, 20% agree, 4% are neutral, 4% disagree and 7% completely disagree. As far as the tenth question is concerned "I don't like the way teacher corrects my mistakes when speaking and this keeps me away from speaking" 73% of students completely agree, 16% agree, 2% are neutral, 5% disagree and 4% completely disagree. With regard to the eleventh question "Not knowing the right pronunciation of a word bothers me and I feel I am a bad speaker of English" 56% of students completely agree, 24% agree, 11% are neutral, 4% disagree and 5% completely disagree. Concerning the twelfth question "The teacher listens carefully only to the students who are good at speaking" 62% of students completely agree, 9% agree, 15% are neutral, 4% disagree and 11% completely disagree.

## 6. Recommendations and Suggestions for further Studies

Based on the findings revealed from this study it is recommended that in order to improve the speaking skills students need to practice it outside the university environment. Giving more importance and extending the number of oral communication activities during EFL classes is another recommendation. Next, involving specific problems such as the lack of motivation, usage of mother tongue and lack of confidence should be carried out.

This study was about Basic English Skills students' factors that prevent their oral communication and the number of students that were interviewed was only 55. The findings are limited to this number of participants and the SEE University context and as a result no generalization could be made with these findings. Applying this instrument to ESP students or to a bigger number of students and/or to high schools' pupils may reveal different results.

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# Smartphone Use Contributed to Individual Tendencies Towards Social Media Addiction and Negative Effects in Southeast European University Students During the COVID-19 Pandemic

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**Abstract:** Students of Southeast European University in distance learning during the COVID-19 pandemic had few opportunities to socialize in person, resulting in a significant rise in the use of smartphones and technology. For educational purposes the use of smartphones generally represented an alternative and turned to be useful but, however excessive use may promote addictive tendencies towards social media use, and at the same time with negative consequences for students' psychological health. So, with this study, we examined the occurrence of smartphone and social media application use in first year students in distance education at Southeast European University during COVID-19 pandemic. Respectively, we investigate the impact of different social media applications on self-described tendencies toward social media addiction. 95 students of both genders were interviewed, who spoke on the use of the smartphone and social media applications, specifically WhatsApp, Facebook, Twitter, TikTok, Instagram, Snapchat, Telegram, Messenger, and YouTube. Differences in social media addiction with different patterns of social media use were investigated. On average students using WhatsApp and Viber reported the lowest social media addiction compared with students using Facebook and TikTok. In general, we found time spent on smartphone using Facebook.

**Keywords:** *Distance Learning; Smartphone; Social Media Use; Addiction*

## 1. Introduction and background to the study

The lives of many students at Southeast European University are today increasingly influenced by new technological devices, including smartphones. The coronavirus disease 2019 (COVID-19) pandemic occurred while digitalization was progressing in every aspect in our University. Additionally, many students had opposing psychological and behavioral effects due to the COVID-19 pandemic, mainly because of spending more time at home and with major use of technology. Therefore, with this study we aim to evaluate health and social outcomes of smartphone overuse among our students at SEEU during the COVID-19 pandemic, analyzing patterns and aims of use, as well as the eventual presence and degree of addiction. This is no doubt that this related to the social distancing.

## 2. Setting of the study

COVID-19, the acute respiratory syndrome related to the new coronavirus (SARS-CoV-2) infection, dramatically spread worldwide from China since the end of 2019. It reached Italy, first among European

countries, on February 2020. The following further rapid diffusion to other continents on March 11th 2020, led the World Health Organization (WHO) to declare a pandemic. The study took place over a 2-month period, from February 2021 to March 2021. In that time North Macedonia, within the second wave of the pandemic, was at epidemiological risk and time by time lockout was imposed by the Commission of Infectious diseases and Epidemiology. Particular approaches to contrast the spread of the disease were taken and tuned, based on the different risk scenarios. Where the overall risk of COVID-19 spread was increased, the movement of people and the economic and social activities were more limited according to the Commission of infectious diseases and Epidemiology which varied on a period basis. Teaching and educational activities and services were irregularly carried out. For the remaining teaching weeks for students, distance teaching (online) was the only modality of education which was guaranteed

### 3. Selection of study participants

This study was based on anonymous questionnaire, which was administered to two of my groups online during the second wave of COVID-19 pandemic. The test was compiled by teachers of English. Questions were created in Google Forms. They were electronically (email, WhatsApp) explained in detail together with the aims of the study, and directly sent to students. In total 60 students participated and replied in the study. All students spontaneously and voluntarily joined the survey. Their answers were documented on Google sheet forms, and then analyzed.

### 4. Data collection

The questionnaire was designed to understand modalities (frequency, and aims) of smartphones use, its impact and adverse effects on everyday life and their behaviors, in order to reveal the eventual occurrences and degree of addiction, during the COVID-19 pandemic. The study included questions on frequency of smartphone use (i.e. time of smartphone use per day, time between wake e up and start of use, and frequency) and about patterns and effects of their utilization before and during the pandemic, evaluated with the following items "most frequently used functions, "aims of use", "adverse effects "towards smartphone use. The most frequently used functions included: "telephone call", "social network" \*Facebook, Instagram), "games" "education", online chat (WhatsApp)", "photos "videos" and "music". To investigate the aims of smartphone use, we included the following items "boredom", "habit", "pleasure", "game ", "communication", "learning", "stress" relied" and "adaptation to others". As for the adverse effects, the answers included "superficial approach to learning", "distraction", "mood modification", "loss of interest", "isolation", "sleep troubles", "ocular adjustments ". Participants gave to each of these four items a score, ranging from 1 (never) to 5 (always). The last few questions were related to the evaluation of eventual occurrence and degree of smartphone addiction, measured by the Smartphone Addiction Scale Short version (SAS-SV). Questions included daily-life disturbances, overuse and tolerance. Responses are rated on a six-point Likert scale ranging from "strongly disagree - 1" to "strongly agree - 6," with higher scores indicating more addictive smartphone behavior. This study used the Smartphone Use Motivation Scale compiled by Chen and others [1] based on the theory of IT addiction.

### 5. Statistical Analysis

R version 4.0.4 (Foundation for Statistical Computing) for data analysis was used. Simple descriptive statistics were expressed as frequency and percentage for categorical variables, mean and standard deviation (SD) for continuous variables. Paired-samples t-test was used to compare data on patterns and smart-phone use in the target population, before and during the COVID-19 pandemic. A  $p$  value lower than 0.05 was considered statistically significant.

## 6. Discussion

Although the present survey was equally offered to both genders, a significantly greater devotion by females was evidences. This could reflect increasing high degree of attention and interest of girls than boys to initiatives relating to technology. Despite the limitations of an inhomogeneous representations of the population analyzed, either in gender or geographic origin, however, the validity of the results obtained may not be affected, also in light of overlapping conditions of the different students' background, in terms of economic, social and school setting during the pandemic where students increased their average daily smartphone use. This could be explained by the extensive use and the various role played by smartphones during the pandemic. This is expected, considering the potential task of smartphones as source of communication, information, and entertainment. Indeed, it's a combination of services provided by the web and those of cell phones, allowing communication and information to flow from distance. At this time of social separation, as observed in present study, people relied on such useful aspects more than in normal circumstances. So, our study evidenced an increase, during the pandemic, of smartphone functions like telephone calls, videos, online chats, and social network. Certainly, this reflected physical relationship and contacts with relatives, especially friends, due to the strict social distancing measures adopted by the authorities. In general, during the pandemic communication devices seemed to be the only support for the human relationship, and almost replaced face-to-face interactions, becoming perhaps the only channel for social connections, especially among the young people and students. Moreover, smartphones in one way or the other provided to students the opportunity to continue schooling and education. Indeed, the partial and total closure of schools forced us during the pandemic period to create and use online learning platforms, which had pedagogical and psychological consequences in students' life and families, due to the need of proper technological skills, new learning techniques as well as availability of digital devices and connectivity to internet. All the online learning led to more time spending on screen, resulting in turn to a greater possibility of students' distraction by social media. Moreover, increased digitalization widened the "educational gap" among families, specifically poorest students were the most penalized as they do not likely have a quiet place in their home for their studies and online learning, or their own digital devices for an easy and quick access to online education. So, many students reported that COVID-19 pandemic affected their learning, online education quality was perceived as lower than physical presence and pandemic-related anxiety had a negative impact on students' academic performances. Definitely, our survey confirmed that the use of smartphone for recreational purposes became more frequent during the pandemic. The amount of interactions due to CoV-2 among family members or friends contributed to increase the anxiety levels among students. Then, they reported that smartphones allowed containing negative emotions, stress and sense of isolation. However, smartphone addiction became frequent in comparison with the pre-pandemic period. Along with the that its overuse had many negative effects, such as depression, social problems, anxiety, low self-confidence, stress, low school performance, leading the students to be less focused during classes and have more superficial approach to learning. Actually, during the COVID-19 pandemic our students had sleep disturbances, ocular alterations. Generally, students screen time during the pandemic increased a lot and along with that its addiction.

## 7. Conclusions

The present study focused on the smartphone addiction during the COVID-19 pandemic and pre-pandemic. Through a survey of 95 students the results indicated more frequent smartphone use among students at SEEU during COVID-19 pandemic, compared to the pre-pandemic period. This was unconditionally related to the social distancing measures adopted during the months under this research. The study at the same time revealed the changing outline and aims in the use of smartphones among students, which limited some effects of the crises. In fact, it was used for many purposes starting as human connection, learning and entertainment, as well as providing psychological and social support. But in the meantime, it was also witnessed a significant increase of overuse and addiction. All this led to many unfavorable new conditions, such as sleep disorders, mood variations, loss of interest, superficial approach to learning,

isolation. Teachers or health professionals should have been aware of such risks related to inappropriate and overuse of smartphones during the pandemic. Together with parents, teachers should have monitored the adverse effects also, in order to early recognize signs and symptoms at high risk for addiction.

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# The Communicative Approach in English Language Learning

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**ABSTRACT:** The importance paid to the teaching of foreign languages, especially English language teaching in the context of North Macedonia is a natural result not only of tradition, but also as a consequence of the new reality created in North Macedonia. However, the creation of the new reality has been preceded by a series of ongoing processes of integration at the European and global level, which obviously could not have been achieved without communication, interaction and mutual understanding between people of different linguistic, ethnic and cultural backgrounds. Consequently, the interest in learning foreign languages is constantly growing, which is fully in line with global trends when considering globalization and the need for intercultural communication. Interest in English becomes legitimate when one considers the status and role that English has today as the 'lingua franca' of the civilized world.

*Keywords: Communicative Approach, Foreign Languages, Teaching and Learning, English*

## 1. Introduction

The importance paid to the teaching of foreign languages, especially English language teaching in the context of North Macedonia is a natural result not only of tradition, but also as a consequence of the new reality created in North Macedonia. However, the creation of the new reality has been preceded by a series of ongoing processes of integration at the European and global level, which obviously could not have been achieved without communication, interaction and mutual understanding between people of different linguistic, ethnic and cultural backgrounds. Consequently, the interest in learning foreign languages is constantly growing, which is fully in line with global trends when considering globalization and the need for intercultural communication. Interest in English becomes legitimate when one considers the status and role that English has today as the 'lingua franca' of the civilized world.

## 2. Effective communication

At the core of all efforts is the social orientation to language learning. Based on the fact that in everyday life every individual has to carry out a series of tasks every day, all documents promote active learning and an action-oriented approach, at the core of which is the attitude that language users should be seen as factors in society. To fulfill the tasks assigned to an individual, he/she must be equipped with a range of competencies that include the knowledge, skills and abilities that enable effective communication between people; in other words, he/she must be able to be an effective communicator.

The questions that arise in relation to communication skills are: 'What is effective communication?' 'What does it involve?' 'What does one need to know to communicate with others?'. The answers seem to be simple: successful communication means 'knowing how, when and why you should say something to someone'. All the linguistic and social knowledge for effective interaction is contained in these ten words. In the past a special emphasis was placed on the question of how (grammar) and what (vocabulary). If a parallel is drawn between language and a building, grammar can be thought of as the architect's blueprint and words as the building blocks. Therefore, without an architect's plan, a building cannot be built, even if a person has a million blocks [1]. It is clear that the approaches used today in foreign language learning are intended to enable genuine interaction with others. Therefore, communication involves the question of why, to whom and when, as they

offer the possibility to communicate in an understandable and appropriate way with users of other languages regardless of the fact that they live in the same neighborhood, at a distance or even on another continent.

### 3. Approaches

#### 3.1. The comprehensive approach

In language learning, students' attention can be focused on certain issues or on the language as a whole. In cases where we want to focus the foreign language student's attention on certain parts, those parts can be grammatical structure (time), language function (expressing thanks), area related to vocabulary (food and drink), or phonological features (accent or a particular sound). On the other hand, when attention is focused on the language as a whole, students, through a large number of activities, use the language for practical or real purposes, in other words, they act as real users of the language.

The advantage of the comprehensive approach to language learning lies in the fact that it enables those who learn that language to consider it as a powerful tool for communication and interaction and not as a sterile, unrealistic and out-of-context learning; therefore, also artificial and not authentic, as is the case when students are exposed to segmented language, when they are not taught language but meta-language. Here we will focus on the use of language alongside its learning, which means that language is considered as a means and an end, not as an end in itself. Today it is universally accepted that the existence of a lot of information has become a guiding principle in education; that is why different teaching is promoted. This also applies to learning. On the other hand, the word literacy has also been re-evaluated in terms of semantics. It is no longer applied exclusively to the ability to read and write, but it also includes other types of skills: computer skills, music skills, visual arts skills, and the like. Communicative approaches take all this into account and integrate procedures, strategies, and techniques that exploit the potential of non-linguistic and extra-linguistic materials by using them as teaching materials to enable genuine communication. Therefore, language teachers should encourage students, especially in the early stages of learning, to use those kinds of skills in which they are most confident, or which they consider to be the most appropriate at a given moment. This is especially true for young learners, but it is not excluded for teenagers and adult learners either. Students may differ in age, however, in the classroom environment they tend to behave more or less the same way.

Since communication mainly means sending and receiving orders, students must develop the four language skills that constitute the essence of communication. The development of perceptual skills, such as listening and reading, will enable students to accept orders and, depending on the tasks they have to fulfill, select the important information. However, since language skills are not isolated but are usually integrated for communication purposes, once the order has been received and the information relevant to the task has been identified and selected, learners must be able to make decisions and to respond properly in a concrete situation to a concrete request. In a language-related situation, their response is an educational function, which is performed by one of the productive skills, speaking or writing.

#### 3.2. Modern approaches

Considering the multiple information and therefore the different types of learners, contemporary approaches promote active learning. Communicative approaches, task-based learning, and project-based learning offer a range of opportunities to awaken student curiosity and motivation, engage students in classroom activities, and enable further development of skills, abilities, their opportunities and attitudes. In the classroom, students can engage in a range of tasks. The question that arises in this case is: "What is considered a duty?".

A task is any activity that aims to achieve a concrete goal by applying a procedure or a sequence of procedures or a sequence of strategies. Proponents of task-based learning universally recognize that a classroom task can be anything, e.g., finding a location, reading a map, finding a solution to a riddle, finding an address by reading map, measuring the dimensions of an object, or building a toy airplane, or predicting fortune by following the teacher's instructions, drawing a plan of the school building, ordering a meal by reading the menu, making a phone call, and the like. In our case, this means teaching English, apart from the common goal, it is equally important to use the knowledge and skills of the students and to enable them to communicate, interact and collaborate with their peers. them for the fulfillment of the task, focusing on meaning and form [2] since grammar is knowledge found in the head of the individual and not in the rules of any book [3]. By completing tasks, undertaking projects, working in groups, interacting, sharing and caring,

sharing information, doing work, and being responsible, students develop their personal and interpersonal skills and are better prepared for work. The team that awaits them in real-life situations.

As pointed out in the previous paragraph, there is a wide variety of tasks that can be used as language activities in the classroom: some of which are games, optical illusions, crosswords, and riddles, but also practical activities which, in addition to the intellectual engagement of students, require also mental engagement. All these have in common the efforts to remove the threat and fear of making mistakes and to create a suitable environment for students to facilitate the teaching and learning process.

#### 4. Advantages

The universally accepted advantages of the communicative approach and task-based learning are as follows:

- In the learning process, students do not study the language, but they participate in activities that have the value of practical education;
- The subjects and areas of learning are in the sphere of students' interest, which should increase the level of motivation and commitment;
- Students are exposed to the English language in its natural, authentic, and non-artificial form. This language is likely to be meaningful, so it stands to reason that the activities are also meaningful.
- The whole activity takes place in English; therefore, the students consider the English language as a means of communication and not as a final product;
- Language is not learned through a set of grammatical structures. The acquisition of knowledge and the perception of reality are done in the English language, so the language that is desired to be learned is used both as a means and as an end;
- Learning is done in groups with students who have different knowledge. Groups with different abilities are inevitable at all stages of language learning in schools. However, this turns into an advantage in communicative approaches and task-based learning. Students with poor background knowledge benefit from group work because by collaborating on a task they learn not only from the teacher and their materials but also from their peers.
- In the learning process, attention is focused on students as individuals, therefore students are encouraged to study and learn at their own pace using their preferred learning style.

#### 5. Teacher's role

Approaches through communication and task-based learning require starting from the traditional role of the teacher as well as the student [3]. In language learning through communication, the key role of the teacher is to facilitate learning, which mainly means that:

- He/she coordinates the activities in the classroom. Consequently, the role of the teacher is less dominant, and obliges him to emphasize the contribution of students through independent learning with the given resources;
- As a class leader, the teacher is responsible for grouping activities into 'lessons'.
- In some activities the teacher can play the role of the language instructor by presenting the new language, having direct control over the performance of the students, its evaluation, and improvement;
- In other activities, he/she can intervene, but will not allow learning to develop through independent activities;
- In language activities, the class is divided into pairs and groups which interact independently of the teacher. In independent activities, he/she can act as a consultant, advisor, or monitor, to discover the weak and strong points of students, which he/she will use as a basis for planning activities;
- From time to time, the teacher can participate in activities as a 'communicator' who stimulates and introduces the new language but leaving the initiative to the students. By assuming the role of "communicator", the teacher puts himself on an equal footing with the students. This helps reduce tension and overcome barriers between them, thus creating a suitable environment for learning. As a result, the relationships between students and between teacher and students are more relaxed and cooperative, which enables interaction;

- Students are not constantly corrected. Errors are treated with more tolerance, as a normal phenomenon in the development of communication skills, where the focus is on fluency rather than accuracy.

## 6. Changes and results

What changes have been observed in the role of students in communicative approaches and in task-based learning? Since the emphasis is placed on the communication process and not on the mastery of linguistic forms, the student assumes the role of a common negotiator [4]. In the learning process, he/she negotiates between the student (him/herself), the process and the object of learning. This type of negotiation is important in the learning process, as it enables students to develop their critical skills, make decisions, take responsibility for their own learning and learn independently.

The teacher should encourage students to take responsibility for their own learning, offering them opportunities for individual and independent work and enable students to learn according to the dynamics they want in order to achieve the specified learning outcomes.

The benefits of students from this type of negotiation are multiple: they gain self-confidence, they are ready to take initiatives, take risks and make decisions based on sufficient and reliable information.

The student and the group within the activities undertaken by the class. Through this type of negotiation, students gain self-confidence in interaction, in sharing and exchanging information.

In group activities and procedures, they gain self-respect, learn to show respect to their colleagues, cooperate with them, and adjust their views in certain situations so that the group makes joint decisions, etc.

Students and the class within the activities undertaken by the group. Through this type of negotiation, students learn to share responsibilities with others and contribute as individuals and as team members to the fulfillment of the task. This increases awareness of roles and responsibilities as individuals in the classroom, at school, in the community, and in the world at large.

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**PARALLEL SESSIONS PAPERS  
PRESENTATION**

**SESSION 1**

**ARTIFICIAL INTELLIGENCE AND  
DIGITALIZATION  
SESSION CHAIR: DR. DONALD ELMAZI**



# Application of Sentiment Analysis and Event Classification based on XLNet in the Financial Area

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**Abstract:** Investment research and analysis in the financial area use a large number of real-time market information. Due to financial terms and characters in financial news, sentiment analysis and event classification have great difficulties. In this situation, this paper proposes the Fin-XLNet model by training financial corpora based on the XLNet, and then complete sentiment analysis and event classification tasks of financial news. Our experimental results show that this model outperforms both native and related models. Based on the Fin-XLNet model, we build a real-time service system to output the results of sentiment analysis and event classification to the real-time data warehouse architecture. This paper also supports complex finance scenarios through micro-service clusters.

**Keywords:** *Fin-XLNet; XLNet; Sentiment Analysis; Event Classification.*

## 1. Introduction

In the investment area, collecting and analyzing public information is the key to avoiding unnecessary risk exposure and making effective investment decisions. Nowadays, it is popular for institutional investors to extract valid viewpoints and emotional tendencies through enormous unstructured data, such as research reports and financial news, as alternative data. Using alternative data can increase the information advantage of investors, leading to more accurate analysis and prediction of future asset price trends, thereby assisting investment decision-making and optimizing investment performance. Due to the character of the financial area, its sentiment analysis is different from most published algorithm papers about sentiment analysis based on social media and daily news. Mainly because, firstly, the corpus of the financial area is different. There are fewer general emotional words and more words describing the changes in the stock market, which are not involved in the traditional sentiment dictionary. Secondly, the importance of the title of financial articles is equal to the main text, and the main text is generally long text. Thirdly, investment requires high timeliness and excellent availability of the model. It is necessary to complete the sentiment analysis and classification inference of a large number of corpora in a short time. In summary, this paper proposes a new architecture for sentiment analysis and event classification based on XLNet. Specifically, the main contributions of this paper are in three areas:

- Propose a financial sentiment analysis and event classification process.
- Build the Fin-XLNet model, including training a corpus of the Chinese financial area and fine-tuning this model for different financial classification tasks.
- Make a model application solution based on big data ecology and microservices

## 2. Related Work

Financial markets are greatly affected by market emotion fluctuations. Investment behaviors in securities, commodity futures, foreign exchange, and other fields need to rely on massive and real-time financial news to assist decision-making. Therefore, the sentiment analysis and event classification of financial news are critical, especially the particularity of Chinese financial news proposing higher requirements for sentiment analysis and event classification. There are several scholars who have used algorithms to achieve this target.

Machine learning methods for sentiment analysis have been applied to datasets of tweets or news [1], [2], [3], [4]. The authors in [2] test StockTwits tweets sentiments with binary classifiers in machine learning, showing that the SVM classifier is more accurate than the Decision Trees and Naive Bayes classifier. In [3], the authors use various statistical and machine learning with semantic features to get the result of real-valued sentiment score from micro- blogs data. They show that machine learning improves the accuracy of classification.

Researchers have also used lexicon-based methods and machine learning for sentiment analysis. In [4], the authors show that the combination of lexicon-based methods and machine learning are more efficient than single models. However, traditional machine-learning methods cannot extract complex features and keep the order of words in a sentence. These tasks require deep learning, which extract complex feature, location and order information [5].

Deep learning uses multi-layer nonlinear processing unit devices for more complex feature extraction and transformation, resulting in a better effect of sentiment analysis [6]. Lots of papers prove the effect of deep learning models, such as recurrent neural networks (RNN) [7], convolutional neural networks [8], and attention mechanism [9] on emotion analysis in the finance area. The word [10] and sentence encoders [11] are introduced and improved as deep learning methods in NLP, bringing the successful effects in NLP, which is crucial for emotion analysis.

Deep-learning and transfer-learning significantly improved the results of emotional evaluation from financial news recently [12]. In [13], the authors incorporate inductive transfer-learning methods such as ULMFiT [14] for sentiment analysis in finance, showing improvements compared to traditional transfer-learning approaches. NLP transformers, BERT and RoBERTa shows the improvement in sentiment analysis. In [15], the paper proves the effectiveness of the RoBERTa model compared to dictionary-based models. In [16], the authors use models including lexicon-based feature extraction, word and sentence encoders and NLP transformers models. This paper test model effectiveness with the same dataset, indicating that modern NLP transformers can efficiently replace lexicon-based approaches.

However, the above papers mostly use English texts as their experiment data. Only a few papers concentrate on the sentiment analysis of Chinese texts. In [17], the authors use the n-gram language model to construct the stock dictionary of Chinese texts. Then they show that the Naïve Bayes classifier is more accurate compared to K-Nearest Neighbor and SVM classifier when using term frequency weighting. The authors in [18] design a target-based sentiment annotation corpus on Chinese Financial news text and then construct an annotated corpus with multiple targets and sentiments. In this corpus, the targets are the entities for enterprises, including company names, brand names, and other financial entities. Then they show that the BERT is more efficient than LR, SVM, XGBoost, LSTM-ATT and TD-LSTM, proving that deep-learning methods are more useful than machine learning methods.

Overall, most models cannot solve two fundamental problems: the particularity of terms segmentation of Chinese financial news and the requirement of higher accuracy for classification models in the financial area. Therefore, this paper introduces the XLNET model, renews the corpus of financial news, and combines it with the real- time big data service system to realize the real-time output of higher-precision labels of Chinese financial news, meeting the needs of investment research, risk control, and operation in the financial area.



### 3. Methodology

#### 3.1. Financial sentiment analysis and event classification process

Financial sentiment analysis and event classification have the similar process, which contain four steps: preprocess data, input data, extract text features and classify text. The process is presented in fig. 1. Because this paper uses XLNet as the major model, we use XLNet as the sample model below. Specifically, the concrete steps are below:

**Step 1:** Preprocess data. The collected data has some noises, so we process a regularization to remove text fragments affecting sentiment analysis for clean data.

**Step 2:** Input data. We input the clean data into the XLNet tokenization module, which is input texts

$$X = [x_1, x_2, \dots, x_T].$$

**Step 3:** Extract text features. The input text is serialized by the XLNet tokenization module. Each word in the input text  $X$  is transformed into its corresponding number through the vocabulary dictionary to obtain the serialized text data  $E = [e(x_1), e(x_2), \dots, e(x_T)]$ , which  $e(x_i)$  denotes the serialized representation of the  $i$ th word in the set. The autoregressive encoder is used to train the serialized text to obtain the dynamic feature representation of the text data. The text data features are represented as  $T = [T(x_1), T(x_2), \dots, T(x_T)]$ , where  $T(x_i)$  denotes the feature vector of the  $i$ th word. When the auto-regressive encoder is used to extract text features, the relative position relationship of each word and its other words in the current text is firstly calculated. Then the relative position information is used to adjust the weight of each word to obtain the new representation of each word in the sentence. The text feature  $T(x_i)$  uses the relative position relationship of the words, so the words have better expressions in different contexts, leading to better distinguishing the different meanings of the words in different contexts.

**Step 4:** Text classification. We input the text feature vector to the downstream XLNet model for sentiment analysis and text classification and then obtain the result

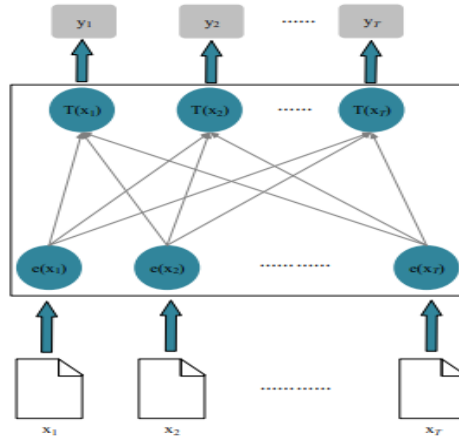
$$Y = [y_1, y_2, \dots, y_T].$$

#### 3.2. XLNet and Fin-XLNet

XLNet is based on an auto-regressive language model that is friendlier to downstream tasks. The autoregressive language model has high computational efficiency and clear probability density of modeling. Suppose we have a length- $T$  sequence  $X = [x_1, x_2, \dots, x_T]$  and the objective function of the auto-regressive language model is defined as

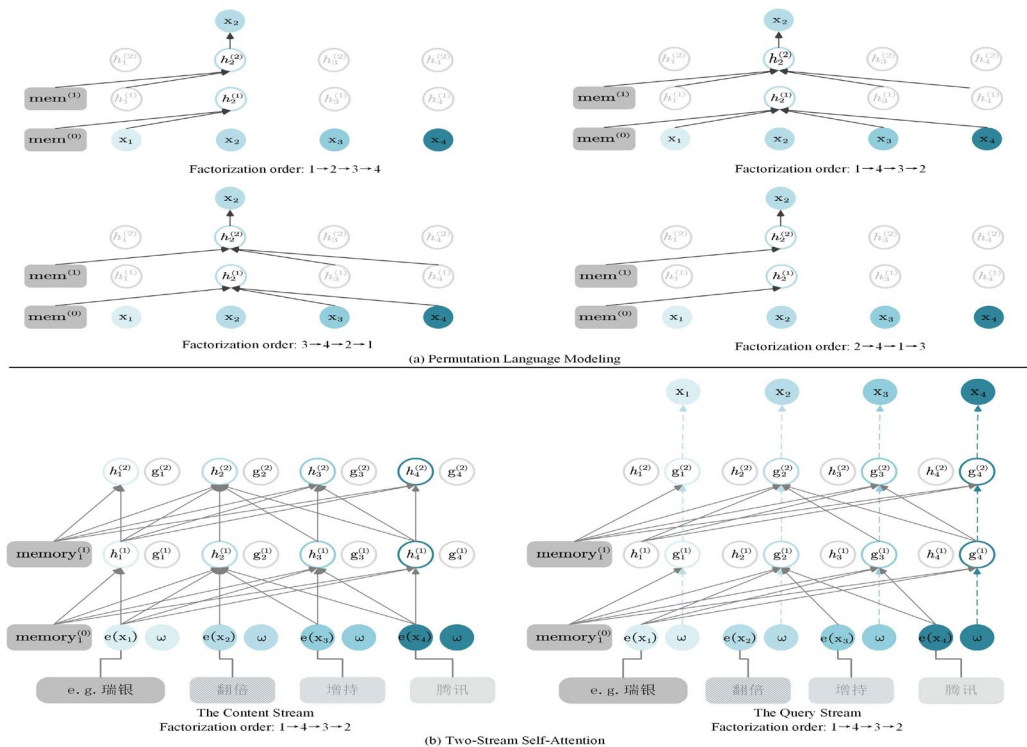
$$\begin{aligned} \max_{\theta} \log p_{\theta}(X) &= \sum_{i=1}^T \log p_{\theta}(x_i | X_{z < i}) \\ &= \sum_{i=1}^T \log \frac{\exp(h_{\theta}(X_{1:i-1})^T e(x_i))}{\sum_{x'} \exp(h_{\theta}(X_{1:i-1})^T e(x'))} \end{aligned} \quad (1).$$

$h_{\theta}(X_{1:i-1})$  is the above information and information of  $x$  produced by neural models,  $e(x)$  denotes the embedding of  $x$ .



**Figure 1.** The Overview of XLNet

Equation (1) shows that the auto-regressive language model predicts the next word based on the above information, and the model cannot see the following information. Suppose the desired predictor is  $x_t$ ,  $x < t$ , represents the  $t-1$  words before the predictor  $x_t$ , and  $p(x_t)$  is the probability of predicting based on the former information of  $x_t$ . The auto-regressive language model cannot recognize the context, which is a fatal weakness for downstream tasks. So XLNet proposes a method called Permutation Language Modeling (PLM) to solve this problem. XLNet uses permutation language model, which enables it to learn bidirectional contexts jointly with order aware via positional encoding. Specifically, it randomly arranges the word order to predict the word in a given position. PLM requires two steps to achieve the target. Firstly, PLM needs to perform a factorization order on a sequence to obtain different word orders to get context information when predicting words. Suppose the given sequence  $X = [x_1 x_2 x_3 x_4]$ , the sequence is  $1 \rightarrow 2 \rightarrow 3 \rightarrow 4$ , and the factorization order is that  $1 \rightarrow 2 \rightarrow 3 \rightarrow 4$ ,  $1 \rightarrow 4 \rightarrow 3 \rightarrow 2$ ,  $3 \rightarrow 4 \rightarrow 2 \rightarrow 1$ ,  $2 \rightarrow 4 \rightarrow 1 \rightarrow 3$ , and so on. An example of predicting  $x_2$  based on the different orders generated by the factorization order is shown in Figure 2(a).



**Figure 2.** Permutation Language Modeling and Two-Stream Self-Attention of XLNet

For the factorization order method, given a length-T sequence  $X = [x_1, x_2, \dots, x_T]$ , there are  $T!$  different

orders to estimate the joint probability distribution defined on all such sequences. When the sequence length is too large, the algorithm's complexity will be too high. Therefore, XLNet uses equation (2) to estimate the probability of token  $x$  and predict some last words in every possible permutation.

$$\max_{\theta} \mathbb{E}_{z \sim Z_T} \left[ \sum_{i=1}^T \log p_{\theta}(x_{z_i} | X_{z_{<i}}) \right] \quad (2)$$

In this equation,  $Z_t$  is the set of length-T sequences,  $z$  is the sequence sampled from  $Z_t$ ,  $z_t$  is the value at position  $t$  in the sequence  $z$ ,  $\mathbb{E}_{z \sim Z_T}$  is the expectation function of sampling results. Secondly, PLM uses attention mask to simulate different word orders and does not change the real order of the sequence. PLM not only solves the problem that the autoregressive language model cannot obtain the context memory but also avoid the problem that different masks are independent in the BERT model. However, the PLM method cannot recognize the correct sequence when predicting the current word, so we use two stream self-attention. Two-stream is divided into the content stream and query stream. The traditional auto-regressive language model, which has a length-T sequence  $X = [x_1, x_2, \dots, x_T]$  is defined as

$$p_{\theta}(X_{z_i} = x | X_{z_{<i}}) = \frac{\exp(e(x)^T h_{\theta}(X_{z_{<i}}))}{\sum_{x'} \exp(e(x')^T h_{\theta}(X_{z_{<i}}))} \quad (3)$$

$h_{\theta}(X_{z_{<i}})$ , only has the content information of and its above information, instead of positional information. Due to PLM will disrupt the order of sequence, so we need to add positional information  $z_t$ , when predicting word on position  $t$ , which is defined as

$$p_{\theta}(X_{z_i} = x | X_{z_{<i}}) = \frac{\exp(e(x)^T g_{\theta}(X_{z_{<i}}, z_i))}{\sum_{x'} \exp(e(x')^T g_{\theta}(X_{z_{<i}}, z_i))} \quad (4)$$

In equation (4),  $g_{\theta}(X_{z_{<i}}, z_i)$  represents the hidden state of the query, which contains the content information before and the position information of  $x$ . It does not encode the content information of  $x$ . The update formula of content hidden state  $h$  and query hidden state  $g$  is

$$\begin{cases} h_{z_i}^{(m)} \leftarrow \text{Attention}(Q = h_{z_i}^{(m-1)}, KV = h_{z_{<i}}^{(m-1)}; \theta) \\ g_{z_i}^{(m)} \leftarrow \text{Attention}(Q = g_{z_i}^{(m-1)}, KV = h_{z_{<i}}^{(m-1)}; \theta) \end{cases} \quad (5)$$

In equation (5):  $m$  is the number of network layers. Usually, the query hidden state  $g^{(0)}$  is initialized to a variable  $\omega$  at layer 0, and the content hidden state  $h^{(0)}$  is initialized to the embedding of the word, that is  $e(x)$ .  $Q$ ,  $K$  and  $V$  are defined as query, key and value respectively, which are matrices through a linear transformation of input data with different weights. Fig. 2(b) is the working principle of content stream and query stream when predicting the sequence 1→4→3→2. Starting from layer 0,  $h$  and  $g$  are initialized to  $e(x)$  and  $\omega$ . When we compute the content stream, we do the standard Transformer computation: when we predict  $x_1$ , we only see  $x_1$  and the last segment information called memory; then predicting  $x_4$ , we see the content of  $x_1$ ,  $x_4$  and memory, and so on. In the content stream, the target word provides its content for the prediction. However, when computing the query stream, for example, when we predict  $x_1$  we only get the memory and the position of  $x_1$ ; then predicting  $x_4$ , we only see the content of  $x_1$  and memory and position of  $x_4$  and so on. In the query stream, the predicted word cannot provide the content information for the model prediction. Finally, XLNet uses cycle mechanism and relative positional embedding to improve understanding of long-distance context semantic information, which comes from Transformer-XL [19]. Relying on relative positional information, Transformer-XL proposes equation (6):

$$\begin{aligned} A_{i,j}^{\text{rel}} = & \underbrace{E_{x_i}^T W_q^T W_{k,E} E_{x_j}}_{(a)} + \underbrace{E_{x_i}^T W_q^T W_{k,R} R_{i-j}}_{(b)} \\ & + \underbrace{u^T W_{k,E} E_{x_j}}_{(c)} + \underbrace{v^T W_{k,R} R_{i-j}}_{(d)} \end{aligned} \quad (6)$$

where  $E$  is the word embedding sequence;  $R$  is the relative distance between two positions. The following are the efficient computation of attention with relative positional embedding. Firstly, the relative distance of word  $i$  and word  $j$  is an integer from 0 to  $M + L - 1$ , where  $M$  and  $L$  are the memory length and segment length,

respectively.

$$Q = \begin{bmatrix} R_{M+L-1}^T \\ R_{M+L-2}^T \\ \vdots \\ R_1^T \\ R_0^T \end{bmatrix}, W_{k,R}^T = \begin{bmatrix} [W_{k,R} R_{M+L-1}]^T \\ [W_{k,R} R_{M+L-2}]^T \\ \vdots \\ [W_{k,R} R_1]^T \\ [W_{k,R} R_0]^T \end{bmatrix} \in \mathbb{R}^{(M+L) \times d} \quad (7)$$

Hence, the matrix rows consist of all possible vector outputs of  $W_{k,R} R_{i-j}$  for any  $(i, j)$  and have defined  $Q$  in a reversed order,  $Q_k = W_{k,R} R_{M+L-i-k}$ . Next, they collect the term(b) for all possible  $i, j$  into the following  $L \times (M+L)$  matrix,

$$B = \begin{bmatrix} q_0^T W_{k,R} R_M & \dots & q_0^T W_{k,R} R_0 & 0 & \dots & 0 \\ q_1^T W_{k,R} R_{M+1} & \dots & q_1^T W_{k,R} R_1 & q_1^T W_{k,R} R_0 & \dots & 0 \\ \vdots & \ddots & \vdots & \vdots & \ddots & \vdots \\ q_{L-1}^T W_{k,R} R_{M+L-1} & \dots & q_{L-1}^T W_{k,R} R_{M+1} & q_{L-1}^T W_{k,R} R_1 & \dots & q_{L-1}^T W_{k,R} R_0 \end{bmatrix} \quad (8)$$

$$= \begin{bmatrix} q_0^T Q_{L-1} & \dots & q_0^T Q_{M+L-1} & 0 & \dots & 0 \\ q_1^T Q_{L-2} & \dots & q_1^T Q_{M+L-2} & q_1^T Q_{M+L-1} & \dots & 0 \\ \vdots & \ddots & \vdots & \vdots & \ddots & \vdots \\ q_{L-1}^T Q_0 & \dots & q_{L-1}^T Q_M & q_{L-1}^T Q_{M+1} & \dots & q_{L-1}^T Q_{M+L-1} \end{bmatrix}$$

Then, they further define

$$\tilde{B} = qQ^T = \begin{bmatrix} q_0^T Q_0 & \dots & q_0^T Q_M & q_0^T Q_{M+1} & \dots & q_0^T Q_{M+L-1} \\ q_1^T Q_0 & \dots & q_1^T Q_M & q_1^T Q_{M+1} & \dots & q_1^T Q_{M+L-1} \\ \vdots & \ddots & \vdots & \vdots & \ddots & \vdots \\ q_{L-1}^T Q_0 & \dots & q_{L-1}^T Q_M & q_{L-1}^T Q_{M+1} & \dots & q_{L-1}^T Q_{M+L-1} \end{bmatrix} \quad (9)$$

The  $i$ -th row of  $B$  is simply a left-shifted version of the  $i$ -th row of  $\tilde{B}$ . Similarly, they collect all term(d) for all possible  $i, j$  into another  $L \times (M+L)$  matrix  $D$ ,

$$D = \begin{bmatrix} v^T Q_{L-1} & \dots & v^T Q_{M+L-1} & 0 & \dots & 0 \\ v^T Q_{L-2} & \dots & v^T Q_{M+L-2} & v^T Q_{M+L-1} & \dots & 0 \\ \vdots & \ddots & \vdots & \vdots & \ddots & \vdots \\ v^T Q_0 & \dots & v^T Q_M & v^T Q_{M+1} & \dots & v^T Q_{M+L-1} \end{bmatrix} \quad (10)$$

After that, they follow the same procedure to define

$$\tilde{d} = [Qv]^T = [v^T Q_0 \dots v^T Q_M \ v^T Q_{M+1} \dots v^T Q_{M+L-1}] \quad (11)$$

Again, each row of  $D$  is simply a left-shift version of  $\tilde{d}$ . Hence, the main computation cost comes from the matrixvector multiplication  $\tilde{d} = [Qv]^T$  which is not expensive anymore. Fin-XLNet is the model with the financial corpus and XLNet network. Firstly, we use SentencePiece package and embedded byte-pair-encoding (BPE) algorithm to generate financial corpus by millions of financial news and ordinary texts [20],[21],[22]. There are some reasons to propose FinXLNet. For one thing, XLNet has a great long text recognition ability. It gets so many SOTA achievements in text classification tasks [23]. For another thing, financial news has a number of specialized vocabularies, thus we need to pretrain a specialized corpus of the Chinese financial area to get reasonable word vector and word token for more accurate classification results. Secondly, we tokenize the daily financial news from Fin-XLNet and put the token into Fin-XLNet model for downstream sentiment analysis and event classification tasks. Thirdly, the financial market generates thousands of financial news daily, so an old model cannot fit the changeable financial texts. We have to renew our model based on big data ecology and microservices. The specific iterative process is shown in the table 1 below.

Table 1. Iterative Process of Fin-XLNet model

<p><b>Input:</b> <math>\mathcal{R}, \mathcal{C}, \mathcal{C}', \mathcal{X}, \mathcal{D}, \mathcal{H}, \mathcal{P}</math></p> <p><math>\mathcal{D}</math> is a cloud database</p> <p><math>\mathcal{R}</math> is a set of <u>old financial</u> news (<math>\mathcal{R}_x, \mathcal{R}_y, \mathcal{R}_z</math>), <math>\mathcal{R}_x</math> is raw text; <math>\mathcal{R}_y</math> is sentiment label; <math>\mathcal{R}_z</math> is the label of event classification.</p> <p><math>\mathcal{X}</math> is the updated <u>XLNet</u> model, which contains tokenization module <math>\mathcal{X}_x</math> and parameter module <math>\mathcal{X}_y</math>.</p> <p><math>\mathcal{C}</math> is a set of daily financial news that is updated daily (<math>\mathcal{C}_x</math>), <math>\mathcal{C}_x</math> is raw text; <math>\mathcal{C}_y</math> is sentiment label; <math>\mathcal{C}_z</math> is the label of event classification.</p> <p><math>\mathcal{C}'(\mathcal{C}_x, \mathcal{C}_y, \mathcal{C}_z)</math> comes from <math>\mathcal{C}</math> which added labels by <math>\mathcal{X}</math> and revised label by user; <math>n</math> is the element number of <math>\mathcal{C}'</math>.</p> <p><math>\mathcal{H}</math> is a micro-service <u>system</u>.</p> <p><math>\mathcal{P}</math> is a financial news <u>API</u>.</p> <p>Function <math>UpdateM(\mathcal{R}_x, \mathcal{R}_y, \mathcal{R}_z)</math> renews tokenization vocab and trains <u>XLNet</u> models.</p> <p>Function <math>UserCheck</math> means user read daily news and correct wrong labels.</p> <p><b>Output:</b> New Pre-trained <u>XLNet</u> Model <math>\mathcal{X}</math></p> <pre> 1: <math>\mathcal{R}, \mathcal{C} \leftarrow \mathcal{D}</math> 2: <math>\mathcal{X} \leftarrow UpdateM(\mathcal{R}_x, \mathcal{R}_y, \mathcal{R}_z)</math> 3: <b>for</b> <math>x_i \in \mathcal{C}_x</math> <b>do</b> 4:   <math>Token\ x_i \leftarrow \mathcal{X}_x \leftarrow x_i</math> 5:   <math>y_i \leftarrow \mathcal{X}_y \leftarrow Token\ x_i</math> 6: <b>end for</b> 7: <math>\mathcal{C}'(\mathcal{C}_x, \mathcal{C}_y) \leftarrow Negative(x_i, y_i)</math> 8: <math>z_i \leftarrow \mathcal{X}_z \leftarrow \mathcal{X}_z \leftarrow x_i \in \mathcal{C}_x</math> 9: <b>for</b> <math>(x_i, y_i, z_i) \in \mathcal{C}'</math> <b>do</b> 10:  <math>UserCheck \leftarrow \mathcal{P} \leftarrow \mathcal{H} \leftarrow (x_i, y_i, z_i)</math> 11:   <b>if</b> <i>wrong</i> <math>y_i</math> <b>or</b> <i>wrong</i> <math>z_i</math> <b>then</b> 12:     <math>(x_i, y'_i, z'_i) \leftarrow UserCheck</math> 13:     <math>\mathcal{R} \leftarrow \mathcal{R} \cup (x_i, y'_i, z'_i)</math> 14:   <b>end if</b> 15: <b>end for</b> 16: <b>if</b> <math>n \bmod 10^n = 0</math> <b>or</b> <math>NotUpdateTime &gt; 3\ months</math> <b>then</b> 17:   <math>\mathcal{X} \leftarrow UpdateM(\mathcal{R}_x, \mathcal{R}_y, \mathcal{R}_z)</math> 18: <b>end if</b> 19: <b>return</b> <math>\mathcal{X}</math> </pre>
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### 3.3. Model application solution based on big data ecology and microservices

For the convenience of investors easily use our model, we make a model application solution based on big data ecology and microservices based on Fin-XLNet (figure 3). This system has three sections. The main function shows below:

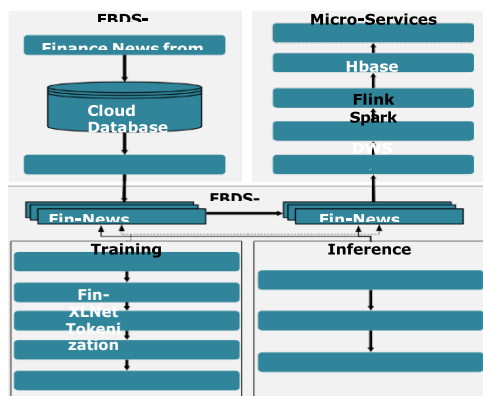


Figure 3. Model Application Solution based on Fin-XLNet

Section 1: FBDS is a model applied solution of financial big data service. The function of FBDS-Data is to

collect financial news data from different sources and save them to the cloud database. Then we input the data to FBDS-Serverless for training and updating the deep learning model.

Section 2: We use FBDS-Serverless to train and update the deep learning model by the distributed server for the sake of sentiment analysis and negative news classification of financial news. The training process includes preprocessing data, tokenizing input data, using an optimizer to fine tune the model, and then validating the model. The inference procedure only has three steps that preprocess data, tokenize input data, and output validation through the model. Next, we get the result set.

Section 3: We push the result set into micro-services and then build an open platform of FBDS API to provide services.

#### 4. Experiments and Results

We compare our Fin-XLNet with other pre-trained models based on Chinese. For similar situations, we use six epochs, Adamw optimizer with 10% warm-up rate, the learning rate of  $2e^{-5}$ , and the epsilon value of  $1e^{-8}$ . The dataset description, models parameters settings, and experimental results are mentioned as follows:

Models	Government	Force Majeure	Product	Project	Other	Operation	Credit	Accuracy	Regulatory Manage..	Market	Finance	Guarantee
Fin-XLNet	54.2	57.1	60.6	64.1	70.4	85.1	90.9	92.8	94.6	95.8	97.4	98.6
XLNet-mid	38.9	48.9	60.0	56.1	65.8	85.0	90.8	89.4	92.7	94.5	88.3	96.5
DeBERTa-large	45.0	58.8	62.9	57.5	70.8	80.5	89.3	85.8	91.4	93.7	82.5	95.8
XLNet-base	27.3	33.4	56.5	43.9	59.7	76.8	88.2	86.2	90.3	92.9	85.1	92.2
BERT-mid	29.8	43.8	58.5	66.6	67.3	84.4	89.2	84.4	88.6	95.0	83.5	96.1
MacBERT-large	28.9	52.3	53.9	69.4	72.1	84.1	87.5	85.5	91.3	94.9	82.5	91.4
BERT-base	21.5	34.6	57.2	45.3	59.3	79.3	85.8	82.7	85.6	91.1	81.4	92.2
RoBERTa-large	10.3	35.6	50.5	53.1	67.8	78.2	88.1	81.4	89.4	92.5	77.3	88.5
RoBERTa-base	10.3	21.3	45.9	47.6	60.7	76.5	83.9	77.3	85.8	91.2	77.3	86.5
MacBERT-base	23.8	34.6	48.6	62.0	63.5	79.5	83.5	83.7	86.3	91.5	78.5	88.4

Figure 4. F1-Score Heatmap of Event Classification

##### 4.1. Dataset Description

This dataset has 254476 samples labelled as “negative” and “neutral and positive”, because we only focus on the negative news to avoid firm risks. Then The “negative” samples are split into 12 subclasses: credit risk, market risk, financial risk, operation risk, management risk, project risk, guarantee risk, force majeure risk, product risk, regulatory risk, government risk, and other risks. The distribution of “negative” and “neutral & positive” is class-wise balanced. Then we split this dataset randomly into the Train set (80%) and the Validation set (20%).

##### 4.2. Models Parameters Settings

Table 2 shows the parameter setting of compared models. Specifically, due to the lack of enough pre-trained models based on the Chinese language in the same number of parameters, we use three types of models named “base”, “mid” and “large” [24],[25]. Our Fin-XLNet model has 24 layers, 768 hidden states, 12 heads and 209M parameters, which has the same parameter setting as XLNet-mid, rebuilt corpus, and fine-tuned by our financial dataset. In comparison, base models have 12 layers, 768 hidden states, 12 heads and 110M parameters, and large models has 24 layers, 1024 hidden states, 16-heads and 330M parameters.

**Table 2.** The Parameter Setting of the Models

Models	Parameter Setting
Fin-XLNet	24-layer, 768-hidden, 12-heads, 209M parameters
XLNet-base	12-layer, 768-hidden, 12-heads, 117M parameters
XLNet-mid	24-layer, 768-hidden, 12-heads, 209M parameters
BERT-base	12-layer, 768-hidden, 12-heads, 110M parameters
BERT-mid	24-layer, 768-hidden, 12-heads, 210M parameters
MacBERT-base	12-layer, 768-hidden, 12-heads, 102M parameters
MacBERT-large	24-layer, 1024-hidden, 16-heads, 324M parameters
RoBERTa-base	12-layer, 768-hidden, 12-heads, 110M parameters
RoBERTa-large	24-layer, 1024-hidden, 16-heads, 330M parameters
Deberta-Large	24-layer, 1024-hidden, 16-heads, 324M parameters

### 4.3. Results

#### 4.3.1. Sentiment analysis

Table 3 reports our sentiment analysis of the financial news task. Fin-XLNet achieves the best results with 91.8% accuracy, 93.9% recall and 89.6% precision. From the difference between Fin-XLNet and XLNet, we demonstrate the necessity of rebuilding the corpus of the Chinese financial corpus. XLNet-mid gets the second-highest percentage of accuracy, recall and precision, which proves that XLNet has superiority in these classification tasks compared with other pre-trained models. Significantly, large models achieve more accurate results due to more hidden states, heads and parameters. RoBERTa-base achieves the worst result, with 81.2% accuracy, 84.5% recall and 79.3% precision.

**Table 3.** The Results of Sentiment analysis

Models	Accuracy	Recall	Precision
Fin-XLNet	91.8	93.9	89.6
XLNet-base	88.5	91.1	87.8
XLNet-mid	90.3	92.1	88.9
BERT-base	84.8	83.2	85.9
BERT-mid	86.6	85.7	87.3
MacBERT-base	85.2	86.8	84.6
MacBERT-large	87.3	89.7	85.6
RoBERTa-base	81.2	84.5	79.3
RoBERTa-large	85.1	85.3	84.8
Deberta-large	87.1	88.5	86.7

#### 4.3.2. Event classification

Figure 4 shows the event classification of negative financial news furtherly. There are 12 subclasses of negative financial news, including credit risk, market risk, financial risk, operation risk, management risk,

project risk, guarantee risk, force majeure risk, product risk, regulatory risk, government risk, and other risks. Fin-XLNet has the best results (92.8% accuracy) in 7 subclasses, especially on guarantee risk and finance risk with 98.6% and 97.4% respectively. RoBERTa-base is the worst model for 4 subclasses of event classification, with only 77.3% accuracy.

## 5. Conclusion and future work

Sentiment analysis and event classification are essential tasks when we analyze alternative data in the financial area. This paper proposes a financial sentiment analysis and event classification process. Then we build the Fin-XLNet model for sentiment analysis and negative event classification. Next, we compare the performance of different language models when using the financial news dataset. Our model outperforms other pre-trained models in sentiment analysis and event classification tasks in Financial Area according to the experiment results.

Furthermore, we make a model application solution based on big data ecology and microservices. With the accumulation of the financial news corpus database, we can continuously increase the effect of the Fin-XLNet model. In the future, we will further classify financial news and form a multi-level event classification system. Finally, we will quantify sentiment analysis to support more complex financial situations.

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# On the Performance of Imputation Techniques for Missing Values on Healthcare Datasets

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**Abstract:** Missing values or data is one popular characteristic of real-world datasets, especially healthcare data. This could be frustrating when using machine learning algorithms on such datasets, simply because most machine learning models perform poorly in the presence of missing values. The aim of this study is to compare the performance of seven imputation techniques, namely Mean imputation, Median Imputation, Last Observation carried Forward (LOCF) imputation, K-Nearest Neighbor (KNN) imputation, Interpolation imputation, Missforest imputation, and Multiple imputation by Chained Equations (MICE), on three healthcare datasets. Some percentage of missing values - 10%, 15%, 20% and 25% - were introduced into the dataset, and the imputation techniques were employed to impute these missing values. The comparison of their performance was evaluated by using root mean squared error (RMSE) and mean absolute error (MAE). The results show that Missforest imputation performs the best followed by MICE imputation. Additionally, we try to determine whether it is better to perform feature selection before imputation or vice versa by using the following metrics - the recall, precision, f1-score and accuracy. Due to the fact that there are few literatures on this and some debate on the subject among researchers, we hope that the results from this experiment will encourage data scientists and researchers to perform imputation first before feature selection when dealing with data containing missing values.

**Keywords:** *Data; Missing Values; Techniques; Imputation; Healthcare*

## 1. Introduction

Real-life datasets often contain some missing values or data, which pose a problem to data scientists and researchers working with them. The pattern of the missingness [1-2] of these missing values could be random, that is, missing completely at random (MCAR) or missing at random (MAR). It could also be non-random, that is, not missing at random (NMAR). Some of the reasons for these missing values could be due to errors in the equipment, inappropriate pattern of data capturing, faulty sampling, damages in the specimen used, respondents' irresponsive disposition to certain information or incorrect measurements. Hence, the need to find an appropriate technique in handling these missing values so as to obtain optimal results from the analysis of the data given. This study compares the performance of seven imputation techniques, which are Mean imputation, Median Imputation, Last Observation carried Forward (LOCF) imputation, K-Nearest Neighbor (KNN) imputation, Interpolation imputation, Missforest imputation, and Multiple imputation by Chained Equations (MICE), on three healthcare datasets, which are the breast cancer [3], the heart disease [4] and the pima indian diabetes [5] datasets. Some percentage of missing values - 10%, 15%, 20% and 25% - were introduced into the datasets under the assumption of MCAR, and the imputation techniques were employed to impute these missing values. The comparison of their performance was done using two error evaluation

metrics - root mean squared error (RMSE) and mean absolute error (MAE). While the evaluation metrics used to determine whether to perform selection before imputation or vice versa were the recall, precision, fi-score, and accuracy.

## 2. Datasets

The healthcare datasets used in this study are the breast cancer [3], Heart Disease [4] and Diabetes Mellitus [5] Datasets. These datasets were taken from the popular kaggle database.

## 3. Missing Data Imputation Techniques

This section discusses some selected imputation techniques that will be used in this study. The selected techniques are Mean imputation, Median Imputation, Last Observation carried Forward (LOCF) imputation, K-Nearest Neighbor (KNN) imputation, Interpolation imputation, Missforest imputation, and Multiple imputation by Chained Equations (MICE).

## 4. Feature Selection

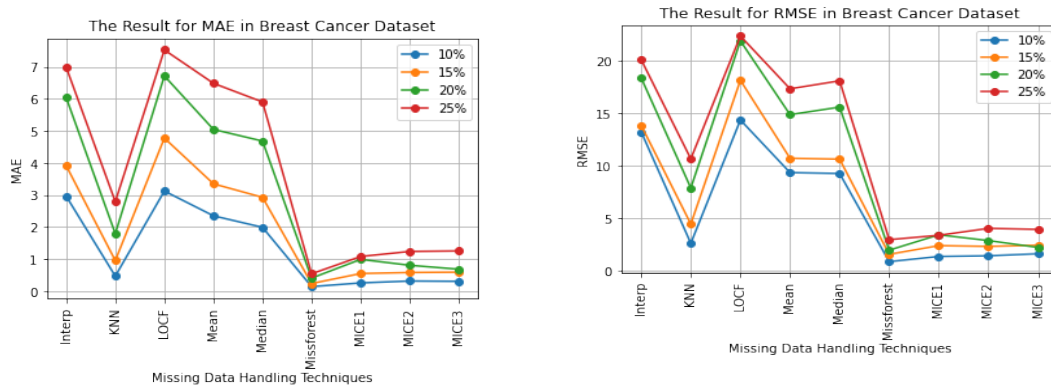
Feature selection is necessary in ML so as to reduce the curse of dimensionality and to build a model that is simple and explainable. It aims to choose a subset of the features in a given dataset, known as the relevant or best features, by removing irrelevant and redundant ones [6]. This section discusses briefly feature selection and the method used in this study.

## 5. Evaluation Metrics

This section discusses the metrics used for the evaluation of the performance of the imputation methods. The metrics are the RMSE, MAE, recall, precision, f1-score, and accuracy. A brief explanation of each will be given in this section.

## 6. Results and Discussion

### 6.1 Performance of the Imputation Methods



**Figure 1:** Missing Data Handling Technique Imputations Errors in Breast Cancer Dataset: MAE (left side) and RMSE (right side).

Figure 1 gives the RMSE and MAE of the missing data handling technique imputations for 10%, 15%, 20% and 25% missing values respectively. The results given in the figure shows that Missforest algorithm has the

lowest errors for both RMSE and MAE. This demonstrates that it performs best compare to other imputation methods used.

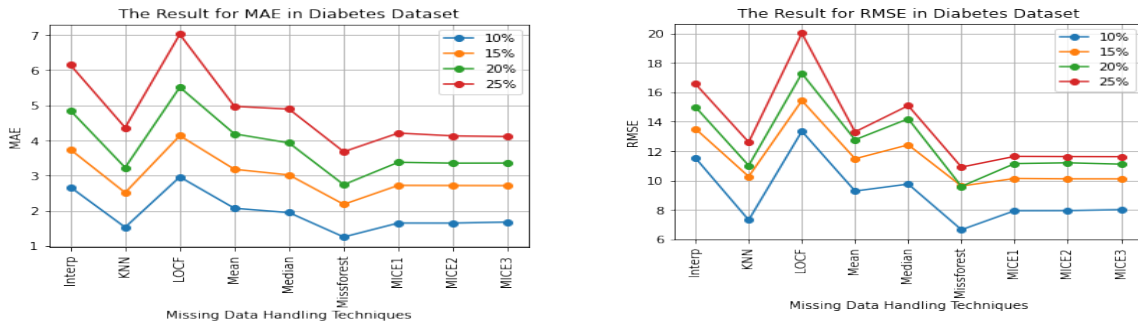


Figure 2: Missing Data Handling Technique Imputations Errors in Diabetes Dataset: MAE (left side) and RMSE (right side).

The results of the imputation errors on diabetes dataset is shown in Figure 2, which gives the RMSE and MAE of the imputations for 10%, 15%, 20% and 25% missing values respectively. Here, the Missforest algorithm also has the lowest errors for both RMSE and MAE. Thus, it is the best performing algorithm on the diabetes dataset.

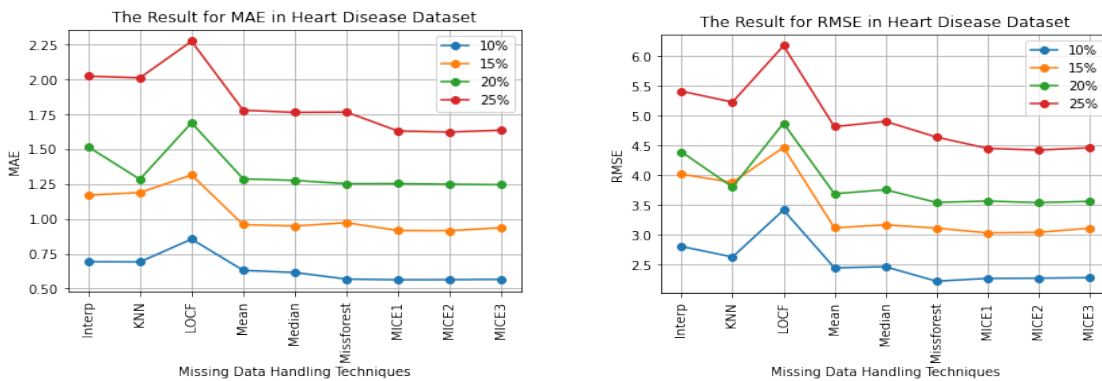


Figure 3: Missing Data Handling Technique Imputations Errors in Heart Disease Dataset: MAE (left side) and RMSE (right side).

The results for the imputations in heart disease dataset is shown in Figure 3. The RMSE and MAE for 10%, 15%, 20% and 25% missing values is slightly different from what was seen in the previous two datasets. Although the Missforest imputation method still maintains the lowest error for RMSE but has around the same error values with MICE for MAE.

### 6.2 Feature Selection Before Imputation and Vice Versa

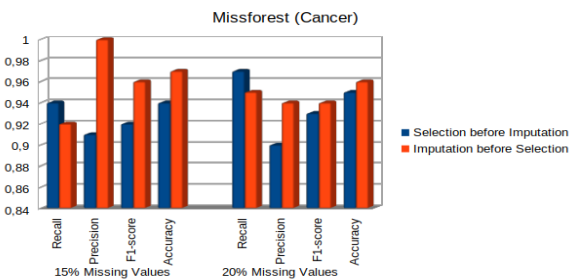


Figure 4a: The performance of the Classification Algorithm for Feature Selection before Imputation Versus Imputation before Feature Selection (Breast Cancer)

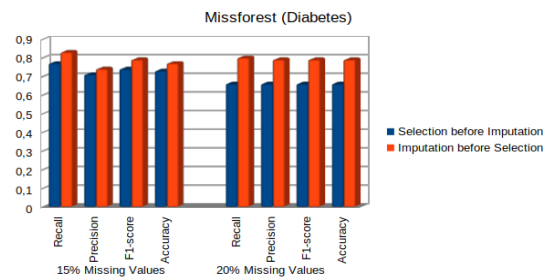
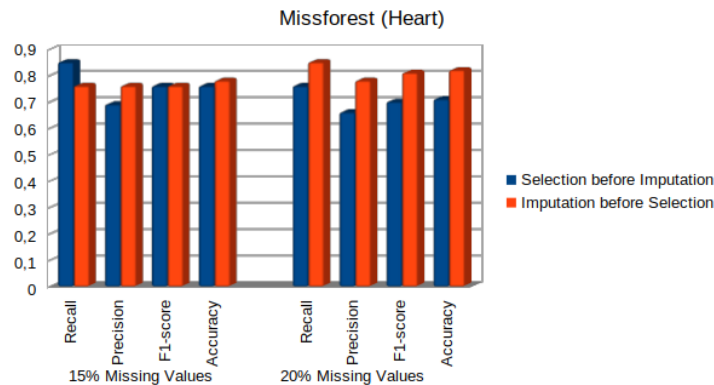


Figure 4b: The performance of the Classification Algorithm for Feature Selection before Imputation Versus Imputation before Feature Selection



**Figure 4c:** Classification Algorithm Performance for Feature Selection before Imputation Versus Imputation Before Feature Selection (Heart)

## 7. Conclusion

This study aimed to achieve two things: (1) to evaluate the performance of seven missing values imputation methods on three healthcare datasets, namely the breast cancer, diabetes mellitus and heart disease datasets. (2) to determine whether it is better to impute missing values before performing feature selection on a given dataset or to perform feature selection on the dataset before imputing the missing values.

To achieve the first objective, the RMSE and MAE were used as evaluation metrics for the performances of the missing data handling techniques. Lower value of both RMSE and MAE demonstrates better performance of the methods. Missforest imputation method got the lowest error for both RMSE and MAE in most of the percentages of the missing values introduced into the three healthcare datasets. Hence, it performed the best among the imputation methods. Next in performance, is the MICE imputation. In a similar study carried out by Wu et al. [7], MICE was one of the two suggested best imputation methods that could perform better with small scale database.

For the second objective, random forest algorithm was used for the classification predictions and the metrics used were the recall, precision, f1-score, and accuracy. The experiments were conducted using the two best imputation methods - Missforest and MICE - from the results of the performances of the seven imputation methods used in the previous experiments. The results, from the second experiments, show that it is better to impute the missing values first in a given healthcare dataset before performing feature selection than to perform feature selection before imputation.

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# Dam Cognification and Their Impact on Resolving Climate Emergency

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**Abstract:** Most of currently available algorithms applied in predictive monitoring and management of dams and dam systems are Genetic Algorithm (GA), bat algorithm (BA), particle swarm optimization algorithm (PSOA), HS, the Artificial Immune Algorithm (AIA), Harmony Search Algorithm (HSA), the random forest (RF) intelligent algorithm. On the rise are also many hybrid models, for substations and their subsequent aggregate pumps used in a connected reservoir system, as well as on other different parts of the dam operations. What is observed is the rise of dam and dam systems cognification. Discussed are the possible impacts of widespread implementation of these algorithms on the climate emergency we are in, as well as what these or similar models could have if applied worldwide and their potential for carbon savings.

**Keywords:** *Cognification of dam systems, hybrid model diagnostics, dam optimization, water savings, dam substation management*

## 1. Introduction

There are a great number of algorithms and different IT solutions for various parts and systems related to dams, their efficacy and their stability and the safety of their structures, starting from the dam structure itself to the dam safety, and further dam safety in face of seismic movements, to the efficiency of hydropower energy production, irrigation and its overall environmental impacts.

Researching the current algorithms and their acronyms on dam and reservoir optimal operation for irrigation and hydropower energy generation, we can list the following which are directly relating electricity production that are:

ACRONYMS

ACO Ant Colony Optimization

BA Bat Algorithm

BBO Biogeography-Based Optimization

CSO Cat Swarm Optimization

CA Cellular

AutomataFA

Firefly Algorithm GA

Genetic Algorithm

HBMO Honey Bees Mating Optimization

MHA Meta-heuristics algorithm

MSA Moth Search Algorithm

PSO Particle Swarm Optimization

SSO Shark Smell Optimization

SA Simulated Annealing

WCA Water Cycle Algorithm WSA

### *Wolf Search Algorithm*<sup>1</sup>

With all these algorithms it can be observed that the shortcomings to linear programming are in its linear rigidity. Which are addressed by more recent models, especially blackbox models and hybrid models. Most of these algorithms or better yet approaches to writing an algorithm belong to two categories: “*physics-based or data-driven. Recently, a third approach which is a combination of these deterministic and statistical models is emerging for scientific applications.*”<sup>2</sup>

Such a hybrid models’ approach can be tested on a small reservoir, with specific focus to dam efficacy and protection of the system from the so-called dry running, focusing on mechanization overuse during unprotected running, but also calculating the number of m<sup>3</sup> wasted in unnecessary over pumping. These are the areas with potential great improvements and especially taking this to the realm of small and medium dams and their systems as they are usually not using any advanced technology. The space for dam cognification is very wide, from different algorithms working on dam safety and stability of its structures, further seismic stability and predictions, to than hydropower production and especially hydropower production in multi dam systems where there is a huge number of variables for relatively small cubic numbers of water compared to large dam structures. To further sedimentation tracking, predicting, and analyzing its origins for better dam performance.

## **2. Body**

Researching all the different linear programming algorithms listed in the introduction it can be observed that their advantages, which are always connected to a single focused parameter, usually addressing one relevant data set. As well as their shortcomings to all the other relevant parameters in regards to the very dynamic dam and reservoir systems are inadequate, and that dams and their systems do need more complex algorithms to serve them.

For example, looking at the seepage algorithms and their comparison with statistical models, the BPNN-GA algorithm proposed by Xuan Zhang and collaborators, stands out as a massive improvement over the standard statistical model.

For their work they took a typical dam in China as an example. Applied, monitored and improved by Back Propagation Neural Network (BPNN) combined with Genetic Algorithm (GA) which was further compared with Statistical model as a traditional safety diagnostic model for dam seepage, which can barely show the nonlinear relationship between dam seepage and the load sets, together with the fact that it has the disadvantage of poor extension prediction. “In this paper, the theories of Back Propagation Neural Network (BPNN) combined with Genetic Algorithm (GA) are applied to the seepage prediction model. Taking a typical dam in China as an example, the prediction results of BPNN-GA model and statistical model are compared with the monitoring values. The results show that the improved dam seepage model enhances the ability of nonlinear mapping and generalization and makes the seepage prediction more accurate and reasonable in the near future. According to the established criterion, the safety state of the dam in flood season is evaluated.”

<sup>1</sup> “Review on Dam and Reservoir Optimal Operation for Irrigation and Hydropower Energy Generation Utilizing Meta-Heuristic Algorithms” by KAI LUN CHONG, SAI HIN LAI, ALI NAJAH AHMED, WAN ZURINA WAN ZAAFAR, RAVIPUDI VENKATA RAO, MOHSEN SHERIF, AHMED SEFELNASR, AND AHMED EL-SHAFIE, Received December 29, 2020, accepted January 18, 2021, date of publication January 25, 2021, date of current version February 3, 2021, Digital Object Identifier 10.1109/ACCESS.2021.3054424

<sup>2</sup> “Hybrid analysis and modeling, eclecticism, and multifidelity computing toward digital twin revolution”, by Omer San, Adil Rasheed, Trond Kvamsdal published at arXiv:2103.1462

Applying such algorithms to dam safety not only allows for clear, simpler and more effective seepage control but also allows for better dam monitoring and maintenance during and after the flood season. From this

example we can see that neural networks combined with GA are much better suited for dam monitoring systems than the traditional statistical models or linear algorithms are. "Combining the seepage theory with BPNN-GA, an improved seepage model is established and applied to the monitoring and analysis of the uplift pressure of Cotton Beach dam. The results are shown as follows:

- (1) From the prediction results of the two points, compared with the statistical model, the BPNN-GA model has high prediction accuracy and can predict the trend of data change better. This shows that it is reasonable and feasible to apply the BPNN and GA theory to improve the seepage prediction model.
- (2) Compared the prediction values of the improved seepage prediction model with the monitoring values, according to the established criteria of the dam seepage safety state, the seepage safety state of the Cotton Beach dam in flood season is evaluated. The results show that the seepage state of the two measuring points is normal, and the seepage control effect of the overflow dam section is good. This method can be extended to other points to obtain a comprehensive seepage safety state and seepage control treatment effect."<sup>13</sup>

An interesting example, important to mention is certainly the development of MOMSA optimization algorithms for multi reservoir systems, and although it is not addressing the hydropower production it has potential for hydro power optimization as well. And though hydropower and water savings are a subject has great potential for improving the overall global warming potential of small and medium dams, it is important to address these kinds of algorithms that are yet not considering the integrations with IPCC methods and tools, but if combined a huge potential can be open especially towards connecting the gap in terms of widespread implementation. "Optimization of multi-reservoir systems' operation has attracted the attention of many researchers over the world. As a result, several evolutionary algorithms have been developed in recent years to solve such complex problems. The MOMSA is one of the newest optimization algorithms which indicated supreme performance in solving the complex engineering problems. Due to the novelty of this algorithm, it has not yet been investigated for the hydropower optimization. In order to refill this research gap, this study investigated the performance of MOMSA in the optimization of operation of the Karun multi-objective multi-reservoir system. Three objectives of the downstream demand supply, the flood control, and the hydropower generation were considered in the optimization model. The results of the MOMSA were compared with two well-known multi-objective algorithms of the NSGA-II and the SPEA-II. A series of performance evaluation criteria were employed to compare the algorithms efficiency. The main results of this study are as follows:

- The results for the Karun multi-reservoir system with 1800 decision variables, demonstrated that the MOMSA algorithm with the minimum sum of objectives of 1359.01 had better performance than the NSGA-II and the SPEA-II algorithms with the minimum sum of objectives of 1580748.67 and 276683.64, respectively.
- The Pareto front obtained by the MOMSA algorithm, with a more uniform distribution, was at a more appropriate level than the NSGA-II and the SPEA-II algorithms.
- In terms of hydropower energy generation, the MOMSA algorithm could optimize the energy production up to 15669.7 GW per year, while the NSGA-II and the SPEA-II algorithms optimized the energy production by 7569.13 and 9026.31 GW per year.
- The results revealed that the average sustainability index obtained by the MOMSA, the NSGA-II, and the SPEA-II algorithms was 86.73, 22.73, and 46.09, respectively, while in the real conditions the sustainability index was 78.87%. This confirmed the superiority of the developed MOMSA algorithm in the optimal operation of the Karun multi-reservoir system.
- The results indicated that the capability of the developed MOMSA became more evident with the increase of the dimensions and the complexity of the problem, while the two other algorithms failed in solving such problems.
- Regarding the convincing results of this study, the novel multiobjective algorithm of MOMSA, as a robust tool, is strongly recommended for the optimization of complex and large-scale problems especially multi-

<sup>13</sup> "Improving Dam Seepage Prediction Using Back-Propagation Neural Network and Genetic Algorithm", by Xuan Zhang, Xudong Chen, and Junjie Li, published at Hindawi, Mathematical Problems in Engineering, Volume 2020, Article ID 1404295

reservoir systems.”<sup>4</sup>

Such optimization algorithms like MOMSA and BNN GA, open the doors to many other small and medium dam systems, that are currently not being adequately addressed for their importance and the role which if cognified they could play in the worldwide carbon reduction and more importantly carbon removal.

### 3. Dam cognification and carbon removal hand in hand

Taking into consideration the overall better performance of MOMSA, BPNN GA, and different hybrid models, it is evident that the management and monitoring of dams and dam structures will be done by algorithms in the future and not by applying the outdated statistical models, or simple yes/no functions even on small dams.

By going through mentioned IT solutions to various dam and dam supporting systems, one can realize that there is a silent dam cognification on the rise, and this is not just large dams but medium and small ones which are being addressed too. The importance of this is huge, not just in local settings but especially in global relations. There are thousands of more medium and small dams than large ones and they are of crucial importance if we are to address the expected global freshwater shortages. Firstly, medium and small dams are more prone to sedimentation and malperformance as a result of mismanagement as there is little to no regulation in most countries across the globe when we are talking about small dams.

Cognifying dams and their systems, is already bringing easier maintenance of the dam structures themselves, higher hydropower electricity production, savings in water storage, and by far limiting the human error by a factor of magnitude. Some of these models are now being actively applied on large dam structures, but what's even more interesting is their applications on medium and small dams, as well as the impressive results gained from the first measurements.

Take into consideration that we have 58 713<sup>5</sup> large dams registered on the ICOLD WDR, and 2.8 million medium and large dams globally<sup>6</sup> the number of small dams is still unknown.

Using available remote sensing technologies coupled with machine learning we can firstly count all the small dams and then calculate the impact cognification would have. Hypothetically let's assume that per dam cognification we can save only 1m<sup>3</sup> of water per reservoir monthly or 12m<sup>3</sup> per annum. Now if we extrapolate this to only listed medium and large dams, we get 2.8 million m<sup>3</sup> per month or 33.6 million m<sup>3</sup> per annum which averages a water consumption of a 320 000 inhabitants city in EU, where an average household uses 105m<sup>3</sup>/year.

The real impact must be by a magnitude greater and that is without counting small dams. And then we have dam sedimentation, which has even more unexplored potential for cognification, starting from sediment tracking before it reaches the lake, tracking sedimentation movement or the river of sediment within the lake, and further calculating using hyperspectral satellite imagery the overall amount and to a degree the composition of sediments like the here mentioned world: “Detection of sediment origins plays a determining role in control and prevention of sedimentation. Nowadays, with the help of studies on sedimentation and erosion, sediment origins can be detected with high accuracy. This research integrated geographic information system (GIS) and remote sensing (RS) techniques to detect the primary source of sediment to

<sup>4</sup> “Application of MOMSA algorithm for optimal operation of Karun multi objective multi reservoir dams with the aim of increasing the energy generation” by Mohammad Reza Sharifi, Saeid Akbarifard, Mohamad Reza Madadi, Kourosh Qaderi, Hossein Akbarifard; published at Elsevier Energy Strategy Reviews 42 (2022) 100883.

<sup>5</sup> [https://www.icold-cigb.org/GB/world\\_register/general\\_synthesis.asp](https://www.icold-cigb.org/GB/world_register/general_synthesis.asp) ICOLD WDR

<sup>6</sup> “Dam Renovation to Prolong Reservoir Life and Mitigate Dam Impacts” by Kondolf, M.; Yi, J., published at Water 2022, 14, 1464. <https://doi.org/10.3390/w14091464>

Taleghan Dam in northern Iran.”<sup>7</sup>

This is the first step to dams becoming carbon neutral, and actually helping fix the climate crisis we are in today. These trapped sediments, that are firstly taking over the water volume space, secondly due to them being heavier than water actually endangering the dam structures and, in many cases, the small dams which are not strictly regulated and lack basic IT are the ones that suffer from sedimentation or dam collapse due to flash floods and high sediment content to begin with. Now if we would have a means to know which small dam where in the world has suitable sediments for soil creation - and mostly all do but we don't know the amount or location, as well as the location of mass sediment influx we could have purposeful agroforestry projects using those sediments to lock the sediment from further formation. And this is just a glimpse at what we could do if we had the actual number of dams, and the actual volume of their reservoirs, as well as the sediment count.

#### 4. Conclusion

This extended abstract is a summary of different algorithms used currently in supporting dams, their proper functionality, their safety and the safety of their structures, as well as their seismic safety, their hydropower production, and sedimentation origins tracking. Neural networks are great and a great way of devouring a huge number of datasets into a comprehensible and clear message for decision makers within the dam management and monitoring systems, having an extra explanatory layer helps people gain more trust into the system. The potential to which dam cognification can and will play a massive role is in the dam's overall ability to harbor life and to support more than it takes. This is why BPNN GA or MOMSA or other multidimensional algorithms are a better way to sustainably manage our water systems, hydropower and flood control worldwide.

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<sup>7</sup> "Dam sediment tracking using spectrometry and Landsat 8 satellite image, Taleghan Basin, Iran" by Sirous Afshar, Abolfazl Shamsai & Bahram Saghafian, published by *Environmental Monitoring and Assessment* volume 188, Article number: 104 (2016)



# Cyberbullying Detection on Twitter Using Natural Language Processing and Machine Learning Techniques

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**Abstract:** People use social media to engage and debate themes ranging from entertainment to sports to politics and many others. The use of social media has also resulted in an increase in cyberbullying, which is occurring at an alarming pace. Many cyberbullying messages may be found in the comment sections of many social media platforms, including Twitter, YouTube, and others. Cyberbullying has the ability to cause stress and mental distress, which should be detected early and avoid being published on social media platforms. In this study, we provide a system for detecting cyberbullying messages in English using natural language processing (NLP) and machine learning approaches. On Twitter, a total of 16851 tweets were gathered. The dataset was applied to an NLP approach to find the most offensive terms associated with cyberbullying. Based on our NLP results, it was clear that cyberbullying happens and must be addressed as soon as possible. The dataset was also utilized to train the random forest (RF) and support vector machine (SVM) algorithms. Random forest surpassed support vector machine, which attained an accuracy of 90.5%, with 98.5%. The root mean square error and mean square error were used to analyze the results. In comparison to the support vector machine, the random forest earned the best error score. Our findings may be utilized by agencies and groups to educate individuals about the proper use of social media in order to avoid cyberbullying.

**Keywords:** *Cyberbullying; Natural Language Processing; Machine Learning Techniques*

## 1. Introduction

Cyberbullying, also known as hate speech, cyberaggression, and toxic speech, is a serious social issue that affects young people who use the Internet today [1]. Cyberbullying can have serious consequences, including low self-esteem, anxiety, depression, hopelessness, and, in some cases, a lack of motivation to live, which can lead to the victim's death [2]. Cyberbullying may happen in a variety of ways, such as the spreading of offensive social media posts (text, picture, and video). An interactive platform that brings individuals together to share knowledge is social media [3]. Online social networks (OSNs) are websites that allow users to connect electronically and chat with one another. It must be emphasized that these social media sites have also fueled online hatred, including cyberbullying. Global Internet and smartphone usage has grown [4], which has led to more people using social media platforms like Twitter, Facebook, YouTube, TikTok, and many more. The majority of cyberbullying victims are young people, typically educated people, who have reported having unpleasant and upsetting life situations [5]. The majority of social media users in Sub-Saharan Africa, including Ghana, Nigeria, and Zambia, use English [6]. Ghana's official language is English, and people use it to express themselves on various social media platforms. The goal of the current article is to identify

cyberbullying in English by combining machine learning and natural language processing techniques. The work is innovative in that it informs policymakers on how to effectively address the issue of hate speech on social media platforms. This will restore reason to our varied communities and create a peaceful atmosphere for everyone.

## 2. Related Work

Our study also considered existing literature that employed various machine learning and natural language processing techniques. To identify and promote positivity in comments, Chakravarthi [7] in a related work developed a multilingual dataset. The researcher also presented a revolutionary custom deep network architecture that leverages a concatenation of embedding from T5-Sentence. The F1-score for their model, which included a number of machine learning techniques, was 0.75 for English, 0.62 for Tamil, and 0.67 for Malayalam. In another related work by using a variety of cutting-edge machine learning and deep learning models, Chakravarthi [8] introduced a multilingual hate speech dataset that promotes equality, diversity, and inclusion (EDI) in English, Tamil, Malayalam, and Kannada. Additionally, Albraikan et al. [4] provided a method for detecting cyberbullying in social networks called the Optimal Deep Learning-based Cyberbullying Detection and Classification (ODL-CDC). In a research, Mahbub et al. [9] examined the role of predatory approach terms in the identification of cyberbullying and suggested a method for creating a lexicon of these phrases. Furthermore, Jones et al. [10] examined the identification of cyberbullying in text messages from mobile phones using an oxygen forensics toolbox. Machine learning and deep learning algorithms were assessed by Bharti et al. [11] to automatically identify cyberbullying from tweets. The GloVe840 word embedding approach and BLSTM, according to their findings, produced the best results on the dataset, with accuracy, precision, and F1 measures of 92.60%, 96.60%, and 94.20%, respectively. Last but not least, Sainju et al. [12] used a mixed-method approach in their study, analyzing xenophobic bullying disclosures on Twitter after COVID-19.

## 3. Data Collection

The Twitter data was acquired through the use of the sncrape Python package. The hashtags #shit, #flooding, #fuck, and #idiot was used to filter all of the tweets published between August 01, 2018, and September 30, 2022. Based on our search parameters, 16851 tweets were collected in total.

## 4. Data Preprocessing

Text categorization algorithms are unable to interpret raw data because they are unable to directly comprehend high-level human language. The preprocessing methods listed below were modified to assist our framework and model comprehend and learn. We decreased the text noise to enhance the performance of the classifier and speed up the classification procedure. This made machine learning and real-time natural language processing (NLP) possible. Unhelpful and distracting components like Hypertext Markup Language (HTML) tags, scripts, URL links, and ads are often used in online writing [13]. Some of the methods used to clean up online writings (tweets) include making all letters lowercase, deleting punctuation, numbers, stop words, links (HTML and URL), stemming, reducing white space, and feature selection. Equation 1 explains the pre-processed stage in the example below:

$$Y_{ij} = TX_{ik} \quad (1)$$

such that: (i)  $Y_{ij}$  preserves the “valuable information” in  $X_{ik}$ , (ii)  $Y_{ij}$  eliminates at least one of the problems in  $X_{ik}$  and (iii)  $Y_{ij}$  is more useful than  $X_{ik}$ . In the above relation,  $i = 1, \dots, n$  where  $n$  = number of objects,  $j = 1, \dots, m$  where  $m$  = number of features after preprocessing,  $k = 1, \dots, l$  where  $l$  = number of attributes/features before preprocessing, and in general,  $m \neq l$ . Additionally, we employ the Term Frequency – Inverse Document Frequency method to select the desired features. Equation 2 below shows the feature selection:



$$TF - IDF = FF * \log(N|DF) \quad (2)$$

where N indicates the number of documents, and DF is the number of documents that contain the feature. FP takes the value 0 or 1 based on the feature absent/presence in the document.

Data annotation is the act of classifying, labeling, and including additional contextual information to a raw data collection so that computers can understand and utilize the data [14]. In this work, we focused on text annotation, adding labels and instructions to the tweets, to better understand how typical human sentences and other textual data are ordered for meaning and to assist our ML algorithm perceive and understand it. Machine learning (ML) can interpret texts' deeper meanings beyond their literal meanings thanks to text annotation [15]. The labeling procedure attempts to classify tweets by determining polarity. There are two columns in the dataset (tweets and results). The computation of the tweets' polarity is shown in equation 3 below.

$$f_m = \begin{cases} f(\text{posScore}), & \text{if } f(\text{posScore}) \leq f(\text{negScore}) \\ -f(\text{negScore}), & \text{otherwise} \end{cases} \quad (3)$$

where  $f_m$  computes the absolute maximum of the two scores. It is worth noting that  $f(\text{negScore})$  is always positive by construction. The negative sign is imposed to obtain a final prior polarity that ranges from -1 to 1.

#### 4.1 The Random Forest Algorithm

The machine learning technique random forest (RF) was used to identify the polarity (results) of the tweets. Each decision tree in the RF has its variable space partitioned into a smaller subspace, resulting in data that is as uniform as is practicable throughout each zone [16], [17]. The RF fits a variety of decision trees utilizing subsamples from the complete data set to improve the regression's accuracy. Its foundation is the premise that different separate predictors each forecast insufficiently in different situations, and that by combining the independent predictors' prediction outputs, overall prediction accuracy may be raised. Equation 4 represents the RF algorithm.

$$\hat{f} = \frac{1}{N} \sum_{i=1}^N f_i(x') \quad (4)$$

To predict the results for  $x'$  we can average the result of all the trees  $f_i$  corresponding to  $x'$ .

#### 4.2. Support Vector Machine

Support Vector Machine (SVM) method for solving both classification and regression problems [18]. It is based on the idea of restricted optimization and employs the inductive principle of structural risk minimization (SRM), which results in an overall optimal answer [19]. However, to establish a relationship between the target variable and the explanatory variables, the SVR only requires a subset of the data called support vectors.

### 5. Conclusions and Future Works

People are interacting with each other more frequently as the number of social media sites grows, which has led to an increase in cyberbullying. We developed a framework based on natural language processing (NLP) and machine learning techniques to detect cyberbullying texts. Twitter, the microblogging website, yielded a total of 16851 tweets. Our models were trained using the dataset. The dataset included 5392 texts about cyberbullying and 11459 texts about non-cyberbullying. Unpleasant words such as "stupid," "idiot," and "fuck" were seen in cyberbullying tests, according to our word cloud. These texts are unpleasant and can cause stress and emotional distress in posters, which must be addressed. Cyberbullying education must be implemented effectively by institutions, agencies, non-governmental organizations (NGOs), and governmental bodies. After dividing the dataset into training and testing sets, the random forest (RF) performed best with an accuracy of 98.5% and an RMSE of 0.2588, while the support vector machine (SVM) achieved an accuracy of 90.5% and an RMSE of 0.2644. The trained models can detect cyberbullying texts on

social media platforms such as Twitter, Facebook, TikTok, and YouTube. These modes can also be used to quantitatively predict the influence of the text using the word cloud generated by NLP. Individuals and organizations can use the model's analysis to provide education on cyberbullying and its impact on the primary poster, particularly young people who use social media sites. In the future, we hope to collect as much information as possible from various social media platforms such as Facebook, TikTok, and YouTube. Deep learning algorithms will be used to train the dataset in order to generate decision-making systems. Furthermore, high performance quantum machine learning models will be utilized to support various machine learning algorithms such as artificial neural networks and ensemble models.

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# PARALLEL SESSIONS PAPERS PRESENTATION

## SESSION 2

### FINANCIAL ANALYSIS AND TRANSFORMATIONS IN ECONOMY -2 CHAIR: DR. DENIS VELIU

# Technological Innovation Capability as a Catalyst to Emerge from Dark Days

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**Abstract:** The adoption of the Sustainable Development Goals (SDGs) by the United Nations in 2015 was globally accepted and encourages actions aimed at sustainability. This initiative has attracted considerable attention in policy debate and research. Several conceptual studies set the agenda and directions for moving forward and achieving the SDGs. One of the key SDGs is sustainable innovation. However, little is known about the effects of business incubators' technological innovation capabilities for sustainability. On the other hand, the COVID-19 crisis has severely threatened the realization of the SDGs agenda, and as such, there is a greater need than ever to incorporate the SDGs to address these unprecedented impacts. In this context, universities have a key role to play in leading innovation and entrepreneurship in a more sustainable way and emerging from these dark days to a new normal, introducing innovations in their products and processes and providing value to their customers and other stakeholders. Thus, this study examines the capacity of technological innovation for sustainable innovation in the context of a new normal. A survey was applied to the managers of incubators in Brazil. The Spearman Correlation test was applied for the analyses. The findings indicate that sustainable innovation is primarily affected by R&D, organizational and marketing capabilities. This study has implications for managers, investors and policymakers. Insights for future studies are presented.

**Keywords:** *Technological Innovation Capability, Sustainable Innovation, New Normal, Business Incubators.*

## 1. Introduction

During these last two years, disparities around the world and within countries have been exposed and organizations and managers have been challenged to redefine organizational practices that enable the creation of new future organizational arrangements. In many parts of the world, society increasingly expects business organizations to help solve problems of environmental degradation, inequality and poverty [1]. There seems to be a growing awareness of the vital role of business organizations, managers and stakeholders in tackling societal challenges including environmental sustainability and emerging to a new normal. The adoption of the Sustainable Development Goals (SDGs) by the United Nations in 2015 was globally accepted and encourages actions aimed at sustainability. This initiative has attracted considerable attention in policy debate and research. Several conceptual studies set the agenda and directions for moving forward and achieving the SDGs. One of the key SDGs is sustainable innovation. Innovation and sustainability form an important link in the pursuit of environmental, economic and social development [2]. The prestigious literature suggests that innovation cements the path to sustainability [3]. Some scholars highlight the importance of innovation for sustainability and the reach of SDGs [4-5]. Kennedy, Whitman and Ende [6] argue that sustainability-oriented innovations are essential for achieving competitive advantage. Business incubators are cited by Chance et.al. [7] as a mechanism to promote sustainable innovation activities among entrepreneurs.

However, little is known about the effects of business incubators' technological innovation capabilities for sustainability. We believe that business incubators can serve as mechanisms to drive sustainable innovation. Incubators can engage environmentally sustainable entrepreneurs. However, little is known about the effects of business incubators' technological innovation capabilities for sustainability.

This study relates the capabilities of technological innovations and sustainable innovation performance through the lens of business incubators. The ability to innovate has generally been seen as one of the main factors that contribute to increasing competitive advantage for companies in the 21st century [8]. Technological innovation capabilities significantly improve innovation performance [9] and create value for stakeholders [10]. Thus, using the analogy of Lau, Yam and Tang [9], the performance of sustainable innovation depends on the technological innovation capacity of business incubators. The business literature has not yet brought studies on this relationship. In this way, this study contributes to the understanding of the interaction between technological innovation capabilities and sustainable innovation performance through the lens of business incubators in Brazil; (ii) it can improve understanding of the role of incubators to encourage sustainable innovations; (iii). The choice of Brazilian incubators is due to the relevance of these organizations to drive sustainable innovations in Brazilian enterprises. This article is structured in the following sections: literature review; study framework; methodology; results and analyses; conclusions and recommendations.

## 2. Literature review

Sustainable Development has received increasing attention from academics, industry representatives and policymakers [4] and should ensure that companies balance their economic, environmental and social performance [8]. Silvestre and Tirca [4] argue that equal consideration should be given to the economic, environmental and social dimensions when making business and political decisions. One of the key areas highlighted by the development discourse is the role of innovations in improving sustainability. In this sense, Smith, Voß, and Grin [5] emphasize that the concern with sustainable development tends to demand a broadening of perspective in innovation studies.

Studies show a positive relationship between innovation and sustainable development [8], [4]. Amara and Chen [11] suggest that innovation makes it possible to achieve sustainable performance by creating different processes and products that minimize environmental damage. Thus, sustainability must be approached based on approaches focused on innovation [12]. Innovation positively impacts sustainability performance [13], which is an essential strategy for organizations [14]. We emphasize that the best performance in sustainability cannot be achieved without innovations [4]. Sustainable innovations are inventions that provide essential progress in social, economic and ecological issues [15]. Some studies highlight that sustainable innovations are continuously adopted to improve organizations and the sustainability of the entire supply chain, allowing them to achieve superior sustainability performance [4]. In this context, beliefs that incubators can drive sustainable innovation. Incubators are globally recognized for promoting innovation [16]. However, innovation can only occur if the company has the ability to innovate [17]. Making an analogy with Laforet [17], sustainable innovation can only occur if incubators have innovation capabilities. It is the ability to continually innovate and add value to the customer that will determine the strategic success [18] of the organization, especially the ability to innovate sustainably. There is a direct and positive relationship between technological innovation capability and innovation performance [9]. A sustainable business is based on capabilities to innovate and improvements in the value proposition for the customer [18], creating value and capturing value from sustainable innovations.

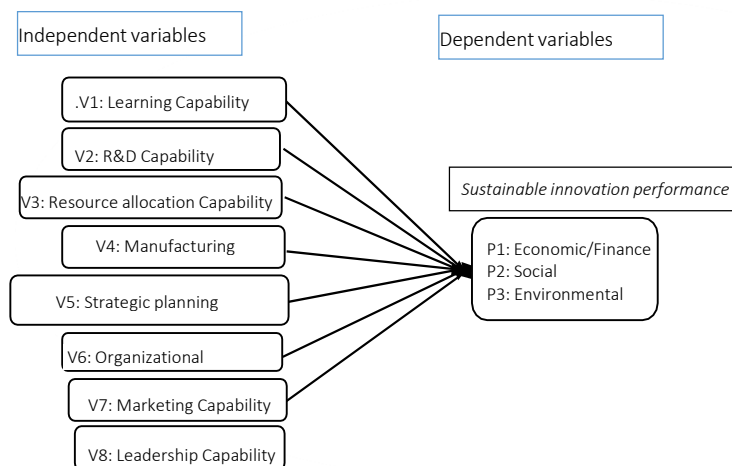
Innovation capability can be understood as a comprehensive set of characteristics of an organization that facilitates and supports its technological innovation strategies" [19]. "Technological innovation capability is a type of asset or special resource that includes technology, product, assets or knowledge, experience and organization [20]; or according to Lall [21], it is the skills and knowledge necessary to effectively absorb, master and improve existing technologies and create new ones. Al-Mubarak and Busler [16] highlight that incubators and innovation programs can result, among other things, in: (1) greater economic development through job creation; (2) a stronger entrepreneurial climate; (3) commercialization and transfer of technology to graduated companies; (4) sustainability of companies graduated in the market with a high survival rate; (5) accelerating innovation with smart products and services; and (6) diversification

of the economy based on company results, such as innovation and technology [16]. Thus, this study relates the capabilities of technological innovation and sustainable innovation performance.

This study adopts the dimensions of technological innovation capabilities proposed by Lau, Yam and Tang [9]: (1) learning capability is the ability to identify, assimilate and explore new knowledge essential for a company's competitive success. (2) R&D capability refers to a company's ability to integrate R&D strategy, project implementation, product portfolio management. (3) Resource allocation capacity is the company's ability to mobilize and expand its technological, human and financial resources in the innovation process. (4) Manufacturing capability refers to the ability to transform R&D results into products that meet market needs. (5) Marketing capability indicates the ability to market and sell products based on an understanding of current and future consumer needs, customer access approaches, and knowledge of competitors. (6) Organizational capacity is the ability to build a well-established organizational structure, cultivate the organizational culture, coordinate the work of all activities towards shared goals, and influence the speed of innovative processes through the infrastructure it creates for development projects. (7) Strategic planning capability is the ability to identify internal strengths and weaknesses and external opportunities and threats, adopt different types of strategies that can adapt to changes in the environment to stand out in the highly competitive environment [9]. The economic, social and environmental dimensions indicated in the prestigious literature are adopted in this study to measure innovation performance.

### 3. Conceptual framework

Figure 1 presents the conceptual model of this study. High-performance innovation capabilities enable better adaptation to changes and overcoming turbulent times in the business environment [20]. Each capability has a different degree of influence to support digital entrepreneurship. Capabilities and resources of an organization are assets that generate value [22] and companies interact aiming at accessing the resources of other companies to expand the process of generating innovation and value.



**Figure 1.** Conceptual Framework

It becomes necessary to transform resources into value for both the customer and other stakeholders (eg suppliers). Capabilities are complementary and innovation or value creation uses various organizational resources [23] (Teece, 2018), such as human and financial resources, and encompasses a vast amount of activities to create value. Following the analogy of Saloner, Shepard and Podolny [24], incubators must focus on innovation capabilities to enhance sustainable innovation. From the theoretical clippings presented, this study has the following variables and hypotheses:

- Independent variables: the independent variables are the innovation capabilities: learning, R&D,



resource allocation, manufacturing, strategic, organizational planning, marketing and leadership.

- Dependent variables: the dependent variables are the sustainable innovation performances: economic and financial, social and environmental.
- Hypothesis: Innovation capabilities impact to a greater or lesser extent the performance of sustainable innovation.

The methodological procedures are presented below.

#### 4. Methodology

This research was elaborated from the literature, in which the variables components of the model (independent and dependent) were extracted. Then, a survey was carried out to managers with experience in managing incubators in Brazil. 65 questionnaires were submitted (to managers) and 48 were answered. Managers with experience in managing incubators were also identified, using the professional platform LinkedIn. Data were collected using a scalar-type judgment matrix, in which managers assigned weights between 1 – less impact and 5 – greater impact. The questionnaire was prepared based on the literature and consisted of two parts: (a) general information from respondents (time of experience in managing incubators and position held) and (b) technical information about the impacts of innovation capabilities on innovation performance. sustainable. Three pre-tests were performed to eliminate instrument inconsistencies. The questionnaires were sent to respondents using the Google Forms platform. Data were collected in the first half of 2021. Data were analyzed using Spearman's correlation statistical technique. The calculations were performed using the R software.

#### 5. Results and Underlying Analysis

This section presents the results referring to the impacts of innovation capabilities on sustainable innovation performance: economic, social and environmental. The results show significant impacts of innovation capabilities for sustainable innovation performance (M=4.35; SD = 0.833). The questionnaire's internal consistency coefficient indicated by Cronbach's Alpha ( $\alpha$ ) is greater than  $\alpha = 0.76$  ( $p < 0.05$ ), a classification considered acceptable. Through Spearman's correlation test, it is possible to verify that innovation capabilities and sustainable innovation performance present positive and statistically significant correlations for most capabilities (Tables 1, 2 and 3).

**Table 1.** Spearman coefficient between innovation capabilities and economic and financial performance

Capabilities	V1	V2	V3	V4	V5	V6	V7
V2	0.07						
V3	0.21	0.47*					
V4	0.28	0.38*	0.16				
V5	0.11	0.38*	0.18	0.58*			
V6	0.14	0.18	0.12	0.29*	0.30*		
V7	0.28*	0.21	0.26	0.30*	0.17	0.48*	
V8	0.017	0.17*	0.05	0.32*	0.38*	0.16	0.38*

Note: \*significant correlation ( $p < 0.05$ )

The results indicate that most abilities present a positive correlation, evidenced by the Spearman coefficient ( $\rho$ ). That is, when one of the variables increases, the other also increases. The two variables move together. Resource allocation (V3) and R&D (V2); strategic planning (V5) and manufacturing (V4); marketing (V7) and organizational (V6) indicate positive and strongly statistically significant correlations ( $p > 0.05$ ). Table 2 presents the correlations between capabilities and sustainable innovation performance from a social perspective.

**Table 2.** Spearman coefficient between innovation capabilities and social performance

Capabilities	V1	V2	V3	V4	V5	V6	V7
V2	0,31*						
V3	0,34*	0,56*					
V4	0,38*	0,44*	0,33*				
V5	0,29*	0,40*	0,44*	0,66*			
V6	0,33*	0,33*	0,38*	0,44*	0,56*		
V7	0,44*	0,18	0,33	0,42*	0,44*	0,44*	
V8	0,33*	0,48*	0,33*	0,38*	0,32*	0,58*	0,38*

Note: \*significant correlation ( $p < 0.05$ )

The results indicate positive and statistically significant correlations for all capacities based on Spearman's correlation coefficient ( $\rho < 0.05$ ), with emphasis on resource allocation (V3) and R&D (V2) correlations; strategic planning (V5) and marketing (V4); organizational (V6) and strategic planning (V5). For environmental performance, the results presented in Table 3 suggest positive and statistically significant correlations, with emphasis on R&D (V2) and learning (V1); strategic planning (V5) and manufacturing (V4).

**Table 3.** Spearman coefficient between innovation capabilities and environmental performance

Capabilities	VI1	VI2	VI3	VI4	VI5	VI6	VI7
VI2	0,76*						
VI3	0,46*	0,64*					
VI4	0,44*	0,46*	0,58*				
VI5	0,46*	0,47*	0,48*	0,74*			
VI6	0,59*	0,59*	0,48*	0,57*	0,78*		
VI7	0,61*	0,46*	0,44*	0,43*	0,48*	0,58*	
VI8	0,33*	0,44*	0,28*	0,46*	0,38*	0,44*	0,38*

Note: \* significant correlation ( $p < 0.05$ )

Our findings support the study's hypothesis: innovation capabilities impact to a greater or lesser extent the performance of sustainable innovation. Findings revealed strategic planning and marketing capabilities as the most significant for economic and financial performance (Table 1). The correlations that stood out the most for social performance are: strategic planning, manufacturing, leadership and organizational (Table 2). The results highlighted the capabilities of resource allocation, learning, R&D, strategic and organizational planning as the most significant for environmental performance (Table 3).

## 6. Considerations remarks

This research aimed to examine the impacts of innovation capabilities on sustainable innovation performance in business incubators in Brazil. This study understands innovation as an integral part of the company's strategy and increasingly recognized as a key factor for sustainable business growth and competitive advantage. The results indicate that companies sign for greater social responsibility, by adopting sustainable business practices involved in their business decisions. The ability to innovate is fundamental for incubators in response to the challenges posed by sustainable innovations, aiming to integrate sustainability into business practices, objectives and, at a high level, strategies as advocated by Evans et al. [25]. Our findings revealed that capabilities have positive and significant impacts for sustainable innovation. Thus, our hypothesis (H1) was confirmed. Through the capability for strategic planning, incubators can improve their responsiveness, ensure the processing of relevant information and link the external environment to the flexibility of the internal capacity to respond to economic, social and environmental issues. In addition,

strategic planning capabilities favor efficiency in clearly defining actions and paths to be followed by incubators to define social and environmental strategies aligned with their business model. The ability to leverage resources also stood out as relevant to leverage other existing capabilities. Resources considered valuable allow incubators to explore external opportunities and thereby increase their value capture through profits and revenues [22]. Just as relevant as strategic planning and resource allocation capabilities is R&D capability. Competitiveness and levels of sustainable innovation are related to the ability to produce and exploit new knowledge. R&D is critical to decisions regarding the most sustainable marketing strategies. Incubators can increase R&D collaborations with external partners. Naturally, leadership is considered a lever of sustainable innovation capability. Leaders must encourage and encourage innovative, sustainability-oriented behavior. The findings allow us to state that innovation capabilities are positively associated with sustainable innovation. These results have managerial implications, as capabilities to innovate can lead to redefining their traditional business models to more sustainable models. The results also have implications for government managers in defining more sustainable policies. Finally, it is suggested as future works: (a) replicating the research, expanding the sample and including specialists from other countries; and (b) assess the impact of innovation capabilities on sustainable innovation performance through resource constraints.

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**PARALLEL SESSIONS PAPERS  
PRESENTATION**

**SESSION 3**

**DIGITALIZATION AND EDUCATION  
CHAIR: PROF.DR. HABIB HAMAM**



# Student Performance Analysis Using Data Mining Techniques: a Case Study

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**Abstract:** This case study analyzes student performance over semesters, considering their grades in the courses they completed during their studies. Estimating their performance in advance can help both educators and students to know where to focus and invest for more successful results. The results of this study can give the curriculum designers useful insights about the course prerequisite relations and for the student's academic advisors to direct students according to their expected success using their previous performance data. This study is conducted on 114 IT-related engineering programs students. Different data mining methods are applied to see the relationship between the course performances through the semesters.

**Keywords:** *Student Performance; Data Mining; Clustering; k-means.*

## 1. Introduction

Today, with the help of advanced information management technologies, universities keep vast amounts of student performance data. This data is precious for higher education institutions as it can be used to analyze the quality of the teaching process, help the faculties with the curriculum design and even to see if there is a need to offer new courses or to make changes in the existing teaching plan. Data mining techniques can provide lots of useful information for both management and academics whose aim is always to improve the quality of education.

There are many studies in the literature applying various data mining techniques to educational data [1-2]. Many of the studies aim to predict the student performance using various types of inputs. Student age, gender, and nationality are some of the common features used in the prediction models [3]. In Asif et al., [4], researchers showed that student performance can be predicted by only using their earlier grades (without considering socio-economic data) with reasonable accuracy. In this paper, a non-profit foundation university in Sarajevo, Bosnia and Herzegovina is selected to conduct data analysis on student performances. The aim of the study is to see how the core programming and mathematics courses affect the performance of the student in the following semesters. First, the students are clustered according to their performance in the core courses and the characteristics of each cluster are presented. Then, the correlation between each course and student performance over the four following semester is calculated and the relationship between them are discussed. The rest of the paper is organized as follows. In section 2, the data that is used in this study is described. Section 3 and 4 gives details of the analysis conducted using clustering, correlation, and regression methods, respectively. Lastly, in section 5, final conclusions and results are discussed.

## 2. Data

The data used in this study is taken from the International University of Sarajevo (IUS), Faculty of Engineering and Natural Sciences for all grades obtained by IT students from the courses offered in 4 semesters: Fall 2020, Spring 2021, Fall 2021, Spring 2022.

### 2.1. Data Set

The data set consists of students from two programs: Software Engineering (SE) and Computer Sciences and Engineering (CSE). The student profile is expected to be the same, as they are generally coming from the same high schools and with a similar background.

In the first year, all engineering students take “CS103 - Introduction to Programming” and “MATH101 - Calculus 1”. These courses are prerequisites to many other courses in their following semesters. CS103 course is the first and second level prerequisite for 11 courses whereas MATH101 is a prerequisite to 10 courses. So, these courses are very core courses for CSE and SE students and the performance of the student in these courses can be an indicator of their performance in the later courses, as expected by the definition of the “prerequisite”. The focus of this case study is on these important courses and their relations and effects on student performance in the later semesters.

The letter grade data is converted to numerical data using the IUS Grade Coefficient table (Table 1). All the analysis in this paper is made by using the corresponding numerical values of the letter grades.

**Table 1.** Letter grade conversion

Letter Grade	A	A-	B+	B	B-	C+	C	E	F
IUS Grade Coefficient	4	3.7	3.3	3	2.7	2.3	2	1	0

### 2.2. Data cleansing and preparation

In addition to the grade letters presented in Table 1, there are grade letters in this university, such as T (transferred course), IP (in progress), N/A (not attending). All the grades other than the ones given in the table are removed from the dataset.

To be able to make an analysis using both courses CS103 and MATH101, the students who did not take both courses are also eliminated from the data.

## 3. Clustering

Clustering is one of the most useful and practical methods in data mining to find data points with similar characteristics and patterns. The idea is to partition the data set into clusters consisting of closer data points than the others. It is also called unsupervised learning since it uses unlabelled data points. It can help the analysts to extract hidden patterns where human eye may not be able to see. It can be applied to wide range of fields; engineering, biological data, marketing etc. [5],[6],[7],[8]. It has been always attracted the researchers, due to its ease to implement and usefulness to analyzing the data.

There are several different clustering algorithms in the literature [9], each having different strengths and complexities. Among all, k-means is one of the most used algorithms due to its simplicity and practicality. Researchers still work on further improving the k-means algorithm and presenting different versions and extensions [10]. The idea behind the basic k-means algorithm is simple: every data point in the data set has a



distance to the cluster center. Predetermined parameter  $k$  is the number of clusters that the analyst wants to partition the data set into.

Aim of the algorithm is to minimize the distances of the data points to  $k$  cluster centers, resulting in  $k$  group of data points with the minimum average distance. One of the important drawbacks of the  $k$ -means algorithm is the initial parameter selections such as number of clusters. If there is no information about the clusters in the data, there are different techniques to find the optimum number of clusters. The Elbow method [11] is one of these techniques where the algorithm is run for increasing values of the  $k$ , and the total squared error (distance) is reported. The point where the error is the minimum gives the optimum  $k$  value for that dataset.

In this study, basic  $k$ -means algorithm is applied to find student groups (clusters) that has similar course performances. The Elbow method is applied to find the optimum number of clusters for our data set. The resulting graph is given in Figure 1. X axis represents the different values of  $k$  and y axis represents the sum of squared distances (distortion) from  $k$  cluster centers. The blue line represents the distortion score whereas the green line is the fit time. The optimal  $k$  value concerning the fit time and the distortion score is found to be 3 for this data set

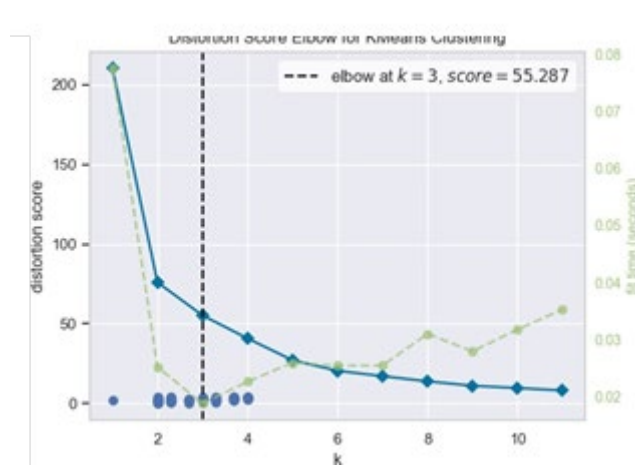


Figure 1. Elbow method distortion scores for  $k$ -means

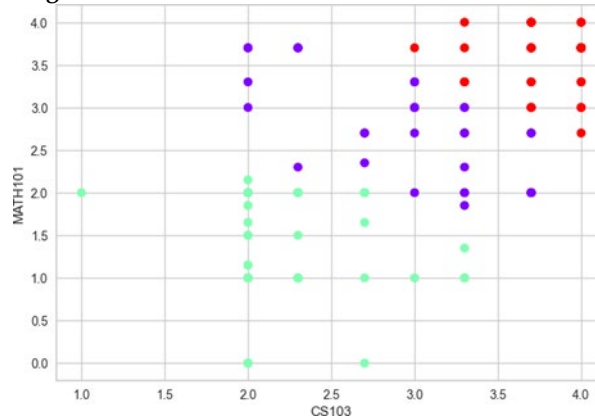


Figure 2.  $k$ -means clustering result for CS103 and MATH101: green-Cluster 1, purple-Cluster 2, red-Cluster 3

In this study, with the help of the elbow method, an optimal number of clusters are set to 3 and  $k$ -means algorithm is applied to the dataset for CS103 and MATH101 course performance scores for CSE and SE program students. The resulting clustering is illustrated in Figure 2. As expected, the clusters were formed in a way that, students with low, average, and high grades from both courses are grouped in clusters 1, 2, and 3, respectively.

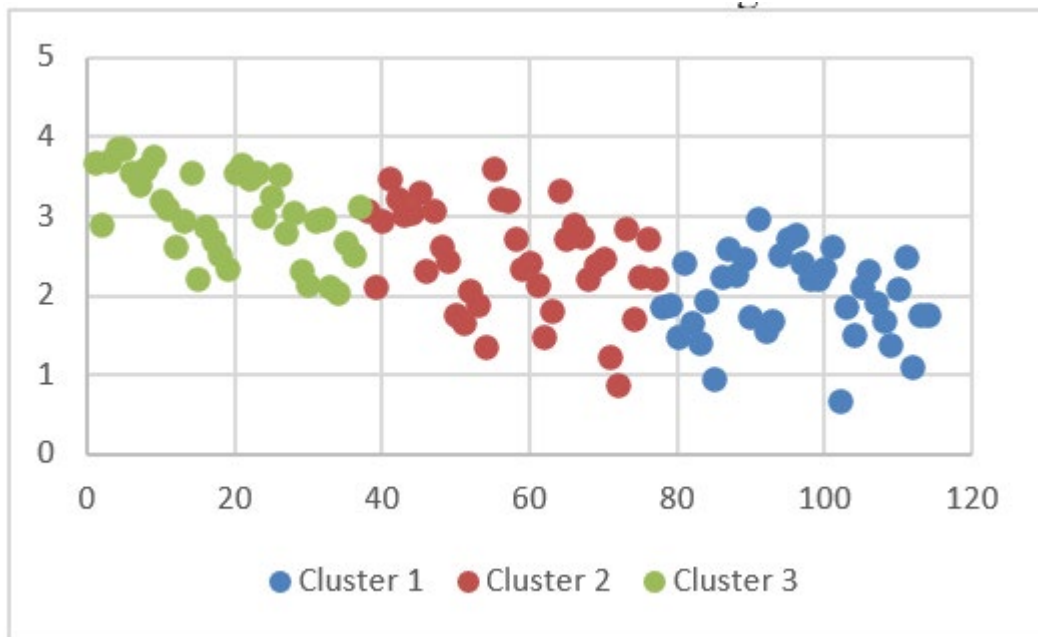
Table 2 shows the three clusters discovered by the k-means algorithm. The values in the table are the average values and the value in the parenthesis gives the standard deviation of GPA of the students in 4 semesters (GPA4). MATH courses and CS courses include all the courses that MATH101 and CS103 is prerequisite to, respectively. These values give insights about the expected course performances in the following semesters according to their performances in the first semester.

**Table 2.** Clusters statistics

	Cluster 1	Cluster 2	Cluster 3	Total
<b>n</b>	45	32	37	114
<b>GPA4</b>	2.15 (0.56)	2.48 (0.73)	2.97 (0.62)	2.51 (0.72)
<b>MATH courses</b>	1.50 (0.68)	2.26 (0.56)	2.87 (0.75)	2.16 (0.88)
<b>CS courses</b>	1.89 (0.64)	2.34 (1.18)	2.75 (0.90)	2.29 (0.96)

To visualize the GPA4 values for each of the clusters Figure 3 is given. In the scatter plot, grey data points represent Cluster 3, orange points Cluster 2 and blue points represent Cluster 1. Even though the data points within the clusters follow a quite scattered pattern, the obvious trend can be observed from the figure. Some other comments can also be made by just looking at this scatter plot.

It can be observed that the students from Cluster 3, called high-performing students from core courses, do not get a GPA lower than 2.0. Similarly, students from Cluster 1, as described as low-performing students from CS103 and MATH101, are very unlikely to get GPA higher than 3.0.



**Figure 3.** Clusters and GPA4

#### 4. Correlation and Regression Analysis

In order to see the marginal relationship between CS103 and MATH101 courses with the student performance on other courses over 4 semesters (GPA4), a correlation coefficient is calculated between each course and GPA4.

The correlation between MATH101 and GPA4 is calculated as 0.43 which is a weak-moderate positive correlation. With CS103 and GPA4, the correlation coefficient results as 0.59 with can be concluded as a moderate positive correlation. It can be valuable to check these relations with other engineering program

students as well, to see the impact of CS103 on CSE and SE curriculum. CS103 would not be expected to have a higher correlation with other engineering students, compared to these IT-related programs.

To further investigate the effect of CS103 performance on students' GPA4, regression statistics are calculated. The Independent variable is CS103 grade of the student whereas the dependent variable is their GPA4. The R square value is found to be 0.33 with p-value being smaller than 0.001 which shows the significance of the results. Note that, low R square values do not necessarily result in a bad representation of the data. In this case, it is obvious that there are other effects on the dependent variable, GPA4, which is probably the reason for relatively low R square values. The regression coefficient for CS103 is resulted as 0.53, meaning for each unit of increase in CS103 grade, GPA4 is expected to increase 0.53 units.

## 5. Conclusion

Estimating student performance in advance has various benefits both for educators and students to know where to focus and invest for more successful results. In this work, a case study using the grades data of CS and SE students in the International University of Sarajevo is conducted. The aim of the study is to see how the core programming and mathematics courses affect the performance of the student in the following semesters.

Using the results from clustering and correlation analysis, it can be concluded that, for CS and SE students, the performance in CS103 introductory course has a moderate to a high level of impact on their following semester course performances. MATH101 course also has a low to moderate level impact on student performance.

At the end of a student's first semester, he/she can be assigned to one of the clusters given in Section 3. The students in Cluster 1 and 2, can immediately be advised and offered support for these core courses to avoid their expected low performances in the following semesters.

For the course instructors, having the student profile on hand (number of students from each cluster) in advance is also a great benefit. The content of the course can be redesigned in a way to reach all levels of students. Students can be grouped using the cluster information and assigned to different levels of tutorial groups.

This analysis can be made for all courses in the curriculum and unseen relations between different courses can be discovered using only student performance data. It can be helpful for the curriculum designers while setting prerequisite conditions and for student advisors, it would be very helpful to direct students to which fields they should invest in or which elective courses they would be more successful.

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# Revisiting VET and Continuing Education: Towards a Knowledge-Based Economy through Best Practices

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**Abstract:** Various sources [1] provide ample analyses on the existence of serious skills gap in all the main sectors of the Albanian economy as the main educational focus has shifted towards Higher Education (HE), thus failing to revitalize the former “backbone” of the economy, i.e., Vocational Education Training (VET) and Continuing Education (CE). As such, this paper undertakes to analyze the most recent developments in terms of VET and CE including the VET laws, the Albanian Qualifications Framework, the amended Labor Code, the Law on Craftsmanship, a new VET Law, amended Law on Pre-university Education, the Employment promotion Law as well as some very recent feasibility studies on Post-Secondary VET. It further provides a number of recommendations and suggestions towards a better integration of VET and CE into a knowledge-based economy, thus filling the skills gap and securing a sustainable future and economic growth.

**Keywords:** VET; Continuing Education; Skills Gap; Albanian Qualifications Framework.

## 1. Introduction

It is a commonly accepted argument that “VET has proved to be a poverty relief and social inclusion mechanism” [2-3]. Regarding Albania, various studies [1][4] provide ample analyses on the existence of serious skills gap in all the main sectors of the Albanian economy. As such, the most recent developments in terms of VET and CE including the VET laws (2002, revised 2011), the Albanian Qualifications Framework (2010), the new National Strategy for VET and Lifelong Learning 2013-2020, the inter-sectoral Employment Strategy 2013-2020 as well as the most recent feasibility studies on Post-Secondary VET conducted by governmental agencies in collaboration with international organizations specialized in professional education have revealed a number of challenges and provided some useful insights into the future developments of Post-Secondary professional education as the main sources of employability. Regarding the total number of students graduating with *Matura* from gymnasias and VET schools, it has almost doubled since 2000/2001. As far as VET is concerned, it consists of VSS-s (Vocational Secondary Schools) and VTS-s (Vocational Training Centers) spread unevenly all over the 12 regions of the country [4]. The following graph provides some data regarding the number of full-time and part-time students and VET offers in public Vocational Secondary Schools (VSS) in the country as of 2014:

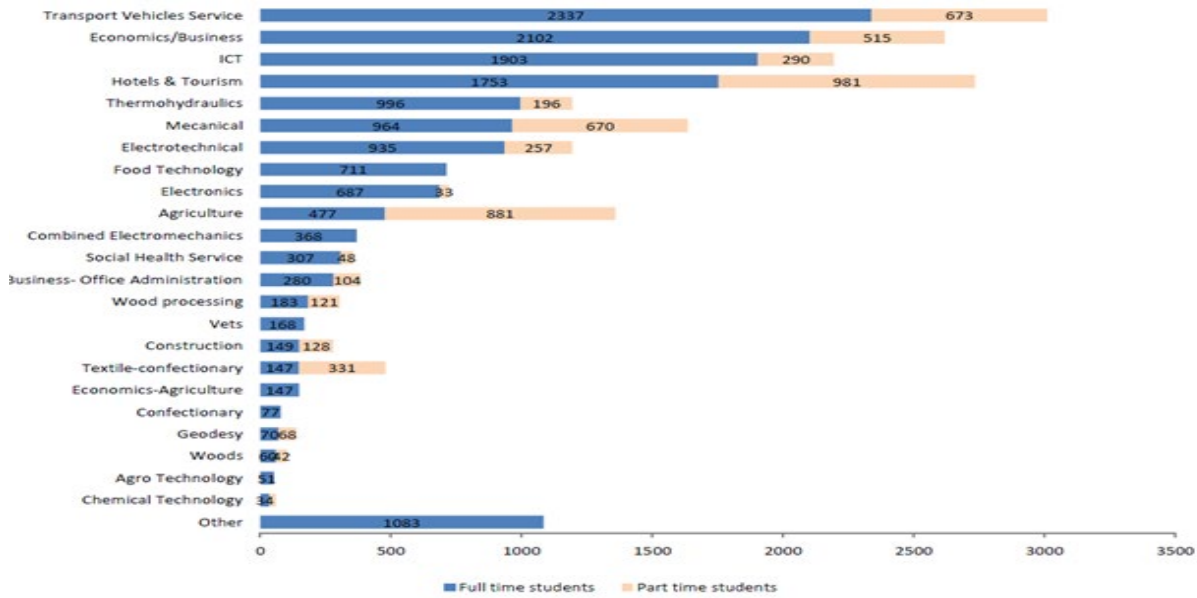


Figure 1. Full-time and Part-time student and VET offers (Copied from [4])

In fact, the main concerns regarding VET providers, both VSS-s (Vocational Secondary Schools) and VTS-s (Vocational Training Centers, commonly regarded as Lifelong Learning Centers), are related among others to the poor performance of the majority of them, lack of practical skills training and poor implementation of part-time vocational education, lack of admission criteria and insufficient teaching staff and infrastructure, lack of autonomy and occupational activity with lots of overlapping as well as lack of collaboration with the private sector, to name a few. The following performance matrix indicates that, out of 52 VET providers in the country, only 1 has a satisfactory performance; whereas the rest, more specifically 19 of them have performed moderately and the bulk of 26 VET providers have underperformed and 6 providers have performed poorly.

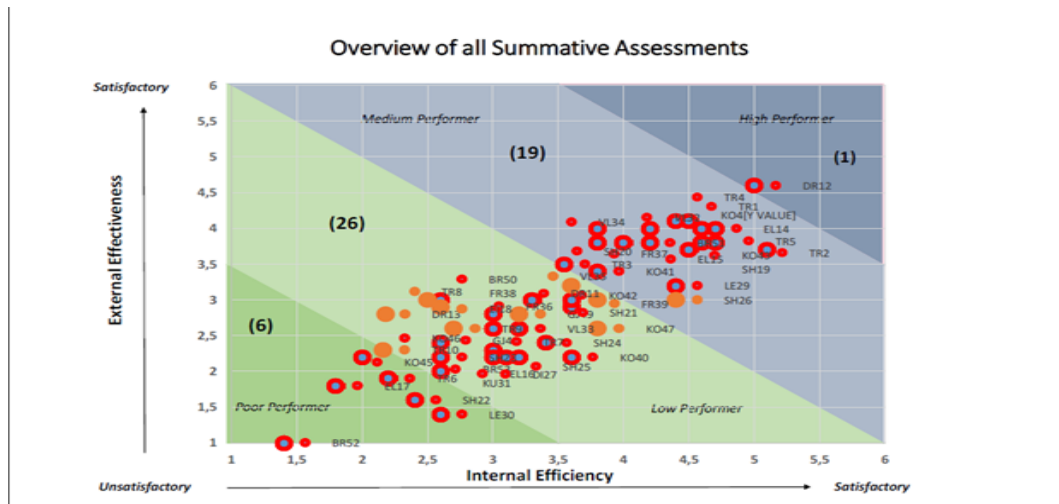


Figure 2. Summative assessments. (Copied from [4])

As such, improving the performance of VET providers requires among others the revision of the legal framework, separation of the VET path from the current state *Matura*, modernization of the VET curricula towards building occupation-related knowledge and skills, harmonization of the VET Management Information System, improving the understanding of the skills demands and informing VET planning, revision and upgrading of the VET part-time system, capacity development of managerial and teaching VET staff and,

the last but not the least, providing sustainable and innovative funding for VET as revealed by the following findings of the feasibility study conducted in 2014 by Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ) and European Training Foundation (ETF).

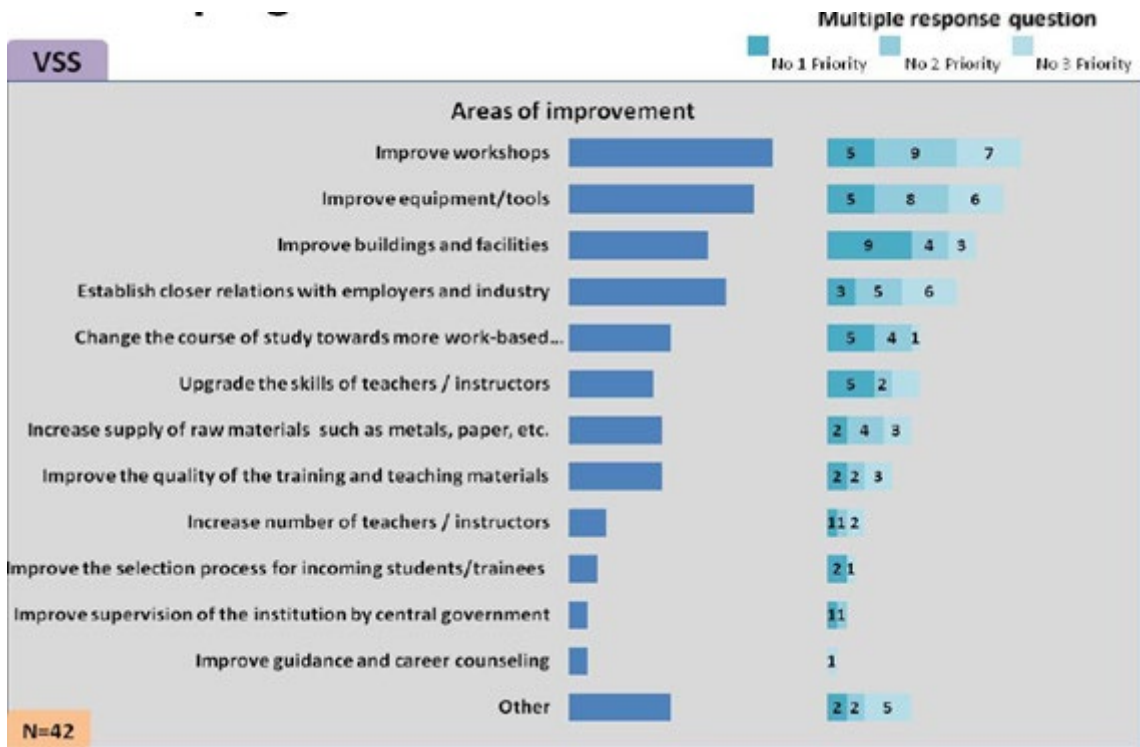


Figure 3. Measures that would most improve the VET programs (Source: GIZ,ETF,2014)

## 2. Revitalizing VET and CE through Best Practices

The best practices and the most recent feasibility studies emphasize that the future of VET belongs to the introduction and implementation of the Post-Secondary professional education regardless of the confusion brought about by various qualifications frameworks including The International Standard Code of Education (ISCED, 1997), the European Qualifications Framework (EQF), the Albanian Qualifications Framework (AQF) and the International Standard Classification on Occupation (ISCO, 2008). To serve this purpose, the following graph proposes three different and integrated models of improving the existing VET system in the country, i.e., Post-Secondary VET programs with a strong focus on “academic” knowledge under the domain of Professional Colleges at Universities; Post-Secondary VET programs with a “mixed” ratio of knowledge and practical workplace-based skills under the domain of different VET providers and Post-Secondary VET programs with a strong focus on “vocational” basic skills as a precondition for the post-secondary VET programs under the domain of Multifunctional VET centers:

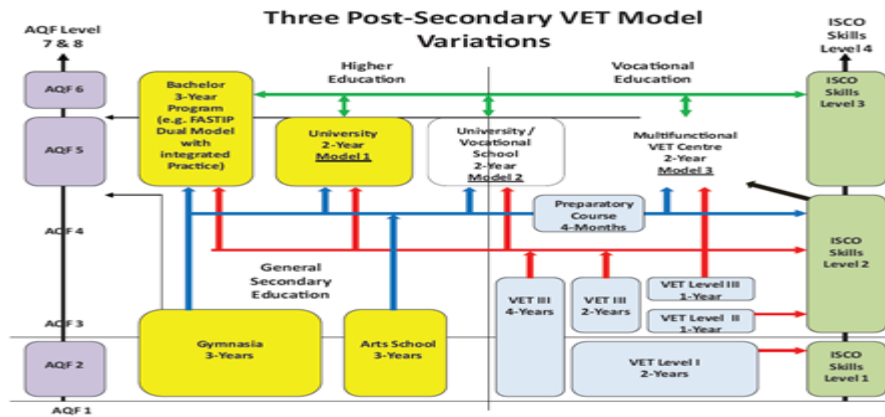


Figure 4. Post-secondary VET model variations (Copied from [4])

Regarding VET funding, a combination of grants/loans, fees, budget allocation, a vet levy for enterprises which do not provide training for their employees as well as a subsidy and/or a tax benefit for enterprises which provide training for their employees, to name a few, would complete the National VET Fund as indicated in the graphs below:

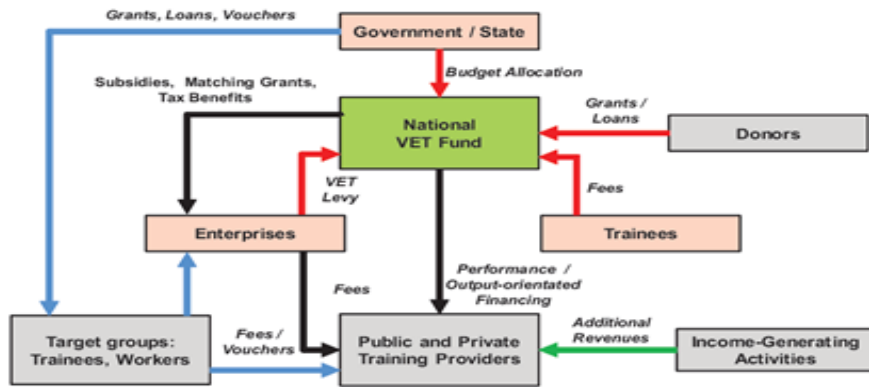


Figure 5. VET funding

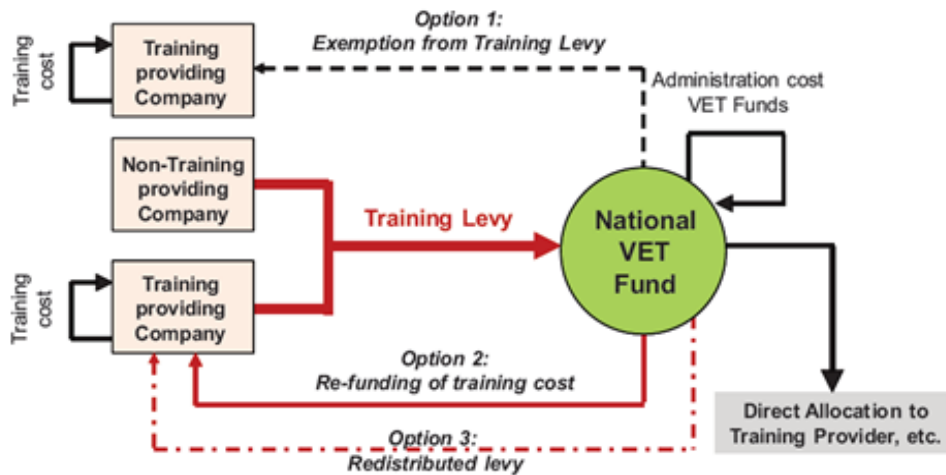


Figure 6. Three pay-back mechanisms (Copied from [4])



### 3. Conclusion

VET providers in the country face a number of structural, programmatic and funding challenges, which, regardless of the ever-increasing number of enrollments, fail to fill the skills gap of the country's economy. Therefore, the introduction of the three models of Post-Secondary VET programs based on the best practices provides a way out towards a more sustainable development. Yet, role of the government as well as the shared responsibility of professional organizations, chambers of commerce, trade unions and individual companies in the better implementation of the model/s remains the key to success.

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# The Equating of Test Scores of Common Subjects from Matura Exams to Improve the Comparability of Admission of Students in Universities

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**Abstract:** The purpose of standard assessments in education is to measure students' achievement in order to make a variety of decisions based on students' performance. Matura exams are standard assessments in Albania which use their results for two main decisions related to students. The first decision is to certify the completion of the secondary school program by the student. The second one is using the results as criteria for entry in universities. Mostly of students that apply for university are from the actual academic year. But there are some students that completed Matura in the previous years. Their results in Matura exams are not from the Matura tests of this academic year. Because of that, the results are not fully comparable even if the same grades have been achieved in the same subjects. If there are students from previous Matura applying this academic year for university studies, it would be fairer to equate test results for each subject with test results of Matura of this year. There are some methods to do it, but we will present one of them, that is the linear method of equating the test results.

Keywords: *Equipercntile; Linear Equating; Scores Distribution; Variability.*

## 1. Introduction

The process of admission of students in universities in Albania is government centralized. The process is very competitive in some programs that includes medicine, pharmacy, computer engineering and finance. The selection criteria are based on the secondary school average grade and in the results of State Matura exams. The data are administered by the Centre of Educational Services which is under authority of Ministry of Education of Albania. The subjects that have main weight to them are math, physics, biology, chemistry and economy. Each of study programs has the list of subjects and/or exams that has more weight in the decision for admission in each of study program for public universities. All the candidates that have submission a request in that program are ranking based on mostly in their results in State Matura exams. The candidates in some cases do not come from the same academic year. In some cases they come from previous years. This means that they had different test content in the same subject. This poses a challenge for the admissions' process for students might have different scores but just because the tests had different difficulties, i.e. one was easier than other.

When two test forms have been properly equated, educators can validly interpret performance on one test form as having the same substantive meaning compared to the equated score of the other test form (Ryan & Brockmann, 2009). Equating procedures are designed to produce scores that can be validly compared across individuals even when they took different versions of a test (different "test forms"). This is the situation when the comparing of performance of students needs more analyses and interpretation.

The most important methods of Equating are: a) Median and Mean Equating method, b) Linear Equating method, c) Percentile Equating method, d) Item Response Theory Equating method.

Below are used two methods for data analysis that are considered to be very convenient for our object and purpose

## 2. Methods

We will use two methods for equating results; linear equating method and equipercentile method. By using the linear method we will transform the results of Matura 2019 in some subjects in equivalent results of Matura 2021 comparing the test forms. We will do that again by using equipercentile method. As the reports include data in percentiles only for two subjects: math and reading & Albanian language the results of using two methods will be compared just for them. The results of equating will be interpreted and do recommend using them in different scenario or situations.

### 2.1. Method of Equi-percentile equating

Equi-percentile equating is defined by a nonlinear transformation between scores. The first step in equipercentile equating is to determine the percentile ranks for the score distributions of each of the two tests to be equated [1](Crocker & Algina, p.462). Scores of two forms are considered to be equivalent according equipercentile equating if they have the same percentiles. The equi-percentile equivalent of a form-X score on the Y scale is calculated by finding the percentile rank in X of score  $i$ , and then the form-Y score associated with that form-Y percentile rank. The equi-percentile method provides for accuracy of equating results along the entire score scale. It also allows for more accuracy than linear equating when test forms differ in overall difficulty level.

### 2.2. Method of linear equating

Linear equating assumes that the only differences between the two tests are mean and variability (as measured by standard deviation or "SD").

Linear equating is a linear transformation. Y and X are the tests to be equated. The parameters a, b and c are value that are known from the characteristics of data of test results for both forms Y and X. Scores  $x$  (on Form X) transform in equivalent  $y$  scores (on Form Y) applying by function

$$y_x = \frac{\sigma_y}{\sigma_x} * x + \left[ \mu(y) - \frac{\sigma_y}{\sigma_x} \right] * \mu(x) \quad (1)$$

$$y_x = \frac{\sigma_y}{\sigma_x} (x - \mu_x) + \mu_y \quad (2)$$

$$a = \frac{\sigma_y}{\sigma_x} \quad (3)$$

$$b = \mu_x \quad (4)$$

$$c = \mu_y \quad (5)$$

Where:

$x$  - is the certain scores in Form X;

$\mu_x$  - is the mean of scores in Form X;

$\sigma_x$  - is the standard deviation of scores in Form X;

$\mu_y$  - is the mean of scores in Form Y;

$\sigma_y$  - is the standard deviation of scores in Form Y.

## 3. Data and Materials

The data are taken from test forms of State Matura exams 2019 and 2021. Comparing scores across the

two tests form is more favorable when the tests are composed with the same content standards. Additionally, the tests would need to use the same blueprints that emphasized the same content areas as well as the same performance-level descriptions.

Below are given characteristics of the design of tests of state Matura that fulfill conditions for applying any methods of equating tests results. The tests of a subject are composed based on the same content starting from 2019 year and on.

There is a blueprint that is prepared before final test design.

There is a well prepared marking scheme for scoring of tests.

There is the same number of questions in every test of State Matura.

The maximum of score of each test is 60.

Time of test is 2h and 30 minutes.

Users of educational tests often seek to compare scores even if the scores were obtained at different times, in different places, or using variations in assessment content and procedures

#### 4. Findings and Analysis

The distribution of students that completed the Math 2019 test has a mean of 27.37 and standard deviation of 12.05 (Table 1). The distribution of students that completed the Math 2021, on the other hand, has a mean of 25.89 and a standard deviation of 10.26 (Table 1). Below are given the score’s distributions that are taken from officially reports of Center of Education Services of Albania (<http://qsha.gov.al>)<sup>14</sup>

The distribution of students that completed the Math 2019 test has a mean of 27.37 and standard deviation of 12.05 as illustrated in Table 1. The distribution of students that completed the Math 2021, on the other hand, has a mean of 25.89 and a standard deviation of 10.26, as illustrated in Table 1.

Table 1. State Matura tests 2019 and 2021

Subjects	Year 2019		Year 2021	
	Mean - $\mu_x$	St Deviation - $\sigma_x$	Mean - $\mu_y$	St. Deviation - $\sigma_y$
Math	27.37	12.05	25.89	10.26
Albanian language	26.78	9.47	33.45	9.97
Biology	36.2	14	41.82	12.98
Physics	39.41	13.22	40.06	12.26
Chemistry	44.86	12.08	39.41	12.38
Economy	37.94	11.1	43.38	11.16

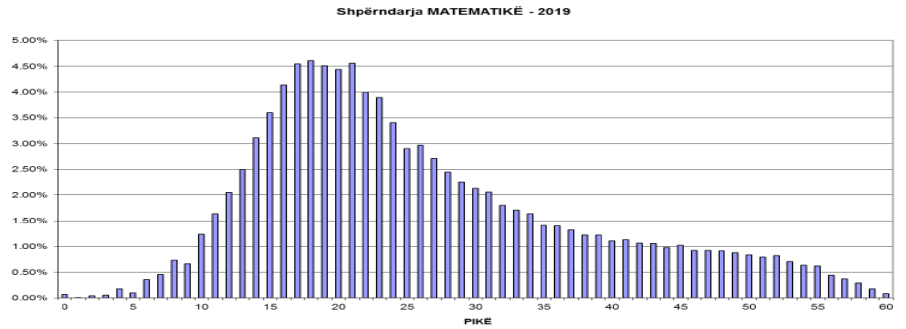
In the Fig.1 and Fig.2 are given Math test scores distribution of 2019 and 2021, from officially reports of Centre of Education Services of Albania<sup>14</sup>:

<sup>14</sup> <http://qsha.gov.al>

OSHA 2021 Public Report of Students Achievements MSH 2021

[http://qsha.gov.al/infos/matura\\_2021/raport\\_public\\_msh2021.pdf](http://qsha.gov.al/infos/matura_2021/raport_public_msh2021.pdf);

OSHA 2019 Public Report of Students Achievements MSH 2019



**Figure 1:** Math test score's distribution 2019



**Figure 2:** Math test score's distribution 2021

Consider a student that achieved a score of 56 in the Math test 2019. By using the transformation for rescaling the scores of Form X to the scale of Form Y:

$$y_x = \frac{10,26}{12,05} * 56 + \left[ 25,89 - \frac{10,26}{12,05} * 27,37 \right] = 50,27 \quad (6)$$

There are almost 6 scores differences. It is big difference if we consider that ranking between candidates is sensitive toward decimals.

The largest difference is for Albanian language and literature subject by 8 scores. The differences in equating the tests scores from 2019 to 2021 year are given for some subject in Table 2.

**Table 2.** The equating tests sores 2019 and 2021 for some subjects

Subjects	2019	Adjusted 2021	Difference 2021-2019
Math	56	50.27	-5.73
Albanian. Language and Literature	52	60.00	8.00
Biology	55	59.25	4.25
Physics	51	50.81	-0.19
Chemistry	57	51.85	-5.15
Economy	54	59.53	5.53

The raw score 55 on Biology 2019 have equity scores 59.25 on Biology 2021, or 4.25 points more. The raw

score 56 on Math 2019 have equity scores 50.27 on Math 2021, or 5.73 points lower. In the same way we can find the adjusted scores for some other subjects which are given below.

By analysing the data by equi-percentile method are used percentile graphics taken from public reports of State Matura exams. 90% percentile rank in math 2019 is 45 points and in math 2021 is 39.

Referring the math subject by comparing the data of graphics the difference of candidates of 90% percentile is six scores negative.

Referring the equi-percentile equating method the difference is 6 points as illustrated in Fig.3 and Fig.4. By linear equating methods the difference is 5.73 points as illustrated above, in Table.2.

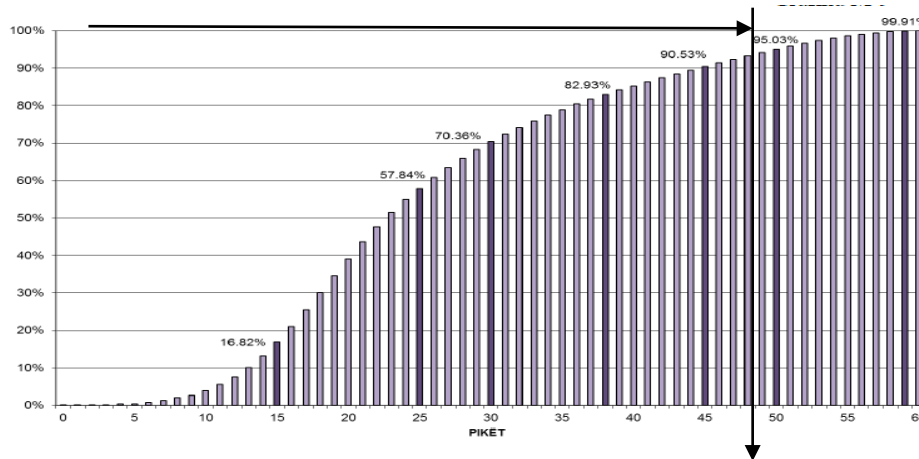


Figure 3: Percentile scores 2019

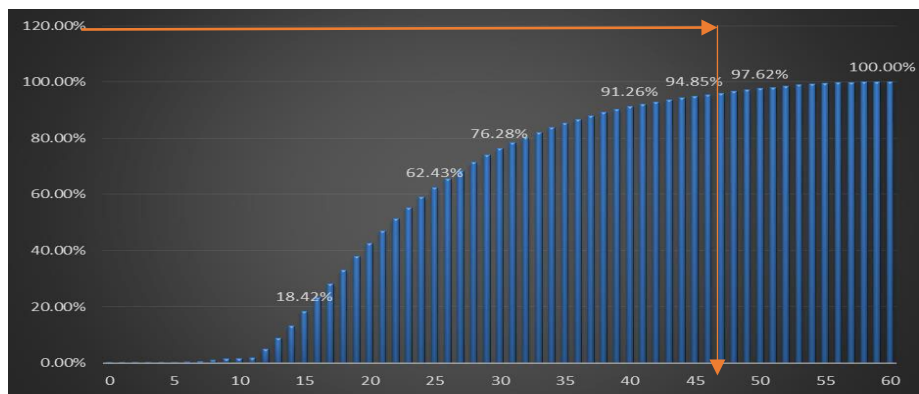


Figure 4. Percentile scores math 2021

Referring the math subject by comparing the data of graphics the difference of candidates of 90% percentile is six scores negative. Referring the equipercentile equating method the difference is 6 points (Figure 3, Figure 4). By linear equating methods the difference is 5.73 points (Tab.2). Inspection reveals that the linear and equipercentile equating functions are fairly similar. Differences between them rarely exceed one raw score point, and in most cases do not exceed plus/minus 0.3 points.

### 5. Conclusion and Recommendations

The equating methods enable comparing the results of students in different format tests composed in common content of a subject. Universities that apply criteria for admission based on the results on specific subject of state Matura exams need to compare the results of applicants. The equating transform is required to be used in such processes where the decision has great impact to participants. The admission process of

students in universities in cases when is required to use these methods give better accuracy in results for ranking candidates. The linear equating and equi-percentile equating methods gives much approximate results  $\pm 0.3$  in equating transforms of scores from various test forms.

This methodology could be used also in the process of requirement of candidates when we are interesting more on ranking of them based on their results and abilities.

The results of using the equating methods gives information and indicate where is needed to improve design of tests.

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**SPECIAL LONDON SCHOOL OF  
ECONOMICS SESSION**

**THE EFFECTIVENESS OF NEW  
TECHNOLOGIES FOR TEACHING CODING  
IN COMPULSORY EDUCATION**

**CHAIR: PROF.DR. MERITA XHUMARI**



# The Effectiveness of New Technologies for Teaching Coding in Compulsory Education

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The purpose of this session is to present the findings from an evaluation research project “Monitoring and Evaluation Services for the 21st Century Schools Programme in the Western Balkans”, realised by LSE Enterprise with a network of researchers from the region. The programme involved the distribution of small computers known as Micro:bits to all primary schools in the region by the British Council, accompanied by teacher training to raise the capacity of education systems to provide instruction in computer coding and programming to young people. The research project evaluated how the ministries of education and school leaders in the Western Balkans supported the introduction of new technologies and digital education in primary school. The research also evaluated schools’ capacities in infrastructure, quality of staff, teachers and school leaders, for implementing innovative teaching methodologies involving critical thinking and problem solving and in using Micro:bits to teach coding skills to young people.

Given this background, the main findings relate to the way the project improved the coding skills and critical thinking and problem solving skills of pupils in the 6<sup>th</sup> -9<sup>th</sup> grades in primary schools during the period 2020-2022. The context of Covid-19 gave a special importance to the research findings with the necessity of using online learning platforms. The increased interest of pupils in IT and new technologies are necessary for the digital transformations as one of the priorities in the field of education.

The research director Professor Will Bartlett will provide an overview, followed by presentations of the findings from the research project in three countries. Professor Merita Xhumari, University of Tirana; Professor Ardiana Gashi, University of Pristina; and Professor Ivana Prica, University of Belgrade will present the results of each country research. The findings are highly relevant to the theme of the conference, given the importance of educating young people in skills that will be in much demand in the future.

**Keywords:** *Digital Transformation, Coding, Microbits, Primary Education, Capacity Building.*



# Evaluating an Intervention to Provide School Pupils in the Western Balkans with a Practical Digital Education in Coding using Micro:bit

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**Abstract:** The level of internet skills in the Western Balkans is generally low. According to a 2021 survey conducted by Eurostat, while 53% of individuals in EU have basic or above basic digital skills, only 24% in Albania and 35% in Bosnia Herzegovina and in North Macedonia have such skills, ranging up to 41% in Serbia and 47% in Montenegro. In this context, the British Council implemented the 21st Century Schools Programme in the Western Balkans, designed to upgrade digital education in 4,000 primary schools throughout the region. It provided teacher training in coding using Micro:bit, provided 100,000 Micro:bit devices to schools, and engaged with policy makers and school leaders to reform the curriculum. This paper sets out the results of a research project evaluating the results of this Programme. The evaluation found that the Programme was transformative in providing a boost to digital education in the region and in introducing or reinforcing the use of critical thinking and problem-solving techniques as a teaching method. The evaluation was based on surveys in a sample of 64 schools throughout the region, backed up by documentary analysis and in-depth-interviews with policy makers, teacher-trainers, school leaders. Surveys (based on questionnaires) were carried out with school leaders, teachers and pupils. The evaluation revealed the overall effectiveness of the Programme despite the difficulties it faced in some countries due to inadequacy of internet connections, out-of-date computer equipment and a lack of suitably qualified specialist IT teachers.

**Keywords:** Digital Education; Coding; Micro:bit; Primary Education

## 1. Introduction

The countries of the Western Balkans (Albania, Bosnia and Herzegovina, Kosovo, Montenegro, North Macedonia and Serbia) lag behind the rest of Europe in the development of their digital infrastructure. Moreover, the level of internet skills in the Western Balkans is generally low. According to a 2021 survey conducted by Eurostat, while 53% of individuals in EU have basic or above basic digital skills, only 24% in Albania and 35% in Bosnia Herzegovina and in North Macedonia have such skills, ranging up to 41% in Serbia and 47% in Montenegro [1]. In this context, the development of the digital skills of the population, especially

of school-age children, is of special importance. It is not surprising, therefore, that the provision of digital skills has rapidly moved up the region's policy agenda.

The British Council 21st Century Schools Programme was announced at the London Summit of the Berlin Process held in July 2018, which proposed a package of measures including a commitment of £10 million to help build digital skills and employment prospects for young people in the Western Balkans. It announced that the British Council would provide training to children in over 4,000 schools in the region, to bolster digital literacy and core skills so as to foster the next generation of innovators and entrepreneurs. The British Council 21st Century Programme included a package of funding provision and capacity building activities across the countries of the Western Balkans. The Programme aimed to address the multiple constraints that prevent primary school pupils from developing their coding skills. The key aim of the Programme was to provide training activities to school leaders and teachers in the application of IT skills, namely in coding and programming using Micro:bit hardware provided by the UK government. The Programme also provided teachers with guidebooks, manuals and teaching materials. Each school participating in the Programme was encouraged to establish a coding club, with a target of establishing coding clubs in 70 % of participating schools. Coding clubs were expected to have up to 30 pupil members who would meet at least once a week in a designated school area (e.g., an IT classroom) to develop joint projects using Micro:bit devices. The Programme provided guidance to school leaders and IT teachers on establishing coding clubs and supported their work with online resources produced in cooperation with the Raspberry Pi Foundation. Projects were able to take part in national coding competitions organised by local British Council offices.

## 2. The evaluation methodology

The evaluation of the British Council 21st Century Schools Programme in the Western Balkans was carried out by a team of researchers from LSE and local experts from the six countries where the Programme was implemented [2][3]. The evaluation project consisted of a baseline study, and endline study, and a final evaluation study. Evidence was gathered through mixed research methods using surveys and in-depth interviews (IDIs). The programme was rolled out in six successive cycles: the 1st cycle in Spring 2019, the 2nd cycle in September/October 2019, the 3rd cycle in January/February 2020, and so on. This paper analyses data obtained from fieldwork interviews and surveys in a sample 64 primary schools. We used schools from the 2nd and 3rd cycles to establish the baseline measurements at the beginning of the Programme in September/October 2019 and at the start of the 3rd cycle in January/February 2020, with extensions to later in 2020 due to school closures in response to the COVID-19 pandemic. We used schools that were to be included in later cycles as a control group of schools. The endline fieldwork was performed on the same set of schools in September-November 2021. Sampling was done separately in a two-stage sampling procedure. Altogether, 5,049 pupils were surveyed in the sampled schools using a pupil questionnaire. In addition to the above, qualitative research was carried out based on 82 in-depth interviews (IDIs) with key informants who were re-interviewed from the baseline survey.

## 3. Effectiveness: Did the Programme achieve its objectives?

Ministries of education were highly supportive of the Programme, not only in terms of facilitating its activities and through adapting the curricula and educational policies to support the introduction of coding in primary schools. The Programme achieved most of its objectives in supporting the integration of coding into the curricula, providing written resources to support the implementation of coding using Micro:bit, in providing training to IT teachers, and in providing additional resources to strengthen the teaching of coding in primary schools. Technical working groups were established in Albania with the support of the British Council to review the curricula and introduce coding in grades 6 and 7 from 2021. Elsewhere, the Programme assisted the development of policy documents designed to integrate coding into primary education, including the Kosovo National Curricula Framework of Kosovo (2019), the Kosovo National Strategy for Digitalisation

of Education (2020-2021), the Kosovo Education Strategic Plan 2022-2026. The Programme was fully aligned with the already developed Strategy for Development of Education in the Republic of Serbia until 2030, and the Strategy for the Development of Digital Skills in the Republic of Serbia for the period from 2020 to 2024. Training in the use of Micro:bit was provided to 505 IT teachers in Albania, 44 IT teachers in Bosnia and Herzegovina, 50 IT teachers in Montenegro, and 608 IT teachers in Serbia. In Kosovo, training was envisaged within the activities of the Kosovo Education Strategic Plan 2022-2026.

At a regional level, a Micro:bit online training course developed by the British Council was translated into local languages to support teachers using Micro:bit in their classrooms, hosted on a Moodle platform. Almost 20,000 teachers completed the Micro:bit online course. A Manual for Micro:bit Coding for Primary Schools was developed by the Petlja Foundation and translated into local languages. A Coding Club Guide was developed in cooperation with Raspberry PI and Micro:bit Foundation to support teachers in establishing and running coding clubs, providing a 12-week ready-made lesson plan with projects to be developed using Micro:bit. A Guide for using Micro:bit accessories with a detailed explanation of around 50 different components that can be used with Micro:bit was developed by the British Council. Over 100,000 Micro:bits were distributed to schools during the Programme throughout the Western Balkans. Six national coding challenges were organised in each country, awards were handed over, and winners of the first national competition participated in a regional coding challenge.

However, the capacities of the school systems to absorb the Programme were limited and this somewhat reduced its effectiveness below that which might otherwise have been attained. The Programme came at an inauspicious time as the onset of the COVID-19 pandemic coincided with the initial roll-out of the Programme, and school closures had a negative impact on its effectiveness. Even without this, the implementation of coding using Micro:bit in the curriculum was limited in some countries and in rural areas due to the inadequacy of internet connections and digital infrastructure, including out-of-date equipment and slow internet connections in some schools. The lack of digital infrastructure was particularly acute in Albania and can only be remedied by a large-scale investment in infrastructure development. Fortunately, this is envisaged in the recently launched EU's *Economic and Investment Plan for the Western Balkans*. In Montenegro also, rural schools have problems with outdated computers and slow internet connectivity.

Our research revealed that the extent to which the curriculum supported the teaching of coding has varied across countries. It was expected that by the end of the Programme 70% of primary schools would provide compulsory or elective coding classes within the IT subject. In practice, the target for teaching coding was fully achieved only in Montenegro, North Macedonia and Serbia. In Kosovo, despite being on the curriculum, at the time of the endline survey coding was not being taught in schools, and pupils were instead learning coding either in coding clubs or in private lessons outside school. In Albania, coding was introduced in the academic year 2021-2022, and coding with Micro:bit was embedded in the IT curriculum of the sixth grade and seventh grades. However, the teacher survey revealed that the target for teaching coding in schools was not achieved in Albania. The implementation of teaching coding was held back by a lack of qualified IT teachers, not only in Albania but in other countries too. In Albania a further obstacle was caused by interruptions to the electricity supply in some rural schools.

### 5. Conclusions

The 21st Century Schools Programme was well aligned with the needs and priorities of the education systems Western Balkan countries. It raised awareness among policymakers on how to strengthen their education systems to better meet future skill needs. In each country, the promotion of coding was well aligned with existing strategies and reform processes, and the Programme was effective in delivering its coding objectives. This achievement was mainly due to the support received from ministries of education throughout the region, which adapted the curricula and educational policies to support the introduction of coding in primary schools and facilitated the activities. However, the limited capacity of the school systems to absorb the Programme reduced its effectiveness. It came at an inauspicious time, with the onset of the COVID-19

pandemic forcing school closures in 2020. This hindered the implementation of coding teaching using Micro:bit. Even without this, the use of Micro:bit for teaching coding was limited in some rural areas due to the inadequacy of internet connections and out-of-date computer equipment and a lack of suitably qualified specialist IT teachers. Overall, the Programme was effective in improving the knowledge skills and confidence of teachers to teach coding and in providing pupils with a much-needed introduction to the subject.

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# Introduction of Coding and Microbits to the Compulsory Education in Albania

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**Abstract:** This paper presents the finding from the current research of the British Council project “Monitoring and Evaluation Services for the 21st Century Schools Programme in Western Balkans”, the Albanian case.<sup>15</sup> The research evaluates how the Ministry of Education and Sports support the primary schools to apply new technologies as microbits. On the other side, the research evaluates the schools’ capacities regarding infrastructure, and quality of staff for implementing innovative teaching methodologies and using microbits as new instruments of teaching. The evaluation research is based on the criteria of relevance, effectiveness, efficiency and sustainability of the British Council Programme during a three-year period, 2019-2022. The context of Covid-19 gave a special importance to the research findings with the necessity of using online learning platforms and new technologies. Given this background, the main findings are related with the importance that all stakeholders consider in application of microbits in the grades 6<sup>th</sup>-9<sup>th</sup> in primary schools during the period 2020-2022. The increased interest of pupils and teachers on new technologies is necessary for the digital transformations that are defined as one of the government priorities in the National Strategy on Education 2021-2026. Extension of teaching coding in all grades of primary education system started immediately to be piloted in the following school year 2022-2023. The research show that capacity development of the schools on using microbits and apply coding will further increase the interest of pupils and the quality of teaching. The weakest point of schools is the lack of knowledge of teachers in using microbits and application of coding in the various teaching subjects in primary education level. Universities might play a crucial role in this regard for further capacity development of primary schools by offering courses on the use of microbits and coding.

**Keywords:** *Digital Transformation, Coding, Microbits, Primary Education, Capacity Building*

## 1. Introduction

In the context of the EU integration and in conformity with the UN Agenda of Sustainable Development Goals 2030, the Albanian Government drafted the Strategy for the Digital Agenda 2015-2020.<sup>16</sup> The Strategy was focused on three main areas: (i) Increasing and promoting e-services for citizens, businesses and public administration; (ii) Promoting the use of ICT in education, in order to bridge the digital divide, empower young people, increase the number of users, and create new jobs in line with technological skills; (iii) Consolidation of digital infrastructure throughout the territory of the Republic of Albania. The competency-based curricula have been started in the school year 2015/2016, while ICT is taught as a compulsory subject from fourth to ninth grade.

In this context, the British Council project “Monitoring and Evaluation Services for the 21st Century Schools Programme in Western Balkans” was designed to upgrade digital education in primary schools by addressing the multiple constraints that prevent primary school pupils from developing their critical thinking,

<sup>15</sup> The authors represent the experts contracted from London School of Economics for evaluation of the British Council project “Monitoring and Evaluation Services for the 21st Century Schools Programme in Western Balkans”.

<sup>16</sup> [https://akshi.gov.al/wp-content/uploads/2018/03/Digital\\_Agenda\\_Strategy\\_2015\\_-\\_2020.pdf](https://akshi.gov.al/wp-content/uploads/2018/03/Digital_Agenda_Strategy_2015_-_2020.pdf)

problem solving and coding/programming skills. The Programme has provided training of teachers and school leaders from January 2019 to December 2021, as well as delivering about 23,560 micro:bits in all primary schools of Albania.

The research survey shows that while the school leaders, teachers and pupils have shown high interest on using micro:bits, the existing laboratories with very old computers cannot be used for teaching coding/programming. This is the reason why 80 percent of teachers and 73 percent of school leaders said “no” to the question “Whether schools have adequate IT infrastructure for teaching programming/coding?” Because of that situation, computer coding/programming is not developed adequately in primary schools. The school infrastructure is going to be improved especially after earthquake of November 2019 in Albania, with reconstruction of the destroyed schools and the new ones that are in the building process. The context of Covid-19 during 2020s gave a special importance to the research findings with the necessity of using online learning platforms and new technologies. It should be noted that the COVID pandemic measures led to school closures during March-June 2020, had a negative impact on the effectiveness of the British Council Programme.<sup>17</sup>

## 2. Methodology

The research carried out by London School of Economics Enterprise is design in two phases, the baseline survey which started at the beginning of training, at September 2019-October 2020, and the endline survey carried out at the end of training, at October-November 2021. The evidence used in this paper refers to the comparison between the baseline and endline research results. A mixed research method was used combining data collection from various instruments such as questionnaires surveys with teachers and pupils and in-depth interviews with policy makers, school leaders, trainers and parents. The research method was applied to the 15 sampled schools, out of which 10 was considered as the Main Sampled School (MSS) and 4 as Control Sampled Schools (CSS). The MSS were selected from the first 2 cycles of the Programme training, and the CSS from the last cycles of the trainings. Another school with potential social excluded children, such as Roma and Egyptian minorities was selected, to better understand the impact of the Programme on social inclusion. The target groups have been pupils in grades 6-9 and their teachers. The sample of surveyed pupils was randomly selected with all pupils of one class of grades 6-9 in each school, where the pupils’ questionnaire was applied. Then was selected the teacher sample with the trained teachers who teach in the sampled groups of pupils, a maximum 5 /school, including teachers of IT. Along with the trained teachers, was selected a group of control teacher in the respective subjects of trained teachers, maximum 3 /school.

## 3. The Research Results

The research aims to measure the changes happened during the British Council Programme implementation evaluated based on relevance, effectiveness, efficiency and sustainability criteria. The Programme relevance was referring to the question “Did the Programme do the right things?” and the results confirm that it was design and implemented well aligned with needs and priorities of the Albanian education system, the requirements and ability of the teachers, and the needs of pupils. The Micro:bit enhanced teaching experience for teachers and learning experience for pupils, as well their willingness for working in computer science in the future, especially for girls and those with more ability, especially in Tirana where coding courses are offered outside schools. While pupils with special educational needs and Roma / Egyptian minorities are differentiated from the rest of pupils and require special attention for improving their coding skills and their social integration.

The Programme effectiveness is referring to the achievement of the objectives. Coding skills are defined among the priority objectives of the National Strategy on Education 2021-2026 and of the modules for school

<sup>17</sup> See: <https://ourworldindata.org/covid-school-workplace-closures>

leaders and teachers' qualifications. School leaders and teachers have organized activities for sharing the knowledge and skills in using Micro:bits and establishing coding clubs in their schools, such as the digital school bell in Krrabë and in Vasil Shanto schools. The school leaders and teachers' assessment of pupils' skills with coding/programming are low, but higher at the Endline survey, compared to the Baseline. This improvement means that although the schools' infrastructure has not changed, there are teachers' training about coding, activities with coding clubs, and the use of Micro:bits by pupils as the main positive factors on the advancement of pupils' coding skills. The Programme efficiency is partly achieved as the available resources have been not adequate, referring to the lack of school infrastructure, and IT teachers. Regarding time, training on coding/programming should be carried out on a regular basis, on the proper time to guarantee a balance of work and family obligations of teachers who want to be trained. School leaders and teachers should be consulted and informed in advance on the training agenda.

The Programme sustainability is mostly achieved, as coding basic skills are a key part of the lifelong learning competencies on which the National Strategy on Education 2021-2026 and the curriculum of the pre-university education system is designed. Sustainability is secured referring to the policy measures in revising curricula and human resource development through trainings of teachers and school leaders. After the training programme, school leaders have reflected on using some new indicators in their monitoring plans to assess how teachers use coding in their teaching. However, the teaching based on coding will be sustainable, if the school infrastructure is improved and recruitment of IT teachers.

#### 4. Conclusions - Lessons Learned

At the end of the evaluation, some lessons learned for future development of the coding skills in primary schools are drawn for all engaged stakeholders. In macro level, referring to the impact of programming/coding in quality of teaching in primary schools, policymakers should take measures to enable and monitor implementation of the strategies, legislation and reformed curricula. All school leaders and teachers should have the same opportunities on their qualification of Coding through regular trainings, similar to the one organized by the British Council Programme.

In micro school level, the role of school leaders is crucial in curriculum application and teachers' motivation through actively participate in capacity building of their schools, collaboration with other community stakeholders to increase resources and energies for application of coding/programming. School leaders need to promote teachers with good performance and pupils with excellent results who demonstrated usage of Micro:bits to school project with the aim to motivate other teachers and pupils, as well as their parents. Their preliminary efforts for establishment the coding clubs in their schools would continue with the school infrastructure development efforts which remains as a main challenge for application of coding/programming. The teachers' interest for training would be promoted to increase their knowledge and appropriate skills regarding Coding. Parents and pupils to find alternative ways for gaining the Coding skills outside the school. Universities and other community stakeholders to offer such opportunities through short term courses on Coding and use of Micro:bits for all interested pupils and teachers.

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# The impact of the 21st Century Schools Programme on enhancing digital education in coding in Serbia

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**Abstract:** This paper sets out the results of a research project evaluating the results of the British Council 21st Century Schools Programme in Serbia. The Programme was designed to upgrade digital education in primary schools throughout the country. It provided teacher training in coding using micro:bit, provided micro:bit devices to all schools, and engaged with policy makers and school leaders to reform the curriculum in conformity with the government's policy priority to upgrade the digital economy in the country. The Programme provided a boost to digital education in Serbia and transformed teaching by introducing the use of critical thinking and problem-solving techniques as a teaching method. The evaluation project was based on surveys in a sample of schools throughout Serbia, backed up by documentary analysis and in-depth-interviews with policy makers, teacher- trainers, school leaders and parents. Surveys were carried out with school leaders, teachers and pupils. The evaluation showed a strong impact of the Programme in Serbia and revealed the strong pressures on the education system in Serbia. While digital connectivity of schools is well developed (except in some remote rural areas), there is an absence of qualified teachers to teach IT skills. Due to the explosion of jobs in the IT sector in the country, and especially in Belgrade, IT professionals can earn many times more in private industry and new IT start-ups than they can earn in schools teaching computer coding. This may become a major impediment to improving digital education in Serbia and may cause a widening of educational inequalities in the country in the future.

**Keywords:** Digital Education, Micro:bit, Evaluation, Serbia

## 1. Introduction

In Serbia, school children have 8 years of compulsory primary education carried out in two educational cycles. Most subjects in the first cycle are taught by class teachers, while each subject in the second cycle is taught by a different subject teacher. According to the PISA 2018 survey, the quality of primary education is poor, and many children leave school without mastering basic competencies. To assist in raising teaching standards and introducing digital education in primary schools in Serbia, the UK government (as a contribution to the Berlin Process) financed a large educational programme in collaboration with the Serbian government, with the British Council as the implementing partner. The "21st Century Schools Programme" provided training to school leaders and four or more teachers from every school in Serbia. The Programme was implemented over five to six successive training cycles over a two-year period. In addition, training of IT teachers in the use of a small computer known as "Micro:bit" was delivered in the second half of the Programme, supported by the delivery of 35,450 Micro:bits to schools in Serbia, with each school receiving a minimum of 30 Micro:bits (depending on school size). During each Programme training cycle, school leaders and teachers received 2-3 days training in critical thinking and problem-solving teaching methods, school leadership training, while teachers teaching information technology related subjects ('IT teachers') also received training in coding using Micro:bit. School leaders were provided with guidance on establishing and running of coding clubs in their schools. The training programme for teachers covered practical application, mentoring and online resources to enable them to effectively teach coding skills in the classroom. IT teachers

were trained in applied physical computing using Micro:bit through a 12-hour online Massive Open On-line Course (MOOC) covering the basics of coding and physical computing and involving practical exercises. Once IT teachers passed the on-line training, they were required to cascade the training to their colleagues by demonstrating the use of Micro:bit in practical implementations of the cross-curricular approach to teaching coding. The training was followed by 12 weeks of practical implementation in the classroom, during which teachers and their pupils were assigned specific projects and provided with hands-on support by mentors during two site visits. The assigned projects involved the development and implementation of a cross-curricular project focused on using Micro:bits in a practical setting.

The Programme intervention came at just the right time regarding the needs of the education system and the education policy priorities in Serbia, as policymakers were prioritising improved digital education. Significant investments in school digital infrastructure were carried out: teachers were given laptops, all schools were provided with at least one digital classroom and internet connection, almost all schools were connected to the academic network supported by the government, and many schools were provided with other more sophisticated digital equipment. When the Programme started, the Ministry of Education Science and Technology Development (MESTED) had already begun to implement curriculum reforms including compulsory computer programming classes for all pupils aged 11-15. The Institute for the Improvement of Education put coding skills in the curriculum and provided mandatory training to teachers on computer programming. Therefore, the timing of the Programme intervention was well aligned with the education reform efforts and was supported in Serbia at the highest level of government. During the Programme implementation, in June 2021, MESTED adopted a new Education Strategy, which was part of an important strategic reform to make digitalisation a priority for the development of the country. The government recognised the importance of education in IT skills. In practice, at the start of the Programme MESTED included computer programming in teaching programmes for all pupils aged 10-15, and additional IT teaching content was provided in the new curricula by adding elective subjects that deal with coding and Micro:bit.

## 2. Methodology and limitations

The data for our evaluation of the British Council Programme was gathered through mixed research methods: quantitative research (surveys) of sampled school leaders, teachers and pupils, and qualitative research (In-Depth Interviews) with stakeholders: policy makers, NGOs, trainers, school leaders and parents. All schools started the Programme with training and mentoring over five successive cycles: the 1st cycle in Spring 2019, the 2nd cycle in September/October 2019, the 3rd cycle in January/February 2020, and so on. The schools from the 2nd and 3rd cycles were used to establish the baseline measurements at the beginning of the intervention in September/October 2019 and at the start of the 3rd cycle in January/February 2020 with an extension to September/October 2020 due to the COVID-19 pandemic school closures. The schools included from later cycles were used as a control group of schools, and baseline measurements on those schools were performed at the same time as for the 3rd cycle schools. The endline measurements were performed at the same time for all schools, in October 2021.

Sampling for quantitative research was done in a two-stage sampling procedure. In the first stage a sample of schools was chosen. It was composed of a Main School Sample (MSS) and a Control School Sample (CSS). After choosing the MSS and CSS schools, in the second-stage sampling procedure samples of teachers, pupils and school leaders were made. Due to COVID-19 disruptions in schools the sample size had to be reduced. While the initial plan was to include 15 schools in the sample, in the end only 12 schools were sampled (of which 9 were MSS schools). However, the pupil surveys took place in only 10 of those schools due to restrictions imposed by COVID-19 on school activities during the baseline. These 10 schools include 4 rural and 3 urban MSS schools, 1 urban and 1 rural CSS school, and 1 'sensitive' school chosen to reflect a special socio-economic issue in the local area. The sampled schools varied in size and performance across the urban-rural divide and within those two groups. The same sample of schools that was used in the baseline was also used in the endline. The sample design used the same school leaders, teachers and pupils at the

endline as at the baseline. In addition, qualitative research was carried out based on dozens of in-depth interviews with policymakers, NGOs, trainers, school leaders and parents, both at the baseline and at the endline.

### 3. The Research Results

In 2020, in response to the pandemic, a state of emergency was announced on 16th March 2020, and schools were closed on 17th March. All the educational content was made available through the free app “RTS Moja škola” for mobile phones and tablets. Teachers communicated with their pupils via internet or mobile phone apps. According to a survey carried out by ZUOV, the main problems related to distance education were lack of resources and technology for pupils (52.3%) and teachers (37.4%), an increased workload and stress during work from home (51.6%), and the low level of digital competences of pupils (33.5%) and teachers (25.3%)[1]. Many pupils in rural areas lacked an internet connection necessary for distance learning. A survey conducted by the Union of Education Workers of Serbia showed that at the end of the second semester, 10-12% of pupils did not have access to distance learning [2]. All this influenced the effectiveness of the BC Programme.

Using Micro:bit to teach coding should make teaching and learning easier both for teachers and pupils. First, coding on Micro:bit is easier than using a conventional computer programme. Secondly, whereas the previous teaching of coding had been done using codes that were written on the blackboard or on paper and rarely implemented in practice, the use of Micro:bit emphasised practical implementation which made teaching it easier, while also making pupils more interested and motivated to participate. While it may have been more difficult for the teachers to learn and implement this to begin with, after implementation both pupils and teachers were delighted to see that this new approach provided an easier and a superior learning experience. This was corroborated by our primary research findings from IDIs with teachers and parents. Some pupils became Micro:bit enthusiasts and pursued additional digital teaching available in the new primary school curricula (like Robotics), while others participated in domestic and international competitions. One of the reason the pupils liked using micro:bit so much was that “for the first time they could see the results of what they are learning right away, in practice”. Parents of the pupils who were taught coding on Micro:bit by knowledgeable IT teachers, even those whose children did not become Micro:bit ‘enthusiasts’, were delighted the public schools “are providing teaching in the same way as in the quality private schools”. Their children, who previously were often not motivated in school, developed a keen interest in coding after being exposed to practical of Micro:bit lessons, and some of them considered coding as a future career direction. Their parents also expressed a hope that a similar teaching approach would be applied in other classes as well.

However, in our sampled schools not enough pupils had exposure to sufficiently skilled IT teachers. In fact, the chief limitation to the effectiveness of the British Council Programme in teaching coding in primary schools was a lack of knowledgeable IT teachers. Both policymakers and school leaders identified this as the main impediment to teaching coding and improving digital competences of primary school pupils. There is a serious shortage of IT skills on the job market in Serbia [3], and the low wages for teachers (including IT teachers) compare adversely to the high wages for IT experts elsewhere in the economy.

### 4. Conclusions

The British Council 21<sup>st</sup> Century Schools Programme intervention came at just the right time to meet the needs of the education system and the education policy priorities in Serbia. According to the Serbian policymakers, the Programme was fully aligned with the government’s strategic approach to the development of the education system. The government recognised the importance of digital education, and in particular the development of digital skills. From the start of the Programme, improvements took place in the enabling environment for teaching coding in schools. More coding content was included in the curricula and an online Micro:bit teacher training course and three textbooks tailored to the Serbian curriculum were developed by

the British Council in cooperation with a local NGO. These were accredited by MESTD and remain in Serbia to be used freely by teachers and pupils. In parallel, the IT infrastructure was improved with new computer hardware and improvements to Internet access for schools.

However, there the Programme did not lead to much improvement in teachers' confidence to teach coding. This was partially due to the fact that IT skills were in great demand on the Serbian labour market and there was a lack of knowledgeable IT teachers in the schools. Fortunately, the lack of good quality IT teachers was quickly identified by the British Council, and they developed a new online teacher training course for Micro:bit which, together with appropriate teaching materials, was well-suited to the Serbian curriculum and the background knowledge of teachers. The results were immediately visible in those schools in which teachers had been trained using the new online course, since the confidence of the teachers and pupils' knowledge began to develop quicker there. Those teachers and schools that embraced the Micro:bit and completed the new online Micro:bit training course delivered amazing results with their pupils. The pupil experience was so positive that those who learned how to do it gained new confidence and appreciation for coding. The reason they liked it so much was that "for the first time they could see the results of what they are learning right away, in practice". The parents found that using Micro:bit in class transformed their children's learning experience; they began to really enjoy school and take more Micro:bit-related subjects. Parents said that finally "their children can learn the same way as in quality private schools" and that they wished the state schools had more subjects with a similar approach to learning. Comparing baseline to endline evaluation results showed that there had been an overall improvement in the indicators relating to pupils' coding skills of pupils. Primary data from the endline pupil survey showed that for MSS pupils the filtered pupils' self-evaluation score had increased by almost 9% since the baseline. For pupils in 5th and 6th grades at the baseline and who were in 7th and 8th grades at the endline, the increase in the filtered coding score was 43%. This improvement may be attributed not just to the Programme but also to the introduction of coding in the curricula for all pupils in grades 5-8.

In conclusion, I would like to make one main recommendation for Serbian policymakers. This is that they should encourage all Informatics teachers, as well as Technics and Technology teachers to pass the Micro:bit online course within the next couple of years. Since teaching coding on Micro:bit is in fact easier than any other option, this will have an effect not only in improving teachers' skills, but also in helping them gain confidence and the respect of their pupils, which will then in turn increase their confidence. Together with the available textbooks that have been prepared in line with the Serbian curriculum this is a sure way to quickly achieve a substantial improvement in the overall IT skills of Serbian school teachers.

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# Digital Skills Development in Kosovo Schools: Impact of Capacity Development of Teachers' Coding Skills

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**Abstract:** Measured with PISA test and World Bank, the quality of education in Kosovo remains a challenging aspect to be addressed. Despite capacity developments of teachers, results from PISA indicate that pupils in Kosovo lack critical and problem solving skills. Recognising these deficiencies, the British Council Programme provided training on critical thinking and problem skills, which also included training in coding using Micro:bits. This paper evaluates the impact of training on coding skills in Kosovo schools. The survey was carried out with 8 schools, totaling 63 teachers and 548 pupils-surveyed in 2019 (baseline) and 2021 (endline). Evidence suggests that the Programme was effective, making a coding a compulsory component within Grade 8 and 9 and there are plans to integrate it in Grade 7 and 8 and coding clubs established in all schools. The Micro:bit devices have been used in coding clubs but with limited coverage of pupils. Digitalisation is one of the key pillars in Kosovo National Development Strategy 2030 and Kosovo Education Plan 2022-2206. Kosovo has the highest internet penetration in the region, with 96% of households having internet connection in 2021. This is an important precondition for developing digital skills needed for education and work.

**Keywords:** *Digital Skills; Capacity Development; Coding; Education.*

## 1. Introduction

Kosovo maintains a high level of participation in primary and lower secondary education, compared with other European countries (KESP 2017-2021) with a low drop-out rate. The quality of education in Kosovo remains a challenging aspect to be addressed. According to a recent study by the World Bank<sup>18</sup>, a child who starts school at age 4 in Kosovo can expect to complete 13.2 years of school by her eighteenth birthday. However, when factoring in what children actually learn, the expected years of schooling decrease to only 7.9 years, which means there is a learning gap of 5.3 years. According to the 2018 Programme for International Student Assessment (PISA) as many as 79% of 15-year olds failed to reach a minimum level of skill in reading compared to 23% of pupils in OECD, while 77% failed to reach a minimum level in mathematics (24% in OECD), and 77% failed in sciences compared to 22% in OECD countries. These results have placed Kosovo in third place from the bottom in the international league table. School capacity building in managing quality started in 2016, following the approval of Quality Assurance Framework in the Pre-university Education Institutions in Kosovo (KEEN, 2019). In 2020, the Ministry of Education, Science, Technology and Innovation (MESTI) approved the Administrative Instruction (AI) No 106/2020 on "The Performance Evaluation of the Principal and Deputy Principal of the Pre-University Public Educational and Training Institutions".<sup>19</sup> The quality of teaching and learning is one of the professional practice standards in the evaluation of school

<sup>18</sup> World Bank press release: <https://www.worldbank.org/en/news/press-release/2020/09/16/kosovo-human-capital-index-lower-than-regional-average-but-higher-than-the-average-for-its-income-group-says-world-bank-report>

<sup>19</sup> <https://masht.rks-gov.net/uploads/2020/10/20201013131849347-rotated-1.pdf>

principals and deputy principals. This new AI may incentivise school management to make more effort to enhance the quality of teaching and learning at the school level.

The paper is structured as follows. Section 2 outlines the utilized methodology, Section 3 discusses findings from evaluation of the performance of the 21<sup>st</sup> Century Schools Programme is presented, responding to key evaluation questions: relevance, effectiveness, efficiency and sustainability. Section 4 provides summarizes key findings and lists key recommendations.

## 2. Methodology

All schools started the Programme implementation with BC training and mentoring over five successive cycles: the 1<sup>st</sup> cycle in Spring 2019, the 2<sup>nd</sup> cycle in September/October 2019, the 3<sup>rd</sup> cycle in January/February 2020, and so on. We used schools from the 2<sup>nd</sup> and 3<sup>rd</sup> cycles to establish the baseline measurements at the beginning of the Programme intervention in September/October 2019 and at the start of the 3<sup>rd</sup> cycle in February/March 2020. We used schools that were to be included in later cycles as a control group of schools as explained below. The endline fieldwork was performed on the same set of schools in *October 2021*. Altogether 8 schools were surveyed. Sampling was done separately in a two-stage sampling procedure. In the first stage a sample of schools was chosen. It is composed of a Main School Sample (MSS) and a Control School Sample (CSS). The MSS includes the schools participating in the 2<sup>nd</sup> and 3<sup>rd</sup> cycles of the BC Programme. The MSS was drawn randomly from two segments: urban and rural. The CSS comprised matched schools that were expected to be in the 5<sup>th</sup> or 6<sup>th</sup> cycles. However, one of the CSS was not included in the BC project. The sampling procedure used was PPS (Probability Proportional to Size), where the probability to choose a school was directly proportional to the number of pupils within that school. The PPS approach was chosen because the main aim has been to measure results on 10-15-year-old pupils, while choosing schools using PPS allows our sample to provide best representation of an average pupil.<sup>20</sup> In the MSS, 2 rural and 4 urban school were surveyed. The geographic distribution of schools in the sample was pre-determined by the geographic distribution of the schools in the respective Programme cycle. The sampled schools vary in size and performance across the urban-rural divide and between those two groups. In addition, a school in an area of potential social conflict was selected to contribute to an understanding of the impact of the BC Programme on primary education in such areas but due to COVID-19 situation the school was not covered in the final sample. After choosing the MSS and CSS in each country, in the second-stage sampling procedure the Teacher Sample, the Pupil Sample and the School Leader Sample were drawn within the sampled schools. The same sample of schools was approached for the Endline Study. It is important to note that one of the CSS schools was not trained by the BC (the explanation provided by BC is that the school is new and not yet registered at Municipal Education Directorate and MESTI).

## 3. Evaluation findings

Based on discussions with teachers and school directors and observations during two trainings, the MEST representative stated that training has been highly appraised by teachers, and it is a well-designed and very practical one. It was noted that it would be desirable for the BC to extend the project and increase the number of teachers to be trained. At the country level 2,495 teachers from Grades 6-9 were trained in CTPS through the BC training for the 21<sup>st</sup> Century Schools Programme. The BC training instructed teaching staff in new techniques and in a larger set of activities that teachers can use in their classrooms. Teachers were also interested to further develop their professional skills in CTPS teaching methods. The Endline Survey results

<sup>20</sup> In PPS procedure each school is assigned weight proportional to the number of pupils in that school, and then the random sample is taken from such "weighted" population, it provides the best representation of an average pupil. This allows that in the second stage, when sampling pupils, each pupil still has an equal chance to be chosen as it had in the original pupil population. This would not have been the case if in the first stage we just sampled schools randomly within each segment, so that each school has equal chance to be chosen, because this would lead to overrepresentation of pupils from smaller schools in the second stage sampling of pupils.

show that school principals in MSS schools slightly agreed that teachers use Micro:bits regularly in their teaching, scoring this at 2.33 while the school principal in the CSS school fully agreed that teachers use Micro:bit in their teaching. In the MSS schools, 12% of the teachers used Micro:bits in up to 25% of their classes, 6% used it in 25-50% in their classes and only 3% of teachers used Micro:bits in 50-75% of their classes and 79% have not used it at all. However, on a scale from 1 = not useful to 10 = very useful, the average score for the usefulness of Micro:bits was reported by teachers at 6.0 in MSS and 7.00 in CSS schools. The COVID-19 restrictions in the form of school closures, shorter teaching hours and restrictions for group work have deterred teachers from using Micro:bits in their classes. The interviewed IT teachers stated is that they had not yet reached the coding week in the school timetable as set out in the curriculum. Pupils with some coding background were more active in coding clubs. The Pupil Endline Survey showed that in the MSS, 12.6% of pupils were members of a coding club (11.8% of boys and 13.4% of girls) compared to only 6.9% of pupils in CSS schools. Some 12% of MSS pupils reported that they use Micro:bit skills outside the school, compared to 7.4% of CSS pupils. Use of Micro:bit at home or access to it elsewhere outside school is also not very common and reported by only 8.8% of MSS pupils and 4.1% of CSS pupils. There is some contraction between pupils' responses and those from teachers and school principals. Information collected from teachers indicates that due to short time available and COVID-19 restrictions, Micro:bit has mainly been used within coding clubs, which are established and active in all participating schools and integrated in regular teaching classes by IT and other teachers.

When re-interviewed, out of 9 IT teachers only one had taught coding in regular classes.

#### 4. Conclusions

The Programme is highly relevant to Kosovo. It developed CTPS skills of teachers, contributing to CTPS skills of pupils. This is expected to improve Kosovo performance in PISA tests and support pupils' advancement in education. For the first time, the Programme introduced coding as a CTPS technique to all teachers. This is an important step towards digitalisation on teaching, which is one of the aims of the Kosovo Education Strategic Plan 2022-2026. The Programme has been highly effective. Most project outcomes and outputs have been successfully achieved, with a few exceptions. Supported by the Programme, coding is now a compulsory component within Grade 8 and 9 and there are plans to integrate it in Grade 7 and 8. School leaders actively support the implementation CTPS and coding skills at school level across the curricula. Almost all trained teachers use CTPS in their teaching and all teachers regularly use and integrate CTPS teaching techniques in teaching and lesson plans. The Micro:bit devices have not been actively used by teachers in their classroom practice but have been used in coding clubs. Coding clubs have been established in all trained schools and were active at the endline survey. However, few pupils have so far participated in coding clubs. The Programme has not been delivered in an efficient manner. In some schools, school leaders and teachers had contributed financially to purchase necessary equipment and materials for coding activities in the Coding Club. While showing commitment it also reveals that insufficient resources were available within the school system to enable the effective deployment of the BC Programme. The Programme has some chance of being sustainable in the future. As a result of the Programme, teachers and school leaders recognise coding/programming as a teaching technique that can be used in all subjects. Before the BC Programme it was thought that coding can be taught only by IT teachers. After the BC Programme, it is likely that coding will become an integral part of teaching. The role of coding clubs is crucial to expanding pupil participation in coding, and encouraging the active support from teachers. The MESTI has accredited the CTPS and coding training programme developed by the BC, and teachers gain 32 hours for relicensing. This is an important achievement from the BC project and there is commitment from the Ministry to expand training provision to all teachers. Key enabling factors to the success of the BC Programme have been the close cooperation between Programme and MEST, the integration of coding in Curricula for the 8<sup>th</sup> and 9<sup>th</sup> grade, the availability and support from school principals, the interest from teachers for expanding knowledge and skills, the increased relevance of IT among pupils, the establishment of coding clubs and competition activities that incentivised

teachers and pupils to work in projects. Key hindering factors to the success of the BC Programme have been the COVID-19 restrictions, the overload of teachers in Kosovo with trainings, the lack of appropriate qualifications of some IT teachers who used to teach a subject that was not related to technology, the lack of IT infrastructure at the school (computers, internet), the lack of financial resources for consumables that are needed to develop projects of coding clubs, the lack of motivation and resistance to change by some teachers and the lack of a follow-up plan to make sure that skills gained are used, particularly with regards to coding. Key recommendations stemming from this evaluation are the following:

- School directors should more carefully select teachers for trainings, to identify motivated and committed teachers who have capacities and willingness to learn but also to pass knowledge and skills to their peers;
- More focus with children with special needs need to be devoted in future trainings. Little effort is put into exploring the interests of children with special needs;
- Competition activities on coding should become a regular activity across all schools. This will incentivise teachers and pupils to explore the new opportunities that Micro:bits allow;
- Projects developed with coding could be stored into a package by subject, so teachers in all schools can learn from successful projects;
- The new AI on school professional development enables schools to organise trainings within the school. The training material is available, for further training in the future.

# ICT in Teaching and Learning Process in Albania

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**Abstract:** The world is characterized by many changes, some of which have come from the rapid development of information and communication technology (ICT). The use of ICT during the teaching and learning process has become a necessity for teachers in Albania. The purpose of this paper is to analyse how much technology has the power and potential to transform the teaching process, how much it affects the success of teaching, as it creates opportunities for students to learn and collaborate with each other, through the exchange of ideas and experiences, as well as solving common problems. In this context the article is based on the literature study on the importance and the way of integrating technology into the classroom during teaching and learning process. Given this background the main findings of this paper focus on the fact that when teachers in Albania are asked if they integrate technology in their subjects they give numerous answers such as: *I use the computer in the classroom to reinforce the issues I have explained, students use the computer to find information, my students use the word to do their homework, use powerpoint to make presentations in class. Are these examples of technology integration? ... Technology does not guarantee useful teaching-learning, and even its inappropriate uses can make learning more difficult. Four questions help the teacher to determine the merits of technology in a lesson or in a given situation: Is the learning content valid? Are the learning outcomes clear, related to the competencies and levels of student achievement? Do the selected learning activities engage the student? How much has technology improved learning so that without it it would not be possible?* As part of the findings in Albania, ICT can offer teachers a range of tools to enrich the content of the lesson or to provide ways to make the transfer of knowledge to students more enjoyable. During this year in Albania, great priority was given to the preparation of students with digital skills, including coding. We consider it important to express our findings in this conference.

**Keywords:** *Digital Transformation; ICT; Coding; Capacity Building; Preuniversity Education.*

## 1. Introduction

The world is characterized by many changes, some of which have come from the rapid development of information and communication technology (ICT). The use of ICT during the teaching and learning process has become a necessity for teachers in Albania. The purpose of this paper is to analyse how much technology has the power and potential to transform the teaching process, how much it affects the success of teaching, as it creates opportunities for students to learn and collaborate with each other, through the exchange of ideas and experiences, as well as solving common problems. In this context the article is based on the literature study on the importance and the way of integrating technology into the classroom during teaching and learning process.

Given this background the main findings of this paper focus on the fact that when teachers in Albania are asked if they integrate technology in their subjects they give numerous answers such as: *I use the computer*

in the classroom to reinforce the issues I have explained, students use the computer to find information, my students use the word to do their homework, use powerpoint to make presentations in class. Are these examples of technology integration? ... Technology does not guarantee useful teaching-learning, and even its inappropriate uses can make learning more difficult. Four questions help the teacher to determine the merits of technology in a lesson or in a given situation: *Is the learning content valid? Are the learning outcomes clear, related to the competencies and levels of student achievement? Do the selected learning activities engage the student? How much has technology improved learning so that without it it would not be possible?*

## 2. Development of ICT in Albania

As part of the findings in Albania, ICT can offer teachers a range of tools to enrich the content of the lesson or to provide ways to make the transfer of knowledge to students more enjoyable. During this year in Albania, great priority was given to the preparation of students with digital skills, including coding. We consider it important to express our findings in this conference. Digital competence is one of the main objectives of the 2021-2026 education strategy. "*Development of digital competence through better use of information and communication technology for teaching and learning*". The main objectives in this field are:

- Creation of appropriate infrastructure for the use of ICT in schools and its maintenance.
- Development of digital competence through the increased use of ICT in all subjects at all levels of education starting from the first grade of basic education.
  - *Inclusion of digital competence in teacher standards.*
  - *Making students aware of Internet security.*
  - *Determination of standards for achieving digital competence according to the format of the European Union.*
  - *Inclusion of lower and higher secondary education students in the national coding program.*
  - *The inclusion of digital competence through information and communication technology from the first grade of basic education.*
- Providing quality ICT services for the pre-university education system
  - *Contracting internet service for schools.*
  - *Designing the methodology for online learning*

The mastery of coding skills and digital competence at a young age is one of the most priority areas of the design and creation of educational policies around the world, including our country. National reports show that more and more special importance is being given to the integration of coding skills from an early age in school with the aim of creating an efficient society that can more successfully cope with the demands and changes that this market and the economy in the following decades. The Albanian government is making many efforts and investments in this aspect, starting from curricular changes such as: changing the subject programs, making it possible to introduce the concepts and notions of coding from the early grades, as well as investments, which aim to create a technologically innovative society. The ICT program for the first grade is designed on the basis of creating students' digital knowledge and skills from an early age, respecting the age framework and the initial level of knowledge that these students possess. The ICT program in the first grade develops the main field and competencies through 4 main topics:

- ✓ Topic: The computer world
- ✓ Topic: Introduction to multimedia
- ✓ Topic: Computational thinking and coding
- ✓ Topic: Safety of working on the computer

The development of the training of teachers, who will teach the ICT subject for the first time in the first grade, has been developed and followed by the Albanian-American Development Fund. During the dates September 12, 2022 - September 16, 2022, the training of 23 teachers was carried out, between the British expert. The purpose of this training was to prepare teachers, who will serve as trainers throughout the continuity of training with other ICT teachers. During these sessions, teachers were introduced to the structure, content and

organization of the ICT program, along with the methodological approaches they should take into account during the lesson explanation.

At the end of the training process, all teachers underwent a test, to see the level of knowledge absorption from this training but also to identify the teachers with the highest performance.

To help the work of the teachers, the interministerial working group has drawn up the "ICT teacher's manual for the first grade". This manual has been drawn up to help the teachers, who will develop the ICT subject in the classroom first, providing important information regarding the content and structure of ICT program development for this class.

Currently, the working group is also finalizing a manual for students in the form of a workbook, where students can work independently and reinforce the knowledge gained in class.

Referring to the education framework for the development of digital competence, the ministry has continued the training of ICT teachers related to various topics on the work and organization of professional networks, including the use of ICT in curriculum implementation and student assessment. The trainings aimed at the professional development of ICT teachers for the safe and efficient use of online platforms in the teaching process have also continued.

- In this framework, about 8,200 teachers were trained for the use of online platforms in the teaching process.
- Training of 1,200 professional network managers on ICT subject innovations, programming languages, as well as the use of the digital platform.
- Creation with MOODLE of the platform for free online training for the professional development of educational workers with a focus on critical thinking, problem solving and coding.
- Drafting the manual and creating video-tutorials to facilitate access to the portal and the use of portal data.
- Realization of 30 tutorial videos to help high school teachers in the implementation of programming languages such as: JAVA, HTML, ADOBE FLASH, as well as algorithms.
- Making short videos and posters by students for students in the context of cyber security at school.
- Raising awareness of high school students through videos created by them, regarding cyber security.

UNICEF's "One Click Away" study shows that one in four children reported having at least one online contact with someone they've never met face-to-face, and nearly 2 in 10 children reported meeting someone in person with whom they have only had contact with on the Internet. Only a small proportion of children are disturbed by these face-to-face meetings. Cyberbullying was reported by less than 1 in 10 children, but this figure is likely an underestimate, given the high levels of face-to-face bullying. When something unpleasant happens to them online, children prefer to seek support from their peers and are reluctant to talk to teachers or childcare professionals. It is worth noting that few children (only 2.9%) are willing to talk to teachers or someone else responsible for child support (0.6%). This is an important finding that has two possible explanations:

- The general environment in the school and the children's trust in other staff is not ideal.
- Teachers and other employees are not seen by children as people who can help them with personal problems on the Internet.

On the other hand, the UNICEF study "Webfactor" underlines that teachers need to receive more updated information related to the protection of children in the online space, because they do not feel sufficiently prepared to deal with cases of violence against children in the space online, and do not know how to support children if they are exposed to inappropriate material online or where to report such cases. Also in implementation of the EU recommendation (Council Recommendation of 29 November 2021 on blended learning approaches for high quality and inclusive primary and secondary education OJ C 504, 14.12.2021, p. 21–29), the education approach is being piloted in our country combined in 4 schools of the country. Blended learning (also known as hybrid learning) is a teaching approach that integrates technology and digital media with teacher-led classroom activities, giving students more flexibility to personalize their learning experiences. In this framework:

- The guide "Implementation of combined education in pre-university educational institutions" was drawn up, the definition of the concept "Combined education", its importance, advantages and disadvantages,

the principles of combined education, the models of combined education, the special and the common between models, organization and learning environment during combined learning, planning lessons with combined education; the model of adapting the daily plan for two consecutive hours, the role of local educational units, the educational institution, the management staff and teachers during the implementation of combined education, the assessment of the student during combined education, the school-family-community partnership.

- The training module "Implementation of combined education in pre-university educational institutions" was designed and accredited, which deals with: combined education, types of combined learning, models of combined learning, planning of combined learning, examples, use of software in blended learning, the importance of digital skills in the learning process.
- 101 teachers and leaders of pilot schools were trained for the implementation of combined education.
- They have been implemented in practice with concrete lessons by the teachers of the pilot schools.

### 3. Conclusion

*"Developing digital competence through better use of information and communication technology for teaching and learning"*. This is the vision in the education strategy for which the Ministry of Education and Sport is working in the future. In order to achieve it in the most qualitative way, the challenges are: the creation of suitable infrastructure for the use of ICT in schools and its maintenance, investment for the addition of digital equipment in schools, the development of digital competence through the increased use of ICT in all subjects at all levels of education starting from the first grade of basic education with coding skills, the inclusion of digital competence in teacher standards, the definition of standards for the achievement of digital competence according to the European Union format, priority is blended learning approach.

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**PARALLEL SESSIONS PAPERS  
PRESENTATION**

**SESSION 1**

**SHAPING THE FUTURE – TRENDS  
SESSION CHAIR: PROF.DR.  
VIJAYAKUMAR VARADARAJAN**



# An Advanced Approach to Analyze Various Internet Metrics: A Case Study

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**Abstract:** According to ISOC reports, IPv6 deployment continues to increase around the world. Nowadays, IPv6 growth is increasing exponentially thanks to its new features: more efficient routing, a huge number of IP addresses, more secure end-to-end connectivity, high quality of service, easy network configuration, etc. According to RIPE NCC website IPv6 address statistics on 7 October, 2022 IPv6 address statistics for Albania (AL) (in /32 blocks) by the quantity of addresses, sorted. The total number of IPv6 addresses is 501 while the total number of addresses is 347392 [1]. Any internet network's QoS and performance are based on the monitoring of various internet indicators throughout time. For instance, average connection speed, network infrastructure, and IPv6 (readiness, enabled networks, allotted prefixes, penetration). This study's goal is to track the evolution of various internet measures in Albania. Analyze and debate the outcomes, highlighting the difficulties and limitations. Finally, the goal of this study is to encourage further investment in this industry by experts and internet service providers. The main recommendation in this study to the telecommunication and IT decision makers is to use widely the IPv6 addresses and minimize utilization IPv4 due to the huge benefits as mentioned above.

**Keywords:** IP; IPv4; IPv6; Comparison; Analysing; Fixed environment

## 1. Introduction

IPv4 is an abbreviation for Internet Protocol version 4. It is the underlying technology that allows us to connect our devices to the internet. When a device connects to the Internet, it receives a unique numerical IP address, such as 99.48.227.227. To send data from one computer to another via the web, a data packet containing the IP addresses of both devices must be transferred across the network.

More than ten years ago, the majority of networking suppliers stopped manufacturing any new data networking systems based on IPv4 for several reasons. The most important reason is the limitations of IP addresses. IPv6 is the next-generation Internet Protocol (IP) address standard that is intended to supplement and eventually replace IPv4, which is still used by many Internet services today. Every computer, mobile phone, home automation component, IoT sensor, and other Internet-connected device requires a numerical IP address to communicate with other devices. Because of the proliferation of connected devices, the original IP address scheme, known as IPv4, is running out of addresses [2].

IPv4 will be unable to assign Internet Protocol (IP) addresses to this rapidly expanding networked society. In 2019, IPv6 is expected to replace IPv4 and become the standard Internet protocol. This paper compares IPv4 and IPv6, as well as the role of IPv6 in the future scenario of a growing connected society [3].

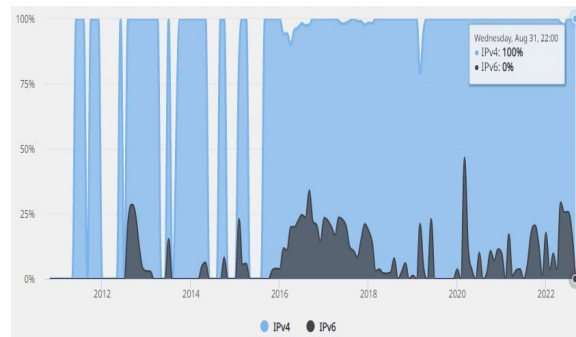
Digital networks are being introduced gradually, and many industries now rely on Internet Protocol to provide direct connectivity to customers at any time and from any location. IP is now used in critical areas

such as video control, telemedicine, the Internet of Things, digital payments, telepresence, and so on. The features, services, and performance of the two protocols, Internet Protocol version 6 (IPv6) and Internet Protocol version 4 (IPv4), can be distinguished. Nowadays, communication companies are experiencing IPv4 exhaustion and the transition to IPv6. IPv6 addresses are more numerous than IPv4. IPv6 has 128 bits, while IPv4 has 32 bits. IPv4 is not inherently more secure than IPv6 [4].

IPv6 is currently incompatible with IPv4 in large-scale applications. Between IPv6 and IPv4, there are three types of transition technologies: dual protocol stack technology, tunnel technology encapsulated by IP datagram technology, and transparent conversion technology. Using the enterprise network application as the object, compare the relevant configuration schemes, simulate the protocol transition technology in the scheme construction, allocate IPv6 addresses on the line, discuss IPv6 security technology, and realize the IPv4 and IPv6 transition under the enterprise network architecture [5-6].

Many of the problems encountered by Internet Protocol v4 are thought to be solved by Internet Protocol v6 [7].

The following part is illustrating some statistics about IPv4 and IPv6 in Albania [8].



**Figure 1.** Overall IPv6 and v4 protocol support in Albania [1]

The graph demonstrated in Fig. 1 shows the changes in Albania's average bandwidth, v6 address types, and default protocol over time. They are created and updated monthly using information gathered by the [ipv6-test.com](http://ipv6-test.com) connection test page. For all of our connection tests, this graph compares the development of IPv6 support with IPv4 support. Since the figures are percentages, we may anticipate that practically all hosts will support IPv4 while IPv6 will only slowly gain.

## 2. Internet Usage

All statistics indicate that the population of Albania has been decreasing gradually since 1990 until nowadays. For example, the population in 1990 was 3,286.03 [9] while the Albanian population on 31 July 2022 is 2,872,758 habitants, a ~ 0.43% growth rate decrease. [10]. Facebook on 31 December 2018 was 1,400,00 and on 31 July 2022 is 1,888,600 users.

**Table 1.** Internet And Facebook Usage In Albania In 2019 And In 2022 [11]

Country	Population	Internet Users	Penetration (% Population)	Users % in Europe	Facebook
Albania in 2019	2,938,428	2,160,000	73,5	0.3	1,400,000 In 31 Dec. 2018
Albania in 2022	2,872,758	2,191,467	76,3	0.3	1,888,600 In 31 July 2022

\*Source: <https://www.internetworldstats.com/europa2.htm#al>

### 3. Results and Discussion

#### 3.1. IPv6 Readiness: IPv6 Enabled Networks

This graph shows the percentage of networks (ASes) that announce an IPv6 prefix for all countries and Albania. The graph shows that in 2012 IPv6 enabled networks started to increase in the form of wobbling until the end of 2015.

On 1 July 2016, the graph has risen until reached 30,95% (13 out of 42 Ases). Then it started decreasing until reached 27,27 on 1 June 2020 as demonstrated in Fig. 2.

We took all BGP table dumps from the Routing Information Service (RIS) for each date we sampled and counted the percentage of ASes that announced an IPv6 prefix relative to the total number of ASes in this routing table. We removed routes that appeared in fewer than ten RIS BGP feeds.

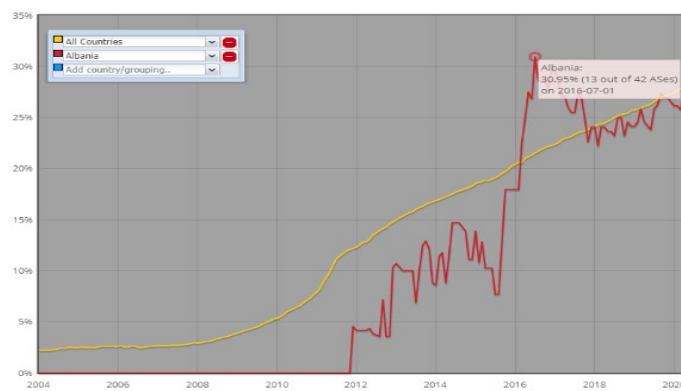


Figure 2. IPv6 Enabled Networks in all countries and Albania [12].

#### 3.2. IPv6 Allocated Prefixes and Penetration in Albania

Figure 3 shows the IPv6 Allocated Prefixes in Albania started on 2nd February 2011 for three categories:

- Allocated as introduced in the red curve
- Allocated and announced individually as demonstrated in the green curve, and
- Allocated and alive as shown in the blue color curve. The prefixes are Less than or equal ( $\leq$ ) /48.

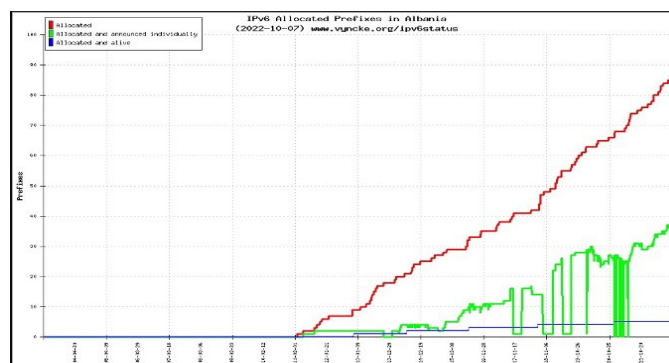


Figure 3. IPv6 Enabled Networks in all countries and Albania [13].

Figure 4 introduces the IPv6 users' Penetration in Albania as measured by Akamai (red curve), APnic (green curve), and Google (blue curve).

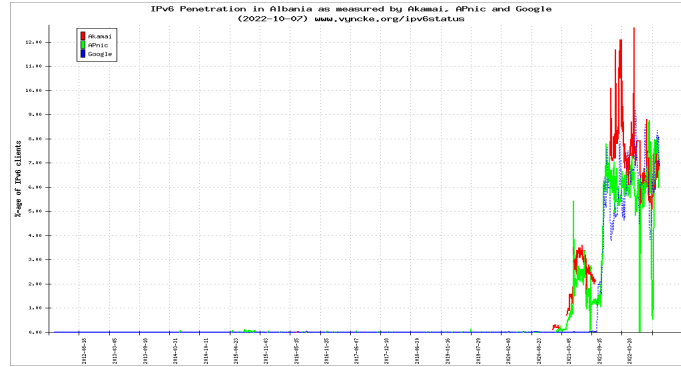


Figure 4. IPv6 Penetration in Albania as measured by Akamai, APNc, and Google [14].

## 4. Albania's Mobile and Fixed Broadband Internet Speeds

### 4.1. Mobile Environment

The speed test Global Index rankings are based on median download speed to best reflect the speeds that a user is likely to achieve in a market.

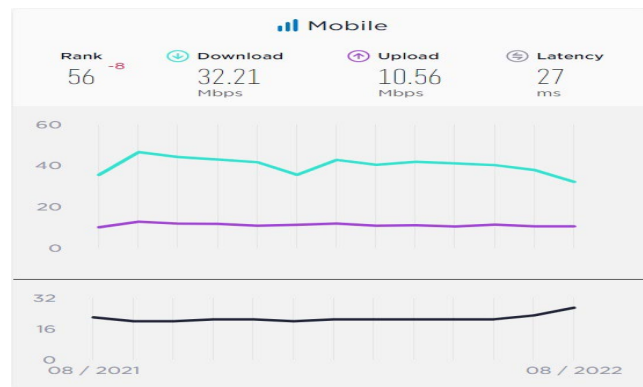


Figure 5. Albania Median Speeds for Mobile, August 2022 [15].

Source: <https://www.speedtest.net/global-index/albania>

Figure 5 shows Albanian speeds for the mobile environment.

The rank is 56. The sign (-8 in red) means down 8 places since last month, July 2022. The download is 32.21 Mbps (the download speed is decreased), the rank is 56 in August 2022 and the maximum speed indicated in the curve 46.65 Mbps is in September 2022, and the rank is 34 while the upload speed is increased and looks like saturated with 10.56 Mbps and the maximum upload speed is in September 2021 with the rank is 34 and upload speed is 12.83 Mbps. In the same figure, the latency is 27 ms jitter 7 ms and the minimum latency is 20 ms, jitter 7 ms in January 2022 with rank 47.

### 4.2. Fixed Broadband Environment

The rank is 98. The sign (-6 in red) means down 6 places since last month, July 2022. The download is 33.67 Mbps (the download speed is decreased), the rank is 98 in August 2022 and the maximum speed indicated in the curve is 39.46 Mbps in June 2022, and the rank is 88 while the upload speed is increased and looks like saturated with 14.81 Mbps and the minimum value of upload speed is in February 2022, 10.19 Mbps with the



rank is 86. The latency is 7 ms in August 2022 and jitter is 7 ms and the maximum latency is 11 ms, jitter is 5 ms in October 2021 with rank 89 as demonstrated in Fig.6, black curve.

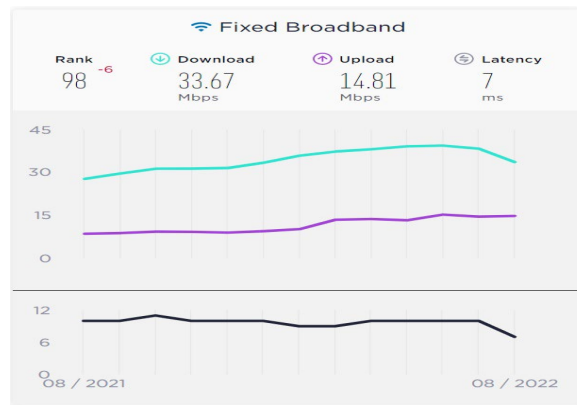


Figure 6. Albania Median Speeds for Fixed Broadband, August 2022 [15].

### The challenges and obstacles are:

- Weak infrastructure in some cities.
- Slower economic growth.
- Quality of service in fixed and wireless IP networks challenges.
- Awareness.

### Key benefits to IPv6 include [16].

- There will be no NAT (Network Address Translation).
- Auto-configuration.
- There will be no more private address collisions.
- improved multicast routing.
- A more straightforward header format.
- Router simplification and efficiency.
- The true quality of service (QoS), also known as "flow labeling," is a technique for determining the value of a service.
- Integrated authentication and privacy protection.
- Options and extensions that are adaptable.
- The administration is simplified (no more DHCP).

## 5. Analyzing

Raising IPv6 awareness in the scientific community and incorporating IPv6 into university curricula. Organizing extensive trainer training, providing IPv6 literature to Albanian-related colleges, and hosting several IPv6 seminars. It has become necessary to establish an IPv6 training center in Tirana under the supervision of RIPE NCC. Activate the Telecommunications and IT Regulation Authority's role in dealing with internet service providers using uniform regulations and standards. Take advantage of other countries' experience in this field during the transition process to avoid any technical issues that may arise and to suggest an appropriate schedule time for migration scenarios from IPv4 to IPv6. Persuade decision-makers that the development of Albania's internet sector means economic growth, and reserve IPv6 addresses for the education sector.

## 6. Conclusion and Future Work

In the proposed approach, we concentrated on various internet metrics from a variety of reliable sources. Unfortunately, we could not obtain related data on this topic from the relevant authorities in Albania. The aforementioned measurements keep tabs on several facets of IPv6 implementation on the global Internet. The various metrics provide diverse perspectives on the issue of how widely IPv6 is being used on the worldwide Internet. In addition to some technical aspects that were not covered in this paper, social and economic issues should be investigated further in future work. The migration scenarios from IPv4 to IPv6 transition mechanism and proposed scenarios for fixed and mobile environments and proposed implemented phases are one of our future work. One of the proposed scenarios we can recommended is a dual stack IPv4/IPv6 backbone. Show that the dual stack is appropriate for ISPs, business networks, and home users. Finally, we introduced a technical analysis of this study in order to make it easier for readers to find what we have reached in an easy and simplified way.

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# An Ecosystem to Support Digital Transformation

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**Abstract:** The arrival of the new technologies brought by the 4th industrial revolution and the digital transformation required by companies is no longer new. However, when companies are small-sized, quite frequently are lacking the resources, time or even competencies to do it by themselves. Universities in a two-way (University-Industry collaboration) or a three-way partnership (Triple Helix) can and should take a leading role in supporting the adaptation and development of these companies. The present paper aims to analyse an example of a triple helix model implemented in the region of Tâmega e Sousa. In this case, we aim to analyse the School of Management and Technology (Porto Polytechnic) and its relations with the local government and industry. To meet the objectives for this work was combined the use of two qualitative methods, the case study and an autoethnographic analysis. As main results, it can be said that the creation of units that are aligned with the university's third mission, and from the projects that have been implemented, both the university-industry collaboration and the triple helix model are identified among these stakeholders. It is important to refer that some of the projects or actions that have been practiced by these stakeholders can be replicated in other regions.

**Keywords:** *Digital Transformation; Triple-Helix; University-Industry; Tâmega e Sousa.*

## 1. Introduction

Digital transformation is redefining businesses across the world [1]. But the new challenges brought by the digital era and the 4<sup>th</sup> Industrial Revolution that companies and society are facing are not unknown. For a long time, that innovation requires the engagement of public and private stakeholders [2], [3].

Coordinated efforts from companies, universities, and governments may create synergies and bring advantages for all of them. A frequent concept that arises when we are talking about innovation is The Triple Helix Model. It states that universities can play an enhanced role in innovation in increasingly knowledge-based societies. Universities can be expected to remain the core institutions of the knowledge sector once teaching is its comparative advantage, when linked to research and economic development [4]. Universities' mission in supporting knowledge transfer, innovation and (technological) development assumes greater importance when located outside the metropolitan areas [5].

This paper aims to present and discuss an ecosystem of innovation created by the School of Management and Technology aiming at the promotion of digital transformation in the region of Tâmega e Sousa (Portugal). At a theoretical level, is aimed to understand the role of higher education institutions in local development. From a case study [6] perspective, it aims to analyse the cooperation strategy that has been implemented. The research work presented in this paper fits into a qualitative study since it aims to provide in-depth

explanations about this case. However, even not aiming at generalization, the case presented, might be transferred to a different situation or context [7].

## 2. Theoretical Overview

In this paper, the concept of digital transformation *describes a process that aims to improve an entity by triggering a significant change to its properties through a combination of information, computing, communication and connectivity technologies* [8]. Here, the concept of change means that transformation does not occur only at a digital level. It requires structural and organizational changes that will lead to a business model improvement [9], [10]. The emergence of the adoption of digital strategies is just another opportunity for collaboration between industry and universities, which may also help firms overcome the cultural barriers in the adoption of new technologies [8].

According to some authors [5], [11], geographical proximity plays a fundamental role as a determinant of university-industry collaboration. In general, firms prefer to engage in collaborative arrangements with first-tier universities as they are likely to offer the most valuable resources and capabilities.

Normally, the relationship between university and industry, brings another stakeholder to the equation, the government. This group takes us to another relevant, and already mentioned concept: the Triple Helix Model: University-Industry-Government [4], [12]. According to Henry Etzkowitz [2] the triple helix model is defined as a derivative of innovative systems for the promotion of knowledge transfer networks underpinned by university-industry-government synergy. Trilateral collaboration between universities, companies and the government are essential to create a favourable environment and stimulate technological innovation [13].

Under the Triple Helix perspective, R&D activities must be a well-organized process of knowledge creation, production, diffusion, and application [14]. The collaboration under the triple helix model brings benefits not only to the involved stakeholders but to society as well.

In short, the triple helix model and researches around this concept aim to identify the best solutions and tools to promote innovation and economic development in knowledge-based economies. Knowledge transfer activities can be presented as one of those tools since the main goal of knowledge transfer is innovation.

## 3. University, Industry and Local Government: The Case of Tâmega e Sousa

The School of Management and Technology (ESTG)<sup>21</sup> is part of the Polytechnic Institute of Porto is located in the region of Tâmega e Sousa in the North of Portugal. In its mission, the first element to be stated is the focus on the region's development. To fulfil its mission, several projects as been developed in association with the Intermunicipal Community (CIM-TS), and with the Chamber of Commerce (CETS). Those projects have been developed under different units that have been created at ESTG.

In the year 2003 was created the Centre for Research and Innovation in Business Sciences and Information Systems (CIICESI). This centre presents as its mission the promotion of research, development, innovation and knowledge transfer at the service of public and private sectors. In 2014 a new unit was created the Entrepreneur Support Office (GAE) aiming to strengthen the relationship with business fabric, through a correct identification of the companies' needs and to foster the process of technology transfer.

Four years later, two new units were created: The Industry Business School (IBS) and the Competence Development Centre in Data Analytics and Business Intelligence (CDC). The Industry Business School aims to train professionals with advanced skills and a high degree of specialization in the field of business management. It seeks to boost the local, national, and international competitiveness of companies through the transfer of scientific and technological knowledge and the sharing of good business practices. This unit has as goal to reach executives and middle and senior managers of SMEs. CDC is a research, knowledge and technology transfer structure. It is a project created in partnership with technology companies working in the

<sup>21</sup> [www.estg.ipp.pt](http://www.estg.ipp.pt)

areas of data analytics and business intelligence. The main reason that supported these specific areas is related to the challenges of digital transformation that companies face. For that this unit develops projects related to innovation, research and technology development involving the private sector (Industry), students and researchers (University). This unit is in facilities managed by the local municipality (Government). Besides the contribution to the student's professional skills development, it fosters ESTG's mission to promote an innovative and entrepreneurial ecosystem in the Tâmega e Sousa region, contributing to the creation of economic and social value in the region.

The most recent unit was a business incubator. This unit works as an extension of a larger business incubator based in a unit supported by Porto Polytechnic (StartUP Porto). This unit is incorporated into the National Incubator Network<sup>22</sup>.

From the unit's description presented above, the university-industry collaboration is clear and present in all the units. Considering the units created in 2018 (IBS and CDC) and 2020 (StartUP) there is a clear focus on the technological field along with the management. In line with the literature, technology is not an end. It must be a tool to make the business model succeed [8]–[10].

Several projects and actions that were and have been developed may also reinforce the collaboration that the academia (ESTG) has been keeping with the industry and government.

Going back to the literature we can say that this school cannot be classified in an entrepreneurial university as a *quasi-firm*, as defined by Henry Etzkowitz [15] looking for financial resources to survive. The school has a budget that is not relying on those financial resources, most of the funding is coming from government support, and the student's tuition fees. Only after the mentioned items is the funding that results from projects and actions developed with the other stakeholders. However, paying attention to the characteristics of the entrepreneurial universities the school under analysis presents most of those characteristics.

Another important element is the fact that the school is outside a metropolitan area and covers a large part of the required competencies by the local industry (most relevant study and research areas are IT, management, law, occupational safety and environment). The existence of this school in this region as well as the units that have been created aims at first this initial approach [5], [16]. To keep an ongoing relationship between academia and industry exists a larger network to attend to companies' specific needs, which can be done by the local school and its units, or by another one [5], [11], [16].

#### 4. Final Remarks

The ecosystem here described intends to position itself as an innovation unit of reference for industry, for the Region of Tâmega and Sousa. To do so, the school that supports the units above presented and described is working side by side with industry and the government (most of the time the local government and associations), promoting like this a triple helix environment.

The delay, of much of the industry of Tâmega e Sousa Region, regarding the integration of physical and digital technologies in all stages of development of its products and services is evident. However, the country and the region itself are in a positive moment with the proliferation of new startups that have been trying to work with traditional industries.

In this sense, applying the concepts of digital transformation is indispensable for the region's industry. For that, according to the literature university-industry collaboration or triple helix models might be extremely useful. These models assume a higher relevance when the location does not present the advantages of metropolitan areas.

In the region of Tâmega e Sousa the ties that this school was able to establish with local industry and local government were the best ingredients for a result able to promote sustainable local development.

<sup>22</sup> <https://portugaldigital.gov.pt/en/accelerating-digital-transition-in-portugal/entrepreneurship-and-startups/national-incubator-and-accelerator-network/>

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# Investigation of Damage from Radiological Dispersal Device

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## Extended Abstract

NATO member states are exposed to asymmetric threats from national and international terrorism, such as the attacks on the United States in 2001, Turkey in 2003, Spain in 2004, and the United Kingdom in 2005. [1, 4] These events include to add the at least 19 serious terrorist attacks prevented by the authorities in Europe since September 11, 2001.

There are several suitable radioactive sources which are used in research centres, medical facilities, industrial and military. The possibility of their being used for terrorist purposes varies depending on the source and type of isotope. Radioactive particles can be portable or fixed, most of them are small, from millimetres to several centimetres, enclosed in capsules for measuring instruments. Only some of the materials listed above are considered likely radioactive sources for RDD based on portability combined with relatively high levels of radioactivity. Those with minimal amounts of radioactivity, for example, smoke detectors, brachytherapy needles, are not a concern. Radioactive waste from nuclear power or weapons facilities is also considered a possible source. [10]

Software platforms can be used to radiological impact assess of actual and potential releases of radionuclides to the environment. They are essential tools for use in controlling routine releases to the environment, as well as planning measures to be taken in case of accidental releases, predicting their impact, and probabilities of using a "dirty bomb". Software platforms enable evaluation of radiation events in various aspects. Several platforms must often be used alone or in combination to address the possible effect of using radioactive sources.

The purpose of this development is to investigate the impact of Pasquill-Gifford atmospheric stability classes on radiological risks and decision-making. Changes in stability classes can affect the dose of radiation from RDD activation and ultimately increase the risk of developing cancers caused by penetrating radiation. In this study, the risk of developing leukaemia was used as target outcome. The correlation between leukaemia risk and changes in Pasquill-Gifford stability classes was estimated since radioactive contamination at RDD spreads in the lower atmospheric layers. Changes in atmospheric stability classes should be considered as a factor that may change risk levels. Such changes may impose new prioritization criteria based on the radiological risk posed by the total TEDE equivalent effective dose of radiation to a potentially affected population.

Ground pollution was simulated using the HotSpot 3.1 codes and the results were simulated in Ci/m<sup>2</sup>. The content of MAR (material at risk) <sup>241</sup>Am 3.7 × 10<sup>15</sup> Bq. The explosive is a constant of 2.2 lb of TNT and was chosen as the amount required for a suitcase bomb [11]. The dispersal parameters of the radioactive substance are as follows: damage ratio (DR) 1.00; leakage factor 1.00; air fraction (ARF) 1.00; respirable fraction (RF) 1.00 and deposition rate 0.15 cm/s [12]. The wind speed is set to 10 km/h (2.80 m/s) at a height of 10 m. The study was conducted on stability class: A and F, with class A (Scenario 1) considered extremely unstable and class F (Scenario 2) as moderately stable. Distance coordinates for all distances are measured along the plume GZ (ground zero) for 0.5, 1, 2, 4, 6, 8, and 10 km. There are no reasons for plume GZ distances.

Atmospheric processes can reduce or enhance dispersion and deposition after the initial release of a radiological source. Three of the most important parameters that drive the phenomena are wind speed, atmospheric stability, and precipitation. Thinning occurs most rapidly at high wind speeds, with unstable atmospheric conditions, with sharp temperature gradients where the surface layer is hotter than the air above it, and during precipitation. For these reasons, land surface deposition as a function of wind distance was estimated in this case.

To estimate the conversion factors for the HotSpot dose, we referred to FGR [11] The residence time is assumed to be 0 minutes to simulate that the material is released immediately to atmosphere. In fig. 3. and 4 the graphical results obtained for each considered scenario are reported. For each stability class and wind speed value, TEDE diagrams and ground deposition diagrams are plotted as a function of leeward distance. The calculated doses can be received by a person at a height of 1.5 m above ground level, who remained entire time during passage of the cloud. Since the release occurs at a release height of 10 m, the doses first increase with distance, reach a maximum value, and then decrease. The heat and smoke will lift the tiny particles of <sup>241</sup>Am into the air and depending on the nature of the radioactive material released, these particles will settle to the ground as they are carried by the wind contaminating the earth's surface. Large particles will pollute in the immediate vicinity of the outflow, while smaller ones (fine and mostly respirable) will travel long distances or rise to high altitudes until they are deposited on the ground. The performed simulations proved the significant influence of resistance classes on the areas of radiation contamination.

In scenario 1, the equivalent dose for the first zone is 0.58 km, for the second zone it is 0.84 km and for the outer zone it is 2.0 km. For scenario 2, the length of the first contour is 17 times greater than scenario 1, for the second it is 24 times greater. The outer the difference is even greater, nearly 49 times more. For the radiative deposition under the two scenarios of Fig. 4. it is evident that at about 250 m from the place of the explosion they have the same values. From fig. 2. the outer contour of scenario 2 is 4 times larger than that of scenario 1.

There are several interrelationships between ground concentrations and release height concentrations depending on meteorological conditions. A high-concentration plume of dispersed radioactive material, contaminants are deposited on the Earth's surface over short distances in the case of weather conditions without cloudy skies and light winds, and when the vertical stability changes from unstable to stable near the explosion. Under stable conditions, maximum concentrations near the Earth's surface amount of material are smaller than those occurring under unstable conditions and occur at a greater distance from the source of dispersion. Large concentrations of radioactive material logically spread over larger distances, minimal concentrations in cases where there are several leakage sources can spread over large areas.

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# Applying Artificial Intelligence Applications in Mobile Health Sector for Combating Covid-19 In Saudi Arabia Roles, Challenges and Recommendations

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**Abstract:** Mobile phones' rapid growth in recent years is fuelling the emergence of mobile health (mHealth), thus contributing to healthcare services' innovative transformation in countries all over the world. The value of mHealth adoption has become more apparent with the novel coronavirus disease (COVID-19) pandemic. In response to the pandemic, Saudi Arabia implemented a series of mitigation efforts, including the development of mobile health applications (mHealth apps) for the public. The aim of this paper is to explore the roles of mHealth apps in combating COVID-19 in Saudi Arabia as well as to discuss challenges associated with such technology and propose recommendations in order to maximize its potential. This paper conducted a review of the literature in this context. Several beneficiary roles were indicated, including creating awareness, health survey and health surveillance, reduction of person-to-person contact, virtual screening, and monitoring, decision support systems for healthcare providers, facilitation response to emergencies, medication accessibility, and integration of patient records. However, despite the potential advantages, the implementation of mHealth is still hindered by poor access to the internet and technical issues, privacy and security threats, and a lack of knowledge in using the technology. Accordingly, recommendations were provided to mitigate the negative consequences of these challenges. First, establish a clear set of laws and regulations concerning the privacy and confidentiality of information. Second, increase awareness among users, healthcare providers, and authorities. Lastly, promoting research and innovation through increase funding.

**Keywords:** COVID-19; Coronavirus; Mobile Health Application; mHealth app; MoH; Saudi Arabia

## 1. Introduction

Mobile phones have witnessed great success and rapid advancements since their introduction into the market over forty years ago. According to Statista (2022), the current number of mobile phone users in the world today is 6.648 billion, and this translates to 83.72% of the world's population. Moreover, the data forecast that the number of mobile users in the world will increase over time to reach 7.49 billion users by 2025 (Statista, 2022). In Saudi Arabia, nearly 92% of the population owns a mobile phone and the number is steadily increasing (Statista, 2020). According to Figure 1, the number of mobile phone users in Saudi Arabia has been gradually increasing over the last couple of years, reaching 30.44 million users in 2020 (Statista, 2020). Additionally, it is estimated that the average annual growth rate of mobile users is around 6%. Thus, current estimates indicate that the country's mobile user base will continue to grow over time, reaching 36.17 million users by 2025 (Statista, 2020).

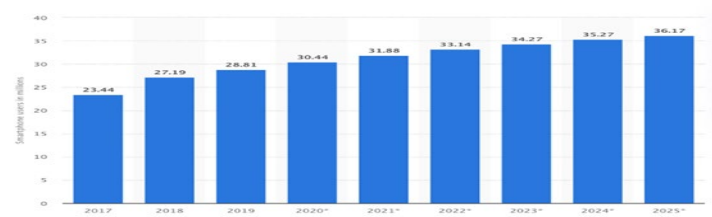


Figure 1. Number of smartphone users in Saudi Arabia from 2017 to 2025 (Source: Statista, 2020)

Mobile technology has evolved rapidly opening new channels of connection and communication among people. Consumers demand for more wireless gadgets and applications has led to a paradigm shift in many industries. One of these industries that are becoming more dependent on mobile technology is healthcare (Al Muammar et al., 2018). Healthcare providers are looking forward to accessing patients’ records more efficiently without being confined to their offices. Patients, on the other hand, are demanding easier and more affordable solutions to consult with their doctors in order to receive vital information regarding their health and well-being. Mobile technology was found to enhance communication between users and the health system, resulting in better health outcomes (Al Muammar et al., 2018). This significant impact is considered the only beginning of the rise and domination of mobile health technology in health care delivery.

Mobile health “mHealth” is considered an important component of electronic health “eHealth”. According to the World Health Organization (WHO, n.d), eHealth is defined as the cost-effective and secure way of utilizing information and communications technologies (ICT) for health and health-related fields, including health care delivery, health surveillance, health literature, education, knowledge, and health research. Many scholars have argued that mHealth and eHealth are closely intertwined, that their technologies complement one another; and that both can effectively improve global health outcomes in a coordinated manner (Motamarri et al., 2014). To date, there is no standard definition of mHealth has been established. However, the term “mHealth” has been defined differently by different scholars and organizations. The WHO defined mHealth as a medical practice and action in public health supported by mobile communication technologies and real-time healthcare data transmission for remote users (WHO, 2011). Dr. Andrew Watson, Vice President of International and Commercial Services at the University of Pittsburgh Medical Centre (UPMC), defined mHealth as simply the evolution of healthcare into the virtual world by using highly portable devices (Congdon, 2013). Additionally, mHealth was defined by The National Institute of Health as the use of mobile and wireless devices to improve patient health outcomes, quality of healthcare services, and health research (NIH, n.d).

The value for mHealth adoption has become more apparent with the novel coronavirus disease (COVID-19) pandemic. The Coronavirus was first discovered in Wuhan, China in December 2019. On March 11, 2020, The WHO officially declared COVID-19 pandemic and announced a public health emergency due to its high prevalence and alarming levels of severity (WHO, 2020). As of March 13, 2022, there were over 455 million confirmed cases of COVID-19 and over 6 million deaths have been reported worldwide (WHO, 2022). This recent pandemic has dramatically affected many industries, including healthcare across the world. Since the outbreak, countries have been utilizing mHealth technologies more than ever to handle disruptions in services and minimize in-person consultations (Alsaleh, 2021). Numerous mHealth initiatives worldwide have demonstrated the efficacy of utilizing mobile health technology to deliver better care in a cost-effective manner. For instance, a web/mobile app called “CANKADO” was utilized in Germany, while the “HeadToToe” app in Switzerland and the “COVID Symptom Study” app in the United States and United Kingdom (Asadzadeh and Kalankesh, 2021). These mHealth apps served as a communication channel between health providers and the apps users. They also covered various scenarios ranging from people self-reporting and screening to visit preparation, remote monitoring, and education for management of the COVID- 19 outbreak (Asadzadeh and Kalankesh, 2021).

Similarly, Saudi Arabia has proactively implemented and activated digital health, including mHealth, to deliver healthcare services to the public. Both public and private healthcare organizations were encouraged to

adopt and utilize mHealth technologies to ensure that the provision of healthcare services is sustained. In Saudi Arabia, the Ministry of Health (MoH) is the primary provider, regulator, and payer of healthcare services (MoH, 2020). In collaboration with specialist organizations, the MoH has launched number of mHealth apps to improve the accessibility of healthcare services across the kingdom. Figure 2. lists the most utilized MoH mHealth apps during the recent COVID-19 pandemic.



**Figure 2.** MoH Apps utilized during COVID-19 pandemic

Number of studies have been conducted studying and evaluating the efficiency and effectiveness of MoH apps. Almufarij and Alharbi (2022) conducted a cross-sectional study to evaluate users' awareness, usage, and perceptions toward services of MoH's mHealth apps including Tawakkalna, Tabaud, Tatamman, Seha, and Mawid. The findings revealed that the most known and used app was Tawakalna, followed by Tabaud, Seha, Mawid, and Tataman. The high knowledge and usage of Tawakalna has been attributed to the various services it provides, its integration with other mHealth apps, and its mandatory use to get services from private and public organizations. Moreover, the findings revealed that most users showed a high level of understanding the purpose, benefits, and services provided by the apps which led to high levels of satisfaction. Another study conducted by Alsaleh (2021), studies provider experience and satisfaction with the use of a (Sehha) app during the COVID-19 pandemic. The study showed that more than 50% of the physicians were satisfied with the work they have done through Sehha App. Moreover, Alanzi et al. (2021) conducted a study evaluating Mawid mHealth app in delivering services during the COVID-19 pandemic in Saudi Arabia. The study evaluated three major factors including ease of use, satisfaction, and benefits of Mawid app. The findings revealed that 82% of the participants referred Mawid as easy to use the application, 79% were highly satisfied with the application, and the majority of the participants reflected potential benefits of using the application. Additionally, Alkhalifah (2021) studied the perspectives of patients' behavior toward mHealth in Saudi Arabia. He examined various factors known to affect mHealth's acceptance. It was found that effort expectancy, performance expectancy, system quality, and social influence are the most important. Also emphasized the significance of trust and how it affects the intention of patients to continue using mHealth service.

The mHealth solutions have attracted scholars from various fields, resulting in an increased number of research publications. However, there is very little literature has reported on the recent role in combating COVID-19 and the related challenges of mHealth apps in Saudi Arabia. Therefore, the aim of this paper is to explore the role of mHealth apps in combating COVID-19 in Saudi Arabia as well as to discuss challenges associated with such technology and propose recommendations in order to maximize its potential.

## 2. The Roles of mHealth Apps in Fighting COVID-19 in The Saudi Context

### 2.1. Creation of Awareness

One of the vital roles of mHealth apps is creating awareness among people. Through mHealth apps, individuals can receive text messages that promote adherence to preventive measures such as mask-wearing, hand washing, and sanitizing. Several studies have shown that text messages help pass information, educate the public, and support behavioral change (Gerli et al., 2021). Moreover, the mHealth apps contribute to raising awareness by providing infographics that clarify information related to the symptoms of Corona Virus, the urgent cases where individuals should go to a hospital, the proper way of handwashing and sanitizing, and the proper social distancing. In 2019, the Saudi MoH has developed Sehhaty app as an innovative solution that enables users to reach health information and medical e-services related to the health of individuals and health awareness in general. Sehhaty provides educational content about the prevention and control of infection. The content includes information about contracting coronavirus, isolation requirements, relieving symptoms, and preventive measures after recovery (Hassounah et al., 2020). The information is provided in Arabic and English languages and presented via videos and infographics that disseminate information needed to create awareness about Corona Virus.

### 2.2. Health Survey and Health Surveillance

Effective health survey and surveillance depend on efficient data collection. Key considerations regarding data collection include the data collection method, the efficiency of the data collection process, and the accuracy of the data collected (Singh et al., 2019). As collecting and managing research data are challenging, technology is necessary to produce accurate data in real time. The mHealth apps are innovative and cost-efficient tools that help collect, analyze, and transform data into useful information needed in fighting the spread of the virus. Therefore, governments in many countries in East Asia and Europe have invested heavily in mHealth apps to manage different aspects of COVID-19 (Singh et al., 2019).

In April 2020, the Saudi MoH developed Tawakkalna. This mobile app uses the global positioning system (GPS) to monitor the movement of individuals infected with the Corona Virus and trace their contacts (Alassaf et al., 2021). Tawakkalna shows the health condition of individuals in regard to COVID-19 infection. Based on health assessment and travel history, individuals are assigned either green, orange, brown or purple codes. Green codes indicate that individuals have no record of infection and are allowed to move without restrictions. Orange codes indicate that individuals have been exposed to a COVID-19-infected person and are obligated to self-quarantine for seven days. Brown codes indicate that individuals are infected and obligated to self-quarantine for seven days. Purple codes indicate that individuals are coming from abroad (MoH, 2020).

The Saudi MoH also fought COVID-19 by developing the Tabaud app in June 2020. Tabaud uses GPS and Bluetooth technology to enhance preventive measures by tracing positive cases and notifying people nearby of potential exposure to Corona Virus (MoH, 2020). It also tells individuals if they have been exposed to someone with a confirmed infection. Moreover, it enables individuals to share their results with whom they had contact in the previous fourteen days.

These apps enhance the Saudi MoH health surveillance to mitigate COVID-19 risk and prevent its spread. The rationale of health surveillance emerged from systematically collecting, analyzing, and interpreting health data to explain and control a health event to be timely disseminated to those who need to know (Decliche & Carter, 1994; Alsyouf, 2020). Furthermore, the data from the surveillance is used to mark the need for public health plans and evaluate the programs' efficiency (Klaucke, 1992; Alsyouf, 2020). These technologies are used to support the initiatives of policymakers, the medical community, and society to manage every stage of the crisis and its aftermath (Jadi, 2020).

### 2.3. Reduction of Person-to-Person Contact

Current evidence has proven that the primary way of spreading Corona Virus is through person-to-person contact. The WHO has reported that the virus spreads between people in close contact with each other. The virus transmits from an infected person to another person through direct contact, mainly in crowded indoor settings, such as workplaces, schools, and hospitals (WHO, 2021). Moreover, people may become infected when touching their eyes, noses, and mouths after touching surfaces that have been contaminated by the virus. Therefore, many governments and health organizations have adopted mHealth technology as a solution to reduce the risks associated with person-to-person contact in health facilities (Williams et al., 2020). For example, the Saudi MoH has developed different mobile apps to reduce activities associated with direct contact. Mawid is a mobile app that allows individuals to book and manage their appointments at hospitals and other healthcare centers electronically (MoH, 2020). Hence, individuals can know the number of available appointments in all health centers. Furthermore, health providers can know the actual number of their outpatients thus reducing congestion and unnecessary person-to-person contact (Hassounah et al., 2020). Khan (2020) examined the role of mHealth technology in enhancing healthcare service delivery in Saudi Arabia. The study found that the mHealth was efficient in reducing the number of unnecessary physical visits to health centers by around 20%.

Tetaman is another mobile app that has been developed to provide health care and protection for infected individuals who are directed to self-isolation (MoH, 2020). The app provides different medical services such as COVID-19 test results, daily symptom check-ups, countdown indicators for isolation days, and alerts through notifications, text messages, and automated calls. Such services reduce person-to-person contact in healthcare facilities and consequently reduce the chance of spreading the virus.

### 2.4. Virtual Screening and Monitoring

The development of technology has led to the emergence of telemedicine as a complementary way to provide healthcare for patients. Telemedicine can be provided through mobile apps.

These apps facilitate managing, monitoring, and treating patients (Williams et al., 2020). They also allow both patients and healthcare providers access to information such as patients' medical records, condition abstracts, and laboratory tests. The availability of such data helps to provide effective and efficient medical services as it offers accurate information, reduces the time taken for data collection, and reduces the cost of monitoring health outcomes (Asadzadeh & Kalankesh, 2021). Therefore, during the COVID-19 pandemic, healthcare providers have activated the usage of telemedicine as a way to fight COVID-19.

For example, the Saudi MoH has developed Seha app as an innovative and sustainable solution to enable patients to receive health and preventive care in their homes (MoH, 2020). Seha provides health services through audio-video medical consultations by doctors and specialists of the Saudi MoH and through using artificial intelligence technologies that enable patients to receive safe and trusted medical information about their cases (Alassaf et al., 2021). Furthermore, doctors can advise patients, based on the severity of symptoms reported, whether to stay at home, take specific medicines, or visit the hospital. Such application helps reduce the over-flooding of hospitals and healthcare centers and reduce the overworking of doctors while ensuring the easier provision of healthcare across distances (Alassaf et al., 2021). Alharbi et al. (2021), conducted a study to evaluate the effectiveness of Seha application in improving healthcare delivery for users in Saudi Arabia. The findings revealed that users of the app had a better health experience in terms of ease of access to healthcare services such as audio-video consultations, their satisfaction with the healthcare services provided, and the efficiency of the system.

### 2.5. Decision Support Systems for Healthcare Providers

The mHealth is widely used as a support system for public health, supported by mobile devices to establish faster communication. This plays a crucial role in supporting administrators, doctors, and healthcare personnel with information related to laboratory activities. Furthermore, the required patient information at the correct time helps make appropriate decisions to avoid any mistakes by the hospital authorities (Jadi, 2020). The body of literature specifically focused on mHealth decision support systems (DSS) for healthcare professionals suggests that such systems facilitate access to medical/health information, increase screening, improve diagnosis, decrease medical errors, increase documentation, and increase efficiency (Bakken, 2014).

Following its vision for better quality and services, the Saudi MoH launched the Sehhaty app. Sehhaty aims to enable people to access health and e-services offered by numerous health organizations in the Kingdom, such as coronavirus self-assessment tests, vital signs updates, COVID-19 test appointment booking, retrieving and sharing sick leaves, tracking prescribed medicine, steps tracker, and other services that are related to individuals and families health and health awareness. The information provided by the app helps healthcare professionals make decisions regarding the status of their patients, view their medical records and access the list of the patients' current and inactive medications, and accordingly prescribe the appropriate medicine (Simsim et al., 2021).

### 2.7. Medication Accessibility

Mobile apps are used for the effective collection, flow, and exchange of data within the network. Citizens, health workers, social workers, and other officials are interconnected to monitor the pandemic and improve decision-making (Rehman et al., 2021). Therefore, the MoH has improved pharmaceutical accessibility using technology. For instance, the recently launched Wasfaty Service connects hospitals and primary healthcare institutions with neighborhoods' pharmacies. For patients, this means they can acquire necessary prescriptions for free at their local community pharmacy (Wasfaty, 2021). By the end of 2021, the Wasfaty Service had connected 74 hospitals and 1,413 primary healthcare institutions to the system and registered 2,193 pharmacies. This will enable it to provide over 8.4 million e-prescriptions by 2020 (Al Aloola et al., 2020).

The advantages of the Wasfaty Service are significant; the system eliminates unauthorized prescription repetition, which reduces overdosing. It alerts physicians to drug and prescription conflicts and warns them about their patients' sensitivity to prescribe medications. The service improves spending efficiency for the healthcare industry by avoiding duplication of prescriptions and offering multiple issuances of medicines for patients with chronic diseases. In addition, the MoH launched a version of its drug directory for smart devices to support efficient and effective medication use. This app makes it easier for physicians, pharmacists, and nurses to verify medication doses before prescribing, dispensing, or administering them to patients. Information is provided in an easy-to-understand manner with concise and specific tutorials on topics such as medical conditions and the medications dispensed to patients (Wasfaty, 2021).

Hazazi and Wilson (2021), stressed on the fact that Wasfaty prescribing program is considered a positive step, providing easier access for most patients to their medications. However, the application may be less attractive to elderly patients living within walking distance to their Primary HealthCare Clinics (PHC), as they prefer to have their medications dispensed from the same PHC rather than being referred to a separate pharmacy. However, they proposed solutions that might aid the elder patients which include policies to implement home delivery/mail delivery for prescribed medications. Therefore, medication services must be responsive to the needs of the elderly and people with disabilities. (Hazazi & Wilson, 2021). During Covid-19, Wasfaty implemented the service of home delivery for prescriptions issued to the quarantined residents. This is to ensure that the beneficiaries obtained their medicines without being affected by the curfew situation that may hinder them from receiving the medication at the right time. Furthermore, it enabled physicians to write

prescriptions electronically through the Wasfaty service system to guarantee the continuity of treatment (Wasfaty, 2021).

### 2.8. Integration of Patient Records

An electronic health record is a very important and crucial service to be provided by the m-health systems. This service is mostly useful for doctors and clinicians that can access patients' details from joining date to medical check-ups, reports, prescriptions, and precautions to be taken by a patient. Apart from that they also contain the information of doctors, nurses, and support staff that assisted the patient during their visit to the hospital (Jadi, 2020). A key solution suggested by Aldekhyyel et al. (2021) is incorporating the Shared E-Health File, a unified national electronic system that enables information exchange among different hospitals. Furthermore, including access to the Shared E-Health File within telemedicine apps may improve patient care and data interoperability (Aldekhyyel et al., 2021).

One of Sehhaty e-Services is the ability to view the medical records of patients and access the list of their current and inactive medications (MoH, 2020; Sehhaty App, 2020). During the curfew, this information exchange helped healthcare professionals make decisions regarding the health condition of their patients, and accordingly evaluate their status based on their history without the urge to meet the patients personally (Simsim et al., 2021). Hazazi & Wilson (2021), argue that integrating patient records could significantly reduce unnecessary duplication of services and care and positively impact the country's healthcare budget by preventing the unnecessary repetition of pathology and radiology tests and reducing medication wastage.

### 3. Challenges Associated with The Use of mHealth Apps

Despite the advancements in healthcare delivery enabled by mHealth apps, there are still some significant challenges associated with its utilization that cannot be overlooked and should be addressed in order for mHealth to be used successfully and on a broad scale within the Saudi Kingdom.

#### 3.1. Poor Access and Technical Issues

This is particularly regarding telecommunications infrastructure that can be a barrier in mHealth applications. For example, those apps require high-speed internet access, smartphones, and remote access to electronic medical records. However, such requirement is not always accessible, particularly among vulnerable and elder populations, because of low ownership of smartphones and poor internet access (Albahri et al., 2018).

Additionally, server failures can cause the hard implementation of services in any application, especially dynamic ones. According to (Harper et al., 2017), the most common server failures are service unavailable due to temporary overloading of the service, reconfiguration (planned) outages including maintenance and configuration changes, design errors in both hardware and software, including application software failures also operations errors due to accidents, inexperience, poor procedures. Due to such server and communication faults, the services of mHealth apps might be interrupted, deleted, or become unreachable (Harper et al., 2017).

Technical problems are common while using mobile apps, which might create a barrier to the use of the technology. According to a study conducted by Alharbi et al. (2021), 43% of the study sample who used Seha app have experienced some sort of technical difficulties which significantly lower reported satisfaction and ease of access to health services. Addressing and fixing these technical problems should help improve the overall effectiveness of the app in the delivery of healthcare.



## 3.2. Privacy and Security Threat

Although many mHealth apps apply variable security measures such as firewalls, tiered passwords, and access control codes, there are still potential risks and serious problems with privacy and inconsistent privacy practices in those apps (Williams et al., 2020).

The devices used in mHealth are connected via the internet to communicate, collect, analyze, and process data. The primary data types collected by MoH mHealth apps include personal information, locations or even photos in some cases. While this has resulted in delivering effective services, it increases the risk of data spread and misuse (Al-Hazmi et al., 2021). This information can potentially be accessed and shared among different parties causing a security threat due to the sensitivity of these information and the lack of enforcement of privacy standards. According to a study conducted by Aljedaania et al. (2021) to evaluate end-users' knowledge and perception of the security of mHealth app; it was found that the majority of the study sample, 95%, are concerned about securing their personal information and health-related data. The study's findings addressed end-users' evaluation of mHealth apps who suggested to apply more security measures. For example, patients' data should be subject to a valid access control policy (i.e., notifying end-users when accessing their data, who, and for what reasons).

## 3.3. Socio-Cultural barrier

The mHealth apps are interfaced with the front-end technologies, smartphones, tablets, computers, and other forms of interaction; thus, the socio-cultural barrier is a common challenge faced in such programs causing to reduce their benefits (Vesel et al., 2015). Age is a significant predictor of the adoption of technology. The elderly population has hesitation to adopt new technology as a result of their cognitive abilities, low awareness of the technology's benefits, perceived competence, and anxiety related to its use (Jadi, 2020).

On the contrary of this, younger generations are more technology savvy than the elderly population. However, the elderly patients were very motivated to utilize e-consultation services via mhealth apps. Moreover, the study highlights the importance of educating the elderly populations on the usage and benefit of mhealth applications and enhancing their overall experience using this technology (Alharbi et al., 2021).

## 3.4. Lack of Knowledge about mHealth Apps

According to a study carried out by Zhou et al. (2019), a lack of knowledge among users concerning the various possible applications of mHealth technology was the second highest rated barrier to the implementation of mHealth. While mobile technology has proven its effectiveness managing and fighting against COVID-19, a lack of awareness about the services provided will only hinder its proper utilization and ultimate advantages.

According to a study conducted in Saudi Arabia by Al-Anezi (2020), patients' knowledge, motivation, and awareness regarding the mHealth benefit is a vital and substantial component to the success of the initiative of mHealth in the country. The study suggested setting long-term plans and strategies for widespread awareness, knowledge and use across the general population to enhance possible acceptance and adoption of mHealth apps. Another study conducted by Alharbi et al. (2021), found that there is a misperception among users that some Saudi mHealth apps can be used only by individuals who use MoH facilities. However, those apps are available for both citizens and expatriates working in both government and private sectors. Thus, there should be more increase in the public's awareness about Saudi mHealth apps.

#### 4. Recommendations

##### 1. Protect the Privacy of mHealth Users

The use of mHealth apps for tracking the movement of individuals who are infected with COVID-19 requires access to users' private information. The government, however, must acquire ownership of patients' data and actively set strict legislation that assures the protection of users' personal information. It is strongly recommended to establish a Saudi regulatory body to monitor these services and oversee the associated security, privacy and ethical issues of these systems and apps. This, in return, will encourage more individuals to use mHealth apps to access healthcare services and meet their health needs.

##### 2. Increase awareness and Use of mHealth Apps

As one of the barriers to using MoH mHealth apps was found to be the lack of awareness. There is a need to increase public awareness through campaigns and advertisements to increase the use of MoH apps to access health services and eventually improve the level of patient satisfaction. Also, improving public trust in these health technologies through education and campaigns should, therefore, help increase the utilization of the app.

In addition to that, there is a need to increase awareness of the benefits of mHealth technology among policymakers and healthcare providers. This is to identify and address the key national healthcare priorities and the specific mHealth interventions that can provide better outcomes and patient benefits.

##### 3. Increase Funding for COVID-19-related Research and Innovation

Research and innovation have been the most impactful technique to tackle the disease. They also provided effective solutions to major concerns of the public, frontline workers, policymakers and industry. Government should increase funding and foster collaboration across sectors, including public entities, private bodies, research organisations and universities to drive research that is specifically targeted toward innovative solutions to combat COVID-19.

#### 5. Conclusion

The rapid growth of mobile phones in recent years has fueled the rise of mHealth solutions, contributing to the global revolution of healthcare services. The importance of mHealth adoption became increasingly obvious during the recent COVID-19 pandemic. Saudi Arabia responded to the pandemic by implementing a range of mitigation measures, including the development of public mHealth apps.

This review presented a number of beneficiary roles of mHealth in combating COVID-19 in Saudi Arabia. This includes creating awareness, health survey and health surveillance, reduction of person-to-person contact, virtual screening and monitoring, decision support systems for healthcare providers, facilitation response to emergencies, medication accessibility and integration of patient records. However, despite the numerous advantages of mHealth solutions, there are still some challenges including poor access to the internet and technical issues, privacy and security threats, and a lack of knowledge in using the technology. These challenges can be resolved by establishing a clear set of laws and regulations concerning privacy and confidentiality of information. As well as increasing public and provider awareness about the importance on mHealth. In order to achieve that, governments, healthcare providers, scientists and the private sector should collaborate towards utilizing mHealth technology and harnessing its vast potentials in the fight against COVID-19.

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# On a Comparative Analysis in Indexed Databases of Research Performance Trends in Western Balkans

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**Abstract:** The outcome of every systematic research is a report in the form of a research report or paper which should follow all requirements set by the scientific communities through centuries of developments in order to get published in scientific journals and conferences. It is worldwide accepted that research performance is characterized by the produced publications. An important development through the recent years, because of the millions of researchers existing worldwide, is the increasing demand for maximizing research outcome visibility. Maximum visibility and impact of the produced research results in the scientific community is the goal of every research group in order to get more funds and keep its research efforts alive. Obviously, this is valid for the career development of any researcher in Universities and Research Centers too. Therefore, the worldwide scientific communities have organized through the years widely accepted criteria and metrics to discriminate research in quality levels. The goal of all such communities is always to rank important and not important results. Based on the above remarks Indexing has emerged as one of the major criteria for any Research Publication characterization. The goal of every research group is to produce more indexed publications in order to increase its impact in its associated scientific society and be selected for more funds in comparison with other relevant groups. Moreover, indexed publications characterize the quality and research performance not only of individuals and groups but, also, that of universities and research centers. If, on the other hand, any organized country is considered in terms of sets of universities and research centers, regarding local research development, then, it becomes reasonable, as a generalization of the above aspects, to consider research performance in country level. The aim of this research is, therefore, to compare research performance and its evolution regarding different countries, with similar characteristics in their organization in comparison to the worldwide competition. Western Balkans is herein selected as such a group of "similar" countries. It is attempted, therefore, to quantify their research performance in terms of absolute numbers of indexed publications starting with the widely accepted SCOPUS indexed database. The most important aspect, however, of this research is to identify the trends in the research developments of these countries. This is of course a work in progress and many more factors should be considered in the quantification analysis attempted.

**Keywords:** *Research performance, Impact of Research, Indexing, Time series models, Trends, Western Balkans*

## 1. Introduction, State of the Art and Contribution

The state of the art in research indexing is constantly evolving as new technologies and techniques emerge. However, some of the most popular and widely used research indexing methods include:

- Bibliographic databases: These are digital databases that contain bibliographic information about research publications, such as the author, title, abstract, and publication details. Examples of bibliographic databases include PubMed, Scopus, and Web of Science.
- Full-text indexing: This involves indexing the full text of research publications, including the body of the article as well as the abstract and other metadata. Examples of full-text indexing tools include Google Scholar and Microsoft Academic.

- Citation indexing: This involves tracking and analyzing citations between research publications to identify relationships and patterns. This method can be used to identify influential research papers and to measure the impact of research. Examples of citation indexing tools include Web of Science and Scopus. Topic modeling: This involves using machine learning algorithms to analyze the content of research publications and identify key topics and themes. This method can be used to identify emerging trends and to group research publications by topic. Examples of topic modeling tools include LDA and Latent Dirichlet Allocation.
- Semantic indexing: This involves analyzing the meaning of words and phrases in research publications to identify relationships and patterns. This method can be used to identify related research papers and to group research publications by topic. Examples of semantic indexing tools include Semantic Scholar and Mendeley.

Overall, research indexing is a critical component of the scholarly communication ecosystem, enabling researchers to discover, access, and build upon existing research. The state of the art in research indexing is constantly evolving as new technologies and techniques emerge to support the evolving needs of the research community.

This paper attempts to address the issue on how to compare countries with respect to their overall research potential. Moreover, to investigate the future trends countries present with regards to such relevant research potentials. Comparing countries in research potential can be a complex process that involves multiple factors. However, here are some key indicators that can be used to compare countries in research potential:

- Research output: The number of research publications that a country produces is a common measure of research output. This can be assessed by looking at the number of research papers published in reputable journals or conference proceedings.
- Research impact: The impact of a country's research can be assessed by looking at the number of citations that its research papers receive. This can be measured using citation-based metrics such as the H-index or the number of highly cited papers.
- Research funding: The amount of funding that a country invests in research and development can be an indicator of its research potential. This can include both public and private sector funding.
- Research institutions: The quality and quantity of research institutions in a country can be an indicator of its research potential. This can include universities, research centers, and government research agencies.
- Human resources: The number of highly skilled researchers and scientists in a country can be an indicator of its research potential. This can include the number of individuals with advanced degrees in science, engineering, and other fields.
- Collaboration: The extent to which a country collaborates with other countries and institutions can be an indicator of its research potential. This can be assessed by looking at the number of international research collaborations, joint publications, and joint funding opportunities.

It is important to note that each of these indicators has its own strengths and limitations, and no single indicator can provide a complete picture of a country's research potential. Therefore, it is often necessary to use multiple indicators and to take a holistic approach when comparing countries in research potential. This research effort is preliminary regarding Western Balkans and attempts to build relevant comparison models based only on their Research outputs as they appear in reputed only research databases containing only peer reviewed journals and conference proceedings publications. Such a reputed Research Database is SCOPUS ([www.scopus.com](http://www.scopus.com)), managed by Elsevier Inc. Since Western Balkans were established during early 1990, the relevant data compared in this study are considered from 1990 till today. The Western Balkans region includes countries located in the Balkan Peninsula of southeastern Europe. The specific countries that are considered to be part of the Western Balkans can vary depending on the context, but the following countries are generally

included: Albania, Bosnia and Herzegovina, Croatia, Kosovo, Montenegro, North Macedonia and Serbia. It is worth noting that some organizations and institutions may include different countries in their definition of the Western Balkans region. For example, some definitions may include Slovenia or Bulgaria. We herein investigate, however, only Albania, North Macedonia and Serbia. The state of the art in such a research concerning Western Balkans research performance could be outlined mainly considering the following articles.

- "The Current Status of Research Performance in the Western Balkans" (2019) by M. Milanovic and M. Todorovic. This article provides an overview of the research performance and impact of the Western Balkans countries, including analysis of the number of publications, citations, and collaborations [1].
- "Bibliometric analysis of research output from Western Balkan countries from Web of Science database" (2019) by V. Katunaric, B. Katunaric and M. Coric. This article provides a bibliometric analysis of research output from Western Balkan countries in the Web of Science database, including analysis of the number of publications, citations, and collaboration patterns [2].
- "Mapping research performance in the Western Balkans: A bibliometric analysis" (2017) by I. Bassi, R. Martin, and J. Scott. This article provides a bibliometric analysis of research performance in the Western Balkans, including analysis of research output, citation impact, and collaboration patterns [3].
- "The role of international collaboration in research impact: A case study of the Western Balkans" (2018) by S. Tominc and A. Marusic. This article examines the role of international collaboration in research impact in the Western Balkans, including analysis of the impact of collaborations with institutions from different countries and regions [4].
- "Assessing research impact in the Western Balkans: A comparative analysis of bibliometric indicators" (2020) by M. Milanovic, M. Todorovic, and G. Jovanovic. This article provides a comparative analysis of research impact in the Western Balkans using bibliometric indicators, including analysis of publication output, citation impact, and collaboration patterns [5].

The contribution of the current research lies mainly in building specific relevant linear prediction models of research outputs in Western Balkans considering peer reviewed reputed databases as SCOPUS, while all previous works presented descriptive statistics results. To the best of our knowledge time series analysis with linear predictive analytics in order to compare research performance in countries level is first time herein proposed.

## 2. Methodology and Results

Linear predictive modelling is a statistical technique that involves using a linear equation to predict the value of a dependent variable based on one or more independent variables. The technique is often used in regression analysis, where the goal is to find a linear equation that best fits the data and can be used to make predictions.

The basic idea behind linear predictive modelling is to use a set of independent variables (also known as predictors) to estimate the value of a dependent variable (also known as the response variable). The linear equation used for this purpose is typically of the form:

$$Y = a + b_1X_1 + b_2X_2 + \dots + b_nX_n$$

where Y is the predicted value of the dependent variable, a is a constant term, X<sub>1</sub>, X<sub>2</sub>, ..., X<sub>n</sub> are the independent variables, and b<sub>1</sub>, b<sub>2</sub>, ..., b<sub>n</sub> are the coefficients that determine the relationship between the independent variables and the dependent variable.



To build a linear predictive model, one typically starts by collecting data on the variables of interest and selecting a set of independent variables that are likely to be related to the dependent variable. The next step is to estimate the coefficients of the linear equation using a statistical method such as ordinary least squares regression. Once the coefficients have been estimated, the model can be used to make predictions about the value of the dependent variable for new observations.

Linear predictive modelling has a wide range of applications in fields such as economics, finance, engineering, and social sciences. It is often used to predict outcomes such as stock prices, customer behaviour, or disease progression. However, it is important to note that linear predictive models are only approximations of reality and may not be accurate in all situations. It is therefore important to validate the model using data that was not used to estimate the coefficients and to assess the model's accuracy and reliability.

Following such a linear predictive modelling approach involving research outputs regarding the three aforementioned compared countries, namely, Albania, North Macedonia and Serbia the results obtained are presented in the next figures 1,2,3,4

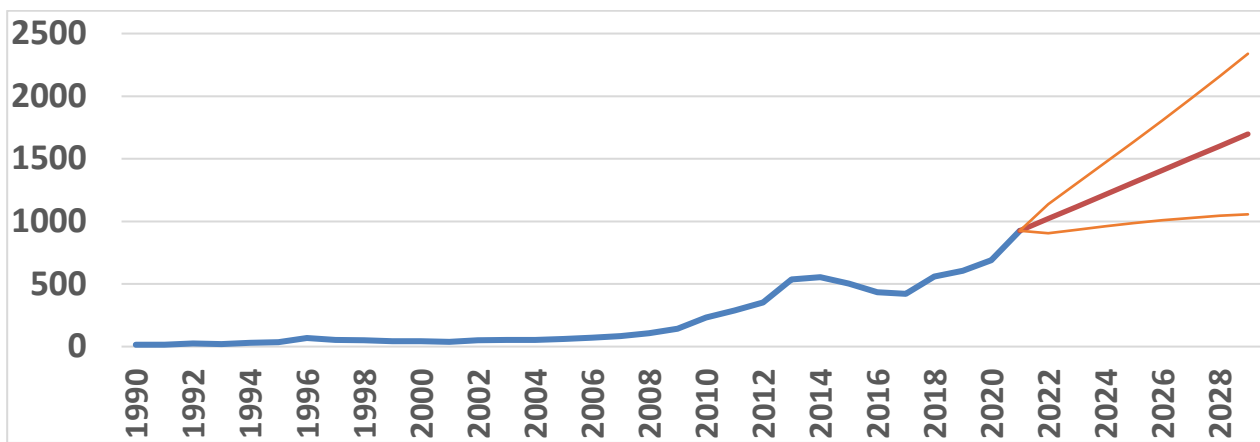


Figure 1. The time series of SCOPUS research outputs concerning Albania. In blue the time series data. In orange the max and min confidence interval predictions. The bold orange represents predicted values.

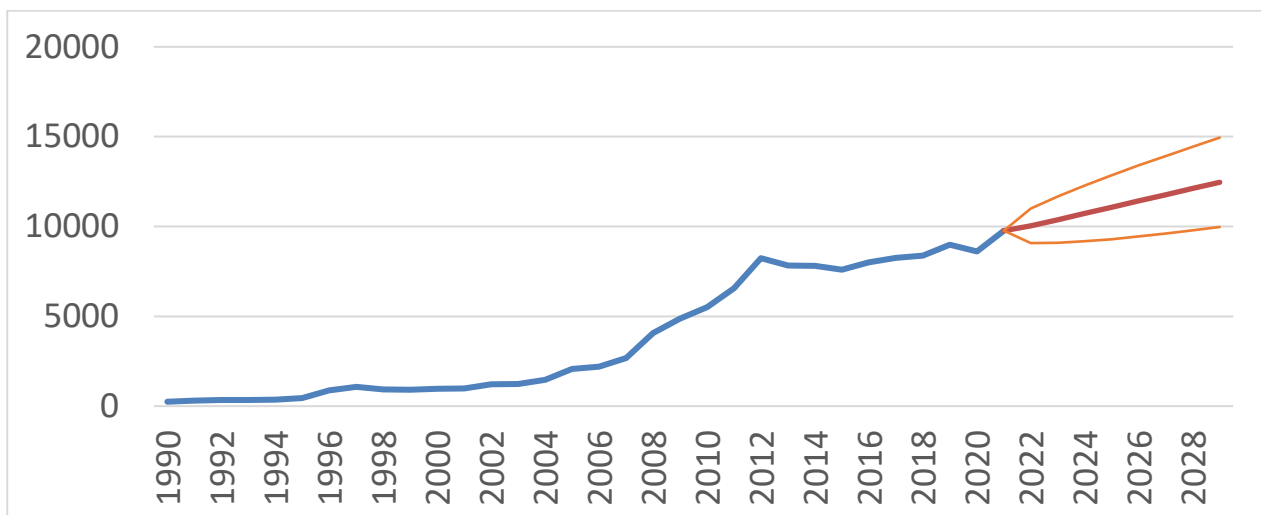
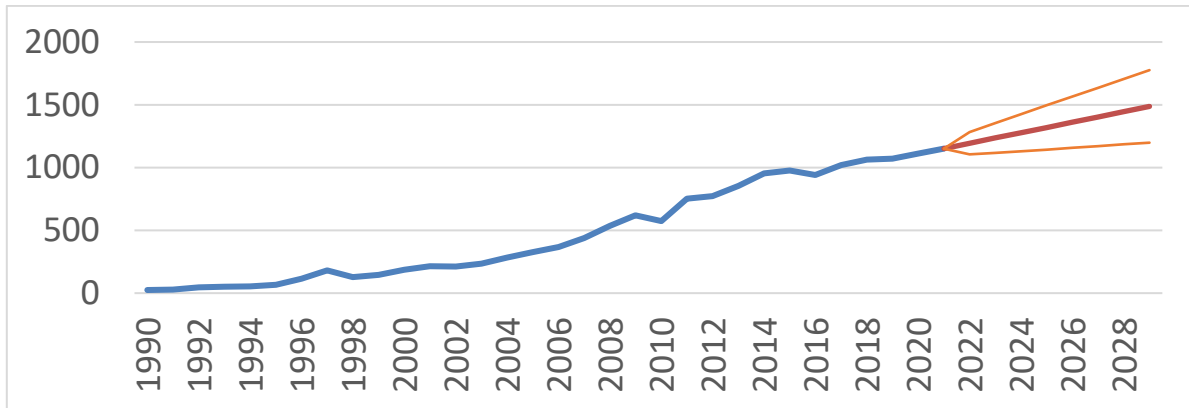
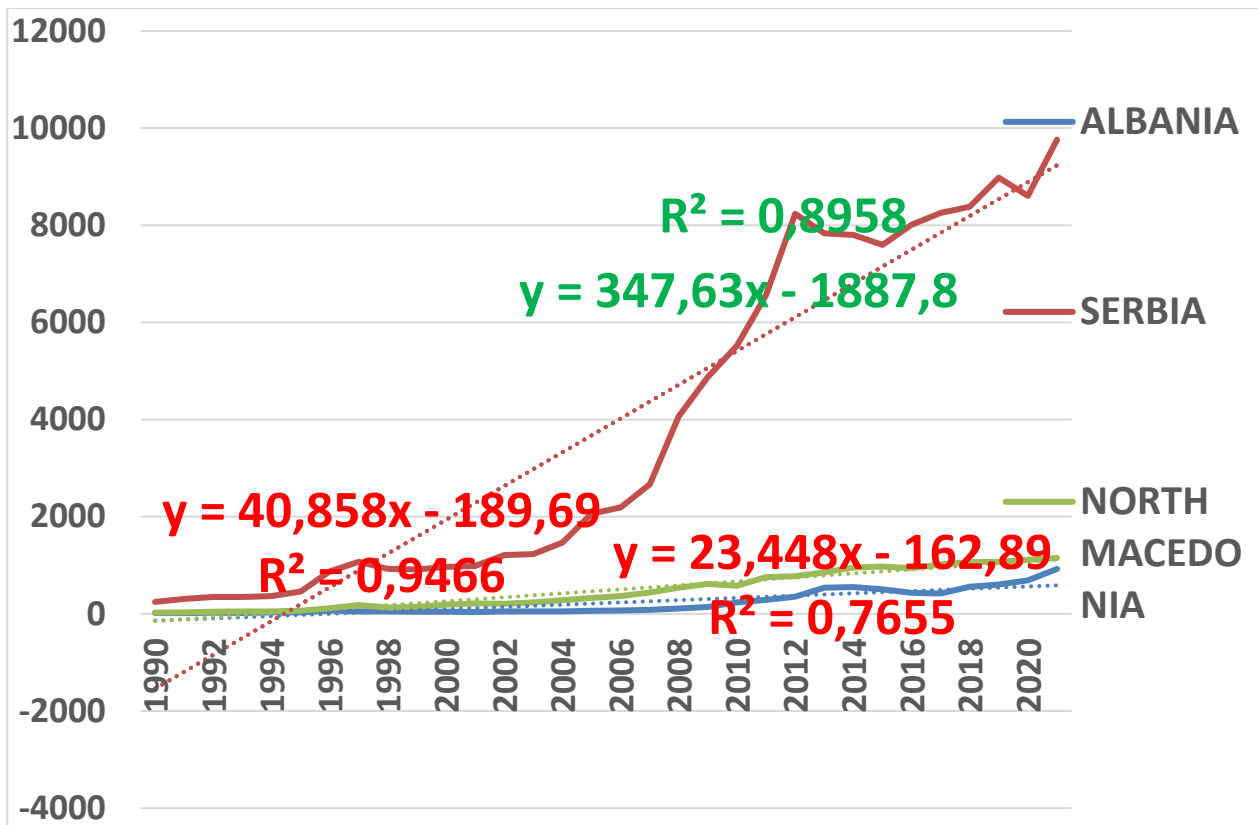


Figure 2. The time series of SCOPUS research outputs concerning Serbia. In blue the time series data. In orange the max and min confidence interval predictions. The bold orange represents predicted values.



**Figure 3.** The time series of SCOPUS research outputs concerning North Macedonia. In blue the time series data. In orange the max and min confidence interval predictions. The bold orange represents predicted values.



**Figure 4.** The comparative analysis diagram for the research outputs of the three aforementioned Western Balkan countries, where the linear predictive models are completely defined. Sorted regarding to their slopes it is obvious the potential of Serbia, with second North Macedonia and third Albania. But according to figure 1 it is obvious that Albania has more potential in the future according to predictive analytics regarding the confidence intervals.

### 3. Conclusions

Following a linear predictive approach this paper considers the research performance trends in three countries of Western Balkans, namely, Albania, North Macedonia and Serbia. Through the presented methodology we build linear predictive analytics models that could forecast corresponding research outputs with good accuracy, achieving relatively high or very high R2 coefficients, especially in the case of North

Macedonia and Serbia. Albania presents more uncertainty and according to the predictive analytics of figure 1 more future potential.

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# On the Integration of electric vehicles to the grid: profiles, potential business models and challenges

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**Abstract:** The Vehicles to the Grid (V2G) concept has become of major importance in the recent years as a research and development issue. Charging electrical and autonomous vehicles is a service absolutely needed for their operation and this can be provided by the Grid. However, the Grid, as well as the smart grid and microgrids, is consisted of many heterogenous power systems, including renewable energy resources interconnected in one integrated power system that should provide power services to many heterogenous customers in a reliable and uniform as much as possible way billing them in a regulated deterministic scheme accordingly. There are several interfaces of Electrical and Autonomous Vehicles to the Grid and, while the most notable one is charging, communications and billing interfaces should be considered too. Therefore, a major characteristic of such a complex system and the homogenous and reliable services it should provide, is that interconnects numerous heterogenous resources and commodities. The integration of so many heterogenous subsystems requires intensive standardization, otherwise proprietary technologies and protocols will never interoperate. The goal of this paper is to comprehensively review all needed interfaces in the integration of Electrical and Autonomous Vehicles into the Grid and thus, to investigate all issues in V2G scheme, after examining in detail the V2G architecture. Moreover, this paper aims at discussing the state of the art in V2G interfacing and outline the current open problems and the roadmap for their solution.

**Keywords:** *Smart grid, Electrical vehicles (EVs), Autonomous Vehicles (AVs), V2G interfacing, Integration profiles, interoperability, business models*

## 1. Introduction, State of the Art in the Integration of EVs/AVs to the Grid and Contribution

The integration of electric vehicles (EVs) into the grid requires the development of new technologies and infrastructure to support the increased demand for electricity. There are several key areas that need to be addressed to ensure that the integration of EVs into the grid is successful:

**Charging Infrastructure:** EV charging infrastructure needs to be developed to support the increased demand for electricity. This includes the installation of charging stations in public places such as parking lots, shopping canter, and residential areas. In addition, charging stations need to be interoperable with the smart grid to ensure that they can communicate with the grid and adjust their charging rates based on the availability of renewable energy and the demand on the grid.

**Smart Grid Technology:** The smart grid is essential for the integration of EVs into the grid. It allows for the bi-directional exchange of data between the EV and the grid, enabling the EV to communicate with the grid and adjust its charging rate based on the availability of renewable energy and the demand on the grid.

Smart grid technology also enables the integration of distributed energy resources (DERs) such as solar and wind power into the grid.

**Energy Storage:** Energy storage systems such as batteries are important for the integration of EVs into the grid. These systems can help to smooth out fluctuations in renewable energy generation and provide backup

power during peak demand periods. In addition, energy storage systems can be used to store excess renewable energy generated during off-peak periods for use during peak demand periods.

Vehicle-to-Grid (V2G) Technology: V2G technology allows for the bi-directional exchange of energy between the EV and the grid. This enables the EV to provide grid services such as frequency regulation and voltage support, and also enables the EV to earn money by selling excess energy back to the grid.

In summary, the integration of EVs into the grid requires the development of new technologies and infrastructure to support the increased demand for electricity. This includes the development of charging infrastructure, smart grid technology, energy storage systems, and V2G technology.

A critical issue in these developments is interoperability. Interoperability is related to standardization. Without development of suitable standards, the integration of electrical and autonomous vehicles is impossible. Electric vehicles (EVs) and smart grids are both integral components of the transition to a sustainable energy future. As more and more EVs are added to the grid, it becomes increasingly important to have interoperability standards that allow them to communicate with the smart grid. Interoperability standards are a set of technical specifications that ensure that different devices can communicate with each other and exchange information seamlessly. In the case of EVs and smart grids, interoperability standards are needed to enable the exchange of data between the EV and the grid. There are several interoperability standards that are currently being developed or used in the EV and smart grid industries. One of the most widely used standards is the Open Charge Point Protocol (OCPP), which allows charging stations to communicate with EVs and with back-end systems. Another important standard is the ISO 15118, which provides a communication protocol for the bi-directional exchange of data between EVs and the grid. This standard enables smart charging, which allows the EV to communicate with the grid and adjust its charging rate based on factors such as the availability of renewable energy and the demand on the grid. Other interoperability standards that are important for EVs and smart grids include the IEC 61850, which provides a communication protocol for the automation of power systems, and the IEEE 2030.5, which provides a communication protocol for the integration of distributed energy resources (DERs) into the grid.

In summary, interoperability standards are crucial for the successful integration of EVs and smart grids. They allow for seamless communication and data exchange between these two important components of the sustainable energy future. Figures 1,2 and Table 1 below present schematically the comprehensive framework outlining the main factors, components and algorithms in the integration of the Grid and EVs/AVs

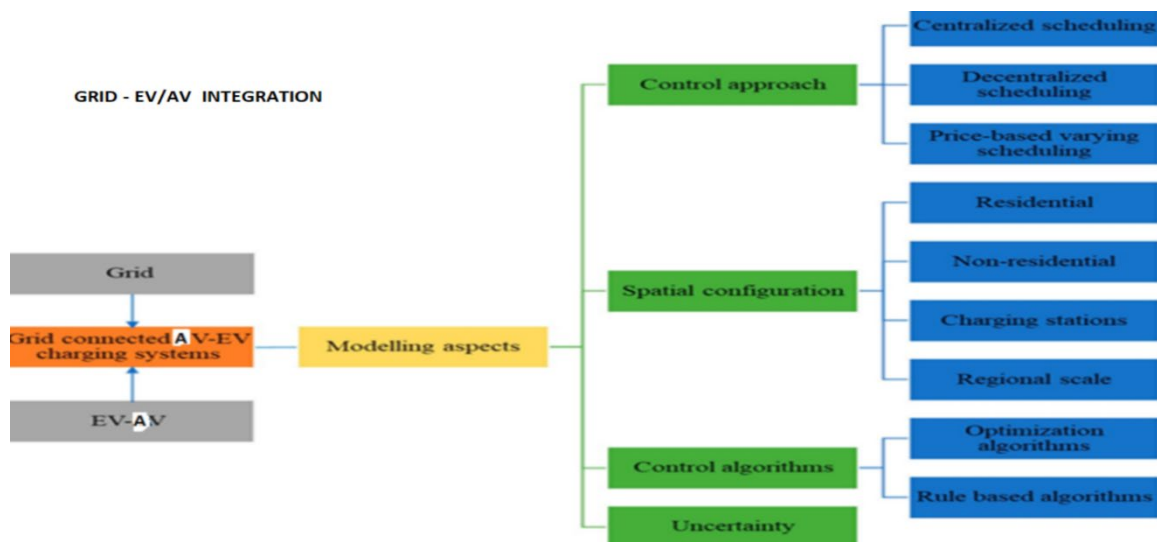


Figure 1. The main components in the integration of Electric (EV) and Autonomous Vehicles (AV) in the Grid

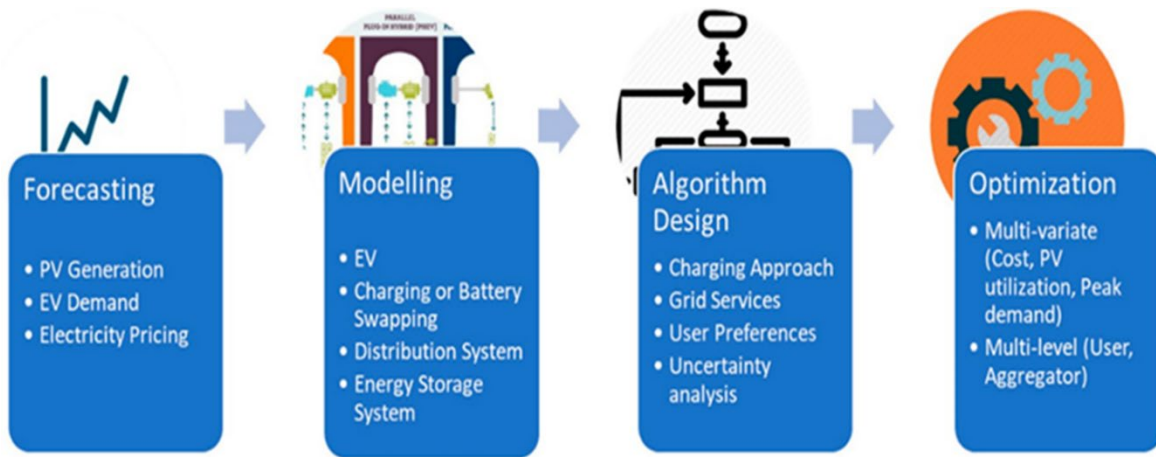


Figure 2. The main components, services and algorithms in the architecture of the integral system between the Grid and EVs/AVs

Table 1. Modes of Interaction between EV and grid.

Features	Unidirectional	Bidirectional
Power flow	Grid-to-vehicle (G2V)	G2V and vehicle-to-grid (V2G)
Infrastructure	Communication	Communication, bidirectional charger
Cost	Low	High
Complexity	Low	High
Services	Load profile management, Frequency regulation	Backup power support, frequency regulation, voltage regulation, active power support
Advantages	Overloading prevention, load levelling, profit maximisation, emission minimisation	Overloading prevention, profit maximisation, emission minimisation, renewable energy sources (RES) integration, voltage profile improvement, harmonic filtering , load levelling, power loss reduction

Initially, V2G involved only energy transfer from EVs to the distribution system. However, with the advancement in technology, two new energy transfer modes (V2H and V2V) are added. Therefore, the bi-directional energy transfer from EV can now be classified into:

- Vehicle-to-grid (V2G): Energy transfer from EV to the distribution network.
- Vehicle-to-home/building (V2H/V2B): Energy transfer from EV to home/building.
- Vehicle-to-vehicle (V2V): Energy transfer from one EV to another EV.

Therefore, there are several integration profiles and business models that are currently being developed to facilitate the interaction between EVs and the grid, emerged from the above presented state of the art framework of the subject integration.

- Vehicle-to-Grid (V2G): This integration profile enables EVs to provide power back to the grid when there is a high demand for electricity. In this model, the battery of the EV can be used to store excess energy from the grid during off-peak hours and then discharge it back into the grid during peak hours. This not only helps to stabilize the grid but also allows EV owners to earn revenue by selling the stored energy back to the grid.
- Grid-to-Vehicle (G2V): In this integration profile, the grid can be used to charge EVs during off-peak hours when there is surplus electricity. This helps to reduce the demand for electricity during peak hours and can also reduce the overall cost of charging an EV.

- Vehicle-to-Home (V2H): This integration profile enables EV owners to use their vehicles as a power source for their homes. During a power outage, for example, the battery of an EV can be used to power essential appliances in the home.
- Business models: There are several business models that are being developed to facilitate the integration of EVs with the grid. For example, utility companies can offer incentives to EV owners for charging during off-peak hours or for participating in V2G programs. EV manufacturers can also partner with utility companies to provide charging infrastructure and other services to EV owners.

Based on the presented so far architecture of the integration of EVs/AVs to the Grid this paper aims at outlining a novel framework for the business models and, most importantly, the new business models emerging from the new technologies, including communication technologies, involved in such an integral architecture.

## **2. Outline of the proposed Framework for new emerging business models implementation based on the state of the art integration profiles of EVs/AVs and the Grid.**

Integral profiles of electric vehicles to the grid is, as already herein discussed, a topic that has received considerable attention in recent years. Here are some literature references that have been useful in the proposed framework outlined in the next paragraphs.

"Impact of electric vehicle integration on distribution networks" by A. H. A. Ali, A. M. K. Othman, and S. Mekhilef. (2015). This article provides a comprehensive review of the impact of electric vehicle integration on distribution networks, including the integration of electric vehicles into the grid and the use of electric vehicles as a grid resource [1].

"Electric Vehicle Integration into Modern Power Networks" by M. A. Abusara, M. M. O. A. El-Saadany, and A. Y. Chikhani. (2016). This article provides a review of the recent research on electric vehicle integration into modern power networks, including the challenges and opportunities associated with this integration [2].

"Electric vehicle charging load profile analysis for different penetration levels in residential distribution networks" by M. A. Al-Safadi, R. A. Jabr, and O. A. Mohamed. (2016). This article presents a detailed analysis of electric vehicle charging load profiles for different penetration levels in residential distribution networks, which can help in the planning and design of distribution networks [3].

"Smart grid-enabled electric vehicle integration: An overview of vehicle-to-grid and vehicle-to-home technologies" by S. S. Jeong, H. Lee, and B. J. Cho. (2016). This article provides a review of smart grid-enabled electric vehicle integration, including the use of vehicle-to-grid and vehicle-to-home technologies [4].

"Electric vehicle charging demand estimation using big data analytics" by D. K. Kim, C. C. Liu, and J. J. Lee. (2019). This article presents a novel approach to electric vehicle charging demand estimation using big data analytics, which can improve the accuracy of electric vehicle charging load forecasting [5].

In the following figure 3 the interactions between the factors involved in the above presented integration profiles are outlined and the relevant actors are shown. In the journal version of this paper the detailed UML system design will be presented.



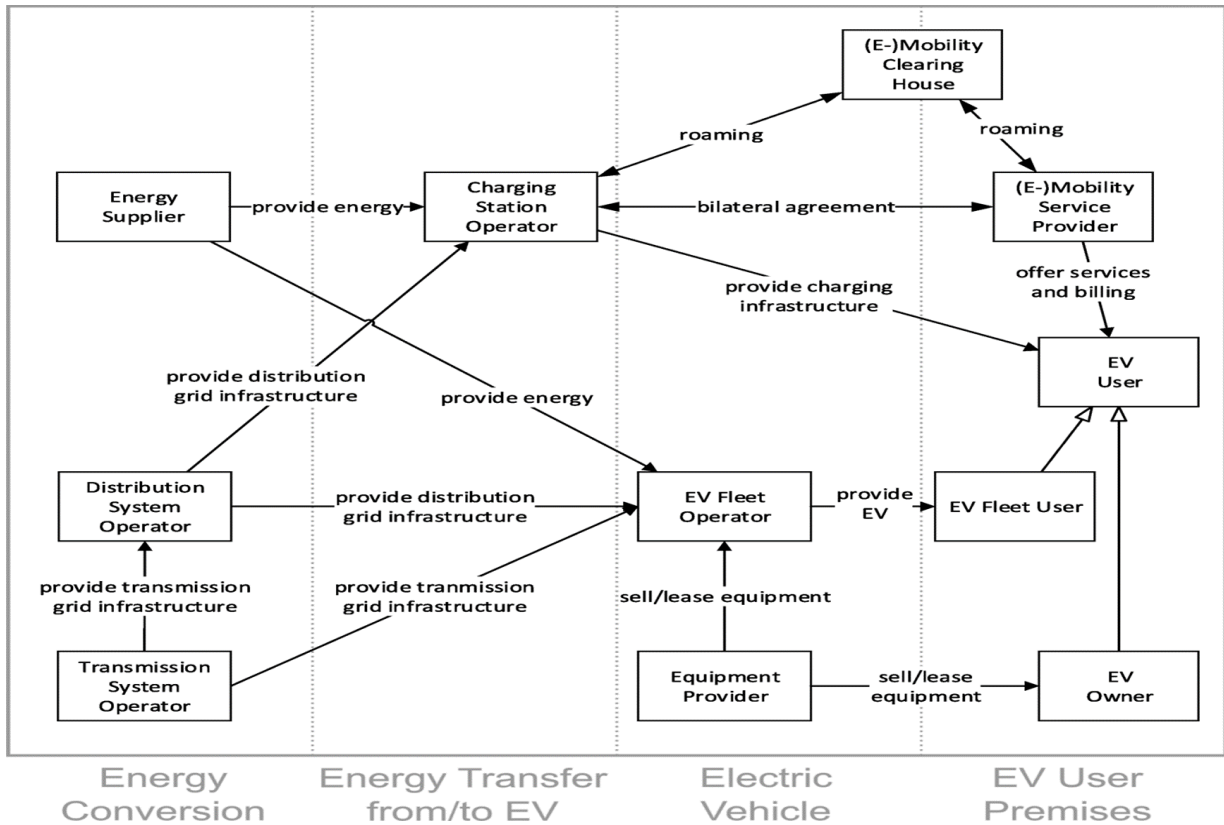


Figure 3. Main traditional actors and their interactions in the integration profiles of EVs/AVs and the Grid.

In the following figure 4 the proposed framework illustrating the new actors and their interactions are presented in order that the emerging services coming from the new integral profiles to be implemented

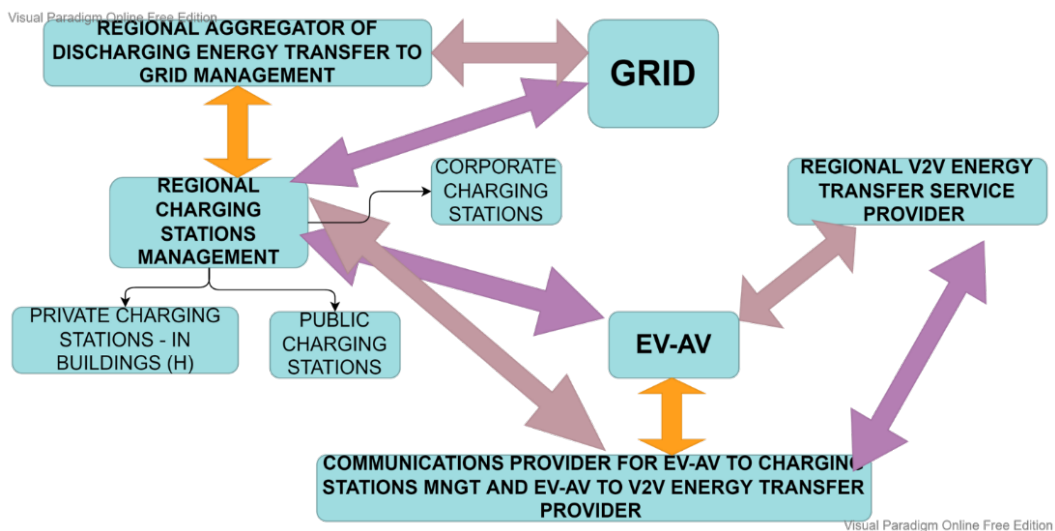


Figure 4. The concept map regarding the actors and their interactions involved in the emerged integration profiles as well as the proposed framework regarding the GRID and EVs/AVs integration for new services and implied business models implementation.

### 3. Conclusion

This paper presents the main architecture in the integration of EVs/AVs and the Grid as well as it discusses interoperability and the relevant standards involved together with the corresponding integration profiles and the associated business models. Based on the new emerging technologies outlines and proposes a framework for these integration profiles describing the new actors involved as well as their interactions. The emerging new business models are preliminarily presented. In the extended journal version of this research the complete architecture and design in UML will be provided.

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# Analyses of Possibilities of Reducing the Number of States of Automata: Case Study Examples

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**Abstract:** The research study investigates automata states and specifically analyzed some case study examples of pushdown automata in order to investigate the main research question. Our main research question is: Can we reduce these automata concerning the number of states? Our main focus is to analyse the formal definition, graphical notation and then analyze in detail some examples of PDA through which we investigate our main research question. In order to investigate we have realized analyses and literature review of some pushdown automata case study examples. The first example is a classical one used in teaching, whereas the second one is a bit more complex since it does not allow empty values, but it should have at least one accepted string. Analyses and description of subclasses and models of PDA and analyses of the research question has been realised. Insights, discussion and argumentations are provided.

**Keywords:** *Pushdown Automata; Deterministic Finite Automaton; Non-deterministic Finite Automata; Transition Functions.*

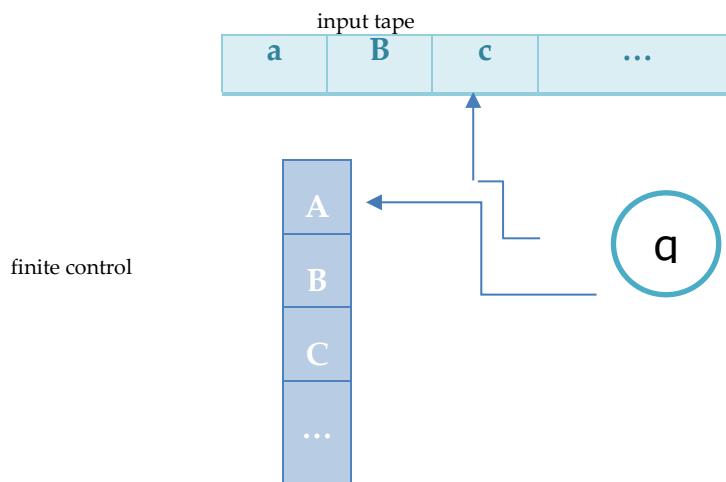
## 1. Introduction

The theory of Automata is a branch of theoretical computer science that deals with the definitions, properties, and applications of different mathematical computation models. It is the study of abstract computing devices, or "machines". These models play an important role in multiple applied areas of computer science as defined by Kuznetsov et al [1]. Finite automata are one of the most fundamental models that have been studied in this theory for a long period of time. It is widely used in areas such as text processing, compilation, pattern matching, network intrusion detection and protection, image analysis and spatial dynamics. According to Rajasekaran et al [2] there are primarily two different types of Finite automata: deterministic finite automata (DFA) and non-deterministic finite automata (NFA). Besides these two models, exist also more complex and more sophisticated models as well, for example, Context-free grammar, Turing machines, etc. According to Cezar Câmpeanu [3] in Deterministic Finite Automata, only one state is defined for each input symbol and empty string transitions are not allowed. Since it has a finite number of states, the machine is called Deterministic Finite Automaton or Deterministic Finite Machine [4]. DFAs are widely used because they have predictable and acceptable memory bandwidth requirements. Whereas, in Non-deterministic Finite Automata, the transition from a state can be to multiple next states for each input symbol as discussed by Desheng Liu et al [5]. That is the reason it is called non-deterministic. According to Sankardeep et al [6] NFA is the preferred state machine for most real implementations dealing with regular languages because it is simpler to construct and manipulate, and also the equivalent DFA of an n-state NFA can have up to  $2n$  states in the worst case.

Regarding to Tadeusz KRASIŃSKI et al [7] as for Pushdown Automata, non-deterministic PDAs are more powerful than deterministic PDAs.

## 2. Pushdown automata

Since Finite Automata are somewhat limited in the languages they can recognize, there is another type of machine called Pushdown Automata, or PDA for short, that can recognize a wider class of languages [7]. Context-Free Grammar provide a method for describing a class of languages called Context-Free Languages and these languages are exactly the languages recognized by Pushdown Automata. Also, Pushdown Automata is an important part of the front end of compilers. They are used to determine the organization of the programs being processed by a compiler; tasks they handle include determining the scope of variables and forming expression trees from input arithmetic expressions. Tadeusz Krasinski, Sebastian Sakowski and Tomasz Poplawski propose a biomolecular implementation of the pushdown automata (one of the theoretical models of computing device with unbounded memory) using DNA molecules and restriction enzymes. Although it is still a theoretical model (not tested yet in a laboratory), this method of DNA replication or transcription control with the use of automaton has one major advantage in comparison of the natural scheme of control – it allows us to make some logical calculations before cell take the final decision. A Pushdown Automata is simply an NFA equipped with a single stack. It moves from vertex to vertex as it reads its input, with the additional possibility of also pushing to and popping from its stack as part of a move from one vertex to another. As discussed by Doug Baldwin [4], there may be several viable computation paths. In addition, as with an NFA, to recognize an input string  $w$ , a PDA needs to have a recognizing path, from its start vertex to a final vertex, which it can traverse on input  $w$ . We have to mention that a stack is an unbounded store which one can think of as holding the items it stores in a tower (or stack) with new items being placed (written) at the top of the tower and items being read and removed (in one operation) from the top of the tower. The first operation is called a Push and the second a Pop. A simple scheme of PDA can be found below:



**Figure 1.** Pushdown Automata scheme

In each step of the process, the input symbol (in this case our input symbol is  $c$ ) and the symbol on top of the stack ( $A$ ) perform a move according to a transition rule. The transition rule is part of a transition rules list that is associated to the given PDA and includes rules like pop the top symbol of the stack, push a symbol (or a sequence of symbols) onto the stack, move its read head one cell (step) to the right and enter a new state.  $\epsilon$  - transitions are also allowed, in which the PDA can pop and push without reading the next input symbol. As

we mentioned before, the PDA is non-deterministic, so there may be several transitions possible in a given configuration. The transition rule can be written in the following way:

$$(q, c, A) \rightarrow (q', A')$$

where:  $q'$  – is a new state,  $A'$  – is a new symbol (sequence of symbols) that may also be an empty sequence, which replaces  $A$  on the top of the stack. There are two alternative definitions of acceptance of an input string  $w$ : by empty stack and by final state.

### 3. Analyses of pushdown automata acceptance

PDA acceptability can be defined in two different ways: final state acceptability and empty stack acceptability. In final state acceptability, a string is accepted by a PDA when, after reading the entire string, the PDA reaches a final state. From the starting state ( $q_0$ ), we can make moves that end up in a final state with any stack values. The stack values are irrelevant as long as we end up in a final state.

For a PDA  $(Q, \Sigma, \Gamma, \delta, q_0, z_0, F)$ , the language accepted by the set of final states  $F$  is –

$$L(\text{PDA}) = \{w \mid (q_0, w, z_0) \vdash^* (q, \varepsilon, x), q \in F\}, \text{ for any input stack string } x.$$

Whereas, for empty stack acceptability a PDA accepts a string when, after reading the entire string, the PDA has emptied its stack.

For a PDA  $(Q, \Sigma, \Gamma, \delta, q_0, z_0, F)$ , the language accepted by the empty stack is –

$$L(\text{PDA}) = \{w \mid (q_0, w, z_0) \vdash^* (q, \varepsilon, \varepsilon), q \in Q\}$$

### 4. Analyses of some pushdown automata examples

To investigate further these concepts we are going to analyze some examples of PDA. So, first we have to construct a PDA that accepts the language  $L = \{0^n 1^n \mid n \geq 0\}$ . According to this language, the number of 0s should be equal to the number of 1s, so if we have  $n$ -number of 0s we should also have  $n$ -number of 1s.

$$L = \{\varepsilon, 01, 0011, 000111, \dots\}$$

If we take one input string, for example, “0011”, then during the first state  $q_1$  we do not read anything from the input string, we do not pop anything from the stack, but we push the first element  $z_0$  on the stack. This is mainly done because we want to know which is the bottom-most element of our stack so that we know when we reach the end of the stack. In some articles and books, the \$ symbol is used instead of  $z_0$ . After this, we move to the second state  $q_2$  and start reading the elements of the input string. If we read the first element and it is a 0, then we do not pop anything but we push this 0 onto the stack. This process may iterate depending on the value of  $n$ . Then, when we get the input symbol 1 the process moves to state  $q_3$  and during this state, if the topmost element of the stack is 0, we pop it and do not push anything on the stack. This may also iterate depending on the value of  $n$ . At the end of the string (when we do not have any more input symbols) we just pop the  $z_0$  from the stack and do not push anything. At this point, the process has reached the final state and the stack is empty, so the input string is accepted.

Below we can see the transition functions and the graphical representation for the PDA.

$$P = (\{q_0, q_1, q_2, q_3\}, \{0, 1\}, \delta, q_0, z_0, \{q_2, q_3\})$$

$$\delta(q_0, \varepsilon, \varepsilon) = (q_0, z_0)$$

$$\delta(q_0, 0, z_0) = (q_1, 0z_0)$$

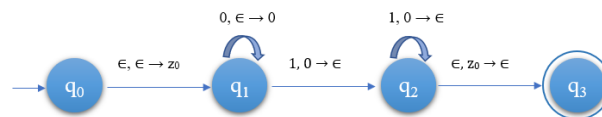
$$\delta(q_1, 0, 0) = (q_1, 00z_0)$$

$$\delta(q_2, 1, 0) = (q_2, \varepsilon)$$

$$\delta(q_2, \varepsilon, z_0) = (q_3, \varepsilon)$$

**Table 1.** Analysis of the State

Nr.	State	Unread output	Stack	Transition
1	q <sub>0</sub>	0011	z <sub>0</sub>	1
2	q <sub>1</sub>	011	0z <sub>0</sub>	2
3	q <sub>1</sub>	11	00z <sub>0</sub>	3
4	q <sub>2</sub>	1	0z <sub>0</sub>	4
5	q <sub>2</sub>	€	z <sub>0</sub>	5
6	q <sub>3</sub>	€	€	6


**Figure 2.** Graphical representation of PDA for the given language L

### 5. Analyses of Even Palindrome

As another example, we analysed a PDA that recognizes the language of even length palindromes of the form  $L = \{wwR \mid w = (a+b)^+\}$ . Intuitively, this PDA pushes the input symbols on the stack until it guesses that it is in the middle and then it compares the input with what is on the stack, popping of symbols from the stack as it goes. If it reaches the end of the input precisely at the time when the stack is empty, it accepts the string. But this particular example is limited only to a-s and b-s characters, and since it has a positive closure it means that it must contain at least one palindrome ( $\epsilon$  is not allowed). As for the first part of the language:

- w – represents the first half of the string,
- wR – represents the reverse of the first half (w).

For this Pushdown Automata, we will have 4 states which are (q1, q2, q3, q4). If we take the string “abba” as an input, then during the first state (q1) we don’t read any input symbol, we don’t pop anything from the stack, but we push a symbol (z0) onto the stack to denote the first element of our stack. Then, during the second state (q2) we get the first input symbol “a”, we don’t pop anything from the stack but we push that symbol to the stack. The same is done when we get the second input symbol “b” as well, we just push it to the stack. After that, we assume that we have reached the middle of the input string and during this phase, we don’t read any input symbol, we don’t pop or push any symbol from stack; we just go the next state which is q3. During this state we get the next input symbol which is “b”, we check if “b” is the current element on top of the stack and if it is, we pop it, also we don’t push anything to stack. The same is done with the next input symbol of the string (“a”) and it goes on until we reach the end of our input string. After that, we assume that our string is finished and we don’t read any input symbol, but we check if the symbol of the stack is (z0). If it is, that means that we reached the end of the stack, so we pop the (z0) and continue to the final state q4 (q4 can be also written as qf). Since our stack is now empty and we have reached our final state, this string is accepted.

The transition functions and the graphical presentation of the PDA are shown below:

$P = (\{q1, q2, q3, q4\}, \{a, b\}, \delta, q1, z0, \{q3, q4\})$

$\delta(q1, \epsilon, \epsilon) = (q1, z0)$

$\delta(q1, a, z0) = (q2, az0)$

$\delta(q2, b, a) = (q2, baz0)$

$\delta(q2, \epsilon, \epsilon) = (q3, \epsilon)$

$\delta(q3, b, b) = (q3, \epsilon)$

$\delta(q3, a, a) = (q3, \epsilon)$

$\delta(q3, \epsilon, z0) = (q4, \epsilon)$ .

Table 2. Analysis of the State

Nr.	State	Unread output	Stack	Transition
1	q <sub>1</sub>	abba	z <sub>0</sub>	1
2	q <sub>1</sub>	bba	az <sub>0</sub>	2
3	q <sub>2</sub>	ba	baz <sub>0</sub>	3
4	q <sub>3</sub>	a	az <sub>0</sub>	4
5	q <sub>3</sub>	ε	z <sub>0</sub>	5
6	q <sub>4</sub>	ε	ε	6

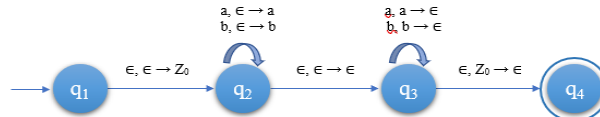


Figure 3. Graphical representation of PDA for the given language L

If we take another input string which is not an even palindrome, for example, the string “abab”, we will notice that on state q<sub>3</sub> the process will be blocked since the input element won't be the same with the element on top of stack. Therefore, nothing will be popped from the stack and we will not reach the end of it. That is why strings that are not an even palindrome will not be accepted.

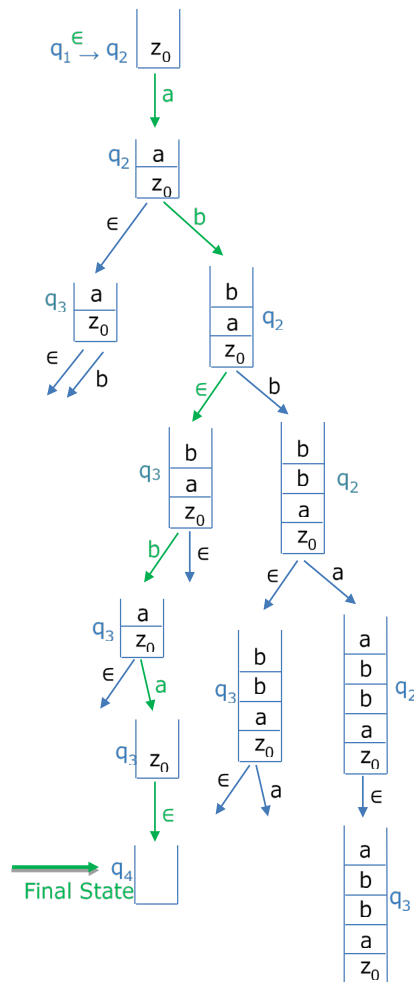


Figure 4. Diagram of all paths for the given PDA

## 6. Conclusion

In this study we used several case studies to investigate the process of analyses of the efficiency of Pushdown Automata. Regarding the research question: Can we reduce these automata concerning the number of states? Accepting states can be distinguished from other states in a variety of ways. The transformation preserves realtime behavior but not determinism. The loss of deterministic behavior cannot be avoided, since for each choice of  $n$  and  $p$ , there is a deterministic PDAM  $n$  such that no equivalent PDAM with fewer states can be deterministic. Bolding or highlighting the name, or using a double circle instead of a single, are common methods. When a machine just has one accepted state, it is frequently given the letter A. state.png accept It's worth noting that a machine with no accepting states accepts no string as part of the language (including the empty string) - it's essentially the Empty Language.

Besides the mentioned examples analysed were also subclasses of pushdown automata (PDA) such as superdeterministic pushdown automata and visibly pushdown automata, and other popular models of time-dependent behavior such as timed pushdown automata (PDTA), recursive timed automata (RTA) or dense-timed pushdown automata (dtPDA).

The two subclasses are investigated regarding the inclusion problems of PDA. Superdeterministic pushdown automata (SPDA satisfies the following conditions:

- A is deterministic and of finite delay,
- for all accessible configurations in reading mode  $c_1, c_2, c'_1, c'_2$  and  $w \in \Sigma^*$ , if both of the following are satisfied:
- $\text{state}(c_1) = \text{state}(c_2)$ ,
- $c_1 \xrightarrow{w} c'_1$  and  $c_2 \xrightarrow{w} c'_2$ ,

then,  $\text{state}(c'_1) = \text{state}(c'_2)$  and  $|c_1| - |c'_1| = |c_2| - |c'_2|$ .

On the other side, visibly pushdown automata (VPA) are special pushdown automata whose stack behavior (pushing, popping, or no stack operation) is completely determined by the input symbol. Each nondeterministic VPA can be transformed into an equivalent deterministic one, that is the main reason this type of automata enjoys many good properties similar to those of regular languages class. VPAs are very useful as specification formalism for verification for pushdown models, and also as automaton model for processing XML streams.

Timed automata are finite automata extended with a finite number of variables which are called clocks. These clocks can be reset and tested for inequalities with integers. A timed automaton is so equipped that it can read timed words, whose letters are labeled with real timestamps.

As conclusion we might algorithmically transform a formal description of the language to a finite state automaton, and there must be an algorithm that discovers the smallest automaton (by enumeration if nothing else, since the possibilities are finite). However, we do not (yet) have techniques to convert a natural language description into an automata or other formal description.

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# Analyses of Digitalization Possibilities in Education and Assessing the Impact of Gamification of Mathematics

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**Abstract:** The objective of this research is to investigate and assess the digitalization possibilities and the impact of educational games and mobile learning on students for the subject of Mathematics. Through an educational game that has been used by students for learning, the study investigated how it will improve their success and knowledge towards the subject of Mathematics. Learning through educational games has shown as more interactive and stimulated additionally the learners moving in step with the integration digitalization of mobile technology into the learning process. In order to assess and investigate our hypothesis we have devised an educational game and used it to further test student attention, motivation, success and the entire learning process in the course of Mathematics. Further analyzed student feedback and statistically analyzed the results using ANOVA, Analysis of variance is a collection of statistical models and their associated estimation procedures and calculated the Descriptive STATISTICS, the mean, Standard Deviation and the Variance between the experimental and controlled group. Insights and recommendations are discussed and argued.

**Keywords:** *Digitalization; Gamification; Mobile Learning; Mobile Games; Mathematics; Learning Process.*

## 1. Introduction

Course materials are now created, shared, and co-developed on the cloud in the digital age. Students learn to take on more personal responsibility at a young age through digital learning, which also helps them communicate and work in teams better. However, there is lack of research studies in regards of gamification of mobile devices and their use in Mathematics and overall effects and impact it might have. That is why this research study has been undertaken by the researchers is important to be addressed and solved. The digital education expectation gap is larger than most would think, so we look at what it means for the student's digital experiences. Why does a good digital experience in using mobile devices matter? It matters since today's generation of learners primarily use mobile devices and they are mostly used for gaming and entertainment. Therefore, gamification is important and incorporating such an activity that new generations of learners are interested within the education process could yield high results in learning.

## 2. Purpose and objective of Study

The research study purpose therefore is to investigate and assess the digitalization possibilities and the impact of educational games and mobile learning on students for the subject of Mathematics. Since gamification is a preferred activity of the new generations then the argument to use it in education process especially in mathematics can improve the overall attention and results. Therefore, the stud tries to contribute

with, and briefly are research objectives with possible contributions. The research paper is focused on these research objectives:

- The impact of mobile educational games on student`s attention and interest in the learning process
- The impact of mobile educational games on student`s on improving student success in Mathematics
- The impact of mobile educational games on student`s will and motivation
- Research on the adaptation of mobile learning by students and teachers
- Research on how mobile educational games encourage competition among students

### 3. Research Methodology

The research methodology to be employed is quantitative and qualitative. The purpose of the research study is to find out how the Educational Mobile Game will affect the learning process of students and achieve more positive results in the subject of Mathematics. Learning the subject of Mathematics from the game will be more interactive and will have a positive effect by increasing students' interest in learning. Another goal of the research study is to find out how students and teachers will adapt the mobile learning methodology in the learning process. Because children today have access to entertainment environments through games, this application and educational game will not be difficult for them to adapt. Using this new method for learning, we will see if there will be a significant increase in the motivation of the students for learning. Nowadays, children use mobile phones for entertainment purposes, so another aim of the thesis is to increase the motivation and interest of learning by not wasting their time playing, but learning and playing at the same time.

### 4. Hypotheses

The research study will be compiled based on these two main hypotheses:

*H1:* Mobile educational games have a positive impact on improving student success

*H2:* Mobile educational games have an impact on increasing students' attention and interest in learning

The research method used and the methodology must be clearly stated and described in sufficient detail stating the hypothesis and research questions with sufficient references.

### 5. Literature Review Mobile Learning

In the term M-Learning, the M stands for mobile, and the same concept is often referred to simply as mobile learning. M-learning is any type of learning that takes place through a portable, hand-held electronic device. Although the term immediately conjures up images of smartphones, it actually also refers to learning through other types of mobile devices, such as tablets, netbooks, and e-readers. According to Clark Quinn, mobile learning is "the intersection of mobile computing and e-learning: accessible resources wherever you are, robust search capabilities, rich interaction, powerful support for effective learning, and performance-based assessment - learning electronic location-independent in time and space (Blau, et al 2020). M-Learning enables students to bring their learning experiences together in a collaborative environment. The main goal of the next generation of learning systems is to use current and modern technologies to provide new learning, training and education techniques that will be easily accessible to all who want to learn. Although M-Learning has begun to be used to support a wide range of learning activities, not much research has been done to identify student requirements or to understand what types of mobile applications students should use on their mobile devices and how they can to be an effective mobile learning program (Vial, 2019). The concepts of M-learning were given by Alan Kay in the 1970s. He joined the Palo Alto Research Center of the Xerox corporation and formed a group to develop the "Dynabook", which is a portable and protative computer. It aimed to let children have access to the digital world. This project ultimately failed due to the

lack of technological support at the time. By 1994, the first smart phone, the IBM Simon, was created by Mitsubishi Electric Corp. He was defined as a personal communicator. Since that time, technology companies began to design the so-called "smartphones". The invention of the smartphone provided the platform for learning through the phone. Mobile learning is a new technique in the education system, especially in the education of Kosovo. Teaching and learning through mobile devices must be planned before being implemented in the classroom. First of all, the goal that we want to achieve with the implementation of learning through mobile devices should be clear. The following are the steps that must be followed in order to implement M-learning in the classroom. In order for learning to take place at the appropriate level and for students to be successful, the teacher plays a key role.

The educational system should invest in the professional development of teachers, sending them to various trainings for their advancement in technology, especially in the field of M-learning. In addition to professional development on the part of the education system, teachers can also advance on their own initiative, by participating in various conferences as well as through online courses. Teachers need to know mobile devices so that the integration of M-learning is at the right level.

### 6. Analyses Digitalization Process and Digital Literacy

Digital literacy involves more than simply being able to use software or use a digital device; includes a wide variety of complex cognitive, motor, sociological and emotional skills that users need to function effectively in digital environments (ESHET-ALKALAI, 2004). Although mobile learning has many advantages, it can be a distracting tool for learning. Teachers should teach students how to use mobile phones for pedagogical purposes. As the novelist Umberto Eco said, "If you want to use television to teach someone, you must first teach them to use television."

Facebook and texting do not count as digital learning skills (Barber, et al., 2012). Young people use the mobile for entertainment purposes, such as social media, various games, music, social communication, so they must have knowledge of how to use the mobile in the classroom. Students must follow the teachers' instructions about the use of mobile phones for educational purposes, during class they must not access social networks or communicate with society.

The abilities needed for both school and the workforce have changed as a result of technological advancements. Knowing how to access, search for, and critically evaluate information was a requirement for digital literacy, which evolved parallel with the development of the internet (Liu et al., 2020). Users have acquired new abilities to create digital resources as a result of the development of social networks like YouTube and Pinterest and the accessibility of mobile devices, which is characterized by media literacy (Koc & Barut, 2016; Liu et al., 2020). The new talents will vary over time as technology advances, rather than being static (UNESCO, 2017). Institutions and individuals still have a problem in recognizing, modifying, and incorporating the advancements into their specific needs. Various studies on digital literacy have offered suggestions for mappings. Several studies have show that to effectively use technology for learning, users must gain the knowledge and skills necessary. One difficulty is that users must invest time in learning new skills in order to use and implement the technology (Fucili et al., 2020). Beyond the usage of tools and software, the digital transformation of the classroom has an impact on the knowledge and abilities of its users, teachers, and students, as well as the didactics and procedures of educational institutions (Fucili et al., 2020) & Vasilev et al (2020). Digital pedagogies, technological models, and adaptable, open, smart, and disruptive technologies are some examples of how educational technology is used nowadays (Sánchez, A. C et al 2017). Participants in educational institutions must be alert and ready to keep up with changes.

### 7. Devising Software Solution

The created software was created as a solution to test the research objectives. In contrast to the use of created games that require a large amount of modeling and development efforts, the "gamification" approach suggests the use of game thinking and game design elements to improve student engagement and motivation (;). (Bucea et al, 2022), (Rampelt et al, 2019) and Jackson, N. C. (2019). After researching about educational applications in Albanian language, which compared to applications in English language are few, most of them are for basic operations in Mathematics. The functions are very simple which can only be used by children in grades lower than fifth grade. Since there is no application for the fifth grade and the materials belonging to this grade, then we decided to solve this problem by creating an educational game about 5 chapters from Mathematics of the fifth grade, which can be expanded to the whole material. The educational game is called mole mash and has 5 levels, after each level questions from the subject of Mathematics are presented according to the selected categories. In addition to the game, there are also quizzes with the same categories, then the other option is with learning materials, videos for explanation and tasks that students can repeat as many times as they want. In the Points option, students can see their points for each category as for both game and quiz. Another option is a video about using the app and one about the app. There are many opportunities for learning by students in the app, which can be used anytime and anywhere once downloaded and installed on their mobile. Students can use the application and the educational game without having to connect to the Internet, making the way of learning even easier than learning through web applications where the user must have access to the Internet.

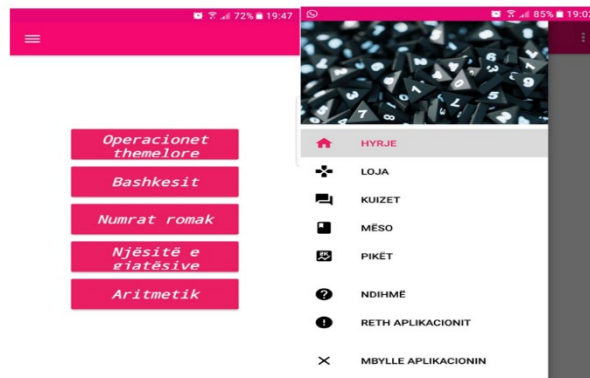


Figure 1. The Interface of the Software Solution

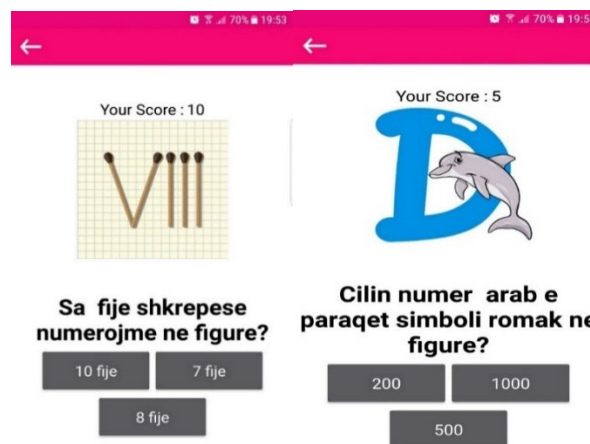


Figure 2. Learning Assessments in Mathematics

8. Findings and Results

The expected findings and arguments of the work should be described and explicitly argumenta. All the tables, images and figures should be centered. Figures and images should be numbered and figure headers should be placed under the figure or image; as for the tables, they should also be numbered and the table header should be placed at the top.

References (if any) of the tables, figures and images should be presented right under the tables, figures and images in the form of author surname and publication date.

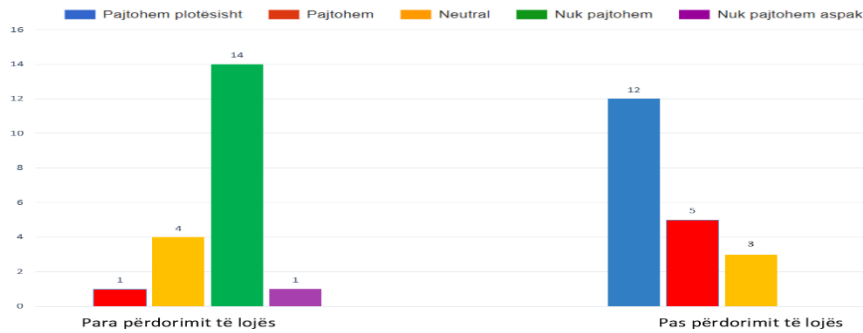


Figure 3: Has the mobile educational game improved my ability to understand the subject in general?

In the figure above, we can see that the graph before using the game shows that almost all the students surveyed disagree that mobile educational games encourage competition among them. We see that 14 of the students disagree, 4 are neutral, 1 disagree and 1 did not agree at all. In the graph after using the game, most of the surveyed students agree that mobile educational games encourage competition between them, 12 of the students fully agree, where 5 of them agree and only 3 have a neutral attitude. From these positive results we see that mobile educational games encourage competition among students.

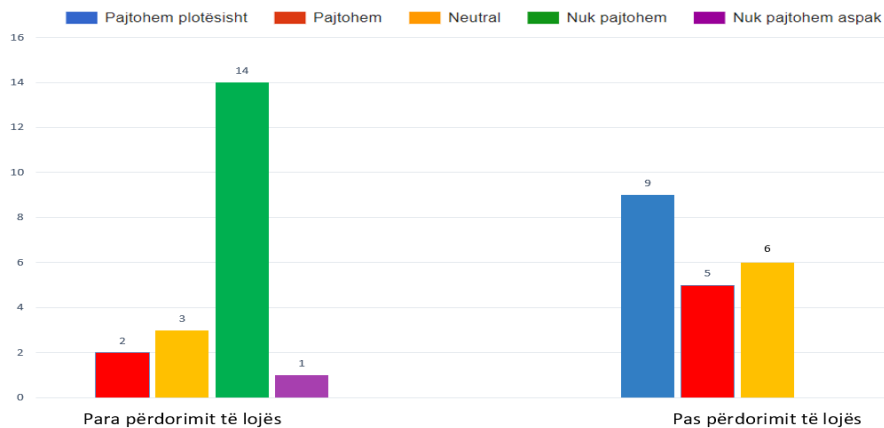


Figure 2. The impact of the mobile educational game for students to understand the subject in general

In figure above, we can see that the graph before using the game shows that almost all the surveyed students disagree that the mobile educational game has improved their ability to understand the subject in general. We see that 14 of the students disagree, 3 are neutral, 2 disagree and 1 did not agree at all. In the graph after using the game, most of the surveyed students agree that the mobile educational game has improved their ability to understand the subject in general, 9 of the students fully agree, where 5 of them agree and 6 have a neutral attitude. From these positive results, we see that the mobile educational game has had a positive impact by improving the students' abilities to understand the subject in general.

Descriptive Statistics we have used are analyzed using ANOVA. ANOVA or else know as Analysis of variance is a collection of statistical models and their associated estimation procedures used to analyze the

differences among means. ANOVA was developed by the statistician Ronald Fisher. ABOUT of two groups. Statistics table \_ descriptive results before preparation by \_ of game AND circumstances in classical shows that the average of the results ABOUT group Experimental it's **44.95** WHEREAS ABOUT the control group it's **45.63**. From these results we see that the control group before the preparation has an average more of higher than the experimental one (**The experimental group 44.95 < control Group 45.63**).

Descriptive STATISTICS									
	N	Range	Minimum	Maximum	Sum	Mean		Std. Deviation	Variance
	Statistics	Statistics	Statistics	Statistics	Statistics	Statistics	Std. Error	Statistics	Statistics
Experimental	20	40	20	60	899	44.95	2,450	10,957	120,050
Controlled	19	40	20	60	867	45.63	2.636	11,490	132.023

Results descriptive from the table for test statistics after using the game and preparing in a traditional way show

that the average of the results for the experimental group is **52.15** while for the control group it is **47.05** . From this positive result where **experimental Group 52.15 > Group of control 47.05** we see that the game educational for the subject of Mathematics has a positive impact on the success and knowledge of students.

### 9. Conclusions and Recommendations

Mobile learning in general is considered by the participants in this study as an effective tool in improving the learning process. Based on the conclusions and analyzes drawn from this research study, we can recommend mobile learning for the entire educational system. From the empirical study of the data and their analysis from a quantitative and qualitative point of view, which were carried out in the experimental group and in the control group, after comparing the results, the influence of the Mathematical educational game has shown itself by making differences in the achievements of the students in the subject relevant. The experimental group that used the educational game for learning reached a significantly higher level of Mathematical knowledge. Through the educational game, students found it easier to prepare for subjects in general. After using the game, the students felt motivated, more attentive, more interested and more willing to learn. The students have challenged each other through the game, inciting competition against each other. The educational game has been welcomed and easily adapted by students and teachers. All the mentioned features prove the purpose of this research on the impact of mobile educational games on the subject of Mathematics. The Learn and Play app has changed the way these students learn, making learning more interactive for both the teacher and the students. It has also enlightened the minds of students, making them aware that games are not only for fun and leisure but also for learning. For teachers, it is a new path and a new challenge for the integration of mobile learning methodology in the curriculum. The awareness of students towards new technologies for learning is unfortunately low. As evidence, we have the answers to the questions from the first questionnaire, where their opinions about educational games are very negative. We note that students do not have access to and have not previously used any educational games for their lessons.



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## **SESSION 2**

**FINANCIAL ANALYSIS AND  
TRANSFORMATION IN ECONOMY SESSION  
CHAIR: Dr. EDMIRA CAKRANI**



# Regression Analysis of Engineering Index and ISO Standards Index for Balkan Countries

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**Abstract:** The goal of conducting this study was to present the importance of the engineering index and the relations of this index with knowledge, labor force, engineering industry sophistication, infrastructure, digital infrastructure, and safety standards, as the main elements of the engineering index, and connections of engineering index with a quality management concept, especially with ISO standards under a worldwide perspective approach, focusing on Balkan region.

The methodology of the research was collecting data and information about engineering index elements (knowledge, labor force, engineering industry sophistication, infrastructure, digital infrastructure, and safety standards), analyzing them, and building an engineering index, after which a descriptive analysis was performed, as well as a comparison between Balkan countries, followed by regression analysis between engineering index and ISO 9001 index for Balkan countries.

The main recommendation is that strengthening elements of the engineering index and quality management processes and procedures, materialized at ISO standards, helps companies to strengthen their commitment to their clients, and improves the entrepreneurship environment, activities, processes, and procedures, as well as the worldwide economy, as a response to Crisis and Post-Crisis Period.

**Keywords:** *Engineering Index; Engineering Industry Sophistication; Digital Infrastructure; ISO standards.*

## 1. Introduction

The goal of conducting this study was to present the importance of the engineering index and the relations of this index (which is formed by knowledge, labor force, engineering industry sophistication, infrastructure, digital infrastructure, and safety standards indexes, as the main elements of the engineering index) with quality management, ISO standards, especially with ISO 9001:2015.

## 2. The field of engineering

The field of engineering is broad, evolving, and integral to the promotion of human development and economic growth. Engineering plays a critical role in designing and developing infrastructure, systems, and processes that make the world safe, and ultimately support the achievement of broader social milestones such as the United Nations' Sustainable Development Goals (UNSDGs), and as we enter the fourth industrial revolution, engineering will also drive innovation and help grow the digital economy too. Of course, each country will have to determine its engineering priorities, based on its domestic circumstances. Engineering capability gaps will also differ depending on national goals, as well as a country's education system, income level, and economic structure. Addressing these gaps could require more engineering graduates, but it will

more likely require interventions in education programs, graduate training, and professional development. To bring this diversity of challenges and solutions to life, we have examined specific engineering capability issues in Balkan countries Albania, Bosnia & Herzegovina, Bulgaria, Croatia, Greece, Romania, Serbia, Slovenia, Turkey, nine different Balkan countries, and in the analysis section, we discuss the context, and drivers of engineering capability gaps in these countries, as well as potential thoughts on how to address them.

### 3. Literature on engineering and its elements

Currently, literature on engineering and its elements (knowledge, labor force, engineering industry sophistication, infrastructure, digital infrastructure, and safety standards), has been improved all around the world, because concepts of engineering and its elements, applied correctly, help private and public organizations to be improving entrepreneurship performance oriented and achieving competitive advantage, in an open market when and where the offer is much higher than the demand, one of the main characteristics of last 50 years of the world economy.

### 4. The role of engineering activity

Engineering activity boosts economic growth. As a measure of the extent to which countries can conduct engineering activities safely and innovatively and as a tool for understanding the factors that determine overall engineering capability across countries, serves "The Engineering Index", which provides a comparative measure for countries of the world in six categories of knowledge (a measure of contribution to and advancement of knowledge in engineering and technology), the labor force (the availability and diversity of engineers in the economy), engineering industry (the strength and sophistication of the engineering industry), infrastructure (the ability of infrastructure to support and demonstrate engineering activities), digital infrastructure (the ability of digital infrastructure to support and demonstrate engineering activities), and safety standards (safety in engineering-intensive sectors).

### 5. Engineering and quality management

On the other side, no matter the size of business organizations, or the specific industries serve, they can benefit from certification to one or several quality management system standards, gaining a competitive advantage when entering new markets, as it represents a known and trusted standard of quality, as well as shorten cycle times and improve accountability, achieve compliance with new regulations faster, become recognized in the field of activity as an environmental leader, streamline the supply chain and reduce reliance on fossil fuels, enhance awareness and improve overall security and safety posture, engage staff at all levels and secure executive-level participation in quality management goals, etc. ISO 9001 is one of the most recognized management standards in the manufacturing industry and an important certification for any organization concerned about improving quality control. Specifically, while acknowledging the importance of engineering and engineering index, in doing business and entrepreneurship ecosystem, prior empirical research does not explain how knowledge, labor force, engineering industry sophistication, infrastructure, digital infrastructure, and safety standards among them together, help and support engineering. There are only a few serious theoretical studies showing the strong connection between knowledge, labor force, engineering industry sophistication, infrastructure, digital infrastructure, and safety standards, but they're not any numerical, statistical, or algebraic studies that show this connection, as well as there, is no previous study that has investigated relations between engineering index with ISO standards, especially with ISO 9001:2015 index. Thus, theory-building is needed, supported by analysis and evidence.

6. Methodology

The methodology followed for the realization of this study was the creation of the idea for the field of study for which the research would be performed, the collection of data, figures, facts, and information about knowledge, labor force, engineering industry sophistication, infrastructure, digital infrastructure, and safety standards, as well as the literature that would be used for the realization of the study.

The literature, data, figures, facts, and information were then read, and selected, to determine the materials to be used in this study. Subsequently, the study methodology has been the processing of data through comparative analysis of knowledge, labor force, engineering industry sophistication, infrastructure, digital infrastructure, and safety standards, worldwide, to produce an engineering index, for which descriptive statistics were performed. After calculating the engineering index, a reverse score for this index was prepared, to show its real value in terms of the classification of countries based on this index, followed by a comparative analysis for Western Balkan countries, undertaken to provide comparative data for identification, quantification, and visualization to display the main research results, and propose solutions for Western Balkans economies. After this, a comparative analysis was followed by regression between the engineering index and ISO 9001:2015 standard for Balkan countries performed to verify, Ho or H1 Hypothesis was true. After writing the final text, the abstract, and the introduction of the paper were constructed, and then the relevant conclusions and recommendations have been drawn, and later all information and data in a user-friendly prepared, visual manner understandable for a wider audience in case of publication of this paper research and in case of presenting findings on scientific occasions related to the issue.

Table 1. A comparative table for Balkan countries, inverse figures

KNOWLEDGE		LABOUR FORCE		ENG. INDUSTRY		INFRASTRC		DGTL INFSTC		SAFETY STNSD		ENGR INDEX	
Country	Rn	Country	Rn	Country	Rn	Country	Rn	Country	Rn	Country	Rn	Country	Rn
Turkey	74	Greece	80	Slovenia	88	Slovenia	73	Romania	76	Slovenia	83	Slovenia	80
Slovenia	70	Slovenia	77	Romania	66	Greece	67	Slovenia	71	Croatia	76	Greece	66
Greece	69	Croatia	63	Croatia	62	Croatia	54	Bulgaria	60	Greece	76	Croatia	64
Serbia	54	Romania	59	Serbia	54	Bulgaria	44	Serbia	53	Albania	66	Romania	58
Croatia	52	Bulgaria	48	Turkey	46	Turkey	42	Croatia	52	Serbia	56	Turkey	54
Bulgaria	50	Turkey	46	B&H	35	Albania	38	Turkey	52	Bulgaria	52	Bulgaria	53
Romania	45	Albania	41	Greece	34	B&H	31	Greece	38	B&H	46	Serbia	47
Albania	32			Albania	13	Romania	30	Albania	37	Romania	41	Albania	27
B&H	13					Serbia	22	B&H	33			B&H	20

Regression analysis for relations between the engineering index and ISO 9001 index has been performed, using data for the engineering index resulting from this research and using data for the ISO 9001 index from previous research of the author of this paper [17].

Table 2. Inverse engineering index and ISO 9001 index [17] for Balkan countries

Country	Inverse eng. index	ISO 9001 Index
Slovenia	73.3	0.0087
Greece	57.3	0.0192
Croatia	56.7	0.0082
Romania	49.8	0.00756
Turkey	48.2	0.00075
Bulgaria	48	0.0075
Serbia	44.8	0.0093
Albania	34.8	0.0023
B&H	28.6	0.0139

**H<sub>0</sub>:** There is a connection between the Engineering index and ISO 9001 index

**H<sub>1</sub>:** There is no connection between the Engineering Index and ISO 9001 index

**Table 3.** Regressive analysis

SUMMARY OUTPUT	
<i>Regression Statistics</i>	
Multiple R	0.168679
R Square	0.028453
Adjusted R Square	-0.13347
Standard Error	0.006295
Observations	8

## 7. Research results

- Based on the data of this research, it appears that the countries of the Balkan countries are at a level unsuitable for the engineering index compared to the goals of these countries for integration in Europe and among themselves.
- Balkan countries rank from 20 to 80 position in a list of 99 countries).
- Serbia, Albania, and Bosnia & Herzegovina are below the Median, 49.3.
- Examining the constituent characteristics of the engineering index, it turns out that Slovenia, is well positioned, followed by Greece, Croatia, and Romania, further by Turkey and Bulgaria, and at the end Serbia, Albania, and Bosnia & Herzegovina.
- Since in terms of the engineering index Balkan countries are not in a suitable position, also for the elements of knowledge, labor force, engineering industry sophistication, infrastructure, digital infrastructure, and safety standards, these countries have shortcomings.
- There is no connection between Balkan countries' engineering and ISO 9001 certificates index. This means the certification process with ISO 9001 standard is not a trend that might support the engineering index in the Balkan region.

## 8. Conclusions and recommendations

The main conclusion and recommendation are that towards fixedness of natural resources and restrictions on boundless economic growth approach, the direction of the engineering index and its elements (knowledge, labor force, engineering industry sophistication, infrastructure, digital infrastructure, and safety standards) is important in overcoming resource constraints. Improving the entrepreneurship ecosystem and achieving competitive advantage requires a positive approach towards knowledge, labor force, engineering industry sophistication, infrastructure, digital infrastructure, and safety standards, requiring improvement of doing business climate in Balkan economies, seeing this as a general macro and microeconomic perspective too, while, in a broader context, this study extends the general understanding of the engineering index and its elements (knowledge, labor force, engineering industry sophistication, infrastructure, digital infrastructure, and safety standards) relations to be used for a future managerial approach/mechanism in real-world situations, suggesting future research could focus on developing and validating the proposed framework and investigate the issue in more contexts and settings. There is no connection between Balkan countries' engineering and ISO 9001 certificates index. This means the certification process with ISO 9001 standard is not a trend that might support engineering trends for this region. The main recommendation for improving doing business climate, entrepreneurship ecosystem, and competitive advantage requires investments in engineering index, knowledge, labor force, engineering industry sophistication, infrastructure, digital infrastructure, and safety standards to strengthen their commitment to their clients, improving processes and



procedures, to achieve the competitive advantage, as a response to Crisis and Post-Crisis Period.

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# Challenging Application of the Circular Economy through Artificial Intelligence

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**Abstract:** Considerable literature and experiences of the last decades has brought to the stage the circular economy, as the new format of doing economy. Through applying circular economy society can use in a rational and efficient mode the scares and limited resources of our only planet.

The presented idea in this paper will be supported and argued, through the presentation of sources of authoritative scientific literature, as well as primary empirical findings. Comparisons, analysis and generalizations on the primary and secondary findings will also be part of the methodology, along with other research study instruments used in this paper. What are the mindsets, policies and ways of using Artificial Intelligence in the Albanian reality of circular economy applied cases? I will answer the above research question through the collection of primary empirical and analytical data collected in the Albanian reality. The data on the Albanian environment and economy will be collected across the intensive industrial and urban development areas, without excluding rural areas. To achieve this goal, direct and online communication will be used through questionnaires and surveys specially prepared for this purpose. The forecasted findings of this work will support the hypothesis and the conclusion that the application of artificial intelligence in the circular economy models in Albania could be part of the innovative global trends of doing economy, benefiting society and the nature.

**Keywords:** *Circular Economy; Artificial Intelligence; Natural Resources; Society.*

## 1.Introduction.

During the last two centuries, the society has been able to create and develop an advanced economy, based on the development of industrial technologies, at the same time it has been able to generate well-being and comprehensive progress. Visible advances are the product of society's knowledge and training, supported by new technologies, without which the above indicators could not be achieved. But, as we have reached the two decades of the new century, contemporary society is facing new challenges in relation to the model of economic development and the use of technologies.

## 2. A new mindset of human's interactions versus natural resources

Human knowledge and advanced technologies are going to the heart of the earth capable of grabbing everything, from which the life history of our planet, the Earth, was created. According to the forecasts of The Global Material Resources Outlook to 2060, [1] the use of global materials will rise double to those of today. Not only that, but the endless oceans and atmosphere to interplanetary space, are almost entirely under the power of human knowledge and advanced technological instruments created by the intelligence and power of humans. Although there are many articulations and ideas developed on EC, in content the CE is about the rational and careful management of natural resources.

In this interaction, I intend to argue that human knowledge and advanced technologies can be integrated and create models of economic development by applying advanced technology products. A significant case seen under this perspective is the treatment of the interaction of the Circular Economy and Artificial intelligence. The concept of the circular economy is oriented towards the restorative and regenerative model. The model states that by keeping materials at their optimal use and value continuously, the system can be

optimized [2]. The optimization in question can only be provided by digitalization and more precisely, AI. The Circular Economy enables a model of economic development, according to which the continuously increasing fulfillment of the all-round needs of society does not exhaust the resources of nature, generates economic growth and care for the human and natural environment. The Rocky Mountain Institute estimated in the year 2000 that the flow of natural materials globally is 500 billion tons per year but only 1% is put into durable products and still there 6 months later, the other 99% is waste. (ABC, 2001).

Even the model in question, is sustainable in financial terms (cost/benefit). According to Ellen Macarthur Foundation [2] CE is a "restorative and regenerative system by design, which aims to maintain products, components and materials and their highest utility and value".

Studies show that in Europe, the Circular Economy can generate benefits of up to 1.8 trillion Euros by 2030 [2]. Beyond these figures, the circular economy in Europe can contribute to facing the challenges of preserving natural resources, promote innovation, take care of the environment and create employment. All these indicators can be articulated as indicators of growth for Europe and not only. Investments in AI-focused ventures have grown 1,800% in just six years, from \$282 million in 2011 to more than \$5 billion in 2016. [3].

An AI system is a machine-based system that is capable of influencing the environment by producing an output (predictions, recommendations or decisions) for a given set of objectives. It uses machine and/or human-based data and inputs to (i) perceive real and/or virtual environments; (ii) abstract these perceptions into models through analysis in an automated manner (e.g., with machine learning), or manually; and (iii) use model inference to formulate options for outcomes. AI systems are designed to operate with varying levels of autonomy [4].

## 2.1. Definitions linking AI with Circular Economy

Among definitions on AI, I choose to bring to attention the definition of an AI system follows that of the OECD principles: *"An AI system is a machine-based system that is capable of influencing the environment by making recommendations, predictions or decisions for a given set of objectives. It does so by utilizing machine and/or human-based inputs/data to: i) perceive real and/or virtual environments; ii) abstract such perceptions into models manually or automatically; and iii) use Model Interpretations to formulate options for outcomes."* [4].

If I refer to the period of the last decade it can be seen that there is an increase in scholarly attention to the measurability of AI and its diffusion in society. It brings to attention applications and investments in businesses, where the main attention of studies was also focused. Thus, the World Intellectual Property Organization [5] offered a report on technology trends in reference to artificial intelligence. In this report, they were mainly focused on patenting and innovations in the industry, as well as purchases of industrial equipment from different companies. At the European level, I would highlight the work of the Joint Research Center of the European Commission (EC-JRC), which published an orientation study report for the EU on artificial intelligence [6].

Several scientific definitions consider the circular economy as a restorative, regenerative and sustainable economic model linked to the "production and consumption of goods through closed loop material flows that internalize environmental externalities linked to virgin resource extraction and the generation of waste (including pollution)" [7]. The above-mentioned authors mention that circular economy is an approach that would transform the function of resources in the economy [8]. It "refers mainly to physical and material resource aspects of the economy – it focuses on recycling, limiting and re-using the physical inputs to the economy, and using waste as a resource leading to reduced primary resource consumption". For prestigious institutions invested in this area a circular economy is an alternative to a traditional linear economy (make, use, dispose), in which we keep resources in use for as long as possible, extracting the maximum value from them whilst in use, then recovering and reusing products and materials [10].

"A circular economy provides opportunities to create well-being, growth and jobs, while reducing environmental pressures. The concept can, in principle, be applied to all kinds of natural resources, including

biotic and abiotic materials, water and land' [11]. The objective of the circular economy is to reduce the environmental impact of resource consumption and improve social well-being. [12].

The circular economy is an economy "where the value of products, materials and resources is maintained in the economy for as long as possible, and the generation of waste minimized". The transition to a more circular economy would make "an essential contribution to the EU's efforts to develop a sustainable, low-carbon, resource-efficient and competitive economy". Through this new model of doing economy society is facing the challenges of the negative effects of the model we have applied which are multifaceted, numerous and growing, just like the global economy itself. [11]. Under this reality, new solutions and instruments are needed on the way to another model of economic development. It is estimated that the solutions in question can come by applying new technologies, including faster, interactive, and agile learning processes, and by designing interactive cycles, building models as examples for application, which beg for redesign of multifunctional tasks of the new economy.

There are several scientific definitions on AI introducing application of the AI in the circular economy model. According to definitions if AI is a field of computer science that deals with the development of machines that work and react like humans. [13]. AI deals with models and machines that perform human-like cognitive functions, such as reasoning and learning. AI enables specific applications that include: using image recognition to determine when fruit is ready to harvest, matching food supply and demand in the most effective way and increasing the value of food by-products [14]. The application of artificial intelligence has a proportional benefit in the field of circular economy. These include: applying real-time traffic data to reduce traffic congestion, optimizing energy usage for cooling servers in various data centers, and improving collaboration between car sharing companies and automotive companies [15]. The equivalent opportunity of AI in accelerating the transition to a circular economy for consumer electronics is up to \$90 billion per year in 2030 [16]. In this case applications here include: selection and design of specialized materials; extending the lifespan of electronics through predictive maintenance; and automating and improving e-waste recycling infrastructure through the combination of image recognition and robotics.

Artificial intelligence (AI) can play an important role in enabling the transition to models away from Business-as-Usual Models. As a subset of technologies that deals with models and systems that perform functions generally associated with human intelligence, such as reasoning and learning, AI can be complementary to human capabilities and capabilities, augmenting them. Numerous positive experiences are demonstrating and showing how AI could contribute to facing the new challenges of contemporary society.

### 2.2. How AI contributes to the circular economy?

CE and AI are considered as two dominant trends accelerating the transition towards the required economic models. The acceleration in question can be achieved, among others, through the creation of products with components of circulating materials, the application of circular business models as well as the optimization of the infrastructure of the circular economy. [17]. AI contributes through iterative design processes assisted by industrial equipment that enable rapid prototyping and testing. By combining real-time and historical data from products and users, AI can help increase product turnover and asset utilization through price and demand forecasting, predictive maintenance and smart asset management, etc. Artificial intelligence can help build and improve the reverse logistics infrastructure required to "close the loop" on products and materials, improving processes for sorting and dismantling products, remanufacturing components and recycling materials. Although circular strategies aim to close material flows and to extend the lifetime of the products, companies face serious challenges in the transition towards a circular model. If we consider recycling processes the potential value unlocked by AI to help design waste into a circular economy for food could be as much as \$127 billion per year by 2030 [18]. This mission is enabled across the cycles/processes of cultivation, processing, logistics and consumption.

The circular economy aims to extend the life of products, while in this process companies face serious challenges in the transition to a circular economy model. In this face of digitalization, digitalization provides accurate information on the location and availability of products, which facilitates companies in the transition to a more circular sustainable model. [19]. Not only that, but the use of digital technologies leads to the reduction of waste, extends the life of products and minimizes transaction costs that enable efficient processes in business companies and not only. AI helps to enhance circular business models of closing/slowing and narrowing the loops by increasing resource efficiency. [20].

Through data analysis AI can help to define circular business patterns [21]. Artificial intelligence combines historical data and real-time data discovered about products and their users, so AI is able to improve asset utilization and product turnover by predicting demand using intelligent inventory management. [22]. They recommend that currently, one of the most important roles of circular business models is to share and lease the products instead of selling.

### **2.3. Values of intelligent ranking systems in regard to the circular economy.**

To illustrate levels of applications across several sectors, I am choosing food, agriculture and mechanical engineering as a case study. The use of AI enables cost efficient and highly accurate classification between material types and brand owners. Data collected across installations is stored in the cloud and used to continuously improve the identification algorithm [12]. AI can also help with the sorting of waste and materials, enabling their proper separation and collection for possible secondary use [23]. Investments in AI-focused ventures have grown 1,800% in just six years, from \$282 million in 2011 to more than \$5 billion in 2016, according to CB Insights.

AI in agriculture helps provide contribute to data driven solutions, supports monitoring and effectiveness in time, while increasing safety and effective consumption of products, which means more effective use of natural resources, reduction of pollution and shortages. Automation of consumption of agricultural resources. The rapid developments of AI enable effective and new tools to develop effective agricultural models, with equal opportunities for society and especially for its needy categories. Meanwhile, the application of AI in agriculture saves the use of natural resources, their rational use and also protects the environment. [24].

AI can assist farmers in monitoring crops, soil use, grain and guide the appropriate decision-making of agricultural producers. For example, sensors with their data and images taken in the field, AI algorithms, determine the right time to plant seeds, harvest fruits, etc., using resources more efficiently. Through AI weather forecasting algorithms using historical data of the territory, as well as through sensor data in the field. Weather forecasting helps farmers save crops, weather erosion, etc.

Meanwhile, through the processing of data on consumer behavior, they predict the data on the quantity, quality, games of products in agriculture, rationalizing the production and use of natural resources for consumption, while they can also distribute urban food waste for consumption. How much food waste is there in the world today? Artificial intelligence systems can be transformed into robotics that also perform programmed actions, just like humans to give answers on several critical issues linked to this discussion. Design iterative machine learning techniques can be used to design products, materials and components based on circular economy principles. [25]. Machine learning describes a computer program that is designed to extrapolate information based on observed patterns. [26]. Some of the machine algorithms include supervised learning, unsupervised learning, reinforcement learning and evolutionary algorithms

### **2.4. How important is the use of AI in agriculture, in reference to the CE model?**

There are at least 570 million smallholder and family farmers, [27], and it is estimated that almost 1 billion people work in this sector, representing 28% of the global workforce. If we use AI, we can reduce grain losses by 30%. Imagine how important this indicator is, especially today in the period of global crisis caused by the

events in Ukraine. AI is becoming rapidly an integrated part of daily activities and economic activities [28] transforming the attitudes and patterns of the society [22].

### 3. Conclusions:

The advancement of technology will enable artificial intelligence to be integrated into complete systems for the creation and operation of the circular economy, and contribute to models of sustainable development, under the economic, social and environmental dimensions.

Digital professional education and training is a must to accelerate the application of AI in circular economy models, going all the way to end users. Partnership with the industry should be built in order to accelerate the transition to the Circular Economy.

Investment in AI sector will impact multisectoral progress in contemporary society;

Albanian and other WB countries should be part of AI advancements in order to rapidly be integrated as part of EU standards;

Linking AI with Circular Economy, will contribute towards the UN SD Goals benefiting society and nature.

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# Financial Institutions before and after the Pandemic of COVID 19: An Empirical Measurement of their Financial Stability

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**Abstract:** The financial stability in general is really difficult to be defined as well as measured. Compared to price stability it needs way more engagement in measuring due to the miscellaneous variables composing the financial system but not only. Their interaction is what makes the analysis even more difficult. Even though, nowadays, researchers from central banks and not only, have done their effort to analyze the behavior of the financial stability by using different financial indicators and their relationships. Moreover, this type of analysis intends to make a proper assessment and evaluation of the risks arose in the financial system. This paper makes a synthesizing of several articles written about the overall financial stability with the focus on the stability of financial institutions. Moreover, a quantitative analysis is conducted based on this stability on the period before and after the pandemic of COVID 19. This quantitative measure of the stability of financial institutions might be used by the policy makers and other participants of the financial system to make a proper monitoring of the level and fluctuations of the financial stability of the system. It might also help in contemplating the main variables responsible of the financial instability and take precautions and measures to monitor and keep them in control in order to downplay their negative role on this perspective. The paper is composed as follows: The first session describes the meaning of the financial stability and the variables related to that. The second session makes an in-depth analysis of the behavior and the relationship among these variables to draw conclusions about their effect. This analysis is done on a timeframe of 10 years including the year of the pandemic. Based on the trends driven by the session two, the session three makes a future forecast analysis on the conditions of the financial market for 5 years. The paper concludes that the times of crisis driven by major causes like pandemic, provide financial instability. In order to face them properly, finding the roots of the problem is not sufficient. A contingency plan is always needed if we want the effect of the turmoil to fade away.

**Keywords:** *Financial Stability, Financial Institutions, Pandemic, Variables, Contingency Plan.*

## 1. Introduction

There are several ways to define financial stability. The majority of them agree that the absence of systemic incidents in which the financial system fails to function is what defines financial stability (crises). It also has to do with how resilient financial systems are to pressure. In times of financial instability, when it is absent, the full worth of financial stability is best demonstrated. Banks are hesitant to support profitable ventures during these times, asset prices diverge significantly from their intrinsic values, and payments may be delayed. Bank robberies, hyperinflation, or a stock market meltdown might result from significant instability. The confidence in the financial and economic system may be seriously shaken.

The pandemic of COVID-19 likewise the other previous crises once again showed that the financial market will always be at risk unless the governments interfere to smooth the transition from such turmoil. Moreover, at institutional level there will always be required a contingency plan to avoid the bankruptcy in crisis times. Anyway, even though the pandemic caused financial crisis, the economic behaviour of the

financial institutions seemed to be somehow different from the other types of businesses. Apart from economic factors, there were included other demographic, behavioural and psychological factors that affected the decisions of the investors but also that of the general public on their approach toward financial institutions. As such some of them experienced blossoming during the pandemic like insurance companies and pension funds. Some others suffered losses but at a rate that might have been easily overcome.

The unlike behaviour of this sector compared to the other businesses and industries is the driven motive of this research paper. An empirical analysis is done based on the financial reports provided by the websites of the financial institutions to measure their financial stability on the time of COVID-19. There are miscellaneous models and financial tools that can be used to analyse the financial stability on individual business level as there will be further explained.

## 2. Impact of the pandemic on the financial stability

Multiple articles have been written by scholars on the impact that the pandemic had on the financial stability of all the sectors of the economy. All of them agree that the crisis arose from the pandemic shocked the whole financial system and affected the financial institutions operating in there. Even though there might be plenty of articles on the analysis of different financial institutions, the focus has been mostly concentrated on the performance of banks and insurance companies, as the biggest sectors of this industry.

According to the following definitions, financial stability is: (i) the absence of notable fluctuations; (ii) the absence of crises; (iii) analysis of the impact of financial stability on macroeconomic conditions; (iv) using the broad definition of financial stability as being closely related to money, the real economy, as well as fiscal policy. Financial, fiscal, political, and economic instability are intricately linked; instability in one sector can result in instability in another and vice versa, according to Keliuotyte [1]. The presence of a link between the stability of the financial system, financial development, specific forms of financial integration, and economic growth has also been demonstrated by Tumpel-Gugerell [2].

When compared to the Great Recession, several authors claim that the COVID-19 problem is very different. Parisi[3] noted that the US economic condition was particularly favourable in the start of 2020 and continued to improve in several sectors until an economic pandemic struck. Although the economy experienced a significant shock, the negative impact was less severe than it would have been in other crises since things began to turn around more quickly than they had in previous downturns. The COVID-19 pandemic, [4], is distinct from the 2008–2009 financial crisis since it affected the majority of firms, whereas the latter was more closely linked to the property market and financial institutions. Gonzalez-Paramo [5] claims that crisis prevention—rather than the eradication of their effects—is the primary goal of financial stability policy. It is significant to note that financial systems have grown increasingly susceptible recently to systemic shocks. In addition, a variety of hazards, both endogenous and exogenous, pose a danger to financial stability. For instance, as mentioned by Bauer and Granziera [6], private sector leverage affects how vulnerable a country is to financial stability. The maturity and risks transformation, as well as the price of risk procyclicality, are other conventional sources of financial system fragility [7].

Whereas historically financial systems have mostly been concerned with the economic security of transactions, the growing significance of non-financial elements has brought attention to the importance of environmental, social, and governance risk. [8]

Similarly, the current situation shows that, in addition to those already listed, health crises like the pandemic may potentially pose dangers to financial stability. The COVID-19 pandemic, which served as an exogenous shock, increased the need for a variety of restraints, which in turn led to a decrease in economic growth. The pandemic resulted in severe supply-side and demand-side shocks [9], worsening the state of the private corporate sector and posing serious risks to the banking industry and hence financial stability. While the banking industry appears to have retained liquidity in recent months, as the crisis continues to unfold, the concerns persist. Both the public and commercial sectors will need to act in order to avoid those hazards. [10] Governments and investors must support financial institution solvency and work to establish the necessary

framework for them to play a key role in the nation’s economic recovery. This will involve direct assistance from governments and development organizations for managing non-performing assets and balance sheets. Development finance institutions play a crucial role in de-risking financing to sectors that are essential to the economic and social recovery, such as MSMEs, women-owned businesses, and lower-income households. This is especially true in lower-income, unstable, and conflict-affected markets. [11]

Referring to the insurance companies’ sector, the European Insurance and Occupational Pensions Authority recommends that national supervisory authorities lessen the impact of the coronavirus disease 2019 (COVID-19) pandemic on the European insurance industry because it has significantly disrupted the economy, businesses, and people live. Insurance firms; capacity to operate is in jeopardy as they attempt to balance a sharp rise in the number of claims with the stability of their capital and solvency. [12]

Karolina Pulawska’s [13] study uses financial statement data from European insurance firms from 2010 to 2020 to assess the COVID-19 pandemic’s consequences on insurance companies. The findings unequivocally show that the pandemic had a negative impact on the insurance industry’s ability to function. During the epidemic, German and Italian insurance businesses in particular saw a decline in return on assets.

**3. Methodology**

The emphasis of this paper is put on the empirical analysis conducted by secondary data provided on the websites of the companies. As an interesting field of study, it finds the market of financial institutions as of great importance of studying the impact that the pandemic had on their overall financial performance.

**3.1. The sample of the research**

Referring to forbes.com the study uses 10 top financial institutions in the world by revenue. This sample is thought to be representative enough to the population of financial institutions as they are classified as the top 10 by a prestigious ranking body. The limitation in the selection of this sample is that it is not currently updated, as it belongs a ranking of 2020. Anyway, it is thought to not manipulate the overall results at a significant level. The financial institutions used in this analysis are as follows:

Rank	Company	Industry	Revenue	Total Assets	Headquarters
1	Berkshire Hathaway	Conglomerate	247.5 billion	707.8 billion	United States
2	Ping An Insurance Group	Insurance	163.6 billion	7,143 billion	China
3	Allianz	Insurance	143.9 billion	973 billion	Germany
4	AXA	Insurance	113.1 billion	1,008 billion	France
5	JP Morgan Chase	Banking	105.4 billion	2,687 billion	United States
6	ICBC	Banking	105.4 billion	4,027 billion	China
7	China Construction Bank	Banking	95 billion	3,376 billion	China
8	China Life Insurance	Insurance	92.7 billion	362 billion	China
9	Bank of America	Banking	91.2 billion	2,325 billion	United States
10	Agricultural Bank of China	Banking	87.6 billion	3,287 billion	China

Figure 1. Top 10 financial institutions in the world

### 3.2. The analysis variable

The financial variable used to explain the financial stability of these institutions is the z-score. It tells if the value of the assets is sufficient to cover the total value of the liabilities of an institution, as such it provides information on the solvency of the business. The higher its value, the better as it tells that the company doesn't suffer insolvency risk. The fluctuations of the values of the z will tell about the sustainability of financial institutions sector during the pandemic. It is calculated as follows:

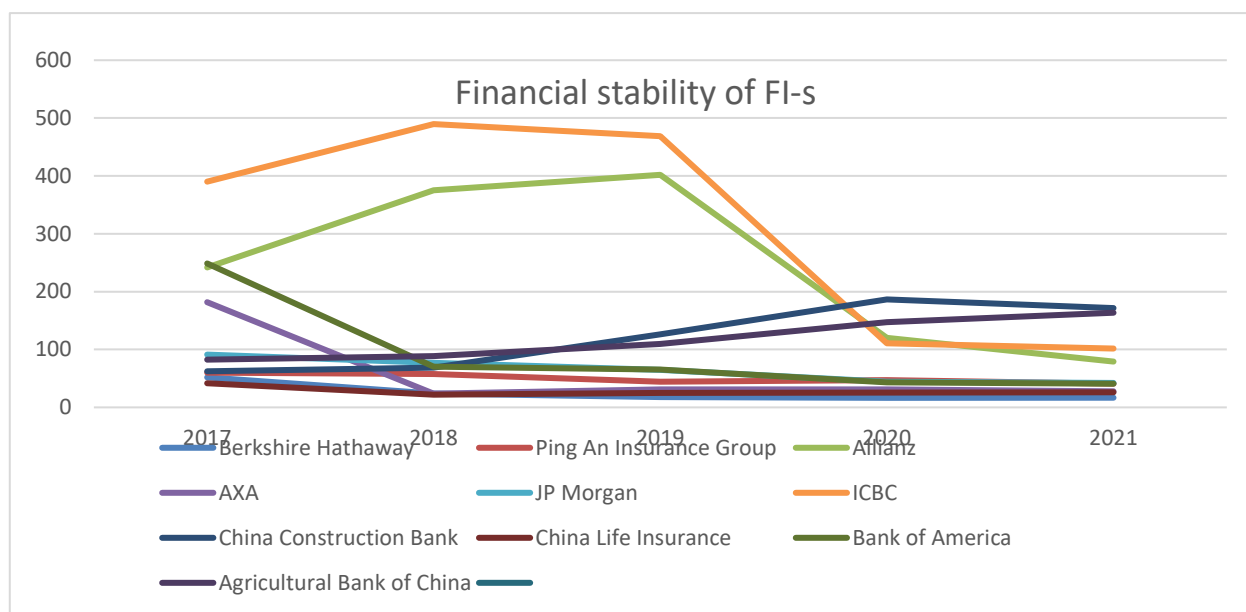
$$z \equiv (k+\mu)/\sigma,$$

-k is equity capital as percent of assets,

- $\mu$  is return as percent of assets,

- $\sigma$  is standard deviation of return on assets as a proxy for return volatility

### 4. Data analysis and results



**Figure 2.** Financial stability of financial institutions

This chart of the financial stability clearly shows that the financial institutions are divided in three main groups referring to the values and the behaviour of the financial stability represented by the z-score. One group is represented by the companies with low values and declining patterns during and after the pandemic, referring merely to Europe.

The other group is composed of private American and Chinese institutions with high values of the financial stability but with a huge decline during the pandemic.

The third group is composed of Chinese public institutions with good values and increasing slope.

### 5. Conclusion

The pandemic of COVID-19 has put the whole economic system in difficulty. It has also put in question the ability of the countries to recover from such types of major causes which bring turmoils to the global financial system.

Different countries showed different approaches to facing the crisis and taking the necessary measures for the future after it. Most of the financial indicators showed a huge decline in their values which all in all are

translated in a declining of the financial stability for all the sectors of the economy. Some countries like China with the support of the government were able not only recover from the crisis arrived from the pandemic but they also showed the opposite behaviour of the financial indicators compared to the other countries and institutions.

Probably the effects of the pandemic may be yet to come, as such all of the financial institutions are aware of the need for a contingency plan in case such problems will be repeated again.

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# Challenges and Opportunities of Islamic Finance in Albania

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**Abstract:** Islamic finance, also referred to as Ethical finance, is a type of banking and financial services that adheres to Islamic law and principles. Despite being a relatively new form of finance, it has gained worldwide recognition, especially in countries with a significant Muslim population, but also in many Western countries that have altered their legal and regulatory structures to accommodate and to foster the growth of this sector. Islamic finance promotes financial inclusion, particularly for individuals who have voluntarily excluded themselves from using conventional financial services due to religious convictions. In Albania, where there is a considerable traditional Islamic population, the establishment and growth of Islamic finance is expected to contribute to financial inclusion by providing alternative banking and investment services, as well as increase market competition. Despite its growing popularity and clear benefits, Islamic financial institutions still face various challenges in implementation. This paper aims to examine the current state of Islamic finance in Albania, evaluate potential challenges, and identify opportunities for further development.

**Keywords:** *Islamic Finance; Islamic Banking; Ethical finance; Albania; development.*

## 1. Introduction

Since the fall of the communist regime in the early 1990s, Albania has undergone a remarkable transformation from a communist-style economy to a market-based economy. This transition has been characterized by a series of reforms aimed at liberalizing the country's economy and attracting foreign investment. Despite the challenges posed by privatization, fiscal consolidation, and trade reform, Albania is today regarded as a developing country, and issues related to financial development, financial inclusion, and access to finance are of great concern, because access to finance is crucial for the development of a country as it enables various stakeholders to invest in productive activities, create jobs, and spur economic growth. It helps individuals, businesses, and entrepreneurs to obtain the capital they need to start or expand their operations, purchase equipment, and pursue new opportunities. Without access to finance, many individuals and businesses may struggle to achieve their goals, and the overall economic growth of the country may be hindered. Additionally, access to finance can help address poverty and inequality by providing underserved communities with the means to invest in their future. In the case of Albania, the banking sector is the main channel through which households and businesses can obtain financing as the financial sector is dominated by banks, which account for close to 90% of the total financial sector assets, with shares of non-bank financial institutions making up the remainder [12]. Given that Albania has a significant Muslim population, with more than 60% of the population being Muslim according to the 2011 census [8], it can be assumed that religious considerations may play a role in the voluntary exclusion of some individuals from accessing financial services. Although this topic has received limited attention in academic research, some studies, such as Musta [11], have confirmed that Muslim-owned businesses may have a nuanced approach to conventional financing

options. According to the Global Findex Database [15], 10% of the unbanked population cited religious beliefs as their primary reason for not having a bank account. This number could potentially be higher if one takes into account that in many countries, having a bank account is a requirement for receiving a wage or conducting business. Theoretically, according to a World Bank report [14], IF can play a significant role in enhancing financial inclusion in countries with dominant Muslim populations. Thus, the purpose of this study is to assess the challenges and opportunities of accommodating alternative financial options such as IF in Albania.

## 2. Islamic finance as an alternative to conventional finance

Islamic finance is a form of financial system that operates in accordance with Islamic law (Shariah). It offers an alternative to conventional banking, based on the Islamic principles of fairness, justice, and social responsibility, and aim to promote ethical and sustainable economic development.

Islamic finance is an attractive option for individuals who have voluntarily excluded themselves from accessing conventional financial services due to a conflict with their religious beliefs. This group faces barriers to finance not due to lack of eligibility, but due to demand-side factors such as personal ethical, moral, and psychological attitudes towards money and the financial sector. This includes individuals who distrust financial institutions and those whose religious beliefs, particularly in the Muslim community, prohibit the use of conventional financial services due to their interest-based practices [13]. Islamic finance prohibits the charging and paying of interest (riba), which is considered usurious and unjust, as well as investments in businesses that are considered to be harmful to society, such as gambling, alcohol, and tobacco. Instead, Islamic finance relies on profit and loss sharing (PLS) arrangements, where the financial institution and the customer share in the profits and losses of the venture. This alignment of interests helps to promote responsible and sustainable financial practices. One of the key features of Islamic finance is the concept of mudarabah, which is a PLS arrangement where the financial institution provides the capital and the customer provides the expertise and management. This arrangement is used in various forms of Islamic finance products, including partnerships, joint ventures, and venture capital financing. Another feature of Islamic finance is the concept of murabaha, which is a form of cost-plus financing where the financial institution purchases an asset on behalf of the customer and sells it to the customer at a markup. The customer then repays the loan in installments over time. This arrangement is commonly used in Islamic finance for consumer financing, such as for the purchase of homes or cars. Islamic finance also includes the concept of sukuk, which are Islamic bonds that are structured as assets rather than debt. Sukuk are used to raise capital for infrastructure projects, real estate development, and other investment purposes. In addition to these financial products, Islamic finance also includes various forms of insurance, such as takaful, which is an Islamic form of insurance that is based on PLS arrangements and mutual assistance. Islamic finance is growing rapidly around the world, with assets amounting to 3.4 trillion USD in 2020 with a projection to rise to 4.9 trillion by 2025 [9]. The growth of Islamic finance has been driven by a combination of factors, including increased demand from the Muslim population for ethical and socially responsible financial products, as well as the desire of non-Muslim investors for alternatives to conventional finance. Islamic finance continues evolving to compete with conventional finance in attracting customers not only from Islamic religious backgrounds, but also from different faiths [1].

Despite its growth and increasing popularity, Islamic finance faces several challenges, including a lack of standardization and harmonization of Shariah laws and practices, limited scope of Islamic finance services (despite some efforts to broaden the scope of Sharia-compliant services offered, Islamic banks and other financial institutions still lag behind traditional banks in terms of the range of services they can offer), limited access to financing for small and medium-sized enterprises, and a shortage of skilled personnel. Nevertheless, the continued growth and development of Islamic finance is expected to provide new opportunities for financial innovation, economic development, and social responsibility.



### 3. Islamic finance experiences in Albania

The banking sector in Albania has been present since the country's formation in 1912, with the first bank opening its doors in 1913. After the end of Communism in the 1990s, the banking sector underwent changes to adapt to the market economy. With well-established financial regulations that align with EU standards, Albania has a two-tiered banking system consisting of the central bank (Bank of Albania) and 12 secondary banks, both domestic and foreign-owned. While Islamic banking has gained global recognition and is present in both Muslim and non-Muslim countries, including many European and Western nations, however, Albania has yet to fully embrace Islamic banking, and its progress in this area is slower compared to other nations. The United Bank of Albania, founded in 1993 as the Arab - Islamic Bank, was designed to operate based on the principles of Islamic banking, where interest is prohibited in borrowings and loans. Despite the long history, being one of the first and oldest bank since the introduction of the two-tier banking system, UBA's performance has been poor. Today, the bank holds only 1.1% of the credit market in Albania, operates in six branches, and employs 86 people. However, it is important to note that the underperformance of the United Bank of Albania may not necessarily reflect the lack of market demand for Islamic banking. The bank does not market itself as a proper Islamic bank and its products and services are not fully compliant with Islamic principles. In reality, this case highlights the importance of the Albanian legal and regulatory framework in recognizing the unique characteristics of Islamic banking products and services and creating a supportive environment for their growth. Improper addressing of issues such as supervisory laws, corporate governance, taxation, etc. may hinder the competitiveness and appeal of Islamic banking products. As noted by Musta [11], a lack of information and prejudice from the general public towards Islamic finance and banking products and services offered by the UBA may also contribute to the weak demand. However, it should be noted that despite the absence of specific legislation for the Islamic banking sector in Albania, the United Bank of Albania has adapted and modified certain instruments to align with Shariah principles as much as possible. These instruments include the Musharrah Contract, Murabahah Contract, Ijarah, and Diminishing Partnership Contract. These offerings demonstrate the bank's commitment to adhere to Islamic principles and offer a range of financial services that cater to the needs of those who follow these principles. According to unverified sources, two additional local banks are contemplating expanding their offerings to include Islamic financial products by establishing an "Islamic window." However, to date, no official applications for licensing have been submitted by either entity.

### 4. Islamic banks vs Conventional Banks

There are several similarities between conventional and Islamic banks. IBs are resource-efficient, profit-maximizing organizations that assist in decreasing information asymmetries, lower transaction costs, and promote a variety of alternatives for small investors and savers [16]. In theory, however, Islamic and conventional banking differ in important ways. Conventional banking, also known as traditional banking, is based on the principles of charging interest on loans, which is referred to as "riba" in Islam. In conventional banking, the bank is seen as a financial intermediary that accepts deposits from customers and lends these funds to borrowers. The bank earns a profit by charging a higher interest rate on loans than the rate it pays on deposits. Islamic banking, on the other hand, is based on the principles of Shariah law, which prohibits the charging of interest. Instead, Islamic banks engage in profit-and-loss sharing (PLS) arrangements, where the bank and the customer share in the profits and losses of the venture. For example, if the bank finances a project and the project is successful, the bank and the customer both share in the profits. If the project fails, the bank and the customer both share in the losses. One of the main differences between conventional banking and Islamic banking is the source of income. Conventional banks generate their income from the spread between interest rates charged on loans and the interest rates paid on deposits. Islamic banks generate their income through PLS arrangements, fees, and commissions. Another difference is the role of risk. In conventional banking, the bank bears the risk of default, while in Islamic banking, the risk is shared between the bank and

the customer. This shared risk helps to align the interests of the bank and the customer, as both parties have a vested interest in the success of the project. One similarity between conventional and Islamic banking is that both provide a variety of financial products and services to meet the needs of their customers. For example, both offer savings accounts, checking accounts, and investment products. However, the specific products and services offered may differ between the two types of banking. In terms of regulation, both conventional and Islamic banking are subject to government regulation, with the specific regulations varying from country to country. In some countries, there are separate regulatory bodies for conventional and Islamic banking, while in others, the same regulatory body oversees both types of banking.

## 5. Challenges for licensing and operating an Islamic Bank

Due to the differences between conventional banking and Islamic banking, there are certain challenges associated with integrating Islamic banking into existing regulatory and legal frameworks, which are primarily designed for conventional banking. In light of the implementation of Islamic banking, some of the major challenges faced by Islamic financial institutions (IFIs) during the application process for obtaining a license in European countries such as the UK, Germany, and France have been identified. These countries have made significant strides in recognizing and addressing the barriers to accommodating Islamic finance within their economies.

### 5.1. On Savings accounts

There is an ongoing debate regarding the definition of a "deposit" in the context of Islamic banking. In conventional banking, a deposit is defined as a sum of money that is paid with the understanding that it will be repaid on demand or as per the agreed terms between the parties. This definition is significant as it guarantees full repayment of the deposit in the event that the bank remains solvent. However, in the case of the profit and loss sharing account (Mudarabah), which is the equivalent of a savings account in conventional banking and is considered a "deposit" in Islamic finance, the depositor must bear the risk of losing the initial capital according to Shariah Law. Initially, in the case of UK, the FSA's assessment of the legal definition of a "deposit," which requires capital assurance, did not align with this concept. However, after extensive discussions, a solution was reached to state that, in addition to full repayment, customers have the option to opt out of deposit protection for religious reasons and choose to be reimbursed using the Shariah-compliant, risk-sharing and loss-bearing formula. This arrangement ensures compliance with FSA requirements while accommodating religious beliefs.

### 5.2. On Deposit protection

The protection of deposits is a crucial issue in the realm of supervisory legislation. According to European and Albanian legislation, a bank must be a participant in a deposit guarantee system, which is typically a fund that provides insurance for deposits up to a certain amount in the event of the bank's insolvency. Some Islamic scholars contend that such a categorical promise to repay deposits is inconsistent with Islamic Law and ought to be altered for Islamic banks as it contravenes the principle of profit and loss sharing [3]. Under Shariah, the client must share the risk with the bank. From a British bank deposit perspective, such an arrangement cannot be considered a bank deposit, as it exposes customers to risk, which is contrary to the statutory framework for protecting bank deposits up to the threshold set by the deposit protection scheme [10]. According to Casper and Ait Allali [5], this issue remains unresolved. In Albania, investor protection is guaranteed by Albanian law and is therefore of utmost importance. Each private bank in Albania must comply with this requirement and be a member of the private bank deposit protection system. However, banks may opt out of the optional deposit protection system. Nevertheless, as previously mentioned, this situation needs to change. One possible solution is to determine whether this instrument

should be classified as an investment management agreement or a bank deposit. If classified as a deposit, it would more logically complement other banking services.

### 5.3. Investment Account Holders

In a traditional banking system, depositors are regarded as debt providers and are compensated with interest payments that are proportional to the duration of their deposit. Conversely, Islamic banking prohibits interest and therefore, depositors are seen as capital contributors [4]. This perspective is grounded in the Mudarabah-partnership principle of Shariah, which outlines the roles of the agent (Islamic bank) and the *rab'ul mal* (capital contributor). The aim of Islamic banks is to offer a consistent rate of return to their "investment account holders" through profit and loss sharing by establishing reserves to stabilize fluctuations. These reserves are stored in profit-equalization reserve accounts or investment reserve accounts that were established to address the commercial risk in Islamic banks [7]. However, such accounts pose a conflict of interest by favoring one class of investors over another, unless strict and unambiguous rules regarding the amounts placed in these accounts are in place [10]. Additionally, it is essential to consider how investment account holders are treated within the company's governance structure, and to first establish who the owners of the firm (in this case, the Islamic bank) are.

### 5.4. The Concept of Financial Risk

The contractual obligation linking Islamic banks' shareholders and investment account holders to share profits from investments led Al-Deehani, Karim, and Murinde [2] to propose a theoretical model in which, under certain conditions, an increase in investment account financing can boost both the market value and shareholders' rate of return for the bank without incurring any additional financial risk. Islamic banks rely on four major sources of funds for their capital structure, which include shareholders' equity, current accounts, investment accounts, and savings accounts. It is not permissible under Shariah to issue preference shares, as it would entail paying fixed dividends to these shareholders. Investment accounts are neither a liability nor can they be classified as equity funds, rather they are a new and distinct type of instrument with a maturity and give Islamic banks the right to invest these account funds on behalf of their holders through profit sharing. Therefore, investment accounts do not present a financial risk to the bank.

## 6. Conclusions and Recommendations

The concentration of the Muslim population in Albania, combined with the advantages of offering alternative forms of financing to conventional credit, make the implementation of Islamic finance and banking in Albania a valuable endeavor. Such implementation would not only increase the penetration of financial services to underbanked customers, but also contribute to social inclusion. The Albanian legal and regulatory framework, being similar to European financial markets where Islamic banking has already established a presence and operates successfully, presents the possibility of accommodating Islamic finance in Albania. There are several challenges for implementing Islamic banking in Albania:

**Lack of Awareness:** There is often a lack of awareness and understanding of Islamic banking among the general population and financial institutions, which can make it difficult to promote and establish Islamic banking services. **Regulatory Challenges:** The regulatory framework is not supportive of Islamic banking and there are limited legal provisions to accommodate its unique features and structures. This results in difficulties in obtaining licenses and permits, as well as in executing transactions. **Competition with Conventional Banking:** Islamic banking may face competition from well-established conventional banking institutions that have a dominant market position. **Lack of Skilled Personnel:** There is a shortage of skilled and knowledgeable personnel who are familiar with the principles and practices of Islamic banking, which can hinder the development and growth of the sector. **Financial and Operational Challenges:** Establishing Islamic banking in a non-Islamic country requires significant

financial and operational resources, including investments in technology, infrastructure, and human capital. This can be a challenge for smaller financial institutions that may not have the resources to invest in these areas. Perception of Complexity: Some individuals may perceive Islamic banking as being complex and difficult to understand, which can discourage its adoption. To sum up, despite the challenges associated with the implementation of Islamic banking in Albania, there are also prospects for growth and advancement, particularly as a growing number of customers look for alternative financial products and services. Therefore, we suggest further research on this topic, beginning with the organization of a conference involving regulatory bodies, academic institutions, financial organizations operating in the country, and investors.

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# Analysis of Banks' Capital Structure: The Case of Albania

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**Abstract:** Finding the appropriate balance between debt and equity is one of the most important decisions that managers must make in a company. Even though there has been an increase in the number of publications on capital structure in the form of journal articles, books, conference papers, and reports, literature on capital structure, especially for banks is rather restricted when compared to non-financial institutions. Therefore, this paper aims to provide a comprehensive perspective on the theoretical and empirical research of capital structure in the Albanian banking system and the variables influencing the choice of how to effectively allocate the capital required for second-level banks. To reach this objective a regression analysis will be used. The sample of the study comprises twelve 12 second-level banks operating in Albania from 2011 to 2020, making a total of 120 observations. The independent factors include bank size, profitability represented by ROE, and tangibility, whereas the dependent variable is the leverage ratio or capital structure. This empirical study investigates to what extent these factors impact the capital structure of the banking sector in Albania and to whether the regression outcomes go in line with the already grounded theories. According to the findings of this research, the main determinants that contributed to the capital structure of the banking industry in Albania between 2011 and 2020 are tangibility and bank size, whereas ROE was found to have no significant impact on capital structure, with all these factors conforming to sign expectations based on the empirical findings presented in the literature review.

**Keywords:** *Capital Structure; Leverage Ratio; Return on Equity; Bank Size; Profitability.*

## 1. Introduction

One of the most contentious and crucial issues in financial management is capital structure. It encompasses investment projects, dividend policy, long-term debt issuance, buyouts, and so on. When the cost of capital is low and the dividend to shareholders is pretty much high, then it can be said that the capital structure is at its optimum. The capital is given by two primary sources: loans and equity. Debt capital has two benefits: Firstly, the interest will be subtracted from the tax base, by that lowering the true cost of debt; secondly, creditors give a strong return, so, during periods when the company's profits are rising higher, they do not share this benefit with the bank's partners who provided the loan. However, there are two drawbacks to this blended debt capital: Firstly, the debt ratio raises the bank's risk as it increases the bank's cost of borrowing. Secondly, if the bank's revenues are reduced and the company has challenges, then the liquidation of the debt's interest will be inadequate to meet the commencement of a process.

Financial institutions' capital structures differ from those of non-financial institutions. Liabilities connected to capital legislation are the most significant variables influencing the capital structure of banks, which are the main sector of financial institutions in Albania. According to Kester [1], banks' policies and risk profiles are presently receiving a lot of attention. This is owing to the current global financial crisis, which has failed in several of the world's major banking institutions. This emphasis on banks is being used to identify risk factors that contribute to the global financial crisis and to establish regulatory mechanisms to prevent those risks.

From a theoretical standpoint, the research seeks to offer information on the issue of capital structure and

regulation among banks in a variety of methods. The study intends to contribute by comparing the various financing channels and funding mix used by banks in Albania to discover best practices. From a practical standpoint, the study's conclusions should be of essential support to the management of the Albanian banking system in their decision-making process and efforts to optimize their bank's performance and value. The main research focus will concentrate on addressing this core question: What are the main factors affecting capital structure in the banking industry in Albania?

## 2. Literature Review

Keown, Martin & Petty [2], defined capital structure as the mix of financial resources such as debt and equity that are shown on company or institution balance sheets. Furthermore, Haugen and Senbet [3] defined capital structure as the choice afforded to enterprises to select between internal and external financial instruments. Meanwhile, Schlosser [4] interpreted capital structure as the ratio of debt to total company capital. Brealey and Myers [5] described the capital structure as a bank's combination of debt, equity, and hybrid instruments. Additionally, capital structure may be defined as the ratio of total debt to total assets at book value, which might affect the bank's profitability and riskiness [6]. Due to several definitions provided by earlier studies, Gitman and Zutter [7] condensed the concept of capital structure to "the blend of debt and equity retained by the business." In other words, when a business or organization seeks to grow its operations or market, it needs money, which might take the form of debt or equity. In general, adopting inadequate capital structure decisions can lead to financial troubles and, finally, bankruptcy. The business's management sets capital structure to optimize bank value [8]. Furthermore, capital structure may be defined as the ratio of total debt to total assets at book value, which might affect the bank's profitability and riskiness [6].

Several types of research have explored the determinants of bank capital structure, and the most referenced and referred publications on bank capital structure are drawn from Frank and Goyal [9]. Based on this prior research, the researchers conducted some significant variables that can define the capital structure model, namely profitability, tangibility, bank size, and growth potential. According to Keshar [10] corporate size, growth rate, and profitability, all have a significant influence in determining financial leverage in financial institutions, whereas business risk, dividend payout ratio, debt service capacity, and degree of operating leverage all play a minor effect. Bas, Muradoglu, and Phylaktis, [11] used World Development Indicators data to examine the drivers of capital structure decisions made by banks in 25 developing countries, and they discovered that tangibility, profitability, and scale are the most important predictors of capital structure decisions. Ramakrishnan [12] investigated the major influence of variables on the determination of capital structure in Malaysian banks from 2009 to 2018. He found that risk, non-tax debt shield, size, and tangibility all have a substantial influence on a bank's capital structure selection. Ogbulu and Kehinde [13] examine the impact of various determinants on the capital structure formation of some banks and firms listed on the Nigerian stock exchange from 2000 to 2015, finding that size has a positive and significant impact on capital structure formation while age has a negative and significant impact. Fauzi, Basyith, and Idris [14] investigated the capital structure determinants of 79 New Zealand banks listed in New Zealand from 2010 to 2020 and discovered that tangibility, growth, signaling, managerial ownership, and bank size are crucial for total debt. Choi [15] studied the important determinants of capital structure of the 50 Korean banks from 2015 to 2020 and discovered that profitability, the tangibility of assets, and bank size have a significant positive relationship with financial leverage, whereas, growth opportunities and tax shield substitutes have a significant negative relationship with leverage.

Masoud [16] also investigated the most important factors of French banks and SMEs' capital structure for 12, 857 French SMEs and banks from 2007 to 2016. They discovered that liquidity, asset structure, and profitability are the most significant factors in the capital structure of French SMEs and banks. Thippayana [17] studied the capital structure determinants of 144 listed banks from 2000 to 2020. He demonstrates that bank size and profitability are important factors of capital structure. Tiwari and Krishnankutty [18] investigated the determinants of capital structure with leverage of banks in the Netherlands from 2011 to 2015

and found a negative and statistically significant relationship between non-debt tax shields and size and a positive and statistically significant relationship between growth and tangibility and leverage ratio, but profitability and risk have no significant relationship with leverage.

Sheyma [19] examined the capital structure determinants of banks in Slovakia from 2009 to 2018 and found that bank size is the only significant determinant of capital structure, whereas non-debt tax shields profitability, the collateral value of assets, growth, tax rate, liquidity, uniqueness, tangibility, and business risk have no significant relationship with leverage. Handoo and Sharma [20] investigated the major capital structure variables of 870 listed banks, Indian private sector enterprises, and government companies from 2011 to 2015. They remarked that the most significant factors of capital structure are the cost of debt, profitability, growth, asset tangibility, size, tax rate, and debt servicing capability.

Amidu [21] found a negative association between leverage and profitability, which is consistent with prior research by Handoo and Sharma [20] and validates the prediction of the pecking order theory. Banks with bigger profits may essentially raise the amount of internal financing rather than external funding. Frank and Goyal [9] studied the effect of capital structure determinants on leverage in American banks from 2000 to 2020 and discover that market-to-book assets ratio and profits have a negative relationship with leverage. According to Amidu [21], profitability, corporation tax, growth, asset structure, and bank size are major elements that determine bank capital structure. Drobetz and Fix [22] demonstrated that enterprises with higher earnings and more investment prospects employed less leverage, correlating the pecking order hypothesis with the trade-off theory. Furthermore, in both market-oriented and bank-oriented economies, the leverage ratio decreases as company profitability rise [23]. Regardless of how the debt ratio is measured, research on capital structure in emerging economies confirms the result that better profitability is related to a lower debt ratio [24]. Several banking sector research [21; 25; 26] confirm the pecking order theory's prediction of a negative relationship between profitability and leverage.

Gropp and Heider [27] found that the tangibility of assets might have an impact on the leverage of banks. The authors asserted that an increase in tangible assets may be beneficial, particularly in times of financial distress, and that the relationship supports the trade-off theory. Furthermore, the presence of tangibility as a capital structure factor might put pressure on shareholders to switch from high-risk assets to low-risk assets [28]. In this perspective, the tangible assets that banks own such as land, buildings, inventories, and current assets may offer a guarantee to the banks for the money that banks already distribute to the debtors and can enhance the amount of debt in the capital structure [29]. However, the pecking order hypothesis suggested a negative association between leverage and tangibility due to the restricted information asymmetry associated with physical assets which makes equity look to have a lower cost [30]. Furthermore, past research has shown that the impacts of tangibility on bank leverage, such as a rise in tangible assets held by banks, may provide more collateral to back up in the case of liquidation, and so can increase leverage spontaneously [31]. As a result of the mixed results and arguments among the theories, the influence of tangibility on bank leverage must be investigated in depth. There is disagreement among experts on the link of leverage to bank size. In evaluating the degree of debt, huge banks do not take bankruptcy expenses into account. As a result, larger banks are less likely to fail. The second assumption is that there is a negative link between leverage and bank size since large banks have asymmetric knowledge. This decreases the possibility of fresh stock issuance being undervalued, leading to the use of additional equity financing. Huang and Song [32] analyzed the capital structure determinants of some Chinese listed banks from 2000 to 2015 and discover that bank size, non-debt tax shields, and fixed assets have a positive significant relationship with leverage and a negative significant relationship with profitability. Abor [33] studied the relationship between long-term and short-term debt and the drivers of capital structure of banks and small and medium-sized banks listed on the Ghana Stock Exchange between 2010 and 2015. He discovers that long-term debt is favorably connected to size and growth while being adversely related to age, profitability, and tax, but short-term debt is positively related to age, dividend payout, and tax while being negatively related to both asset structure and risk.

### 3. Methodology

The population of second-level banks in Albania is composed of 12 banks, Banka Kombetare Tregtare, Raiffeisen Bank, Intesa SanPaolo Bank, Procredit Bank, United Bank of Albania, First Investment Bank (Fibank), American Bank of Investments (Abi Bank), Union Bank, Tirana Bank, OTP Bank, Credins Bank, Alpha Bank. Since the population is not large in number, it also represents our sample. The data of this study are taken from the official pages of banks in Albania and from the National Business Center from 2011 until 2020. All banks are obliged by law to publish their audited annual reports at NBC since 2008. The information taken from those annual reports is considered reliable and ready to use for calculations. The independent factors include size, profitability, capital adequacy, and tangibility, whereas the dependent variable is the leverage ratio. Before running the regression, the data should be tested for multicollinearity, serial correlation, and heteroscedasticity. The regression model is:  $Leverage_{i,t} = \beta_0 + \beta_1(size_{i,t}) + \beta_2(prof_{i,t}) + \beta_3(tang_{i,t}) + \epsilon_i$

Where:

Leverage – Debt / Equity

Size – log of total assets

Profitability – ROE = Net income / Equity

Tangibility – (Equity – Intangible assets) / (Total assets – intangible assets)

To answer the research question, the following hypotheses are built:

H1: There is a significant positive relation between Bank Leverage and Bank Size.

H2: There is a significant positive relation between Bank Leverage and Tangibility.

H3: There is a significant positive relation between Bank Leverage and Profitability.

The pooled model, as well as the fixed and random effect models, is the most estimated model with panel data. The pooled model implies that the intercept is constant across banks and years. The fixed effect allows banks to have their intercept (which may differ between banks but does not change over time). The random effect implies that banks have a shared mean intercept value. As a result, the Fixed Effect is employed in this model since banks have their intercept.

### 4. Analysis of Results

Before running the regression, all these assumptions have been checked and met. Using EVIEWS 10 the data are tested and the results are shown in Table X. As it is observed ROE is excluded from the results since the impact resulted to be insignificant.

Dependent Variable: Leverage, Sample: 2011 2020, Periods included: 10, Cross-sections included: 12, Total panel (balanced) observations: 120

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	3.215884	1.462624	2.198708	0.0301
Bank size	0.199622	0.062269	3.205777	0.0018
Tangibility	1.846339	0.431092	4.282936	0.0000

Weighted Statistics



R-squared	0.802378	Mean dependent var	28.28338
Adjusted R-squared	0.778142	S.D. dependent var	19.33506
S.E. of regression	3.925487	Sum squared resid.	1633.401
F-statistic	33.10606	Durbin-Watson stat	1.175597
Prob(F-statistic)	0.000000		

Table 1: Regression outcome

As was predicted, by removing the insignificant variable, Return on Equity (ROE), the F – statistic is improved and now it is 33.1, and the p-value of F statistics is still lower than  $\alpha$  0.05. The calculations for the model above have a coefficient of variation of R2 80.23 % and Adjusted R2 77.81%, respectively. This shows that the independent variables chosen for this study account for most of the variation or changes in the capital structure of the understudied banks in Albania for the years 2011 - 2020. Two remaining independent capital structure determinants account for 80.23 % percent of the variance. By having R2 = 80.23 %, it means that it explained 80.23 % of the data by this model. Based on the result all the independent variables show to be statistically significant. As for tangibility, it has a p-value lower than  $\alpha$  0.05, concluding to be statistically significant that can be considered for statistical analysis. The results in the table above show that it has a positive relationship with bank leverage. So, if the tangibility of assets of banks increases by one unit, this increase in tangibility will cause an increase in bank leverage by 1.84 units. Bank size results have a p-value equal to 0.0018, which means it is statistically significant since compared to  $\alpha$  0.05, it is lower. By being so, this variable can be considered for predictions and statistical analysis. Moreover, its coefficient shows to be in its perfect outcome. Its coefficient shows that one unit increase in the banks' size in the years 2011 – 2020, will lead to an increase of 0.19 in the banks' leverage. The H1 hypothesis is accepted since the p-value = 0.0018 is lower than  $\alpha$  = 0.05, So the bank size has a positive relationship with bank leverage for 12 second-level banks operating in Albania for the years 2011 – 2020. The H2 hypothesis is accepted since the p-value is lower than  $\alpha$  = 0.05, So the tangibility has a positive relationship with bank leverage for 12 second-level banks operating in Albania for the years 2011 – 2020. The H3 hypothesis is rejected since the p-value is higher than  $\alpha$  = 0.05, So ROE has no impact on bank leverage for 12 second-level banks operating in Albania for the years 2011 – 2020.

## 5. Conclusion

Motivated by significant cross-sectional variance in bank leverage, this research investigates bank capital structure using core findings from the empirical capital structure literature for banks operating in the US, Europe, Asia, and almost all around the world. The sample includes all twelve second-level banks operating in Albania for the data from 2011 until 2020. This paper examines whether bank size, bank tangibility, and return on equity of banks have a significant impact on the capital structure of banks represented by the dependent variable “bank leverage” for the years 2011 – 2020. Aside from the regression model on all bank's data, it is made also a financial analysis for each of the variables and descriptive statistics for all the banks in Albania. In general, the study's conclusions are consistent with earlier empirical research. One variable does not have a significant impact on leverage (return on equity), but for the other variables, bank size and tangibility have an impact on bank leverage. The data suggest that larger banks have more leverage, which may be attributed to the advantage of a great reputation and a broader network, allowing them better access to external funds, including loans on certain occasions. Profitability (ROE) showed to have no impact on bank leverage for the years 2011 – 2020. This might have happened because after the difficult situation those banks faced with non – performing loans in Albania, they started to accumulate much capital to be able to overcome

those financial losses. While bank tangibility shows to affect positively the bank leverage. When the tangibility of banks is increased it will cause an increase in bank leverage too and vice versa. Although the study makes significant contributions, there are several limitations and future studies that should be improved in future research. First, because some banks do not release their full financial records, the analysis did not cover the entire period from 2008 to 2021. Another suggestion for other researchers is also having into consideration the analysis of other variables as well, that might have an impact on the capital structure of banks. Moreover, the fact that it is not much clear the factors that affected tangibility to have that huge increase in 2019, should be analyzed also other indicators too. This might be in the interest of further studies on this topic. The article is also useful for Albanian academic researchers and bank managers who seek to analyze variables influencing bank capital structure for future research and capital structure choices, respectively.

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# An Arima Model for Forecasting the Exchange Rate of the ALL/EUR in Albania

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**Abstract:** The exchange rate is one of the important variables that greatly affect the economy of a country, especially in the conditions of an increasingly globalized economy, where there is a large increase in trade volume between countries that are becoming more and more open to international trade. With the benefits of openness comes the risk of exchange rate. The purpose of this paper is to identify the best Autoregressive Integrated Moving Average (ARIMA) model, in order to predict the exchange rate so to find a way to mitigate the risk of it. Since the main trade partner of Albania is European Union, the exchange rate of Albanian Lek against the Euro will be analysed. In this paper are used daily spot rates of ALL/EUR for the period May 2021 – August 2022. Test results suggests that Arima (2, 1, 1) is the best model to forecast the exchange rate.

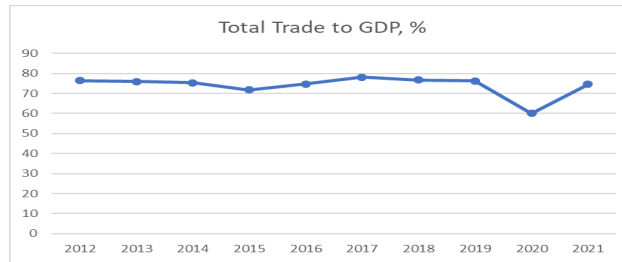
**Keywords:** *Exchange Rate; ARIMA Model; Forecasting; Autocorrelation; Moving Average.*

## 1. Introduction

The exchange rate is one of the important variables that greatly affect the economy of a country, especially in the conditions of an increasingly globalized economy, where there is a large increase in trade volume between countries that are becoming more and more open to international trade. Businesses benefit from international trade, but at the same time they also face the risk of unforeseen movements in the exchange rate, which subsequently affect competitiveness. For small countries, such as Albania, which meet a large part of domestic demand with imported products, the exchange rate directly affects the level of inflation. The exchange rate is one of the most difficult variables to predict, because it is influenced not only by economic factors, but also by political, social, natural factors, etc. Among the many suggested models for forecasting exchange rates, in this paper the ARIMA model will be used, which is one of the variants of the Box-Jenkins methodology. Since generally time series of economic nature are generally non-stationary, ARIMA is more appropriate, because it differentiates the time series to make it stationary [1]. This model is used in various studies. For example, Deka and Resatoglu [2] used it to forecast the Turkish Lira exchange rate against the US Dollar and the CPI in Turkey; Babu and Reddy [3] used an ARIMA model to forecast the Indian Rupee against the Euro, US Dollar, Yen. After testing different models, they concluded that ARIMA gives the more stable results. Hussain et al [4] suggested that ARIMA model outperformed other model in forecasting the exchange rate in Pakistan.

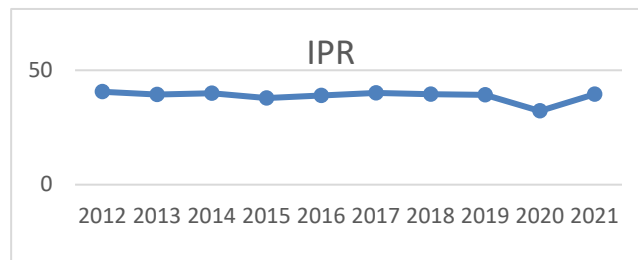
## 2. Some data about Albania

Albania is a small economy, which is open always more and more to international trade. In 2012, the share of total imports and exports to GDP was 76.5% and has been always above 70% for the entire period until 2021, with the exception of 2020, where the share was of 60%, due to trade restriction because of pandemic Covid-19. The average for the period is 74.02% of GDP.



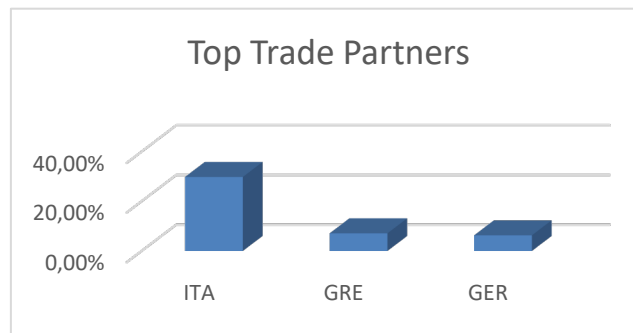
**Figure 1.** Total Trade to GDP in % in Albania, 2012-2021

Trade relations are very important for the Albanian economy. For the period 2012-2021, the import penetration rate, which show the share of domestic final demand being met by imports has been always above 38%, with exception of 2020. The average for the period is 38.8%.



**Figure 2.** Import Penetration Rate in Albania, 2012-2021

According to INSTAT<sup>23</sup>, the European Union is the main trade partner of Albania. For the period January – August 2022, the trade volume with European countries constitutes around 59.7% of the total. Among the European countries, the top trade partners of Albania are Italy, with 29.8%, Greece with 7.1%, and Germany with 6.3% of the total trade. For the same period, exports toward European countries account for 73.2% of the total exports, and imports from European countries account for 52.4% of total imports.



**Figure 3.** Main Trade Partners of Albania, Jan – Aug 2022

### 3. Methodology

#### 3.1. ARIMA model

ARIMA model used in this paper is a variant of the Box-Jenkins methodology [5], which regresses the time series to forecast the value of it. The Box-Jenkins model performs well even with limited time series. In order to forecast, the Box-Jenkins model suggests a procedure with three steps:

<sup>23</sup> INSTAT Press Release September 2022  
<http://www.instat.gov.al/media/10516/tregtia-e-jashtme-gusht-2022.pdf>

- 1-model identification: checking stationarity and identify the model parameters;
- 2-model specification: build “the best” model to predict the values of time series
- 3-forecasting: use the specified model to forecast in-sample and out-of-sample and check the results.

The Box-Jenkins method requires stationary data. This method suggests that the dependent variable values are explained by lagged values of itself and the error term. That means, the forecasting model has an autoregressive component AR, and a moving average component MA.

The AR model is expressed as:

$$Y_t = a_1Y_{t-1} + a_2Y_{t-2} + \dots + a_pY_{t-p} + \varepsilon_t \quad (1) \quad \text{where } p \text{ is the order of autoregression.}$$

Gujarati [6] suggests that the values of dependent variable is also determined by the values of past errors, i.e. past errors should be used as explanatory variables in the regression model.

The MA component is expressed as:

$$Y_t = c + b_1\varepsilon_{t-1} + b_2\varepsilon_{t-2} + \dots + b_q\varepsilon_{t-q} + \varepsilon_t \quad (2) \quad \text{where } q \text{ is the lagged value of the error used in prediction.}$$

Combining (1) and (2) an ARMA (p, q) model is obtained for forecasting:

$$Y_t = c + a_1Y_{t-1} + a_2Y_{t-2} + \dots + a_pY_{t-p} + b_1\varepsilon_{t-1} + b_2\varepsilon_{t-2} + \dots + b_q\varepsilon_{t-q} + \varepsilon_t \quad (3)$$

When the condition of stationarity is not met (this is usual with time series which suffers from trend and seasonality), a variant of Box-Jenkins method is used, called ARIMA (p, d, q), or Autoregressive Integrated Moving Average. In this model, the non-stationary time series is differenced to obtain a stationary time series.

If d =1 (integrated of order I), each value in the time series as expressed as:  $y_t = Y_t - Y_{t-1}$  (4)

When d = 2 (integrated of order II):  $y_t = (Y_t - Y_{t-1}) - (Y_{t-1} - Y_{t-2})$  (5) and so on for integration of higher orders. ARIMA model can be expressed as:

$$y_t = c + a_1y_{t-1} + a_2y_{t-2} + \dots + a_py_{t-p} + b_1\varepsilon_{t-1} + b_2\varepsilon_{t-2} + \dots + b_q\varepsilon_{t-q} + \varepsilon_t \quad (6) \quad \text{where } y_t \text{ is the differenced series.}$$

### 3.2. Data

The time series of the exchange rate analysed in this paper was constructed for the period 01.05.2021-31.08.2022 with the spot rate data obtained from the Bank of Albania. The time series has enough observations to obtain a valid ARIMA model, because it has more than 50 observations [7]. Data analysis will be done through Python.

### 4. Data Analysis

Since the Box-Jenkins method requires stationary data, the first step in analysis is to check for the unit root. It is clear from the graph that the time series is not stationary.

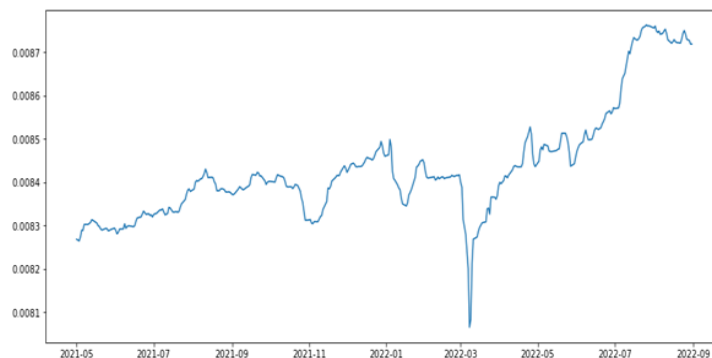


Figure 4. Exchange Rate of All/EUR

This is also confirmed by the results of the ADF test, which are presented in the following table.

**Table 1. ADF Test Results**

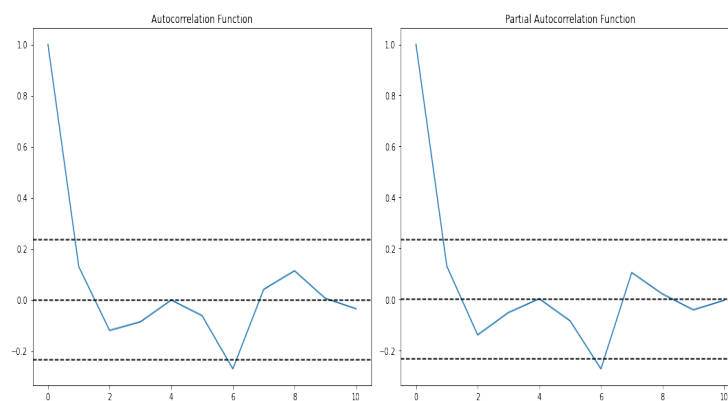
	ALL/EUR	p-value	D(ALL/EUR)	p-value
<b>ADF Test Statistic</b>	<b>-0.550754</b>	<b>0.881726</b>	<b>-7.17678</b>	<b>0.0002</b>
<b>Critical Value 1%</b>	<b>-3.527426</b>		<b>-3.52889</b>	
<b>Critical Value 5%</b>	<b>-2.903811</b>		<b>-2.90444</b>	
<b>Critical Value 10%</b>	<b>-2.58932</b>		<b>-2.58965</b>	

The value of the ADF test is less than the critical value for each significance level up to 10%, thus accepting the null hypothesis of the test, which suggests that the series is not stationary. For this reason, we test the first difference of the time series. The ADF test shows that the D(ALL/EUR) is stationary because the p-value of the test statistic is less than 5%.



**Figure 5. D (All/EUR)**

From the ADF test we get  $I = 1$  for the ARIMA model. In order to find the  $p$  and  $q$  for the model, we plot the autocorrelation function ACF and partial autocorrelation function PACF.



**Figure 6. ACF and PACF Functions**

From the graph it can see that the first value that the PACF drops to zero is for lag value = 2, so  $p = 2$ , while  $q = 1$ , because at that lag value the ACF graph cuts the upper boundary of the confidence interval for the first time. With this information we can build the ARIMA (2, 1, 1) model.



Table 2. ARIMA Model

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	-0.016479	0.017871	-0.922123	0.3571
AR(2)	-0.125253	0.021113	-5.932410	0.0000
MA(1)	0.595745	0.012784	46.59963	0.0000
SIGMASQ	0.034057	0.000761	44.72687	0.0000
R-squared	0.309980	Mean dependent var		-0.016374
Adjusted R-squared	0.304504	S.D. dependent var		0.222456
S.E. of regression	0.185520	Akaike info criterion		-0.519434
Sum squared resid	13.00988	Schwarz criterion		-0.478121
Log likelihood	103.2119	Hannan-Quinn criter.		-0.503044
F-statistic	56.60338	Durbin-Watson stat		1.879071
Prob(F-statistic)	0.000000			
Inverted AR Roots	-.00+.35i	-.00-.35i		
Inverted MA Roots	-.60			

ARIMA (2, 1, 1) result suggests that variables are statistically significant because p-values are less than the significance level of 5%. The coefficient of determination is around 30%, suggesting that the majority of the variation of exchange rate is not explained by the model. The F-statistic is larger than 1, with the p-value less than 5%, suggesting that the entire model is significant. Furthermore, there are very small deviations between AIC, SC, and HQC suggesting that the model is valid. The very small value of the residuals sum of squares suggests that this model fits well with the data.

In order to check if we have a stable univariate process we check if our ARIMA is stationary and invertible. For the stationary process the AR roots should fall inside the unit circle. The same for the MA roots in order to have an invertible process.

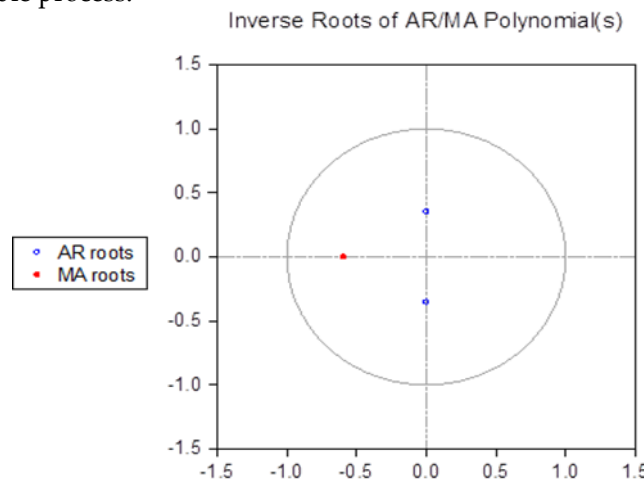
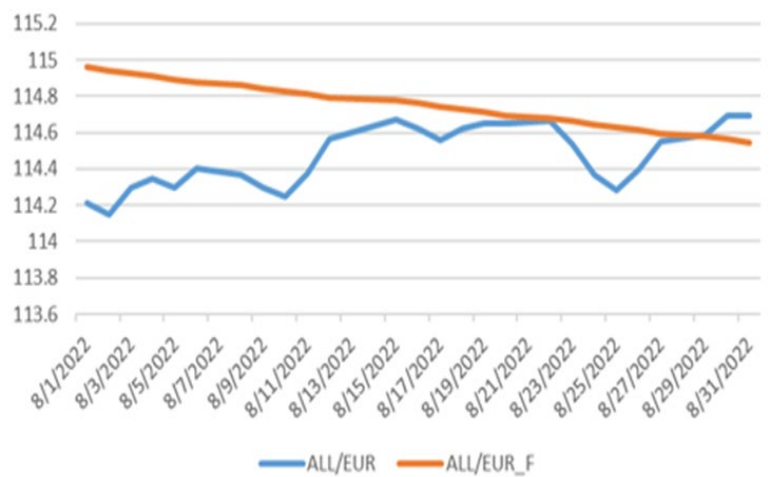


Figure 7. Inverse Roots of AR/MA polynomial

From the graph it can be seen that all roots are within the circle, so the proposed ARIMA model is stationary. The suggested ARIMA model is used to forecast in-sample for the last month of data set (August 2022). From the graph can be seen that there are big differences between observed and predicted values, especially at the beginning of the month. After around 10 observations differences become smaller and for some days there is an almost perfect match between observed and predicted values.



**Figure 8.** In-sample Forecast

## 5. Conclusion

The purpose of this research paper was to identify the best ARIMA model for forecasting the exchange rate of Albanian Lek against the Euro. ARIMA model has three parameters:  $p$ ,  $d$ , and  $q$ . Different combinations of these can produce different ARIMA models, but only one is the best model that fits well with the data. The test results suggest that ARIMA (2, 1, 1) is the best model. The coefficients are statistically significant and RSS is very small, suggesting a good fit to the data. Diagnostic checks suggest that the model is stable and invertible, but the relatively small value of the coefficient of determination suggest that the ARIMA model leaves the majority of volatility unexplained. Testing the model with in-sample forecast for the month of August, which is the last month in the data set, significant differences between observed and forecasted values can be noticed. In conclusion, it can be suggested that the ARIMA model is not appropriate for forecasting the exchange rate of Albanian Lek against the Euro. In order to have good forecasts other methods should be used.

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# Digital Marketing and its Repercussion on what Customer Prefer to Buy

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**Abstract:** With the constantly growing and developing futuristic new technologies, the use of Digital Marketing, Social Media Marketing, and Search Engine optimization (SEO) or Search Engine Marketing (SEM) is also aggregating. Digital Marketing is used by the marketers to support the goods and facilities to the marketplace. Digital Marketing place a remarkable role in cumulative the sales of service area or products. The aim of this study is to analyze and appreciate the digital marketing's influence and how it serves as an important platform for both dealers and customers. We also considered the influence of digital marketing, with a focus on search engine marketing as well as its impact on consumer purchasing performance. The model size for this study is 200 respondents, based on an intended survey for primary data.

**Keyword:** *Digital Marketing; Online Promotion; Purchasing Behavior; Marketing Statement; Email Marketing.*

## 1. Introduction

Digital marketing is no longer limited to marketing or advertising activities conducted on digital platforms; rather, it has evolved into a very broad term that includes internet ads, internet marketing, search engine optimization and socialmedia marketing. Individuals are becoming increasingly communal and comfortable with the use of internet, social media application in a varied way of lifestyle and has now become an essential part of the day to day activities of every individual. Digital Marketing supports a marketer to introduce their products and services to the potential customers via several channels like Social Media, E-Mail Marketing, E-Commerce, Websites etc. A marketer, prior to launching any services, products or facilities online, should conduct an assessment via digital platform and take feedback or responses from potential customers/consumers, so that the marketer can launch the product or services which are in sync to the needs of customers/consumers, also should evaluate the responses given by service users and customers. Marketing methods have shifted from traditional to digital marketing in this extraordinarily evenhanded market and technological advancements. Digital marketing is a technique that may be utilized to expand a firm on a global scale. With the benefit of digital marketing, a customer can also try comparing a product with some other product, as well as enables each and every time of solutions to buy the product, with a return policy that allows customers to revert back asupplied goods if they are unhappy with the performance or functionality of the received goods.

## 2. Objectives of the study

1. To comprehend the effect of digital marketing on buyer purchasing behavior.
2. To comprehend the digital marketing consciousness.

## 3. Hypotheses of the study

H01 - There is no substantial association between individuals' fixed income and commodity preference to be purchased through the Digital Channel.

H02 - There is no substantial association between customer happiness and acquiring a product via a digital channel.

## 4. Research Methodology

To assess the influence of digital marketing on numerous aspects influencing customer purchasing behavior, a structured inquiry will be conducted to collect primary data. 200 people were polled for primary data. Respondents were chosen from the Pune District, Maharashtra, with a focus on the Viman Nagar community near the Pune International Airport. Primary data in the structured plan was gathered through direct questioning to respondents, which was done directly through the survey method. The sample size for this study is 200 people who order products or services through various digital channels. The data was examined, and hypotheses were tested using arithmetic tools such as the chi-square test.

## 5. Results

Numerous questions were asked to the respondents on their Age group, Once-a-month Income, Profession, etc. for considerate their profile and answers. The table below is the interpreted on the source of the responses.

### 5.1. The Chi Square Test: - The association between an individual's typical monthly income and his or her preference for purchasing things through various digital channels or platforms.

**Table 1.** Relationship between average per month income and product liking to buy different through digital channel.

	Specialty Goods	Shopping Goods	Convenience Goods	Total
25000-50000	5	4	2	11
Above 50000	4	21	2	27
10000-25000	2	19	5	26
Below 10000	2	28	6	36
Total	13	72	15	100

The data can be simply interpreted from the above table 1. Hypothesis testing is done to be additional précised. H01 - There is no important relationship between average monthly income and service and product liking to buy through diverse digital channel. The calculated chi-square value is 15.293, and the p-value is 0.018090. With a relevance level of 0.05, the result is crucial at p.05. As an outcome, the h0 is rejected, in addition to the significant relationship between average monthly income and product choice to purchase through multiple internet digital channels.

## 5.2. The Chi squared tests: - Relationship between satisfaction of the purchaser and purchasing of the product through Digital platform

The relationship between the satisfaction of the purchaser and purchasing of the product through Digital platforms, is mentioned in the following table.

**Table 2.** Association amongst Buyer Fulfilment and product purchase complete through Digital Marketing.

	Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree	Total
Social Media	9	12	0	0	0	21
Emails	4	2	2	0	0	8
Others	1	2	1	0	1	5
Advertising	4	8	2	1	0	15
Websites	20	31	0	0	0	51
Total	38	56	5	1	1	100

The data can be simply understood from the above table 3. Hypothesis testing is done to be more précised. H02: Buyer Satisfaction and product purchase via Digital Marketing have no meaningful association. The calculated chi-square value is 41.45. .00047 is the p-value. The result is significant at p.051, by 0.050 near of Effect. Agreeing to overhead table serve analysis, Null hypothesis is *decline*. In other words, there is important relationamong customer satisfaction and buying the goods through Digital channel.

## 6. Conclusions

With the Research conducted, it has been found connection between per month's earnings and the products and services purchased by customer and consumer. Average monthly income of individuals plays an imperative role to buy dissimilar products through most of the Digital Channel. It has also been found that there is an importance difference between the fulfilment level of buyer with buying goods and services online. The majority of customers are pleased with the products purchased through various digital channels. An organization can do a lot more with Digital Marketing if it can identify and meet the wants of its customers.

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## **SESSION 3**

### **STUDENTS SESSION**

**SESSION CHAIR:  
Assoc. Prof. VASIL QANO**



# Analysis of Multi-user Web Application Platforms

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**Abstract:** Cloud computing is a well-known paradigm nowadays because it decreases the cost to access the application, for a massive amount of data from anywhere in the world via internet. This paper takes the approach of testing the performance of web application deployment environment. The main objective of this paper was to investigate the performance of web application deployment infrastructure by growing eventually the number of users that visit the web application concurrently. The infrastructure that was used is part of the services provided by cloud computing, more specifically Platform as a Service (PaaS). This service provided a runtime environment in which we easily created, tested and deployed the web application. Tests were designed by using an open source tool. Web application subject for testing purposes was an open source pet shop application which fulfils the criteria of being a multi-user web application. Tests were created by using an open source application called Apache JMeter. One of main goals was to develop a proper test plan by considering user behaviour accessing a web application. We have developed and implemented three scenarios, started with deployment of the platform, installing dependencies and finally installing the web application used for performance testing. We have tested 2 different deployment platforms, in the first environment everything is installed in one machine and in second environment we separate application server from the database server. We have concluded in results where processes like register, login and checkout consumes much more resources of the server. In the future we will try to understand where machine learning stands in this part of web application development and how it can affect deployment infrastructure.

**Keywords:** *Cloud Computing; PaaS; JMeter; Performance Testing; Multi-user; Web Application.*

## Introduction

Nowadays, cloud computing is commonly used as a service infrastructure. As the computing paradigm has been shifted to cloud computing, devices can utilize the centralized resource in the cloud. [1]. One of the services of Cloud Computing known as Platform as a Service (PaaS) provides a deployment and development environment in the cloud. By utilizing PaaS we are also able to make use of every resource that could help on further development of a web application. A web application on the other hand, is application software that runs on a web server, unlike computer-based software programs that are run locally on the operating system (OS) of the device. Web applications are accessed by the user through a web browser with an active network connection. These applications are programmed using a client– server model structure—the user ("client") is provided services through an off-site server that is hosted by a third-party. Grossman identifies key trends in Web 2.0 for what he calls “the global intellectual economy” [2]. The main objective of this paper was to investigate the performance of web application deployment infrastructure by growing eventually the number of users that visit the web application concurrently. The infrastructure that was used is part of the services

provided by cloud computing, more specifically Platform as a Service (PaaS). This service provided a runtime environment in which we easily created, tested and deployed the web application.

## 1. Principles of Multi-user Web Applications

At the very simplest definition, when we define a multiuser web application, we must conclude by the ability of web application to be accessed by multiple users at the same time (concurrently). Today almost every web application that offers services and give users complex interactivity, it is directed towards being a multi-user web application. And, categories are infinite, going from the most popular one, e-commerce to social media, and different cloud services.

Coming to our specific e-commerce web application, it is in this category, and developers tends to give different approach on how they design the app based on their experience and software resources they are offered to use.

### 2.1 Security Concerns of web application environment deployment

Every web application can take part in being attacked and possibly data theft by detecting flaws in web application design itself or the deployment configuration architecture. There are many different attacks one web application can be concerned for based on the development of web application itself [3]. Starting from cross site forgery (CSRF) which in Django framework while you start developing html templates, there is a CSRF token you should use against this type of attack. Also, there is SQL injection, it consists on executing a form-injected query directly on database and it can retrieve database data, can update and even delete whole database. To be protected from this type of attack, all parameters that end up in database should be carefully tested with any tool that provide SQL injection during the development process in order to avoid this attack.

### 2.2 JpetStore, web application used for performance implementations.

Jpetstore is an application build based on java programming language. This web application is been built on top of MyBatis and SpringBoot. Another framework that has been used for building this full web application is thymeleaf, considered as modern server-side Java template engine, it gives the solution to the development workflow via HTML. It manages a correct display in browser of the information. As per the database, jpetstore uses hsqld. It is an embed database used by spring boot java framework developers.

### Implementation of web application deployment platform, tools and tests design.

Conducting performance testing properly, gives us the best chance of discovering business critical points, ensuring us that our web application won't buckle under load. This brings the problem of customers seeking for alternatives due to slowness. To be able to conduct those tests there is need of third-party libraries or tools in order to keep simplicity and avoid time consuming beyond business meets. Based on research made, open source ones don't limit in type of testing you want to attend, but they are dependent based on tester experience for near production tests achieve.

### 3.1 Test Planning Process

Our main focus while planning those tests is to generate as much real-life scenarios. To simulate the behavior of real users with 'virtual' users, we will use Apache JMeter open source tool like we have mentioned earlier. Ideal case is deploying this tool on multiple servers running simultaneously, with each server simulating multiple virtual users.

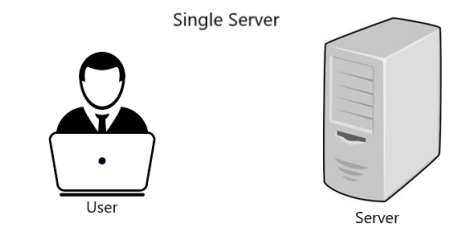
Since we have limited resources, we have used one machine, laptop, for simulating ‘virtual’ users with JMeter tool. According to [4] the Apache JMeter application is open source software, a 100% pure Java application designed to load test functional behaviour and measure performance.

**3.2 Application deployment server environments under test**

The process of deployment for an application it is necessary to be well organized and well prepared to handle the load and to meet the security standards, all this by achieving QoS required. As per the machines, they can be on premise or in the cloud, if you decide to configure from scratch, you have to put a lot of effort on creating the most optimal configurations.

There is development environment and in production environment. Since our purpose in the thesis is to simulate load of multiple users concurrently accessing the web application, the environment is considered as development or testing environment. This environment should be as near as possible to the one in production so any unnecessary bugs could be avoided later in production deployment platform. For server’s OS we have used Ubuntu 20.04, considered as a stable release.

**Environment 1:**



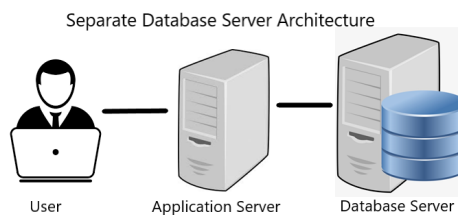
**Figure 1.** Single-server application deployment

For the first environment we considered of deploying our application in one server. This host server will be used as application server and database server. It is supposed to be the simplest architecture of an application deployment.

According to fig.1, every aspect of making an application public is hosted in one server. Deploying application, database, static files, all in one server. This approach is simple and only advantage that has is fast deployment. If the capabilities are for only one server, we will try to explore possibilities of finding faults and how can this type of deployment be optimized in performance and security aspect.

**Environment 2:**

For this environment, in order to increase security for Database we deploy Database on separate host, called database server. We will have an Application Server which will be as midpoint between User-and-Database. Each request from user to application server will be forwarded to database server as queries to be executed. Referring to fig.3 to better understand this scheme .



**Figure 2.** Separate Database Server Architecture

Below is the reference table of the hardware settings of database server and application server used for the test case.

**Table 1.** Hardware settings

Database Server	Application Server
1 Core CPU i7 7th generation	4 cores Intel Xeon w3565
4 GB RAM memory	6 GB RAM Memory
64 GB hard disk SSD memory	64 GB hard disk SSD memory

**2. Simulations and test results**

As we have stated earlier in thesis, tests will be made on three different approach of test environment deployment. All tests in the result will be kept in form of tables taking average value by each test, and then we can create per each test plan one graph for the purpose of analysis. JMeter is considered as just an HTTP Client capable of running multiple sessions in parallel [5].

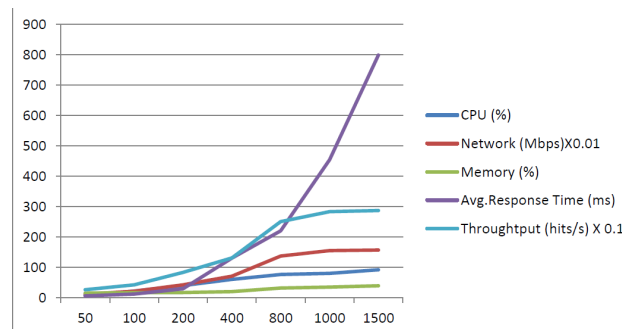
**4.1 Test Results from first Environment Setup, All in one Machine server.**

JpetStore Test Results Environment 1

**Scenario 1:**

**Table 2.** Test plan results, scenario 1.

Users	CPU %	Network (Mbps) X0.01	Avg. Response Time	Throughput (hits/s) X0.01
50	7	11.6	6	26.4
100	22	21.2	12	42.5
200	40	42	29	83
400	60	71	130	131
800	76	137	220	250
1000	80	155	454	283



**Figure 3.** Graphic chart of resources utilization by growing concurrent users

**Scenario 2:**

**Table 3.** Test plan results, scenario 2.

Users	CPU %	Network (Mbps)	Memory %	Avg. Response Time (ms)	Throughput
5	52	11.7	13.7	5	330
10	66	23	40	9	450
20	80	25.5	42.6	28	546
30	86	26.6	42.6	48	570
50	91	27.7	42.7	100	593

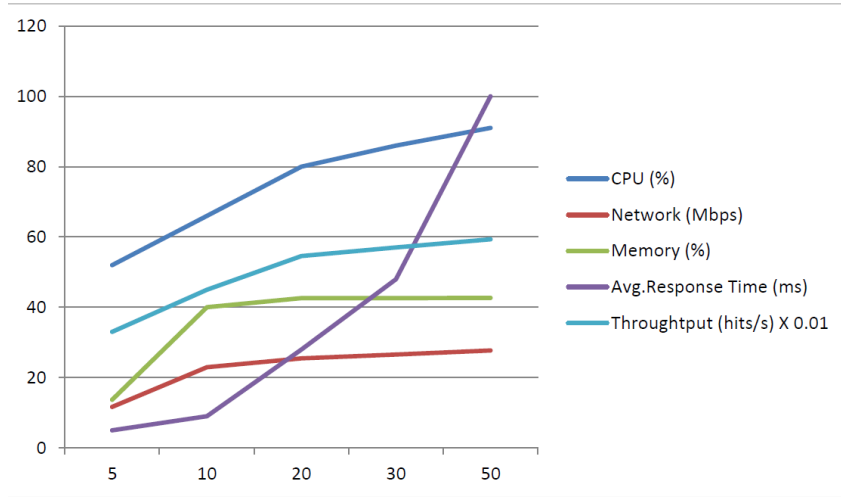


Figure 4: Graphic chart of resource utilization for second scenario

Scenario 3:

At this scenario after we repeated tests several times, we resulted on having error due to limit of TCP ports. This scenario has 2 thread groups, for after login activities, and just for any user as visitor to navigate the web application. Below is the result found after the tests.

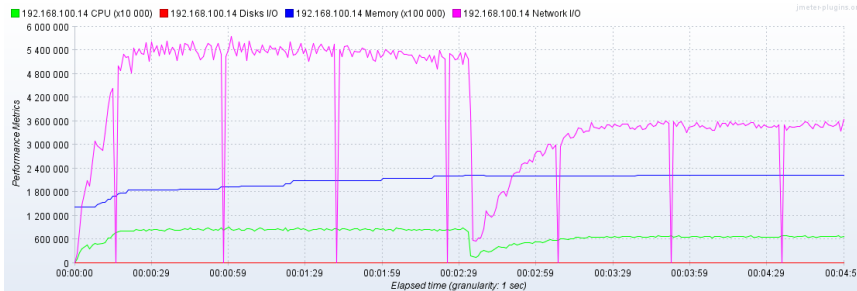


Figure 5. Graph for resource utilization by JPerfmon plugin for third scenario

4.2 Test Results from second Environment Setup, Separate Database server from Application Server – JpetStore Test Results Environment 2 Scenario 1

Table 4. Test results , first scenario, environment 2

Users	CPU Web Application Server (%)	Memory Web Application Server(%)	CPU Database Server(%)	Memory Database Server(%)	Average Response Time(ms)
50	15	25	1	40	8
100	24	25	1	40	9
200	50	25	1	40	10
400	70	25	2	40	160
600	80	40	2	40	400

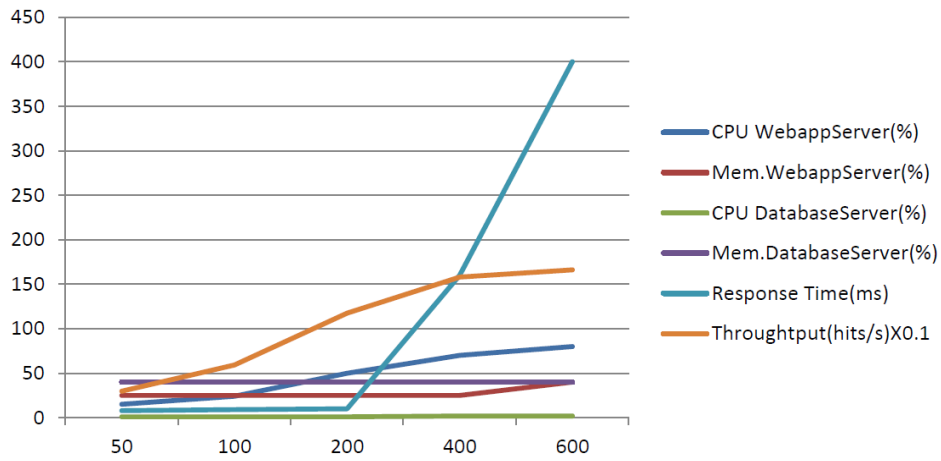


Figure 6. Graph representation of table 4

Scenario 2: In this execution test, results are as below in table 5.

Table 5. Test results, scenario 2, environment 2

Users	CPU Web Application Server (%)	Memory Web Application Server(%)	CPU Database Server(%)	Memory Database Server(%)	Average Response Time(ms)
5	90	20	5	41	59
10	96	20	6	41	90
15	98	21	8	41	145
25	99	22	7	42	200

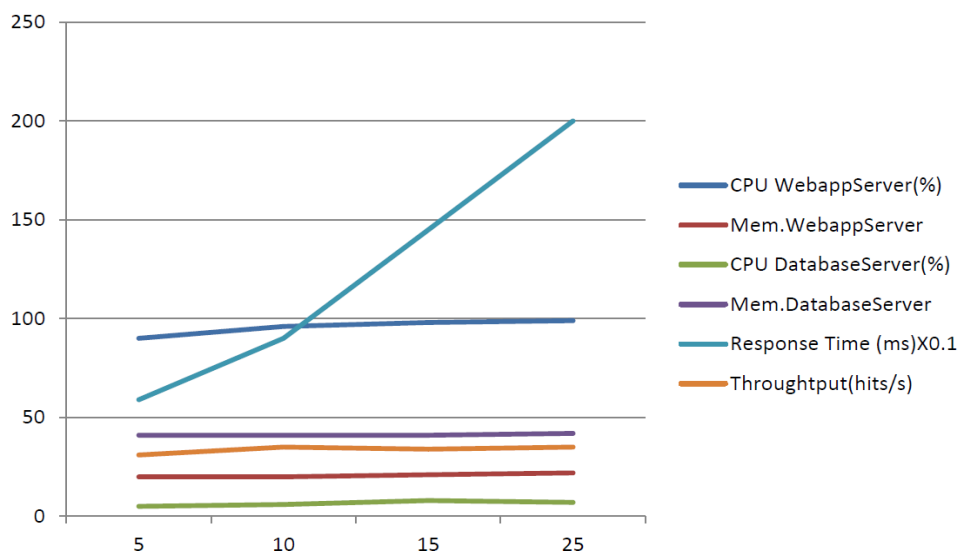


Figure 7. Graph representation of table 5



Scenario 3:

From the fig. 8, it is seen the same behavior as in the second scenario.

Table 6. Test results, scenario 3, environment 2

Users	CPU Web Application Server (%)	Memory Web Application Server(%)	CPU Database Server(%)	Memory Database Server(%)	Average Response Time(ms)	Users
5	90	22	7	42	59.1	
10	96	22	8	42	100	
15	98	22	10	42	170	

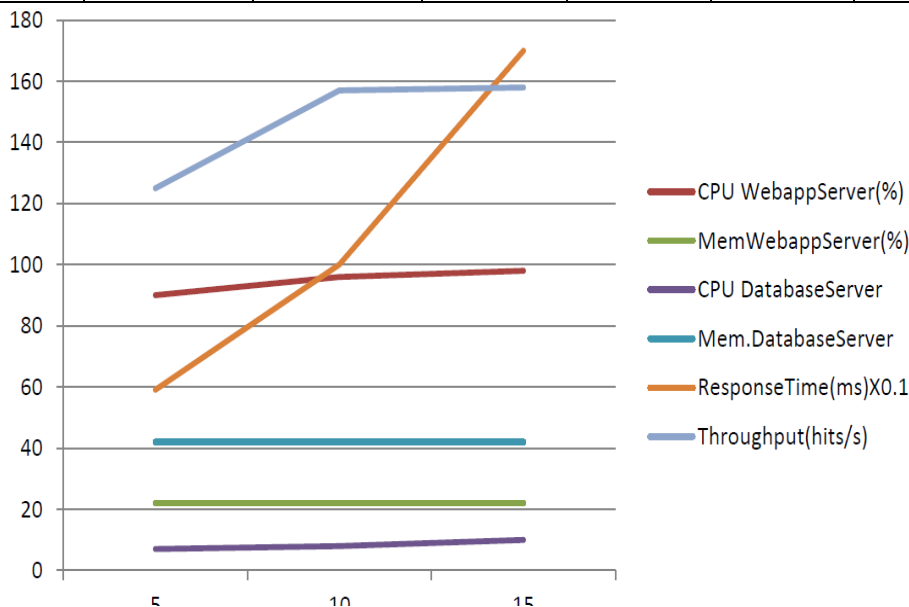


Figure 8. Graph representation of table 6

Conclusions

While we have given a path of how to take an approach on creating a test plan and how to avoid some execution faults of tool itself or the testing environment, tests are executed with limited resources. From the test we have realized, we concluded that forms like sign-in, check-out that occupies the server to execute database queries, or said to execute POST requests, uses much more server resources. From scenarios executed, to achieve a load of 40% of CPU usage, there was needed 200 concurrent users to be simulated by first scenario while from second scenario we have achieved 50% of CPU usage from just 5 concurrent users in the first scenario, and almost 90% from the second environment test.

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# The Incorporation of Complex Machine Learning Algorithms into Iot Based Smart Vessels Automation with Enhanced Security

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**Abstract:** The shipbuilding industry is experiencing unprecedented expansion, but shipowners and operators are keen to get the most out of their investments in new boats so that they can provide passengers an experience that is unlike any other. This is made possible by technology, which allows operators to offer integrated services including booking, check-in, and cabin automation. This may be done from the comfort of your own cabin. Shipyards and other suppliers may be able to provide a hand to cruise line companies in their pursuit of this objective by negotiating the limits and restrictions imposed by the most up-to-date technology in their search for the optimal package. The passengers are the ones who get the benefits of this concerted effort, and they may choose to spend their time on board ensconced in the comfort of their cabins. The cruise ship industry has seen tremendous transformations over the last decade, and it must overcome substantial challenges in order to maintain pace with the growth of the market while also catering to the shifting requirements of prospective passengers. The process of building a new vessel can take many years, starting with the design and ending with the vessel being commissioned. Because of this, shipbuilders and operators face the enormous challenge of ensuring that new ships will be suitable for their intended purposes throughout the entirety of their years of service. It is essential that each of the vessel's components is selected with extreme deliberation in order to not only ensure optimal functionality, but also ensure that the technology is future-proof.

**Keywords:** *IoT, Machine Learning, Smart Vessels*

## 1.Introduction

Shipbuilding is a challenging industry, and cruise lines and yards have to work closely together to find the most effective methods to avoid delays in the construction of their ships. The manufacturing of cabins is constrained by a great variety of constraints, the most notable of which are the thickness of the partition walls and the need to bring down the total weight, amongst many others. Because of this, it is very vital to establish close coordination between operators, builders, and suppliers in order to provide the most ideal solution feasible in terms of design, cost, and reliability. This may be accomplished by developing tight coordination. It is a helpful strategy to prepare mock-up cabins in order to test goods in a controlled environment that will reflect the conditions in which the gadgets will really be put. This is done as a way to verify that the alternative that is selected is one that can be implemented.

The sample room will be essential for determining whether or not the installation process is straightforward and for determining whether or not sufficient space is provided to house all of the electrical

components. This is because more complex systems sometimes need extra installation space. When the partitions are just 30 millimetres thick, the depth of installation is usually a challenge. Additionally, every layer of material added to the wall results in an increase in both cost and, maybe more crucially, the wall's overall weight. The carbon footprint left by these marine giants is now the subject of intense scrutiny, and the reduction in weight has the potential to make a considerable contribution to the overall reduction in the use of fossil fuels. In the effort to bring down the overall ship weight, every component, such as the copper busbar that distributes electricity to the staterooms, is under close inspection. However, in order to decrease power use and, as a consequence, reduce the cross-sectional area of the busbar or cables that are necessary to supply the cabins, certain power outlets may be disabled as part of the cabin automation system. Even while the operators have no intention of preventing passengers from using the electronic gadgets of their choice while on board, they have no intention of doing so either. This will lower the weight by an even greater amount while also saving money on the busbar and the protection for the electrical circuit.

As soon as the issues with the construction have been fixed, it is time to shift attention to the user interfaces, which are going to be a significant part of the experience that the passengers will have. When passengers aboard the ship, they will surely have a positive impression due to the ship's attractive interior; but, having a control system that is well-designed and easy to use will help ensure that they keep having a positive image. Because a cabin automation system that is too sophisticated would distract from the overall experience of the customer, it is imperative that all controls and convenience charging stations be developed with usability in mind.

Only by working closely together and side by side can all issues be addressed, and the best and most effective solutions be discovered. The challenges that were listed above are only a few of the problems that operators, ship builders, and suppliers face when beginning from scratch with a new vessel.

## 2. Why IoT



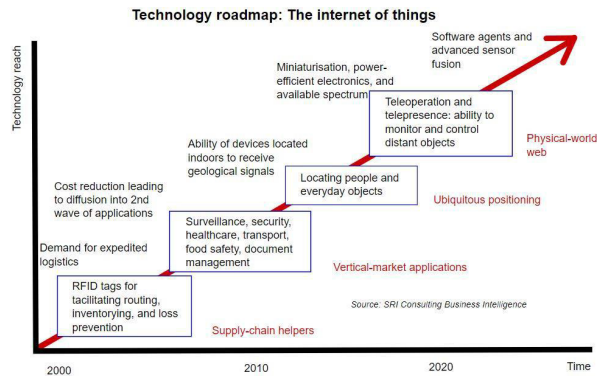
**Figure 1: IoT Communication Scheme**

The ability of individual devices to interact with one another is a necessary prerequisite for the Internet of Things (IoT) to become a reality. This is why communication is the most essential element in its development. Unless one of these abilities is expressly needed by your gadget, all of the other capabilities, such as detecting, manoeuvring, collecting, storing, and processing information, are completely useless.

However, in order to qualify as an Internet of Things device, a piece of hardware has to be able to communicate with other devices. Because real physical and link layer communication in IoT may be performed in many different ways, the manner in which this communication is carried out is not nearly as important as it formerly was.

According to the owner, the preceding Figure 3 is free for anybody to copy and replicate for the purpose of gaining information in any way they see fit. This diagram illustrates the fundamental framework behind how the Internet of Things operates and how devices connect with one another. Figure 3 depicts a typical use

scenario as well as a potential solution for sharing an access point so that several users in a service region may connect to the internet. In recent years, the primary trend of the Internet of Things (IoT) has been the accelerated creation of a large number of devices that can be linked to and controlled by the Internet. Because there are so many different uses for IoT technology, the specifications of each device might vary widely from one another, while most of them have the same fundamental capabilities.



**Figure 2:** Technology roadmap

The Internet of Things makes it possible to combine computer-based systems with the real world in a more direct way, which ultimately results in increased productivity, monetary benefits, and less human effort. In 2017, the number of devices connected to the Internet of Things reached 8.4 billion, showing a year-over-year rise of 31 percent; it is expected that 30 billion such gadgets would be available for sale by the year 2020. By the year 2020, it is expected that the whole value of the Internet of Things sector throughout the world would have reached \$7.1 trillion in terms of its total market value.

### 3. How is IoT connected with AI



**Figure 4:** IoT and AI connected

IoT devices, Edge / Fog nodes, and cloud computing are the three tiers of intelligence that are accessible for the Internet of Things. The temporal sensitivity of the Internet of Things application drives the need for intelligent control and decision-making at each level. For instance, in order to avoid a collision, the camera of an autonomous car has to be able to identify impediments in real time.

It would not be able to make decisions in such a timely manner if information was sent from the automobile to instances hosted in the cloud, and then the forecasts were sent back to the car.

Instead, every aspect of the operation of the automobile need to be carried out locally inside the vehicle itself. In order to bring the concept of smart things closer to becoming a reality, one active field of study is the incorporation of complex machine learning algorithms into Internet of Things devices. This may include deep learning.

In addition, it is feasible to get the most out of IoT installations by analysing and assessing the data generated by IoT devices, discovering information that was previously concealed, and making predictions about control options. In the field of Internet of Things (IoT), a wide variety of machine learning methods have

been applied, ranging from more straightforward approaches like regression, supporting vector machine, and random forest to more complex strategies like convolutional neural networks, LSTM, and variational autoencoders.

#### 4. Conclusion

In summary the Internet of Objects (IoT) is a notion that aims to link the digital world of information technology with the physical world of actual things. Technologies like RFID, sensors, and detectors have made our lives much better and more pleasant. The Internet of Things has the potential to significantly increase data accessibility in nearly every industry around the world, and it will almost certainly cause companies and organizations to undergo fundamental change. As a result, figuring out ways to put the Internet of Things' capabilities to use is expected to contribute to the strategic objectives of the vast majority of technology businesses, regardless of the industries in which they specialize.

The concept of the Internet of Things, as well as the making it feasible to depict, comprehending and implementing the simulation, and creating the automated IoT devices, were all aspects of the thesis that addressed the topic and worked toward the aim. In order to demonstrate how the Internet of Things (IoT) can assist businesses and other organizations in managing a variety of risks, the primary objective was to provide a fundamental illustration of how IoT can be utilized to assist during times of fire emergency or even during a break-in at the time.

At the conclusion of this paper, every one of the issues that I have posed will have been addressed, and an IoT spring boot simulation will have been created.

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# Real-time sign language detection with TensorFlow and ReactJS to accommodate the need of people with fewer opportunities

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**Abstract:** This paper intends to first give an insight into a disability that people worldwide and in Albania face, and then highlight the main concern the deaf community has, that being expression. Then a solution for this problem is presented in the form of a real-time sign language detection web application. This application is firstly described by its structural and functional aspects, by following standard Software Requirement Specification. A description of the software architecture follows this. The technological aspect of the application is thoroughly defined by expressing all the significant implementations of each programming language included after the diagrams and software architecture. The main goal is to offer the newest technologies in the market combined with a well-planned and developed image detection application that is scalable, portable, maintainable, and efficient. This technologically up-to-date application is given in the shape of a full-stack web application.

The application consists of a bi-partial backend, one for creating and compiling the models, namely Python, Tensorflow and Jupyter Notebooks, and the other part held by Node.JS to power the frontend constructed with React and TensorflowJS. It starts with image collection all the way to labelling, then the detection is trained as modules thanks to Tensorflow. Continued by being converted into a TensorflowJs format ready to be uploaded in Cloud, which can be anywhere from Firebase, IBM, or google cloud and such. All are to then be implemented by a simple link in the Application. A fully developed web-based application that can come in handy and aid countless people.

**Keywords:** *Python; Tensorflow; Jupyter Notebooks; Node.JS; React; TensorflowJS; Javascript; Cloud*

## 1. Introduction

Freedom of expression is a universal human right that is a well-known fact. Adding to that right the “Canadian museum for human rights” claims that language rights are human rights. Following the two pillars of thought there is no reason as to why people in this day and age should suffer from a lack of them. Unfortunately, the world it’s sometimes quite cruel to people undeserving of strife. In our case and for the purpose of the software that will be demonstrated in the following chapters of this thesis we will be focusing on the community of people most affected by having a hard time expressing themselves with their language due to their speaking impairment, the deaf community. Millions of individuals worldwide suffer from debilitating hearing loss. The overwhelming majority of them reside in low- and middle-income nations where they frequently lack access to suitable ear and hearing care treatments. Additionally, hundreds of millions of people are at risk for hearing loss from noise exposure, including both industrial and recreational noise. Hearing loss is a serious barrier in the lives of individuals afflicted without appropriate solutions. Public health initiatives can stop many causes of hearing loss. Through rehabilitation,

education, and empowerment, people with hearing loss can realize their full potential. One of these said nations is Albania, which according to the Instat institution 6.2% of the entire population suffers some kind of disability, and 1.5% suffers from speech impairment. A number small in statistics but not for the ones that live that life. The sign language detection web application intends to tackle the struggles of everyday life for these individuals. Serving a bridge between them and people that might have difficulty understanding them, allowing them the freedom of expression and easing their burden. The real-time sign language detection web application, combining some of the latest technologies available right now, intends to create a tool to aid these people. Breaking down the need to have specialized devices or even human translators, the web app can turn every smartphone and every computer at the user's disposal in their immediate, instantaneous translator, to convey every sign they make into written words. This in turn eliminates the need for the receiver of the said message to need to know sign language to communicate.

## 2. Main Technologies

### 2.1. Backend – Python

Python is an interpreted, high-level, dynamically semantic, object-oriented programming language. Because of its high-level built-in data structures, dynamic typing, and dynamic binding, it is appropriate for Rapid Application Development as well as for use as a scripting or glue language to connect existing components. Python's succinct syntax prioritizes readability and usability, which lowers the cost of program maintenance. Python is also very proficient in machine learning, a must-have attribute when dealing with image recognition or detection.

### 2.2. Tensorflow

Is an open-source platform for machine learning. Its extensive, adaptable ecosystem of tools, libraries, and community resources enables developers to quickly create and deploy apps. It is simple to create and train models using TensorFlow and machine learning thanks to the high-level Keras API. Previously the default choice had been Kinect/Kinect Studio, but today, the main object detection frameworks are tensorflow and pytorch, the prior leading at that, especially because it needs no special device to conduct detections. Because of the way that this package works, and the continuous cross-referencing learning models in it, it's able to generate pin-point accuracy detections with little to no errors.

### 2.3. Frontend – Java Script

Although it is most famous for being the scripting language for Web pages, JavaScript (commonly abbreviated to JS) is an object-oriented language that is used in non-browser applications and has lightweight, interpreted first-class functions. It is a dynamic, prototype-based multi-paradigm scripting language that supports imperative, functional, and object-oriented programming paradigms.

### 2.4. TensorflowJS

Having already chosen Tensorflow for the object detection and model training for the back end, it makes it clear that its counterpart for the front end will produce excellent results in "translating" what has been built behind the scenes to be processed of the front. It enables you to create or run machine learning models in JavaScript and use them directly in the browser client side, Node.js server side, React Native for mobile, Electron for desktop, and Node.js for IoT devices.



## 2.5. ReactJS

The advantage of reacting is its ability to be lightweight using virtual DOM and component-based structure. This lightweight is crucial because object detection takes a lot of processing power. ReactJS is also the most popular front-end framework and is largely used in the world of front-end development.

## 3. Image processing and detection implementation

To create the basis of the application I first needed to have python have access to the capturing device's camera, in this case, my laptop. In this event, Jupyter notebook comes in handy. Due to the fact that a compiler in a computer can be used previously and might have libraries and other packets that may overlap or intrude in our work, creating a separate virtual environment in Jupyter allowed me to have only the libraries needed for the development of this software. Starting with:

- import cv2: computer vision
- import uuid: unique universal identifier
- import os: Operating System
- import time

After setting up the number of images needed to be collected, we can go ahead with collection and labeling, namely executing the following script for the collection of images.

## 4. Detection Training

Ending the with image collection partition, it's then proceeded with training these images in order to create detection models. Having imported all the necessary libraries, and having set up the necessary file paths, we go ahead with installing Tensorflow object detection and run the following command to run the training locally on the device.

```
python Tensorflow\models\research\object_detection\model_main_tf2.py --model_dir=Tensorflow\workspace\models\my_ssd_mobnet --pipeline_config_path=Tensorflow\workspace\models\my_ssd_mobnet\pipeline.config --num_train_steps=10000
```

## 5. Testing

After the training period is completed, we can go ahead and test to see the results of the model with the flowing script.

```
for label in labels:
    cap = cv2.VideoCapture(0)
    print('Collecting images for {}'.format(label))
    time.sleep(5)
    for imgnum in range(number_imgs):
        print('Collecting image {}'.format(imgnum))
        ret, frame = cap.read()
        imgname = os.path.join(IMAGES_PATH, label, label+'.'+ '{}'.format(str(uuid.uuid1())))
        cv2.imwrite(imgname, frame)
        cv2.imshow('frame', frame)
        time.sleep(3)

    if cv2.waitKey(1) & 0xFF == ord('q'):
        break
cap.release()
cv2.destroyAllWindows()
```

Figure 1.

Seeing that we have a successful run of this script it can be confidently said that the entirety of the partitions code, be it image collection or the training section has been successful.

## 6. Conclusion

The code in conjunction with the different technologies, contributes in making an application that would otherwise require heavy-duty hardware and specialized individuals a very simple, usable, and portable web app. As of now, the application supports the basic English alphabet and some hand signs, making for about 31 possible detections. Thanks to Python and Tensorflow the application is easily mouldable and easily growable making its potential limitless and timeless. This first version is as small but secure step in the right direction to better the live of a community.

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# Deploying a Scalable Serverless Web / Mobile Application for a Business Using IoT Core Services

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**Abstract:** Nowadays, a large number of companies are migrating to the cloud, leaving behind the concept of maintaining traditional data centres and servers. Reduced infrastructure costs, lower capital costs, and accessibility are the key drivers of this migration. The requirement to make cloud services dynamic is critical given the rising demand for cloud computing and the shifting needs of customers. One such dynamic service is offered by Amazon Web Services (AWS). In this paper, we present a line of work in which we will learn how to set up a complete serverless web application for a campground. As the first winner of a Business Ideas Competition, I wanted to connect this project to a greater extent, so I came up with the idea of building a total serverless web application for the “Olive Camping” business with the help of AWS services. The campground will be launching a mobile app describing in detail every service and attraction throughout the camp that offers features such as waiting times, photo opportunities and notification alerts for people who require it. The target is to fully understand how this technology functions and learn to use most common services. We first explore the architecture by deploying a serverless backend and a serverless mobile front-end. Finally, we describe the design and implementation of a serverless architecture with serverless services for all three layers of our stack: compute, integration, and data stores.

**Keywords:** *AWS; Serverless; Lambda; S3; Cloud Computing; Cloud9; Amplify Console.*

## 1. Introduction

The campsite is rolling out a mobile app that provides many guests with wait times, photo opportunities, notification alerts, and language translation for tourists who require it.

This scalable serverless application is a complete single-page application (SPA) front end that offers a feature-rich user interface. To set up a frontend and create a backend serverless application, we'll take a micro-services methodology.

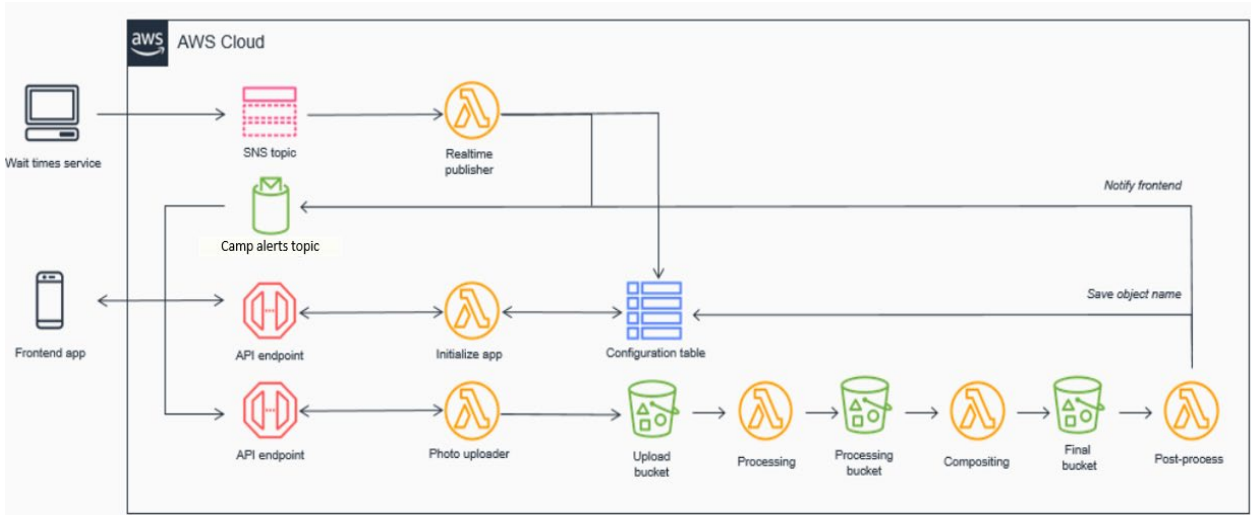
The backend services are accessed through a frontend web application made up of an existing JavaScript web application that is managed by AWS Amplify Console. For hosting and deploying full-stack serverless web apps, Amplify Console offers an easy Git-based workflow. Amplify Console can produce both the front end and the back end, but we will just be utilizing it to produce the front end.

The static web resources, such as HTML, CSS, JavaScript, and image files, will be hosted by Amplify and loaded into the user's browser through S3.

The services that are used in the backend application architecture are AWS Lambda, Amazon DynamoDB, Amazon API Gateway, Amazon Cognito and Amazon S3.

Data is sent and received from a public backend API that was created using API Gateway and Lambda by JavaScript running in the frontend browser application. The Lambda functions of the API employ the persistence data storage layer that DynamoDB offers.

To see the entire architecture, refer to the diagram below.



**Figure 1.** Application Architecture

## 2. Application Deployment

The campground application consists of a frontend and backend, so here we will set up the frontend and then connect it to the backend. Prior to deploying the backend resources, we will deploy the frontend application. Then we will re-deploy after connecting the two. The frontend is a Progressive Web App (PWA) developed in Vue.js.

The frontend code is provided so we deployed it into our own Git-based code repository that is stored in Code Commit. We will create a continuous deployment pipeline to publish the frontend application using AWS Amplify Console.

The backend is made up of serverless microservices by establishing the following:

- A DynamoDB table holding details of each tent and services around the camp.
- A Lambda function that uses DynamoDB to execute a table scan and return every item.
- An API Gateway API that generates a public http endpoint the front-end application can query. This calls the Lambda function, which will return a list of services and attractions.

## 3. Tent Real Waiting Times

In this part, a serverless solution is used to connect a service with real-time data to a frontend application. It illustrates how to link a backend application to the tent-times system and then utilize an IoT topic to talk to the front end.

The Flow & Traffic Controller, a custom program used by Olive Camping, calculates wait times for various services.

- The Controller updates an Amazon SNS topic once per minute. This has already been made for us.
- We'll add a Lambda function to our account that is called whenever notifications about this matter come in. This function will send the message to IoT Core and store it in DynamoDB.
- Finally, we will republish the frontend after updating the configuration of the front-end application to listen to this IoT endpoint.

These two settings are necessary to allow the frontend to monitor the IoT topic for messages about camping time:

- IoT endpoint hostname
- The Cognito Identity Pool ID.

After retrieving these values, the frontend settings will be updated. After making the modification, we will commit it to the git repository, which will cause Amplify Console to automatically republish the application.

## 4. On-tent Photo Process

This chapter demonstrates how to apply a chroma key operation to user-generated photos using a Lambda function. It covers the asynchronous processing of the job and demonstrates how to notify the frontend when the image is available.

Camping guests like snapping pictures of the tents and attractions. Visitors can use this app function to shoot a selfie and view a composite image afterwards. They can then share their creation on social media from this point.

- The front-end makes a call to an API endpoint to obtain a presigned URL for S3 photo upload. As a result, the front-end application can upload files straight to S3 without using a web server. As a result, the S3 Upload bucket now contains a new JPG object.
- The first Lambda function in the sequence is run whenever a new item is written to the Upload bucket. Chromakey is used to remove the green screen background from the image. The finished picture is saved to the Processing bucket.
- The following Lambda function is called when a new item is written to the Processing bucket, and it composites the image with a new background and theme park logo. This outcome is recorded in the Final bucket.
- The final Lambda function is called when a new object is written to the Final bucket, and it notifies the IoT core that the file is ready. Through the IoT topic notifications, this alerts the front-end application.

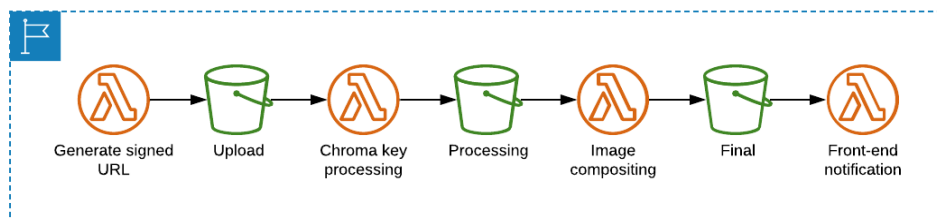


Figure 2. Serverless backend infrastructure

After setting up the application, open URL: <https://main.d2qgiaxgr2gips.amplifyapp.com/#/>

## 5. Conclusion and Future work

To summarize, what the reader of this paper will profit and learn about this new technology.

They will be able to run multiple applications in the AWS environment and become familiar with each of the major services used, like AWS Lambda, AWS Amplify Console, and the AWS Serverless Application Model. It will be easier for them to manage the running application and deploy applications faster and more securely. The application will be accessed by a lot of guests when they enter the camping and have a lot of functionalities such as taking photos and uploading them in the gallery or select and see a service inside the camp.

As future improvements we'll be adding functionalities such as analyzing large amounts of data from guests to generate insights about their visits to the campsite. We will deploy a simulator, configure Kinesis Data Firehose, and set up QuickSight to create a dashboard for camp management. Moreover, add

multilingual support to our front-end application and finally, we will use application events to create a metrics dashboard with Amazon EventBridge, and develop new functionality without modifying existing code.

AWS is being adapted quickly by every organization and in a few years, everybody will use this technology. The paper will be like first hand-on practices with AWS focusing on serverless concepts like event-driven computing and real time messaging.

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# The Role of Strategic Planning in Identifying and Assessing the Environmental Factors Affecting Businesses

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**Abstract:** The Strategic Planning has a significant role in identifying and assessing the environmental factors that affect businesses. It is the primary process that helps business organizations to define their company vision and objectives and take steps toward a better future. For any business to grow and prosper in the long run, managers need to recognize and identify possible changes in the internal and external environment. Organizations without an improper strategic planning program for assessing the different ecological factors an organization can face several challenges. The main objective of this research paper is to evaluate the significance of strategic planning for business organizations to eliminate any challenges resulting from external environmental changes. Furthermore, this research paper will determine the best possible solution to optimize strategic planning that will benefit businesses in gaining long-term- sustainability. In order to answer the research questions, primary data will be collected through a questionnaire that is conducted with 100 employees working at different functional levels in business organizations. This research paper suggests that development and implementation of proper strategic planning not only enhances the efficiency in the decision-making process but at the same time enhances the operational efficiency. An optimization is achieved with respect to the attributes of "efficient and energetic leadership", "good management of funds", "customer focused planning", "strong internal cooperation" so that the overall efficiency of the process of strategic planning can be optimized. The research makes also prominent contributions upon how different environmental factors like the economic, the political and the social categories must be paid attention by different organizational managers to ascertain the areas where changes are to be made.

**Keywords:** *Strategic Planning; Environmental Factors; Organizations; Efficiency; Optimization.*

## 1. Introduction

Strategic management is very effective in making sure that it helps put focus on the business and also makes sure that the employees are focused on one goal of achieving organizational success. For any business to grow and prosper in the long run, managers need to recognize and identify possible changes in the internal and external environment. With the assimilation of strategic change, business managers can bring out the best advantage of new change methods.

The problem statement identified in this research is how improper strategic management processes in an organization can negatively impact business processes. The improvement in different life sectors like science, technology, innovation and communication has changed the entire business world. Strategic planning has become highly crucial in today's business scenarios because of which there has been a substantial increase in uncertainty and competition for all organizations [1]. The primary purpose of this research is to evaluate the significance of strategic planning for business organizations to eliminate any challenges resulting from

external environmental changes. Furthermore, this research will determine the best possible solution to optimize strategic planning that will benefit businesses in gaining long-term- sustainability, as per the following objectives:

- To analyse the importance of strategic planning for assessment of environmental factors affecting businesses.
- To analyse the crucial success factors that promote effective strategic planning for business organizations.
- To identify areas of optimization of strategic planning that will empower business organizations in tackling environmental pressure.
- To identify measures in tackling environmental challenges for long-term business sustainability.

The Research Questions and Hypothesis are:

What is the role of strategic planning for assessment of environmental factors affecting businesses?

What are the crucial success factors for effective strategic planning for business organizations?

What are the areas of optimization of strategic planning that will empower business organization in tackling environmental pressure?

What measures can be implemented in tackling environmental challenges for long-term business sustainability?

• *H1: Strategic planning optimization helps the organization in analysing environmental challenges that affect the business*

• *H2: Strategic planning optimization does not help the organization analyse environmental challenges affecting the business.*

## 2. Literature Review

Strategic planning helps businesses with the assessment of the environmental factor and is considered the most vital quality that enables the business's needs while keeping the environmental factors into consideration. There are several external environmental factors such as economic, technological, global, ethical, legal, socio-political and another environment. In such cases, strategic planning helps businesses to understand their target customers [2]. Generally, three basic types of strategies have been established for the strategic planning of competitive businesses. Namely, the Cost Leadership Strategy, The Differentiation Strategy, and the Focus strategy. Overall, by formulating and implementing the evaluated strategies in the businesses in an effective manner, strategic planning can prove to be extremely beneficial for the business environment [3]. Sustainability in the business environment can be influential towards better maintaining program services, employee relationships and staff members among the participating business organizations.

Having effective leadership in strategic planning significantly helps the environmental factors of the business. It enables communication development, enhances teamwork and collaboration and engages better employee motivation strategies. Therefore, it is the leaders who are responsible for the strategic plans that determine the future of the business organization. Moreover, researchers consider leadership to be a primary responsibility which enables the teaching and practice of the basic strategic values in business organizations.

Furthermore, adopting a customer-centric approach in the assessment of the business environment in business optimizes strategic planning. The goal of customer-oriented companies is to satisfy customers' needs to retain them for longer. For example, the evaluation of customer feedback. It often focuses on customer service and initiates the changing business according to consumer need.

By successfully implementing strategic planning against the changing environment, a company can get a competitive advantage over other companies. Sometimes, burning political issues in the global scenario have a significant impact on the functionalities of a business organization as that particular socio-political incident impacts the overall economy, including employment, growth, trade and finance. At that time, different works



like recruiting new staff and managing costs of the business operation become very tough. Further, importing and exporting goods becomes very difficult; side by side, customers; behaviour also gets influenced by political uncertainties. However, companies can deal with these types of challenges by adapting corporate strategy based on different factors like current market conditions and the nature and scope of the present change.

Although globalization has added comfort to human life, companies face a lot of challenges while coping with globalization as they have to adopt numerous new technologies, new difficulties such as recruiting new employees to add value to the new consumers and dealing with international competition all become pretty challenging for aspiring companies. So, the companies need to build some well-planned business strategies which go hand-in-hand with their corporate goals in order to attain success in the international market. When a company tries to resolve cultural issues while providing products and services all over the world, this strategy can help the respective company in getting quick success.

### 3. Methodology

The post-positivism research philosophy has been looked upon, by means of which background information on the topic has been developed. The background information is accumulated through secondary data belonging to the published data sources. Additional first-hand information from validated sources also has been accumulated, and the current trends in the business environment related to strategic management are properly focused upon [6].

Through the deductive approach of data collection, the latest data and evidence in the form of empirical evidence has been accumulated on the importance of strategic planning for assessing environmental factors affecting business [4]. The current trends and latest information have been extracted as a result.

With the aid of exploratory research design technique, different forms of quantitative information have been accumulated and are systematically arranged for smoother evaluation. A survey program is executed as part of the research design technique [5]. The utilization of this research design procedure will result in sequential data collection and analysis that will lead to better accuracy in the research findings.

In the course of the accumulation of data, a closed-ended questionnaire has been regarded [4]. This will be the primary tool for data collection, which will outline several factors that influence a business organization's strategic planning while negating environmental challenges [6]. To achieve refined sets of information reflecting on the role and importance of strategic planning, designing the closed-ended questionnaire has been done in a systematic approach. The questionnaire is designed in a Likert scale pattern which comprises both demographic information of the participants and different categories highlighting important areas of the thesis program. In the survey, the questionnaire comprises of 21 questions, out of which 5 questions outline the demographic profile, while the rest of the 16 questions have been segmented under different categories such as strategic planning, assessment of environmental factors, and optimization of strategic planning and issues and challenges. The Likert scale is predefined in this closed-ended questionnaire in which option for an answer are integrated into the form of 1 (depicting strongly disagree) and 5 (depicting strongly agree). Under each of the category, 4 questions have been integrated to make the data collection program easier.

On the other hand, the reliable databases used are Google Scholar has been regarded to collect the secondary data. Furthermore, consideration of keyword-based searching techniques has been done for faster accumulation of reliable data associated with optimization of strategic planning and issues and challenges for the business organizations.

The subjects of the overall sample size for the primary data collection program of the research will be 100 employees working at functional levels in business organizations. The employees would be reliable and appropriate individuals with high strategic management experience.

With this random sampling technique's aid, appropriate samples with proper knowledge and the idea of strategic management practice impact have been looked upon [7].

A survey program has been used for the accumulated quantitative information. The survey is conducted to gather insights and relevant data for the project from relevant sources. In order to collect a validated set of data in alignment with the objectives of the research project, attention has been given to first-hand empirical data from relevant sources. To support the empirical data, evidence from published literature sources has been duly extracted. During data collection, a survey program has been initiated, and opinions of past authors showcased from trusted articles and peer-reviewed articles have been collected, reflecting on success factors that promote effective strategic planning for business organizations. Prior to the extraction of data, a check on their credibility and the information quality has been done. This tactic has been crucial to achieving optimized findings [8].

The extraction of the evidence accumulated from the survey program has been done by application of the Microsoft Excel analytical tool. The opinions presented by employees have been analysed in detail, highlighting the role of effective strategic planning in eliminating environmental challenges.

Different forms of analytical tools such as descriptive statistics, frequency analysis, correlation analysis and regression analysis have been used to analyse the quantitative information accumulated from the survey program. Apart from this, graphical analysis has also been regarded to evaluate the trend of the demographic responses, which has been illustrated with the help of the Google form analytical tool.

One of the significant limitations is the inclusion of 100 employees in the questionnaire during the survey program. Such inclusion is a limitation as a diverse opinion will not be accumulated, and it might affect the overall findings. Not getting first-hand information from managerial executives due to time restraints.

Selection of the primary qualitative data would have yielded better and more authentic results because that would have helped in the ideation of the factor that causes challenges to strategic planning from the management's perspective.

The highest form of ethical compliance will be made to maintain honesty and integrity during the data collection program.

#### 4. Conclusion

The responses have been recorded by some matured respondents who are young and educated and are working in an industry that demands continuous strategic planning for ensuring growth and success of the banking organizations. Also, in brief it can be said the responses that are being recorded are highly reliable and relevant to the topic discussions.

The strategic Planning (SP) as well as Optimum Strategic Planning (OSP) must be carried out for assessing the environmental factors that is definitely going to influence the process of effective decision making in the context of a business organization.

A customer centric approach must be undertaken for enhancing the optimum strategic planning as the customer feedback contains the valuable insights as well as inputs that are needed for developing and updating the process of strategic planning from time to time. The correlation analysis clearly reveals that the assessing of the environmental factors is having strongest association with the OSP or optimum strategic planning.

The intended audiences (that is the managers involved in the process of strategic planning) in the context of a business organization must take the following measures for ensuring good development of strategies while regulating the business planning for guiding the future business activities. Information must be gathered regarding the system of knowledge distribution so that an efficient planning process can be kept running on a continuous basis. Operational and financial issues must be sorted out well in advance for attaining an efficient planning process.

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# Impact of Social Media on the Brand Awareness of Albanian Companies

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**Abstract:** In the past years we have seen a great increase in Social Media usage in business growth matters. Social Media Marketing has been the top element that has achieved a business's economic growth and brand awareness. The aim of this research is to provide information and proof about the actual situation of Social Media's importance to Albanian businesses and to assure that Brand Awareness is a known term in the Albanian market. The method used for the conduction of this study is the qualitative method based on interviews and social media sites examination. Through this method, the research can be more straightforward and realistic to the aim of the study. This study has shown that Albanian businesses are still adapting to technological changes and trends, and are mostly willing to undertake work on trying to create a good marketing strategy for their brand. Albanian businesses despite their type of entity are informed about social media's effectiveness on brand recognition and economic growth. We can state that digitized business operation has grown through the past years and it's not anymore at an infancy level. The growth of social media marketing to create business awareness is on the right path of growth, and it can be said with certainty that in a short time Albanian business will be comprehensive in their importance and usage

**Keywords:** *Social Media; Marketing Strategy; Paid Advertisements; Brand Awareness; Brand Equity; Albanian Market.*

## 1. Introduction

Social media is one of the most popular sources for granting brand discovery and sharing. This type of platform has shown its influence during the past years by becoming the ruling form of marketing a business or brand. Conducting a strong marketing strategy is what creates easy steps for a business to achieve economic growth and be distinguished by consumers. With a considerable number of social media sites, it is important to know what a solid ground for businesses is to leverage social media. It is crucial to distinguish whether a social media site is right for business usage and if it fits the brand image of a company. Understanding what a brand stands for and how it should be visualized should be a company's first step in creating a strong marketing and brand awareness achievement strategy. A lot of users and now businesses are trying to embrace the power of social media and its effect on a company's profit. Businesses are adapting to new trends, ways, and categories of technology to raise brand effectiveness and the so-wanted profit. It has been seen that in the last years Albanian businesses are getting more and more informed on how to digitize their brand. Since the COVID-19 pandemic hit, the major part of Albanian businesses changed their marketing strategy and derived their brand toward modernization and digitalization. Brands decided to maintain their businesses virtually and offer an online portal for their customers to navigate. Given the background, many companies using social media platforms as a marketing instrument don't seem to follow a particular strategy. Meaning, the importance of social media in brand awareness and development, most Albanian companies don't have a clear purpose for using digital marketing. This ends with the fact that despite the need of using social media networks as a tool that provides business growth, it is still not clear how these tools can be used to monetize and measure a company's influence and business performance.

The aim of this research is to achieve a thorough analysis of the Albanian business's approach to social media site usage and brand awareness achievement importance.

## 2. Literature Review

### 2.1. Social media

In recent decades, social media has become the most influential phenomenon in communication [1] (Kaplan & Haenlein, 2010) Communication between users and the whole community is facilitated to help build trust among members [2]. (Leimeister, Sidiras, & Krcmar, 2006). New ways to build and maintain social media sites are being offered more to people, alongside relationship creation, information sharing, and even participation in social media [3]. (Lorenzo-Romero, Constantinides, & Alarcón Del-Amo, 2011). Ben Lutkewich [4] in his report for Tech Target defined Social Media as a collective term for websites and applications that focus on communication, community-based input, interaction, content-sharing, and collaboration.

As a communication tool, Social Media is very important when it comes to businesses. As the director of communication between the company and customers is bidirectional, businesses can take advantage of these social media marketing tools to build relationships with their clients in a more direct, effective, and controllable way. Social Media plays a crucial role in brand discovery and sharing. In business, they are used to market products, promote brands, and help businesses connect to customers.

Social Media has a huge impact on helping businesses reach their target audience effectively. In today's era if you are not online then you're more likely to not be discovered and not overcome the competitiveness. Social media offers an easy way for companies to achieve brand loyalty, easy communication with their consumers, being distinguished from their competitors, a bigger audience, and increased profit. By making the brand visible to society, a business is more likely to succeed rather than just waiting for customers to come by themselves.

### 2.2. Social media usage

According to the Office of National Statistics, consumers are spending more time using social media as a tool for purchasing goods and informing themselves about brands and products specific brands provide. Since the pandemic, buyers are choosing to purchase products and services online rather than physically looking for what they need. The 2022 customer is more likely to buy a product promoted online rather than going to an actual shop and be thrilled about some product advertised inside the shop.

On the other hand, consumers are talking more about their experiences with a particular company or product. Active Social Media Users are more derived from reading product information and reviews online and according to OBERLO almost 47% of all internet users say they post reviews about a product, company, or service each month. Customers are raising brand awareness by sharing their experiences and reading what other users have to say about a particular product or brand. Social media based on this scenario helps in protecting brands. According to Nielsen's Global Online Survey, 61% of social media users share their experiences online to give recognition for a brand doing a good job of providing products and services. Happy customers leave cheerful reviews that matter on helping other consumers on recognizing a brand or a particular product.

Companies are increasing their investment in social media because social media usage by consumers has increased massively during the past years. According to Forbes, social media will be the preferred way for consumers to learn about brands, ahead of all other channels including email, TV, and print advertising. All of this supports that in order for businesses to thrive, they must prioritize social media. Most businesses nowadays use social media as their selling portal. They try to create brand awareness and promote their products and services online in order to catch more audiences and be distinguished from their competitors.

2.3. Social media

Paid social media is another word for advertising. It's when brands, to have their content shared with specific audiences who are likely to be interested, pay money to social media sites such as Facebook or Instagram either through "boosting" their content or designing memorable advertisements.

According to EMarketer, Paid Social Marketing has increased because customers are not only spending more time on social media sites but are also purchasing more goods via e-commerce and online platforms. This makes ads a necessary part of the online shopping process because customers will tend to buy more if they see more.

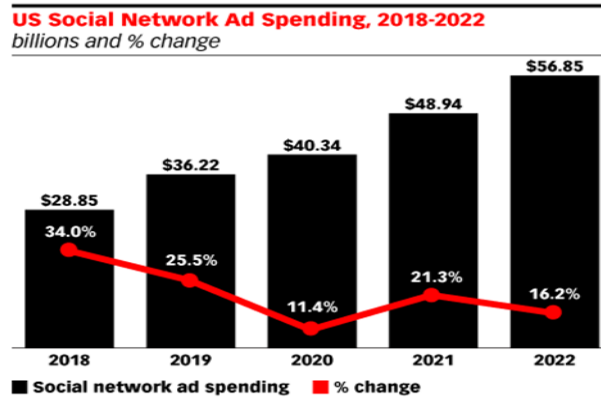


Figure.1 US Social Network Ad Spending, 2018-2022

2.4. Brand awareness

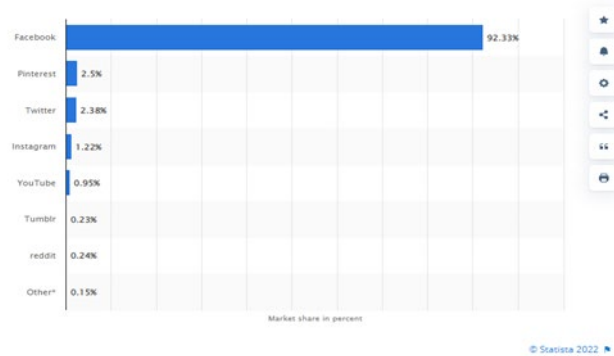
Brand awareness is a general term that emphasizes how aware consumers are about a brand or its products. Simply said, it is the measure of how distinguished, recognizable, and memorable a brand is to its target market.

According to Jin & Villegas [5] (2007), they proclaim that brand and product are linked because it helps the consumer to get the capacity for recognition or remember a specific brand. Brand Awareness is a measure of a consumer's brand recall and brand recognition. Evaluating and predicting consumer behavior is required for brand management. Therefore, brand awareness is the much-needed feedback for existing advertising and marketing campaigns.

Kumar & Moller [6](2018) claim that brand familiarity motivates customers to adopt the brand products when they release something new with the brand name. Commonly, customers like to be familiar with the products as people have their experiences and have better knowledge about the product or service because brand knowledge and past experiences of the consumers make the brand and product well known [6]. It is most common when consumers are familiar with the product, they make decisions without knowing about other products because of their preferences [7](Aaker, 1991).

2.5. Albanian Business's approach to Social Media

According to Lloyds Bank, sales support and customer service are relatively undeveloped as marketing tools, nevertheless providing such services can determine a plus. E-commerce is in its infancy with only a limited number of domestic merchants offering this option in Albania.



**Figure 2.** Leading social media websites in Albania in 2021, based on the share of visits – Statista

According to a survey carried out by the Albanian Institute of Statistics during 2018–2019 for the purpose of examining the usage of social media in households and by individuals, 87.1% used them on a daily basis. Clothing online purchases had the highest percentage of transactions (82.6%), growing by 4.0% from 2018.

Overall it can be stated that Albania’s approach to social media is much higher than it was some years ago. Albanian businesses want to follow trends and differentiate themselves from the market. A great number of Digital Marketing Agencies are showing the need that Albanian businesses have in achieving business growth. Albania is adapting to new changes really fast and good opportunities seem to be ahead. According to a survey carried out by the Albanian Institute of Statistics during 2018–2019 for the purpose of examining the usage of social media in households and by individuals, 87.1% used them on a daily basis. Clothing online purchases had the highest percentage of transactions (82.6%), growing by 4.0% from 2018. Overall it can be stated that Albania’s approach to social media is much higher than it was some years ago. Albanian businesses want to follow trends and differentiate themselves from the market. A great number of Digital Marketing Agencies are showing the need that Albanian businesses have in achieving business growth. Albania is adapting to new changes really fast and good opportunities seem to be ahead.

### 3. Research methodology

#### 3.1. Research strategy

In order to increase the knowledge about this research, a selection of materials was made based on the latest scenarios and analyses about the elements involved in the topic. In the process of searching for the appropriate literature, specific keywords were used; for example: “Social Media Sites”, “Albanian Market”, “Brand Awareness”, “Brand Equity” and “Social Media Ads”.

After collecting all the necessary sources to gather the desired data for the search, an evaluation was made for the sources to be credible, reliable, relevant, and reputable to the purpose of the research. Furthermore, the information gained by the selected data was used in interview formulation and analysis of responses.

Alongside interviews, two important social media sites were reviewed for all the respondents. Facebook and Instagram were selected as the most used social media sites for promoting Albanian businesses.

#### 3.2. Methodology

The research method used for the conduction of this research was the qualitative research method involving interviews and sites evaluation for data collection. The qualitative research method is defined as a research method that focuses on gathering data through open-ended and conversational conversations. The purpose of this study is to get the Albanian business owner’s perception of the importance of social media usage, therefore the qualitative method is suitable for the scope of this research.



### 3.3. Interviews

The primary source of data of this research is obtained through the responses of interviews. Research interviews are a qualitative data collection technique that involves two parties, the interviewer and the respondent. Interviews are used by researchers when a piece of specific information is needed that can be obtained only through one-to-one meetings or a contact of a target group through direct questions. Interviews are also made in the form of surveys which are a fast and easy to collect information type of data collection form.

In this research face to face, interviews were conducted with a group of Albanian business owners. The questions were direct and worthy of the purpose of the study. Direct answers were received alongside details about the requested phenomena. Interviews were conducted in the Albanian language and were translated to English for the purpose of the study. The questions of the interview were believed to be helpful to the scope of the research and can be found in the Appendices section. Noting that before conducting the interviews, the area and purpose of the research were presented and explained to the respondents so that they could have a clear idea of what exactly was tried to achieve through this research.

Furthermore, the right to remain anonymous in case they wanted was given; otherwise, it would represent an ethical issue in the research study. Lastly, respondents were assured that all the information given regarding their businesses would be kept in confidentiality and will not be used for purposes other than the research study. Each interview conducted took on average 34 minutes to finish.

## 4. Data analysis

### 4.1. Nature of Albanian Business and their Identification

When the 5 companies interviewed were asked what their business was about and what they offered they all said that they offered physical products. Respondents 1 and 2 were mostly in the same industry, Respondent 1 is more of a family business and had their products purchased only physically by the customers. On the other hand, Respondent 2 offered delivery for their products but the reservation of the goods was made either by phone calls, email, or physical order.

Respondents 3, 4, and 5 all offered online delivery and allowed the customers to purchase their goods through their social media. They offered the client the opportunity to shop online.

*"Our clients can also purchase products through our website. They can pick whichever product they want, make an order and we later deliver the product to their requested location. The payment is either taken in cash or as a bank deposit. We don't offer PayPal or any other online payment yet. We are still working on implementing that."*

*"We offer product ordering through our Instagram account. We post each of our products on our Instagram account and customers contact and order from there. We offer delivery at their homes and accept only cash payment."*

*"Usually our clients are businesses, they send representatives to choose products and make the purchase through declarations. The payment method is usually with bank deposits."*

Representative 1 stated that the business was part of the food industry, usually, their products were purchased from friends and clients in the neighborhood. The representative described the business as a small family business and stated that sometimes they had orders from events and lately had created an agreement with another company near them for supplying them with their products. Mostly the business was run by the family and three other employees were hired. The business has been operating only in Tirana, Albania since 1992.

*"We consider ourselves a small family business. And our main goal is to provide the best products to our clients. We are a bit old-fashioned and we have not adapted yet to this technological era. We are learning and taking small steps on trying to get modernized."*

Representative 2 explained that the business operated as a catering business as a restaurant. Their products were purchased by walk-in customers and they had massive orders for events. The representative described the business as a limited partnership with 2 owners working and being present all the time at their business. The business had more than 10 employees. The business has been operating in Tirana, Albania since 2009.

*"Our main goal is to create satisfied and loyal customers. We offer products that will please any type of customer. We consider ourselves a well-founded business and feel that we are distinguished from our competitors for the friendly environment and service we offer."*

Representative 3 described the business as a Wholesaler and Supplier company for electronics products. The representative stated that the company firstly started as a LTD with 2 owners and now is in the process of separation where the representative will be the only owner. The company is more B2B oriented but also stated that they offered their service to walk-in customers as well. There are four employees currently working in the company. The company has been operating in Albania since 2008.

*"We are more B2B derived, because our main customers are businesses. We would like to expand in the future to becoming retailers as well but that takes a lot of time and effort. We are comfortable in the wholesaler competition because we are surely recognized by our customers. We offer explicit products for the best prices in town."*

Representative 4 described their business as a small family business. The business is part of the clothing industry and offers clients unique products for reasonable prices. It serves walk-in customers but online customers can make purchases as well. There are 2 family members working on managing the business. The company has been operating in Tirana, Albania since 2015.

*"We run this business as a family. Our main goal has been offering clients qualitative products for reasonable prices. We do operate online but not in a professional way. We want to grow our business but it takes a lot of time to do so."*

Representative 5 explained that the company is part of the construction industry. The business was run by family members and the representative described the company as a Limited Liability Company. There are more than 50 workers currently working for the company. The business has chosen to employ mostly family members. They had partners from all over the world and offered their services beyond the Albanian Market. The company has been operating in Albania since 1998.

*"We see our company as a family business even though we represent a LTD. We have decided to have trusted family members on our staff. We provide services to countries besides Albania, mostly those in the Balkan. We see ourselves as well grown and are open to new opportunities that may arrive."*

#### **4.2. Role of Social Media Marketing in enhancing Brand Awareness**

Although the respondents have different types of businesses operating in different industries when they were asked on how they identified their brand with only their name. Additionally, the interviewees gave certain characteristics to describe their business and tried to show what made their brand recognizable from their competitors and customers.

Respondents 3 and 5 had similar thoughts on how their brand was recognized, they stated that their brand was distinguished by "their name, their logo, their products, and good service." Respondent 2 said that their company was distinguished by "their distinctive name, their fresh products, strategic destination, and friendly service". Respondent 1 differentiated itself from the mass by "unique way of product preparations and family-based environment". And lastly, Respondent 4 stated that their brand was recognizable by "the name, quality of products and funny posts on social media".

When asked about branding strategy, the respondents had different approaches throughout their responses. Respondents 3 and 5 stated that they had hired Advertising Companies several times in order to spread the company's name, "We have hired a Social Media Management Company to take care of our social media sites. They create content from time to time and take care of our website mostly". Respondent 4 described their branding strategy as very effective for their capacity. "We post our products through funny and trending videos, we try to interact with our clients as much as we can, and always find ways to keep them looking at our profile. There is

more to be done but this is all we can afford at the time.” Respondent 2 described their branding strategy as being more direct and stated that they haven’t needed the use of online branding so far, “Our business is more direct, we try to reward our clients and create loyalty in our own way such ways can be providing live music at our restaurant, offering dishes out of the bill for our most loyal customers and celebrating alongside with our customers. We don’t find using social media so important, we are good so far.” Respondent 1 on the other hand described its brand as a small business not yet ready for the application of modern strategies, “As I said before we are an old fashioned business, we are not well informed about having strategies on how to navigate in the market. We offer the best we can to our customers and we are pleased with what we get in return. Maybe when my kids take over the business, branding strategies will be implemented and our business might grow.”

When it came to advertisements, respondents 3, 4, and 5 mentioned that they used paid ads on social media such as Facebook and Instagram. Respondents 2 and 5 mentioned having used advertisements on national televisions and advertisements on the road. Respondent 1 accepted to have used advertisements on national television only once and after that decided to not try it anymore, “I paid for an advertisement some years ago to be run on a national television. It didn’t work. I lost my money and didn’t get any new clients afterward.”

### 4.3. Influence of Social Media between Business and Customers

When it came to the part of social media the businesses used, they quickly responded by showing their social media sites. All the respondents were using Instagram, three out of five were using Facebook, only two were using Tiktok or LinkedIn and only two owned a website.

Respondents 3 and 5 were the only ones using 4 social media sites, running campaigns online, and having marketing companies manage their sites.

“I have decided to have my sites run by a professional marketing company. I think it is better this way and it saves the company a lot of time. We have seen a huge turnover on our orders every time a post is boosted or a campaign is run.”

Respondents 1 and 2 did not use social media so often, if they did they didn’t have professional posts but only made announcements that they needed to make.

“We don’t have the time to use social media as much. We use it once in a while to announce something important happening. We are pleased with the way we approach customers. We don’t think social media is that important.”

Respondent 4 used only Instagram and TikTok and tried to follow the newest trends and be close to the followers and customers.

“I try to post daily. I get inspired by different influencers and try to apply them to my content as well. I run ads, take time to talk to customers online, and be close to my followers. I like making TikTok videos mostly, I think it is an easy and funny way of product advertisement.”

When asked about the spread of their image 3 out of 5 respondents approved that there is still room for improvement and that they are open to hearing better solutions and ways on how to become better when it comes to social media marketing.

“I see the changes social media marketing does for my company every day. I agree that there are improvements to be made but we are learning as we go. All is new to us and we are trying to be recognized online as much as possible. We are open to hearing criticism and being provided with smarter solutions.”

The rest of the respondents didn’t find the use of social media crucial for their business growth. They were sure that they were going in the right direction by running their business the way they are - without social media marketing.

“I like running my business simply, social media is just complicated. Less time using social media means more time for me to make new clients and provide more products and services.”

The businesses interacted with customers mostly face to face, but Respondents 3 and 4 thought that the interaction with customers on social media is much less time-consuming and effective at the same time.

“I interact with clients mostly through chats. It seems much faster and more effective. They ask about a product, they hear what I have to say and they decide to take it or not. While in the store clients will be looking around in vain and

asking questions all the time about different products shown in the store. I mean it is normal, the client has the right to see whatever they want to see but luckily social media has provided us with a much less time-consuming option.”

## 5. Conclusions

This research has contributed to the literature on marketing research, in the context of creating brand awareness for Albanian businesses. Based on the findings it can be highlighted that social media marketing does influence businesses’ exposure in a better way than other advertising methods.

Moreover, due to findings, it can be stated that Instagram and Facebook are the most used social media sites for the purpose of marketing in Albanian business's marketing strategy.

It can be declared that Albanian businesses are mostly new to the adoption of the right marketing techniques but are willing to make changes for the purpose of business growth. Through the interview responses, we conclude that small family businesses still haven’t understood the importance of social media marketing, while on the other hand big companies have captured the trend of the moment and are trying to create proper branding strategies.

The research implies that the Albanian market is generally informed about the importance of social media marketing to business growth and brand awareness. The Albanian market is business-oriented and offers a mostly young and educated workforce which impacts the growth of marketing in local businesses.

The Albanian market offers a lot of opportunities for investments, and it can be highlighted that this country’s business is derived from creating awareness of their brands and what they stand for. Local businesses are mostly open to new ideas and strategies to achieve growth, while others are not easy to adapt to changes and modern ways of promoting themselves.

We can state that digitized business operation has grown through the past years and it’s not anymore at an infancy level. The growth of social media marketing to create business awareness is on the right path of growth, and it can be said with certainty that in a short time Albanian business will be comprehensive in their importance and usage.

Lastly, this research recognizes the importance of social media marketing in both theoretical and practical forms. The research is applicable to the latest strategies of digital marketing and brand awareness achievement. The research is concise and can be used as a guide for local businesses to follow.

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# The Impact of Debt on Profitability: Case of Rossmann & Lala

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**Abstract:** The increase in competition due to globalization has had an impact even on the Albanian economy. Despite the marketing, competitive advantage, and other brand-related issues, companies rely a lot on debt as well. Capital structure has always played a crucial role in determining the profitability of a firm. This paper is regarding this topic: the impact of debt on profitability. It narrows its analysis to one company, Rossmann & Lala. To provide a clearer framework on how the business is performing, ratio analysis for profitability, liquidity, and debt utilization will be delivered, alongside with multiple regression. The regression performed in R-package, which contains time-series data from 2010-2019 for Rossmann & Lala shows a negative association between profitability and debt. Data was collected primarily by using the listed financial statements of Rossmann & Lala, from 2010-2019 on the website of the National Business Center, QKB. It also reflects the opinions raised in different research papers and academic books. This study aims to provide relevant judgments regarding the financial position of the company and draw conclusions from the regression analysis regarding the correlation between debt and profitability.

**Keywords:** *Debt; Profitability; Multiple Regression; R; Ratio Analysis; Rossmann & Lala*

## 1. Introduction

The transition to a global society has been quite a challenge for the economy worldwide, mainly for post-communist countries like Albania. Local Businesses have attempted to maintain their stability even though the opposition has been increasing a lot. International manufacturers were added to the market and their important aggressive advantage is the image and marketing of their businesses.

In some industries the competition is fiercer than in others, forcing many small businesses to go off the market. Albania has constantly been recognized for its excellent wide variety of small and medium companies. but this variety is shrinking within the customer retail enterprise due to the entrance of many chains of supermarket stores and coffee shops. But despite marketing and brand-related reasons, many other ways might increase the profitability of the organizations, for an instance regarding capital shape concepts.

The utilization of debt in the enterprise has always been a crucial subject matter of discussion among lecturers and now not only. The aim of this study is to provide an analysis of debt and profitability by way of deliberating a chain-retail shop business in Albania, Rossmann and Lala. We will deliver an in-depth analysis by showing some crucial financial metrics concerning its profitability, liquidity, and debt utilization, to give extra relevant statistics to its investors and creditors. We will finalize the examination by running a regression by utilizing the RStudio software. This paper incorporates six parts. The following sections, summarize the objective and the importance of this study. The third section will provide a theoretical framework by providing some important information about Rossmann and Lala. The fourth section is a literature review, which aims to study exceptional perspectives, via summarizing different research and different academic theories. The literature review can be accompanied via records analysis: ratio evaluation and regression. The final part will conclude with the main results derived from this paper.

## 2. Objective and Importance of the Study

The primary goal of the observation is to offer insights into debt management and its effect on retail companies. We are able to give information about two critical debt utilization ratios by taking Rossmann & Lala in Albania as a case to take a look at, and we will attempt to discover a long-term period between the debt-to-assets ratio and return on assets (ROA), ROE, and PM.

By taking a critical approach to debt control, we attempt to identify topics or issues for future studies in retail companies in particular.

This study's paper will contribute to the know-how of debt control. It strives to elevate focus and draw conclusions about the impact of debt on profitability in retail companies, through ratio and regression analysis. These outcomes could be concluded by using taking an actual retail enterprise in Albania, Rossmann and Lala.

## 3. Theoretical Background

Rossmann & Lala is a limited-liability business enterprise, that is owned 75% via Dirk Rossmann and 25% by Altin Lala. It's been operating in Albania since 2008. However, the main and sole distributor is Rossmann's parent corporation in Germany.

Dirk Rossmann GmbH is the second biggest drug shop chain in Germany, and it owns over 3,790 stores in Europe. The company is a distributor of the most famous German manufacturers for personal care, cosmetics, infant and adult bio meals, puppy care, home helpers, and so on. It is a supermarket chain that operates in Tirana, Durrës, Shkoder, and Prishtina in Kosovo [1].

## 4. Literature Review

This section reviews the literature associated with the incorporation of debt within a commercial enterprise and its impact on profitability. The relationship between debt and profitability has been a subject of discussion for several authors, several of which can be summarized in this part of the study. Before going into the specifics of the relation between debt and profitability, it's far critical to have a look at the core principles of capital structure to get a better understanding of the significance of debt inside a company.

Many authors have studied the concept of capital structure throughout the years, and many theories have been developed with regard to this topic. The most famous is probably Modigliani and Miller's theory. Welch [2] summarizes the two most important concepts of this theory, which are: "In a scenario of perfect competition, with no taxes, the value of the unlevered firm is equal to the value of the levered firm, and the risk rises with leverage. In a scenario with taxes, leverage lowers tax payments". Other important theories include the agency cost theory of capital structure, signaling theory, tax theory, etc. Swanson, Srinidhi & Seetheraman [3] summarizes the main theories reading capital structure including the agency cost theory. This theory states the conflict that exists between shareholders and managers, and shareholders and creditors. This is related to the idea that managers are inclined to use the profits of the companies they oversee for personal advantage at the expense of shareholders. On the other hand, debt incentivizes owners to invest in less-than-optimal ways. Agency costs were discussed by Baker and Martin [4] as well. According to them, these costs need to be weighed against the tax advantage of debt.

Wali, Goher & Mehboob [5] arrived at the same result regarding the relationship between long-term debt and profitability. The regression analysis was performed for 17 companies. However, short-term debt showed a significant and positive impact on profitability. Habib, Khan & Wazir [6] studied the effect of debt on profitability. The data was collected for 340 firms listed on Karachi Stock Exchange (KSE) from 2003 to 2012. The dependent variable is the return on assets, and the independent variables used are: Short-Term Debt to Asset, Long-Term Debt to Asset, and Total Debt to Asset are used as independent variables. Size, Sales Growth, and Growth Opportunity are used as control variables. The authors concluded that short-term debt, long-term debt, and total debt are negatively correlated with return on assets. The same result was yielded by

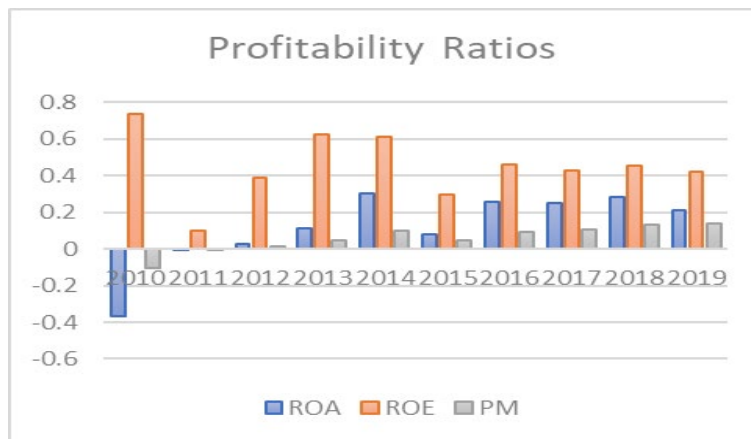
Shubita & Alsawalhah [7] in their study, which included 39 industrial companies listed on Amman Stock Exchange. The results suggested a negative relationship between debt and profitability. As representatives of debt financing, the author took short-term debt, lengthy-time period debt, and total debt. those have been independent variables, while ROE, ROA & PM, were taken as dependent variables, and firm size (FS) and firm growth (FG) as the control variables. The outcomes revealed a negative affiliation between long-term period debt and corporate profitability, while the alternative variables proved to be statistically insignificant in explaining the version in profitability.

**5. Ratio Analysis**

This section analyzes the profitability, liquidity, and debt utilization ratios of Rossmann & Lala for the duration of 2010 up to 2019.

**5.1. Profitability Ratios**

Profitability ratios are financial metrics that measure the ability of a company to generate profits relative to its assets, equity, and sales. The three common profitability ratios are return assets (ROA), return on equity (ROE), and profit margin (PM).



**Figure 1.** Profitability Ratios. Data from QKB Website (2021)

It is important to know how efficiently a company is using its assets and the number of earnings utilized by invested assets. This area of concern is reflected by the return on asset (ROA). As we can see from Figure 1, the highest return on assets is in 2014, 30% of the profits were generated from utilizing assets. However, this percentage fell in 2015 to 8.17%. Ever since it has been increasing, resulting in 28.14% in 2018. In 2019, ROA decreased to 21%. If we base our analysis on the trend of ROA throughout the years, we conclude that in the last years ROA has been increasing steadily from year to year, but on the other hand, if we consider 2010 up to 2015 the company was experiencing many fluctuations. This is reflected in the ROA between 2014 and 2015, which fell from 30% to 8.17%. Table 1 shows that the net income fell by 45.29% from 2014 to 2015, whereas the total assets increased by 101.5%. These changes justify the big difference between the ROAs from these years. Regarding ROE we can see that the company relies on Equity since the values throughout the years are high and PM is increased over years till 2019 with 13.9%.

**Table 1.** Percentage change of ROA from 2014 to 2015

2014	2015	%change
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<b>Net Income</b>	135,943,616	74,375,197	-45.29%
<b>Total Assets</b>	451,983,628	910,749,678	101.50%
<b>ROA</b>	0.301	0.082	-72.85%

Data from QKB Website [8]

One possible reason for this sudden and big difference is that the sales during the year 2015 fell. The decrease in sales is also seen in the inventory build-up in 2015. Table 2 shows the percentage change in inventory throughout the years. The biggest change in inventory was in 2015. This inventory build-up is also justified by the low-profit margin in 2015, which fell from 9.66% in 2014 to 4.66% in 2015. To sum up, we can conclude that the company's sales during 2015 were low. This led to an inventory build-up. Since the company relies a lot on its current assets, the build-up in inventory influenced the total assets that the company owns. So, the company was not using efficiently its assets and this resulted in a lower ROA for 2015.

**Table 2.** Percentage change of inventory

2012	2013	2014	2015	2016	2017	2018
-9.3%	11.3%	-5.9%	69.1%	2.5%	22.5%	0.6%

Data from QKB Website [8]

Return on equity measures the profits made for each dollar from shareholders' equity. Based on graph 1, ROE was at its highest levels in 2013 and 2014, with 62.2% and 61.45%. It reduced almost in half in 2015, and has been increasing ever since, but without reaching the levels of 2013 and 2014. It decreased slightly in 2014, and sharply in 2015, from 61.45% to 29.33%. As stated above, in 2015 the company's performance was poor in comparison with the other operating years. Profit Margin (PM) follows the same pattern as the other two profitability ratios, showing a steady increase from year to year, with the only exception in 2015, which fell by almost 52%. It is important to compare the performance of Rossmann & Lala with its competitors, like Conad Albania or Big Market, to see if they were facing difficulties during this period too. Big Market's financial statements are made individually for every chain store that it operates, so it is impossible to deliver a profit margin representative for all the stores. So, we narrowed my analysis to Conad Albania. Table 3 shows that even Conad experienced a decrease in the value of the profit margin, but at lower levels than Rossmann & Lala. One of the reasons why this happened is that during this year, 2015, many other new competitors entered the market, like Spar and Eco Market. These are also chain supermarkets in the retail industry.

**Table 2.** Profit Margin 2014-2015

PM	2014	2015
<b>Conad</b>	1.61%	0.33%
<b>Rossmann</b>	9.66%	4.66%

Data from QKB Website [8]

## 5.2. Liquidity Ratio

Liquidity ratios are an important class of financial metrics used to determine the ability of a debtor to reimburse current debt obligations without raising outside capital. To measure Rossmann & Lala's margin of safety, we have calculated two important liquidity ratios: current ratio and quick ratio.

Based on Figure 2, we noticed that the company has been having liquidity problems from 2010 up to 2014.



For four years, its current ratios were less than 1, implying that Rossman & Lala was having issues with covering short-term obligations and cash flows. These results were somehow expected for 2010 and 2011 as the company entered the market in 2009.

However, starting from 2014 up to 2019, the current ratios have been higher than one, giving the company a better picture regarded to liquidity.

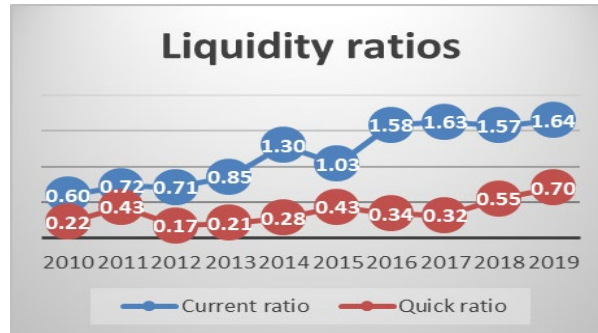


Figure 2. Current and quick ratio. Data from QKB Website [8]

Another important measure of the liquidity of the company is the quick ratio, which uses the same formula and concept as the current ratio, but it subtracts inventory from its calculation, giving creditors a more detailed look into the company’s ability to cover its short-term obligations. As seen in the table the quick ratio has always been lower than 1.

But before drawing any conclusions from these figures, it is important to keep in mind the type of business Rossmann & Lala is. As previously mentioned, this company is a chain store, really similar to a supermarket. And for this type of business that operates in the retail industry, inventory moves quickly. Since the current ratio includes inventory, it will be large for businesses that engage extensively in the selling of inventory. That’s why removing inventory for supermarkets will result in their current liabilities becoming inflated under the quick ratio compared to their current assets. Figure 3 below shows inventory as a percentage of current assets for each year. And except for the year 2011, for all the other years inventory accounted for more than half of the company’s current assets. This again proves the point that the current ratio delivers a more concrete and fairer framework for the company’s financial health regarding liquidity.

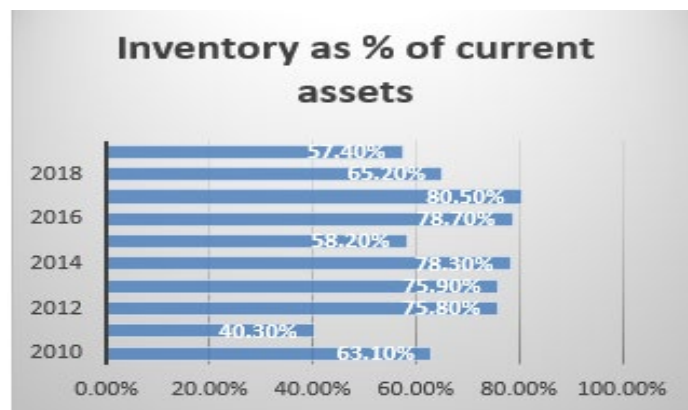


Figure 3. Inventory as % of current assets. Data from QKB Website [8].

### 5.3. Debt Utilization Ratio

As a representative of this group of ratios, we have chosen to analyze the debt total asset ratio and debt-to-equity ratio. The debt to total asset ratio is an indicator of a company’s financial leverage, as it shows how

much of the company’s assets are financed by its creditors. Based on Figure 4, we notice that the company was highly leveraged in its first years, which is common when a business enters a new market for the first time. But this leverage continuously decreased from year to year. Again, 2015 stands out from the other operating years, because Rossmann & Lala increased the amount of debt used to finance assets. The company might have borrowed to pay off its liabilities, for example, wages, inventory costs, and other operation-related expenses.

But since 2015, the debt that the company has carried has been decreasing constantly, to 38.4% in 2018, slightly rising in 2019 to 44.1%. A good debt ratio is considered one which is close to 40%, and in the last years, the company seems to fall into this group.

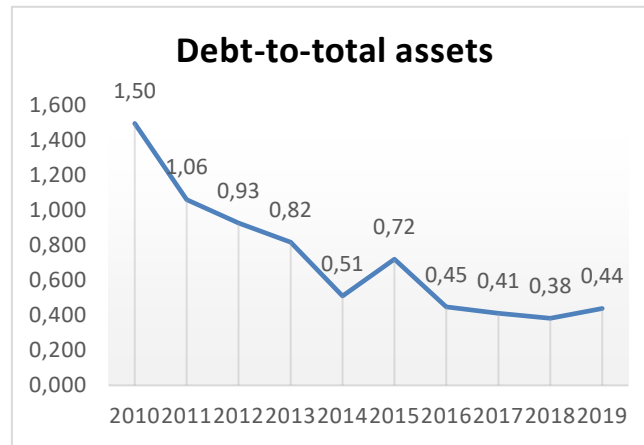


Figure 4. Debt-to-total assets ratio. Data from QKB Website [8].

The debt-to-equity ratio represents the amount of debt and equity used to finance a company’s assets. Table 4 shows how this ratio has been throughout the years. In 2010 and 2011 the ratio was negative, which implies that the book value of equity was negative. This typically occurs when a company has had problems raising money to cover historical net losses.

However, the situation started improving from 2012 until 2014. But because of the financial difficulties in 2015 as mentioned in our analysis, it raised in 2015 again. A good debt-to-equity ratio is considered to be 1 to 1.5. But in recent years this ratio has been decreasing below 1, which implies that the company is not relying a lot on debt to finance its operations or to expand itself.

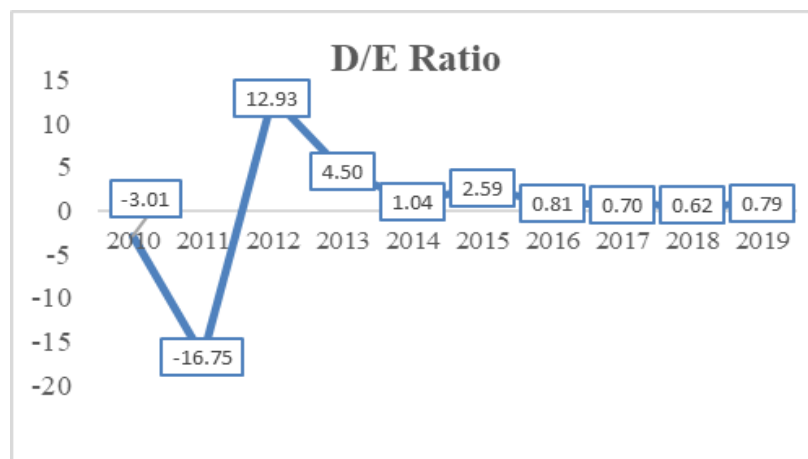


Figure 5. D/E Ratio. Data from QKB Website [8].

## 6. Methodology

This research will use time series analysis to identify the possible association between debt utilization ratios and profitability ratios, for Rossmann & Lala. The profitability ratio that will be taken into consideration is the return on assets ROA, ROE, AND PM, whereas the representative ratio from the debt utilization group of ratios is Debt-to-Total Assets. The study covers the period 2010 – 2019. The data used are secondary data, obtained from the financial statements of Rossmann & Lala on the website of the National Business Center, (QKB). The data is then calculated to derive the figures for ROA and Debt-to-Total Assets. R Programming will be used to analyze these data.

### 6.1. Model Specification

To analyse the long-term relationship between Debt-to-Total Assets and Return on Assets, ROE, and PM, we will run a multiple regression model. The dependent variable will be Debt-to-Total Assets, and the independent variables will be ROA, ROE, and PM. The model will be run through the R Programming software and will determine if there exists a long-term relationship among the variables.

The variables are calculated by the authors using the financial statements of Rossmann & Lala, and they are all entered in number form, with three decimals.

In this paper, we will test the following hypothesis:

*H1: Debt-to-Total Assets is negatively associated with ROA.*

*H2: Debt-to-Total Assets is negatively associated with ROE.*

*H3: Debt-to-Total Assets is negatively associated with PM.*

The reasoning behind this hypothesis is that increasing debt leads to increasing costs, which on the other hand, decreases net income. This will be reflected in lower profitability variables.

On the other hand, if the debt is utilized properly, it increases the profit. But based on our ratio analysis, Rossmann & Lala has had an increasing ROA and a decreasing Debt-to-Total Assets throughout the years. This implies that the company itself does not rely on debt, but rather on equity. So, based on these reasons, we would expect a negative correlation between ROA and Debt to Total Assets ratio.

Based on the literature review, we noticed that profitability ratios other than ROA are studied. These include ROE, PM, Net income to Total Assets, and EBIT to Total Assets.

There may be many factors affecting profitability ratios other than debt utilization ratios, but the data is limited to 10 observations, and increasing the number of independent variables would not be reasonable.

Before running the regression there are several assumptions to be tested if correctly fulfilled:

a. One assumption of multiple regression is the correct functional form of the model, which means, including all the important variables, excluding extreme outliers, etc. This can be evaluated through Ramsey-Regression Specification Error Test (RESET) Linearity Test, which consists of adding non-linear transformations of fitted original regression data as independent variables to original regression and assessing if non-linear transformations of fitted original regression data as independent variables are jointly statistically significant [9]

b. The time series should be tested for its stationarity, which means that its variance and mean should be constant over time, or else the series is non-stationary. Using OLS, in case of non-stationarity, can lead to false results. We can use different tests for stationarity, but in this paper, Augmented Dickey-Fuller test will be used [10]. If the time series results non-stationary at level, it can be transformed into a stationary one by taking the first difference (lag), second, and going on like this.

c. The time series should be tested for normal distribution of the residuals,

There are different tests that can be conducted for normality assumption:

- Visual tests by using Histograms (If the histogram is roughly “bell-shaped”, then the data is assumed

to be normally distributed. Q-Q plots (If the points in the plot roughly fall along a straight diagonal line, then the data is assumed to be normally distributed).

- Statistical Tests (Shapiro-Wilk Test, Kolmogorov-Smirnov Test etc.)

In this paper, we perform both visual and statistical tests (Shapiro-Wilk Test)

d. Another assumption of multiple regression with time series data is that the errors are independent (i.e., there is no autocorrelation). We will use the observable residuals the Durbin-Watson test statistic DW. When residuals are not autocorrelated, the DW Statistic is in the range of 1.5 to 2.5. e. The errors should have constant variance (i.e., they are homoscedastic). We will perform the Breusch-Pagan Test to check this assumption

## 6.1. Results

- The Linearity Test indicates a p-value = 0.8261, which is greater than 0.05 (the significance level). In this case, we Fail to Reject the H0 which means there is linearity in the model.

- The ADF test indicates that all variables (ROA, ROW, Debt-to-Asset Ratio, and PM) are stationary at level, which means OLS can be used.

- Both visual (Q-Q Plot) and statistical (Shapiro-Wilk) tests for normally distributed residuals indicate that the normal assumption is met. From the output, the p-value = 0.5142 > 0.05 implying that the distribution of the data is not significantly different from a normal distribution. In other words, we can assume normality.

- DW test statistic is equal to 3.1. The acceptable range for Durbin-Watson Statistic is 1.5 to 2.5. Our calculated value is slightly higher than 2.5, but overall, we would conclude that our data are not autocorrelated.

- The Breusch-Pagan test indicates that residuals are distributed with equal variance, p-value = 0.3938 > 0.05.

Considering that all the assumptions are met, we can furtherly proceed with the multiple regression model to test the relationship between our variables.

Test results from the computed regression in R Studio are:

F-statistic is equal to 140.6 (corresponding to a very low p-value), which indicates a good overall fit for our model. According to the results, R<sup>2</sup> and R<sup>2</sup> adjusted are respectively 0.9883 and 0.9813, which means that more than 98% of the variation in the Debt-to-Asset Ratio can be explained by the independent variables (ROA, ROE, and PM). Also, the smaller the gap between R<sup>2</sup> and R<sup>2</sup> adj, the more parsimonious the model is.

If we assess the individual significance of the independent variables, ROA and PM have the respective p-values equal to 0.015 and 0.047, lower than the significance level of 0.05. So, both variables are statistically significant. Meanwhile, the ROE variable has a p-value equal to 0.238, higher than 0.05, which means not significant for this model and can be removed. Therefore, the H2 can be Rejected.

After ROE removal we can see that the multiple regression equation becomes:

$$\text{Debt\_to\_Asset Ratio} = -0.083 - 2.01 \cdot \text{ROA} + 3.43 \cdot \text{PM}$$

The ROA coefficient is -2.01 and its respective p-value is 0.001 (< 0.05), therefore we can conclude that 1 point of increase in ROA decreases D/A Ratio by about 2.01 points. So, the first hypothesis H1 is Failed to Reject. The PM variable has a coefficient equal to 3.43, which means that 1 point of increase in PM increases D/A Ratio by about 3.43 points as indicated by its coefficient and the p-value of 0.048 (< 0.05). So, the third hypothesis H3 is also Failed to be Rejected.

## 7. Conclusions and recommendations

Multiple regression analysis and findings revealed that there is a negative association between debt and corporate profitability for Rossman and Lala. The debt is mainly comprised of long-term debt, as the company's only short-term debt is its tax obligations. This impact was relatively low, but it can be justified by the fact, that profitability is affected by many other factors, corporate-related variables, or macroeconomic variables. A significant variable might be inventory turnover, as the company is in the retail industry.

Macroeconomic variables, that could have been considered are GDP, inflation, exchange rates, etc. We could get more precise results if we were to compare Rossmann and Lala with other retail companies, or if we would consider increasing the number of observations and further deep dive into the reason why ROE results insignificant for the model. This would allow us to increase the number of independent variables as well.

This result was, however, predictable as the company has been relying a lot on its internal financing in recent years, and it has always resulted in a positive and increasing ROA and PM.

This paper is a contribution to the literature regarding capital structure, especially debt.

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# Software Development Using .Net Framework and .Net Core

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**Abstract:** This paper's main goal is to contrast the .NET framework and .NET Core in terms of programming concepts. There is little question that the struggle between .NET Core and .NET Framework will continue, but the future of .NET is promising. Even if both are effective solutions and are favored in numerous IT projects, your choice may be affected by your company's strategy. Because Microsoft will continue to create updates and enhancements to improve both, it's feasible that you won't know which platform to pick. Although the type of application and the platform it will be created on play a big role in the choice between .NET Core and .NET Framework, there are many other factors that must also be taken into consideration, such as compatibility, performance, security, CLI tools, and more.

**Keywords:** .NET; Programming; IT Projects; Applications.

## 1. Introduction

With .NET, Microsoft has achieved its goal of giving developers a single platform on which to tackle every challenge. The .NET technology has been enabling web, desktop, and mobile applications in both start-up and enterprise environments for a few decades now.

There is no question that .NET is essential to the software development sector. The number of open-source initiatives worldwide and the inclusion of C# among the top five programming languages serves as indicators. With the most recent release (.NET 6), which pioneers the idea of universal software development and revolutionizes the industry, its popularity is only going to increase.

.NET is an open-source, cross-platform development environment that can be used to create a wide variety of apps. The Microsoft-designed platform enables the development of online, mobile, desktop, IoT, and other applications using a variety of programming languages and frameworks. You can create a variety of applications kinds using .NET, including command-line, desktop, web, mobile, gaming, and Internet of Things (IoT) applications.

The original version of .NET was the .NET Framework. It communicates with the underlying operating system and offers the developer a set of APIs for the majority of common programming requirements. It only works with Windows. The .NET Framework has been completely rewritten as .NET Core with the intention of being cross-platform. A core set of minimal features that are shared by Windows, Linux, and Mac platforms is defined by its revised architecture. The remaining functionalities are available as library packages for download. ([1]-[15])

Because Microsoft will continue to create updates and enhancements to improve both, it's feasible that you won't know which platform to pick. Although the type of application and the platform it will be created on play a big role in the choice between .NET Core and .NET Framework, there are many other factors that must also be taken into consideration, such as compatibility, performance, security, CLI tools, and more.

### 1.1. .NET overview

The .NET initiative was introduced by Microsoft in July 2000. A variety of technologies developed by Microsoft in the late 1990s are integrated into the new development framework known as the .NET platform, which also features a new programming interface to Windows services and APIs. ([1]-[15])

The .NET Ecosystem is made up of many parts of the development platform as of 2022 (Figure 1). It includes a variety of runtimes, including:

- .NET Framework: WPF, Windows Forms, ASP.NET – Windows-centric.
- .NET Core: ASP.NET Core, Universal Windows Platform - UWP - Cross-platform, coexists harmoniously with other versions.
- .NET 6 : ASP.NET Core, Windows Forms, Blazor, WPF - a platform that unifies desktop, Web, cloud, mobile, gaming, Internet of Things, and AI applications.
- Mono for Xamarin: Android, IOS, OS X - Cross-platform.

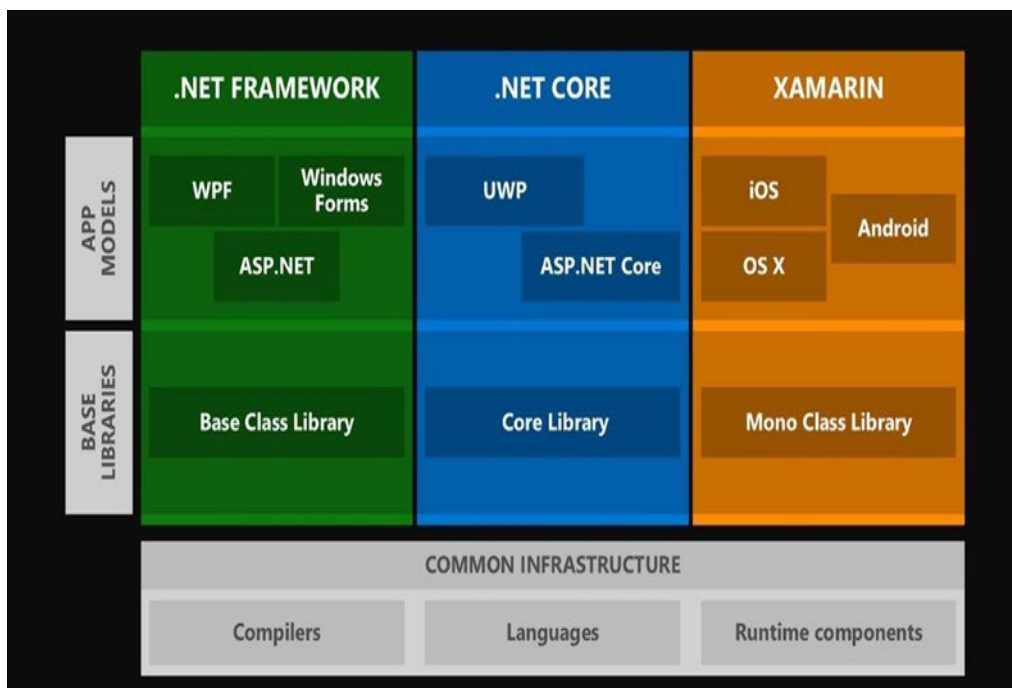


Figure 1. NET ecosystem

## 2. .NET Framework

### 2.1. .NET Framework Overview

The Windows-managed execution environment known as the .NET Framework offers a number of services to its running applications. The .NET Framework Class Library, which offers a library of tried-and-true code that developers can call from their own apps, and the common language runtime (CLR), which is the execution engine that manages running apps, make up its two main parts.

### 2.2. Architecture of .NET Framework

The two primary components of the .NET Framework are the Common Language Runtime and the .NET Framework Class Library. A visual illustration of the .NET framework architecture is presented in Figure 2.



Common Language Runtime serves as the foundation for the .NET Framework. Take the runtime into account as an agent that manages code during execution, providing necessary services like memory management, thread management, and remote access while sternly enforcing type safety and other criteria of code accuracy that improve security and robustness.

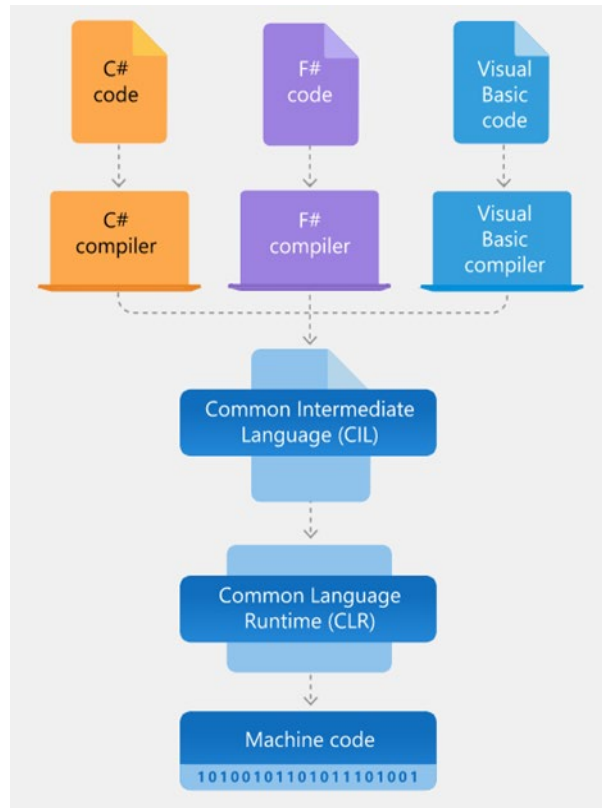


Figure 2. NET Framework Architecture

Actually, a basic runtime notion is the concept of code management. Code that doesn't target the runtime is known as unmanaged code, whereas managed code does.

### 2.2.1. The Common Language Runtime

The Common Language Runtime is the most crucial part of the .NET Framework (CLR). The management of memory, thread management, code management, code safety checking, compilation, and other system functions is handled by the common language runtime. These characteristics are inherent to managed code that utilizes the common language runtime.

### 2.2.2. .NET Framework class library

Reusable types that are closely integrated with the common language runtime make up the .NET Framework class library. The object-oriented class library offers types from which the functionality of your own managed code is derived. By doing this, the .NET Framework types become simpler to use and the learning curve for new .NET Framework features is shortened. Additionally, the .NET Framework's classes and third-party components operate together effortlessly.

For instance, a set of interfaces for creating custom collection classes are implemented by the .NET Framework collection classes. Your collection classes integrate perfectly with the .NET Framework's classes.

### 2.3. ASP.NET Applications

Tools and frameworks designed exclusively for creating web apps are added to the .NET platform by ASP.NET.

A few enhancements made by ASP.NET to the .NET framework include the following:

- C# or F# base framework for handling web requests;
- Razor web page templating syntax, which is used to create dynamic web pages in C#;
- Common web pattern libraries, such as Model View Controller (MVC);
- A system for handling logins that contain libraries, a database, and template pages, as well as multi-factor authentication and external authentication with Google, Twitter, and other services;
- For the purpose of creating web pages, editor plugins that offer syntax highlighting, code completion, and another feature.

#### 2.3.1. Setup configuration in ASP.NET Framework applications

Application-specific information may be readily stored and retrieved thanks to the extensible nature of the ASP.NET Configuration system. It can be read by people. Furthermore, when configuration file settings are modified, the web server does not need to be restarted. The running ASP.NET application receives the updates automatically from ASP.NET and is updated accordingly.

Types of Configuration files:

- *Machine.config* - a global configuration file for the server or computer
- *Web.config* - files used to configure applications, each of which deals with a different application

### 2.4. MVC Pattern

MVC is a design paradigm that separates application logic from the user interface (view), data (model), and application logic (controller). The separation of issues is facilitated by this pattern (Figure 3).

Requests are sent to a Controller who is in charge of interacting with the Model to carry out operations and/or retrieve data when using the MVC pattern for websites. The Model is given to the View by the Controller, who also selects the View to display. Based on the information in the Model, the View generates the final page.

This separation of responsibilities helps you to increase the program's complexity because it's easier to code, debug, and test something (a model, view, or controller) that only has one job. It is more difficult to test, update, and debug code that has dependencies spread over two or more of these three domains. Business logic, for instance, is updated less frequently than user interface logic. Each time the user interface is changed, the business logic object needs to be changed because the presentation code and business logic were combined into one object. This frequently introduces errors; therefore business logic needs to be tested afresh after each little user interface change.

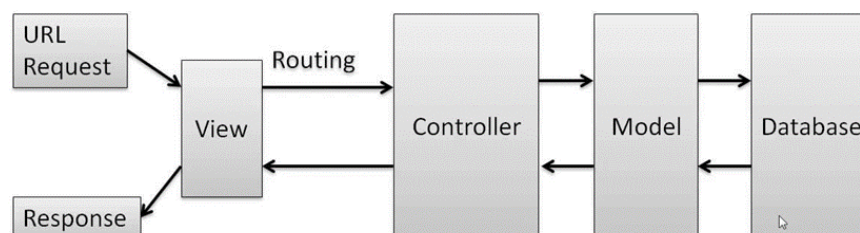


Figure 3. MVC Pattern

## 2.5. Dependency injection in ASP.NET framework apps

"Inversion of Control" is implemented using "Dependency Injection." According to the concept of inversion of control (IoC), the objects obtain the objects they require from an external source rather than creating the other objects on which they rely in order to do their tasks (for example, an XML configuration file).

To demonstrate dependency injection in ASP.NET MVC applications, we can use Repository Design Pattern.

By definition, the Repository Design Pattern in C# acts as a bridge between the domain and data mapping layers by allowing access to the domain objects through a collection-like interface. Data access logic is divided and mapped to business logic components using the repository design pattern. It performs data access logic while interacting with the domain entities. In the Repository pattern, interfaces are used to communicate between domain entities, data access logic, and business logic. It shields the business logic from the specifics of data access.

## 3. .NET Core Framework

### 3.1. .NET Core Overview

The .NET Framework, a free, open-source, general-purpose programming platform from Microsoft, has a new version called .NET Core. The framework is cross-platform and compatible with Windows, macOS, and Linux.

The .NET Core Framework may be used to construct a wide range of apps, including those for mobile, desktop, online, cloud, Internet of Things, machine learning, microservices, gaming, etc.

.NET Core is cross-platform, modular, light, and speedy because it is a whole new framework. It contains all of the necessary parts to operate a straightforward .NET Core application. You can add more functionalities to your application as needed by using the NuGet packages that are available. As a result, the .NET Core software runs faster, uses less memory, and is less complicated to maintain.

### 3.2. ASP.NET Core Applications

The web-oriented application model built on top of the .NET Core framework is called ASP.NET Core. Nothing in ASP.NET Core is truly the same as in the previous version of ASP.NET, despite the fact that the name of the application model contains the well-known ASP.NET appellation. First and foremost, ASP.NET Core features a fresh runtime environment that only supports ASP.NET MVC as an application paradigm. As a result, neither Web Forms nor Web API are exactly replicated in the new web framework. Everything is brand-new, and the only place where some code and technical abilities can be reused is in the world of the ASP.NET MVC programming paradigm, which consists of controllers, views, and routes.

### 3.3. Setup configuration in ASP.NET Core applications

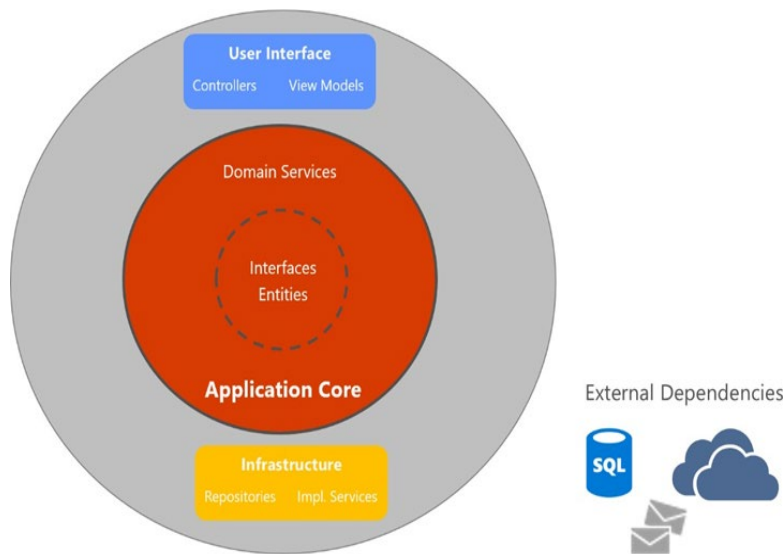
ASP.NET Core no longer uses the *Global.asax* and *web.config* file that past variants of ASP.NET used. In the prior adaptations of ASP.NET, application start-up rationale was set in an *Application\_StartUp* technique inside *Global.asax*. Afterward, in ASP.NET MVC, a *Startup.cs* record was remembered for the foundation of the venture; and it was called when the application began. ASP.NET Core has embraced this method totally by setting all start-up rationale in the *Startup.cs* record.

The *web.config* file has additionally been replaced in ASP.NET Core. Setup itself can now be arranged, as a feature of the application start-up methodology depicted in *Startup.cs*.

### 3.4. Clean Architecture

There are much different architectures approaches that one can use in a web application. In this research and project that I have implemented, I have used Clean Architecture.

Business logic and the application model are at the heart of a clean architecture. Instead of business logic being dependent on data access or other infrastructure issues, this dependency is reversed, with the Application Core being dependent on implementation and infrastructure details. The Application Core defines abstractions, or interfaces, which are then implemented by types described in the Infrastructure layer. This functionality is thus achieved. This building is sometimes represented as a sequence of concentric rings, resembling an onion. An illustration of this type of architectural representation can be found in Figure 4.



**Figure 4.** Clean Architecture representation

### 3.5. ASP.NET Core Benefits

ASP.NET Core provides these benefits:

- A cohesive story for creating web UI and web APIs.
- Designed for testability.
- Coding page-focused situations is made simpler and more efficient using Razor Pages.
- Blazor supports both JavaScript and C# in the browser. Share .NET-written server-side and client-side app logic.
- Being able to create and use software for Linux, macOS, and Windows.
- Community-oriented and open-source.
- Incorporating contemporary frameworks and development processes on the client side.
- It is possible to host Remote Procedure Call (RPC) services using gRPC.
- A configuration system that is environment-based and cloud-ready.
- Built-in dependency injection.
- A lightweight, quick, and flexible HTTP request pipeline.
- Being able to host on the following: Kestrel, IIS, HTTP.sys, Nginx, Apache and Docker

Below is a table of a short description of the differences between .Net Core and .Net Framework

### 3.6. .NET Framework or .NET Core: Which should I use?

The .NET Framework is a better choice if you:

- You don't have time to study new technology because you already know it or have a team with .NET Framework knowledge.

- Choose a stable setting over one that is constantly upgraded and changed.
- Have more frequent release dates
- Have a .NET Framework application that needs its functionality to be expanded (vs. migrating it)
- Are building Windows client applications using Windows Forms or WPF

.NET Core is a better choice if you:

- Would you like to target a larger range of OS systems with your apps? (Create once, run anywhere)
- require scalability and/or great performance
- just starting to learn .NET
- use Docker containers and/or microservices and prefer open-source
- Support for side-by-side installation is required

## 5. Conclusion

The main purpose of this paper is to show the difference between the .NET framework and .NET Core in terms of programming concepts. The future of .NET seems bright, and there is little doubt that the conflict between .NET Core and .NET Framework will persist. The option you make may be influenced by your business model even though both are efficient solutions and are preferred in various IT projects. It's possible that you'll be undecided about which platform to choose because Microsoft will continually develop updates and improvements to enhance both. Although the decision between .NET Core and .NET Framework largely depends on the type of program and the platform it will be developed on, many other criteria must also be considered, such as compatibility, performance, security, CLI tools, and more.

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# Efficient Pathfinding Search Algorithms Heuristics Implementation

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**Abstract:** Nowadays it has become more and more important to reach a destination in a short time, in the shortest path between all the options and possibilities. This need is addressed by different search engines like google maps for example and it is common sense that the user is expecting the result in the least amount of time.

The scope of this publication, is to help the reader understand the mechanism behind pathfinding algorithms integrated with heuristics and on how to choose between them in a given case study. Moreover, this paper aims at illustrating, after pathfinding algorithm selection, how to tweak and improve it in order to better fit the given setup scenario.

With this respect, it will be shown how the A\* algorithm computationally performs in a graph theoretic grid setup, initially in a small one and then, in a graph grid with a 10-fold increase of the initial setup dimensions. This experimental study compares two different heuristics in A\* implementation, the Euclidean distance heuristic and the Chebyshev heuristic. Computational time results are compared with respect to the time taken to produce a final result in each case. Moreover, the total number of nodes involved in the path as well as the total cost estimated are considered per each case. This paper aims at providing information to researchers so that to understand what analysis needs to be done when selecting heuristics associated with pathfinding algorithms heuristics, and at providing relevant performance metrics regarding shortest path planning estimation between two predefined nodes in a graph grid setup. Moreover, aims at providing information on how the heuristics define the decision-making process in the A\* algorithm and on how to weight the time/cost factors importance based on specific use cases.

**Keywords:** *Search Algorithms; Pathfinding algorithms, A\*; Heuristics; Euclidean Distance; Chebyshev Distance; Computational Time; Computational Performance; Graph Cost; Unity; C#*

## 1. Introduction

We live in the digitalized era and aim to make the world smaller and smaller every day by connecting through the network we know as the internet. It's this digitalization that has made it so easy for us to be everywhere at the same time, although virtually and if needed, physically also. We may not know exactly how to reach an appointment location and almost by default we reach out for help to "Google Maps". Ever wondered about the logic behind all the path suggestions to arrive at the desired location, each of them takes a specific amount of time but the colored route is the one that takes less time.

Well, it's the search algorithms in the background making these results possible. These algorithms have been of interest for a long time and have continuously been improved, new ones have been released and each of them aims to target a specific flaw of the previous one. The search needs to be swift and reliable, as it can be understandable, when you are searching for a location in "Google Maps" or from your "TomTom", you don't have the luxury to wait a long time until the results show up.

One extension of the search algorithms is "Pathfinding Algorithms" which are built on top graph search algorithms and explore the route between two destinations or nodes starting from point A and aiming to find the shortest and most reliable route to reach point B, comparing and deciding from all the different possibilities. ([1]-[13])

The pathfinding algorithm we will be exploring is A\* pathfinding due to its nowadays popularity and combination of performance and accuracy ([1]-[13]).

## 2. A\* Algorithm

The A\* method combines the actual cost from the starting point with a projected price to the endpoint to choose the next node to be evaluated. The estimated cost is determined by the heuristic function used by A\*. Although highly preferred in the realm of pathfinding algorithms, A\* does not always produce the best results and generate the shortest path because it mainly relies on approximations and heuristics. A heuristic algorithm sacrifices precision and accuracy for speed in order to solve issues more quickly and effectively.

Every graph has many nodes or points that the algorithm must pass through in order to reach the target node. Each of these nodes' pathways has a numerical number, which is regarded as the path's weight. The cost of that route is calculated as the sum of all paths crossed. Heuristics themselves might have their limitations in specific given scenarios and the individual should do thorough research before deciding with which heuristic to feed the algorithm as in different scenarios, different heuristics perform better.

## 3. Heuristics

Heuristic programming uses a practical approach that isn't always ideal, flawless, logical, or reasonable but is nevertheless sufficient for achieving a short-term objective. Heuristics are tactics developed from prior experiences with problems that are comparable. These methods focus on the use of easily available information to manage problem-solving in machines and abstract problems.

### 3.1. Euclidean Distance Heuristic

The Euclidean distance would be the straight-line distance between two coordinates on a plane. Mathematically it would be calculated as:

If our coordinates are:  $(x_1, y_1)$  and  $(x_2, y_2)$  then the Euclidean distance is:

$$d = \sqrt{(x_2 - x_1)^2 + (y_2 - y_1)^2} \quad (1)$$

### 3.2. Chebyshev Distance Heuristic

Another popular approach is the "Chebyshev Distance" which can be depicted as the movement of the King on a chessboard: it can go one step in any direction (up, down, left, right and verticals). The result of this is that the movement is as fast in a diagonal direction as it can be in a horizontal direction. Mathematically it would be:

$$d = \max(|x_a - x_b|, |y_a - y_b|) \quad (2)$$

### 3.3. Manhattan Distance Heuristic

The Manhattan distance calculates the distances between two vectors or points with real-valued coordinates. It is determined as the total of their Cartesian coordinates' absolute differences.

Mathematically the Manhattan distance between two points p and q in n-dimensional Euclidean space with coordinates  $(p_1, p_2, \dots, p_n)$  and  $(q_1, q_2, \dots, q_n)$  is given by:



$$|p_1 - q_1| + |p_2 - q_2| + \dots + |p_n - q_n| \quad (3)$$

### 3.4. Comparison

Depending on the given grid, these can be chosen instead of the other one most specifically it is proven that if we take into consideration a square grid:

- If only four directions of movement are allowed, Manhattan distance performs better
- If any direction is allowed, Euclidean distance is preferred.
- If eight directions are allowed, the Chebyshev distance is preferred

I would like to deep dive and compare the Euclidean Distance with the Chebyshev heuristics, as they are seemingly a little less limited than the Manhattan distance.

### 4. A\* Pathfinding algorithm implementation in C#

In our case, there will be no difference in the implementation of the source code between these two cases, other than the implementation of the heuristic. In both cases, we will need a PathNode class, which will hold all the required information for a node in the grid together with a reference to the grid itself. To explain each variable, I will be adding comments in the code. As we have explained in the previous chapters, as we are going to use the A\* algorithm, we need to hold information about the coordinates of the nodes, which will be represented by our x and y variables, the gCost which was the cost of movement, the hCost which was the heuristic cost and the final f cost which will hold the information of gCost+hCost. Since the A\* algorithm, recreates the path from all the walked nodes until having reached the goal node we need to keep a reference to the previous node for each current node, this information will be held in the variable: public PathNode previousNode;. Later on, in the implementation, we will be discussing the behavior of the algorithm after introducing obstacles, in simple words, these obstacles will be nothing else but “unwalkable” nodes, which will be initialized at the start of the program. The information whether a node is “walkable” or not, will be registered by the flag Boolean variable in the class, public bool isWalkable; if the node is unwalkable it will be directly added to the closed list, removed from the open list of nodes to be explored and will not be considered anymore by the algorithm.

```
using System.Collections;
using System.Collections.Generic;
using UnityEngine;

public class PathNode {
    private Grid<PathNode> grid;
    //x coordinate
    public int x;
    //y coordinate
    public int y;
    /** As we have previously discussed
     * The function value “f”, which is used by A*, is defined as
     f(n)=g(n)+h(n)
     As a result we will hold this information for each node*/
    //g(n) value
    public int gCost;
    //h(n) value
    public int hCost;
    //f(n) value
    public int fCost;
    /**W will also hold a reference to the previous node
     in order to take note of the path we have been traversing*/
```

```

public PathNode previousNode;
public bool isWalkable;
public PathNode(Grid<PathNode> grid, int x, int y) {
    this.grid = grid;
    this.x = x;
    this.y = y;
    this.isWalkable = true;
}
public void SetIsWalkable(bool isWalkable) {
    this.isWalkable = isWalkable;
}
public void calculateFCost() {
    fCost = gCost + hCost;
}
public override string ToString() {
    return x + "," + y;
}
}

```

Let's continue with the implementation of our main class, where we will be implementing the A\* Algorithm.

As a start we declare all the global variables that we will need throughout the implementation, we need an openList

to hold all our nodes to explore and a global variable that holds all the nodes that have been explored in our case the closedList. If a node is present in the closed list, we don't take that into consideration anymore. Having said so, all our unwalkable nodes end up in the closed list.

We then need a global variable for the grid we will walk and a global variable that will hold the start time of the main functionality (FindPath) and a global variable that will hold the end time of the same functionality, this time will be in milliseconds the reason we need to hold this information globally is because it will be logged in the console later on in our Testing class, this way we will be able to compare the timing results while using both heuristics.

Then we initialize the start node and the end node according to the information we have received as parameters in the FindPath functionality, then we initialize the open list with the start node while the closed list remains empty. As another step we need to initialize our grid nodes, setting the gCost to infinite and then calculating their fCost also, the previousNode is initialized to null since for the moment we don't have any data for the previous path.

Following we initialize our start node, with the gCost set to 0 since we start right off here, with the h cost equals to the result of the functionality that uses a heuristic to produce a cost "calculateDistanceHeuristic" and the f cost =gCost+hCost.

We will open a cycle and continue to cycle up until the open list has nodes. We will set the current node to be the one with the lower fCost. To find out which is the node with the lowest fCost, we will need another functionality which we will name "getLowestFCostNode" which takes as a parameter the open list, and basically using the same logic to find out the minimum value of a vector, defines the node with the lowest fCost.

As a first thing we do, in the beginning of this loop, is check whether we have reached our goal node, and if so, we return the calculated path that we took to reach that goal node, using the functionality the functionality "calculatedPath". This functionality returns a list of nodes and takes as a parameter the end node. But why the end node? As we have specified in the beginning, we hold reference to the previous node we walked, so now we are going to form back the path we took to reach the end node by tracing back the previous ones up until the previous node is not null meaning we have a previous node still. We are going to add the previous node to our final list of nodes, and set the current node with the value of the previous node, this is the logic behind our cycle. After returning from our calculatedPath functionality, we remove the current node from the open list, indicating that it has already been searched and then add it to the closed list. Then we need

to cycle through the neighbors of the current node, for this we are going to build and use the functionality "getNeighborNodeList". We start off by taking as a parameter the current node and first of all check the node which is left of it if its valid meaning if we subtract to the current node x coordinate the value 1 , the result should be above or equals 0 , we add it to the list, then continue checking the node left down to it if its valid , meaning that if we subtract to the y value of the current node, the value 1, the result should be above or equals to 0 . Then continue to search the left up value, which is valid only if by adding 1 to the y value, the resulting value is smaller than the height of the grid. The same logic but reversed is followed to find and validate the neighbors on the right hand of the grid. Just like this we have our eight neighbor positions if they are valid.

After this operation we can start cycling through the neighbors of the current node. The first check we need to do, is see if the neighbor node is already on the closed list, if it is , that means we have already examined it , so we simply continue. Then we need to check if we have a smaller gCost from the current node to the neighbor node, than we had previously. This is why we need to have a variable holding a temporary  $gCost = currentNode.gCost +$  the calculated cost from the heuristic function to find out the distance from the current node to the neighbor node. If we do have a better cost, then we save it by setting as the previous node of the neighbor our current node, then we set our neighbor gCost to be our newly calculated temporary gCost , the set the hCost to be the distance between the neighbor node to the goal node and finally we set the fCost. Finally we check, if the neighbor node is not already on our openList , we need to add it. We have reached the end of our complete pathfinding algorithm. As the last step, outside of the while loop , essentially this means that we have searched through the whole map and we could not find a path , in this case we simply return null.

#### 4.1. Chebyshev distance heuristic mathematical formula interpreted in code and execution results

```
private int calculateDistanceHeuristic(PathNode a, PathNode b)
{
    int xDistance = Math.Abs(a.x - b.x);
    int yDistance = Math.Abs(a.y - b.y);
    int remaining = Math.Abs(xDistance - yDistance);
    return Math.Max(xDistance, yDistance);
}
```

#### 4.2. Euclidean distance heuristic mathematical formula interpreted in code and execution results

```
private int calculateDistanceHeuristic(PathNode a, PathNode b)
{
    int xDifference = a.x - b.x;
    int yDifference = a.y - b.y;

    int xSquare = (int)Math.Round(Math.Pow(xDifference, 2));
    int ySquare = (int)Math.Round(Math.Pow(yDifference, 2));

    int result = (int)Math.Round(Math.Sqrt(xSquare + ySquare));

    return result;
}
```

### 5. Timewise performance in a small and larger graph

The graph we have taken into consideration until now is a small one, with 20 nodes wide and 10 nodes high. So for the small graph observation we will continue to use the example we considered until now. To measure the timing I have introduced one global variable named

public double totalMilliseconds = 0;, which will hold the value :

ts = endTime - startTime; which is calculated inside the FindPath functionality (please see section 3.2).

So, timestamp of end of algorithm process – timestamp of start of algorithm process. Its value will be logged in the console in the Testing class from the line:

```
Debug.Log("Total execution time in milliseconds " + pathfinding.totalMilliseconds).
```

### 5.1. Euclidean Heuristic vs Chebyshev Heuristic timewise performance without, in a small graph 20 nodes wide and 10 nodes length

When enabling the Euclidean heuristic and disabling the Chebyshev heuristic, after running the application we calculate a value of runtime equals to 2.352 milliseconds:

When enabling the Chebyshev heuristic and disabling the Euclidean heuristic, after running the application we calculate a value of runtime equals to 2.9958 milliseconds:

Interesting enough is that when we compare these timing results, with the results when we introduce obstacles, we see that in terms of total cost , we have a better cost in terms of fCost when the path does not have obstacles but we have a worse timing with approximately 0.5 milliseconds

### 5.2. Euclidean Heuristic vs Chebyshev Heuristic timewise performance, in a larger graph 200 nodes wide and 100 nodes length

When enabling the Euclidean heuristic and disabling the Chebyshev heuristic, after running the application we calculate a value of runtime equals to 2.2915 milliseconds:

When enabling the Chebyshev heuristic and disabling the Euclidean heuristic, after running the application we calculate a value of runtime equals to 2.9992 milliseconds:

The result is that no matter how much we enlarge the graph, based on the theory of the A\* algorithm , when we find a path from the start node to the end node , we return it without scanning the whole graph as we will understand next too. What we understand from this result, is that the algorithm timing is not deteriorating the more we increase the graph dimensions , but why so , wouldn't it be more difficult to find the path in a larger graph , since we have more neighbors to examine? Finally no, in fact , and this is where the A\* pathfinding algorithm is more performant then the other ones especially more preferred than Dijkstra algorithm from where it has its roots. Let's go back to previous sections where we have explicitly said that "Another drawback of the A\* algorithm is that It is not optimal as it does not explore all the path once it find a solution.". So once our algorithm found the optimal path comparing the close neighbors until he goal node, it returned the final path . We can increase the graph dimensions as much as we want, but the time to find path until the goal node is going to be the same as we always scan the same neighbors and not the whole graph , as we would have done with the Dijkstra algorithm for example.

## 6. Result Summary Tables

In the following tables 1, 2 the computational timing results obtained by running the pathfinding algorithm in graphs of different scales are presented.

**Table 1.** Heuristic in Small Graph

Heuristic	Number of nodes in graph	Time in ms	Nodes	Fcost
Euclidean	200	2.352	11	111
Chebyshev	200	2.9958	11	110

Table 2. Heuristic in Larger Graph

Heuristic	Number of nodes in graph	Time in ms	Nodes	Fcost
Euclidean	20000	2.2915	11	111
Chebyshev	20000	2.9992	11	110

### 7. Conclusions

Nowadays, in this very small world, it has become more and more important to be connected with each other through different networks. It has become more and more important to be able to reach each other virtually and physically. Scientists for years have been researching ways to shorten distances between two points but until now, no luck in any technology tested. There are even movies dedicated to this topic which would suggest that the only way to shorten a distance between two points, would be to bend the surface that connects them. Well, it is no wonder why up until now, humanity has had no luck in doing so.

Even though we cannot bend surfaces, we can mitigate the issue by exploring the shortest path that connects one starting point and one goal point, being mindful of the fact that we still need to keep a very important factor in mind which is time. The least time-consuming it is to reach a goal point, the better it is for us, and anyone means to pursue the fastest solution.

Computer scientists and mathematicians joining forces together have been researching and improving algorithms that help solve this issue. Some of these algorithms are more time consuming but produce a more reliable result and some others are notably faster but you are not so sure that the path result between point a and b is going to be the shortest, especially when there are obstacles introduced. Hence when developing an application, or designing a network, or in any other real-life scenario where we need to provide the shortest-path solution it is essential that we take the factor time and reliability into consideration. Sometimes it might just suffice to scan the closest neighbor nodes up until the goal node, and sometimes we might need to scan the whole graph taken into consideration in order to produce a result.

For example, say you are driving somewhere, from city "Alice" to city "Bob" you are using google maps and the destination is "Bob", imagine how much time it would take for the application to scan the whole map of the world and produce a result, even though these cities are located in the same state. It is just sensible in this case that there is no need to scan the whole map (which to parallelize with our terminology would be our graph) in order to produce a result, but scanning the closest neighbors up until the destination would be enough.

This is one part of the analysis we need to do when choosing the algorithms to help us find a path. Starting from this, in the last decade there have been made considerable improvements to algorithms of this nature. During the scope of this thesis, we have explored the different search algorithms and its subcategories. We have explained pathfinding algorithms and scratched the surface of each type focusing on A\* algorithm. There is a reason why we chose the A\* one.

The A\* algorithm, is a combination of efficiency and performance. Being an informed algorithm it uses the a heuristic, the logic behind the algorithm brain, to help make a decision on which node to choose next, compared to the neighbors and the previous one. Before choosing which heuristic to use, we need to be mindful of which heuristic performs better in each case. The heuristic is nothing else than a mathematical expression which in our case will be translated in code, that produces a result value.

There are different mathematical expressions that calculate the distance between two points in a plan. Classical examples would be the Euclidean distance and the Manhattan distance. Another interesting one, but not so popular as the previous two, is the Chebyshev distance. It has been researched and studied, that the Manhattan distance heuristic produces a better result when the object is moving in four directions, the

Chebyshev distance heuristic performs better when the object moves in eight directions and lastly the Euclidean distance allows the object to move in any direction. When choosing between them, it is understandable that if the object needs to move in more than four directions, as was our case study, then the Manhattan distance heuristic is the one to be dropped from the list.

When we implemented the A\* pathfinding algorithm, our aim was to produce a result with the shortest number of nodes walked, with the lowest cost and with the best performance timewise. For this, we explored the results when using Euclidean heuristic and then when using the Chebyshev heuristic, by enabling and disabling each one at a time. To be confident in the results produced, we enlarged the graph ten times for both dimensions and analyzed the new results. Taking these into consideration we then compared both cases.

One interesting fact was common in both cases, that the timewise performance did not change considerably when we increased the dimensions ten times. This is because what we have said when we explained theoretically the A\* pathfinding algorithm, that even though we might increase the graph surface, it will scan only the closest neighbors from the starting point to the goal point finding the less costly result and then returning it. So, in both cases the surface scanned has been the same.

We notice that the number of walked nodes from point A to point B is the same for both heuristics, even to be exact, but the F cost is larger when using Euclidean heuristic. Although, we notice that the Euclidean heuristic is more performant timewise in all the cases taken into consideration. So in a scenario when time is more important, the latest would have been chosen for the implementation. To summarize our results, if we were to choose the heuristic based on the F cost, the Chebyshev heuristic would have won the competition, if we were to choose based on time performance when integrated in the algorithm, the Euclidean heuristic would have won. We have provided these results, for the user to choose wisely between them depending on the case study, after carefully weighting the importance of time versus the importance of the F cost.

## References

1. "Artificial Intelligence for Games" by Ian Millington
2. "Introduction to Artificial Intelligence" by Wolfgang Ertel
3. "Heuristics, Metaheuristics and Approximate Methods in Planning and Scheduling" by Jeff W. Kingston and Kevin Tierney
4. "Introduction to A\* Algorithm" on GeeksforGeeks: <https://www.geeksforgeeks.org/a-search-algorithm/>
5. "Efficient A\* Pathfinding" on Red Blob Games: <https://www.redblobgames.com/pathfinding/a-star/introduction.html>
6. "D\* Lite" on Sven Koenig's website: <https://idm-lab.org/project-a.html>
7. "Hierarchical Pathfinding for Video Games" on Gamasutra: [https://www.gamasutra.com/view/feature/131505/hierarchical\\_pathfinding\\_for\\_video\\_.php](https://www.gamasutra.com/view/feature/131505/hierarchical_pathfinding_for_video_.php)
8. "Artificial Intelligence for Robotics" on Udacity, on line course
9. "Introduction to Artificial Intelligence with Python" on Udacity, on line course
10. "AI for Games" on Coursera, on line course
11. AI Stack Exchange: <https://ai.stackexchange.com/>
12. Game Development Stack Exchange: <https://gamedev.stackexchange.com/>
13. GitHub: <https://github.com/topics/pathfinding-algorithms>

# CONFERENCE AGENDA

“INTERNATIONAL CONFERENCE ON INTELLIGENCE – BASED  
TRANSFORMATIONS OF TECHNOLOGY AND BUSINESS”

**13–14 OCTOBER, 2022**

MEET US ON ZOOM



SCAN ME

**Canadian Institute of Technology**

**DAY 1**



**13 OCTOBER**

**9:00 AM - 10:00 AM**

**RECEPTION AND REGISTRATION**

**10:00 AM - 11:00 AM**

ROOM: AUDITORIUM

**OPENING CEREMONY (LIVE STREAMING EVENT)**

**HONORABLE SPEAKERS**

- o Sokol Abazi - Rector of CIT
- o Merita Xhumari - CIT Board of Administration (Chairwoman)
- o Rexhep Mejdani - Former President of Albania
- o Eduard Shalsi - Chairman of Economy and Finance Committee
- o Will Bartlett - Professor at London School of Economics
- o Kushtrim Shala - ICT Co-founder
- o Ismail Kocayusufoğlu - Vice Rector of International Affairs and Dean of Engineering Faculty, CIT
- o Vijayakumar Varadarajan - Program Leader- Engineering, Ajeenkya DY Patil University, School of NUOVOS, Pune, India

**11:00 AM - 11:15 AM**

**COFFEE BREAK**

**11:20 AM - 12:30 PM**

ROOM: AUDITORIUM

**KEYNOTE ADDRESSES**

**SESSION CHAIR:** ASSOC. PROF. DIMITRIOS A. KARRAS

11:20 AM - 11:40 AM



**PROF. DR. SUAD BECIROVIC**

Rector of International Novi Pazaru University, Serbia

**Speech title:** The Development of Cryptocurrencies – Lessons from the Past

11:40 AM - 12:05 PM



**PROF. DR. HABIB HAMAM**

Faculty of Engineering, CIT

**Speech title:** It is time to understand the mechanism of deep learning used in Business and Technology

12:05 PM - 12:30 PM



**ASSOC. PROF. DR. RICARDO RODRIGUEZ JORGE**

Faculty of Science, Department of Informatics, Jan Evangelista Purkyně University, Czech Republic.

**Speech title:** Data Science and Machine Learning Perspectives

**12:30 PM - 01:50 PM**

**LUNCH BREAK**

## KEYNOTE ADDRESSES

02:00 PM - 03:05 PM

ROOM: AUDITORIUM

02:00 PM - 02:25 PM

02:25 PM - 02:45 PM

02:45 PM - 03:05 PM

**SESSION CHAIR:** PROF. DR. ISMAIL KOCAYUSUFOÇLU



**PROF. DR. HRRIDAYSH DESHPANDE**

Vice Chancellor of Ajeenkya DY Patil University Pune,  
Maharashtra, India



**DR. MAARUF ALI**

School of Computing, Engineering and Physical Sciences University of the  
West of Scotland, UK  
**Speech title:** Transhumanism



**DR. ZARA ZAMANI**

Chief Solutions Officer at ChromaWay AB, Sweden, lecturer and  
researcher in the adoption of blockchain in small and medium  
enterprises at Halmstad University, Sweden

03:10 PM - 04:10 PM

ROOM: E2  
**(TESLA)**



GOOGLE MEET

ROOM: A1  
**(ERASMUS)**



GOOGLE MEET

ROOM: C2  
**(ADAM SMITH)**



GOOGLE MEET

## PARALLEL SESSIONS PAPERS PRESENTATION

### Session 1

#### CYBERSECURITY AND CLOUD COMPUTING

**SESSION CHAIR:** Dr. ADISA DABERDINI

GENTA REXHA / AURELA ZYBERAJ / SILVA RUCAJ  
*Albanian University, Tirana, Albania*

**PAPER TITLE:** IMPLEMENTATION OF IDSS IN ALBANIAN BUSINESSES

Dr. ADISA DABERDINI / ELISA SKENDERAJ / NOVRUS METAJ  
*University of Elbasan "Aleksander Xhuvani", Elbasan, Albania*

**PAPER TITLE:** SECURITY APPLICATIONS IN LINUX OPERATING SYSTEMS AND PRACTICES FOR THEIR PROTECTION

Dr. ADISA DABERDINI / ELISA SKENDERAJ / NOVRUS METAJ / INMERILDA HASA  
*University of Elbasan "Aleksander Xhuvani", Elbasan, Albania*

**PAPER TITLE:** CYBER SECURITY IN FORTICLIENT INSTITUTIONS AND ORGANIZATIONS

Dr.. ELENA SIMONOFSKI / RESINA PLLAHA  
*University of "Our Lady of Good Counsel", Tirana, Albania*

**PAPER TITLE:** YOUTH VIOLENCE DRIVEN BY CYBERSPACE

### Session 2

#### FINANCIAL ANALYSIS AND TRANSFORMATIONS IN ECONOMY - 1

**SESSION CHAIR:** Dr. DENIS VELIU,

BESJANA MEMA / GENTA REXHA / MONIKA GJONAJ

**PAPER TITLE:** IMPACT OF COVID-19 ON BUSINESS DIGITALIZATION IN ALBANIA

ASSOC. PROF. FABIAN ZHILLA  
*Canadian Institute of Technology, Albania*

**PAPER TITLE:** THE LOOPHOLES OF THE POLITICAL FINANCE IN ALBANIA

Dr.. DENIS VELIU  
*Metropolitan University of Tirana, Albania*

**PAPER TITLE:** PORTFOLIO OPTIMIZATION IN THE CRYPTOCURRENCY MARKET

GENTJAN SKARA / BOJANA HAJDINI  
*Epoka University, Albania*

**PAPER TITLE:** THE APPLICATION OF EU COMPETITION LAW IN A DIGITAL TECHNOLOGY: NEED FOR NEW RULES?

### Session 3

#### DIGITALIZATION AND EDUCATION

**SESSION CHAIR:** PROF. DR. HABIB HAMAM

PROF. DR. HABIB HAMAM  
*Faculty of Engineering, CIT*

**PAPER TITLE:** TOWARDS PEDAGOGICAL CONTINUITY IN REMOTE EDUCATION

RUFAT OSMANI  
*South East European University, Skopje, North Macedonia*

**PAPER TITLE:** AN OVERVIEW OF THE FACTORS THAT IMPEDE ORAL COMMUNICATION IN EFL CLASSES: THE CASE OF BES STUDENTS AT SEEU

BASRI SALIU  
*South East European University, North Macedonia*

**PAPER TITLE:** SMARTPHONE USE CONTRIBUTED TO INDIVIDUAL TENDENCIES TOWARDS SOCIAL MEDIA ADDICTION IN SOUTHEAST EUROPEAN UNIVERSITY STUDENTS DURING THE COVID-19 PANDEMIC

KUJTIM RAMADANI  
*South East European University, North Macedonia*

**PAPER TITLE:** THE COMMUNICATIVE APPROACH IN ENGLISH LANGUAGE LEARNING

04:10 PM - 04:15 PM

COFFEE BREAK



04:15 PM - 06:15 PM

**ROOM: E2  
(TESLA)**



GOOGLE MEET

**ROOM: A1  
(ERASMUS)**



GOOGLE MEET

**ROOM : C2  
(ADAM SMITH)**



GOOGLE MEET

## PARALLEL SESSIONS PAPERS PRESENTATION

### Session 1

#### ARTIFICIAL INTELLIGENCE AND DIGITALIZATION

**SESSION CHAIR:** Dr. DONALD ELMAZI

Dr. XINLI HE / JIAJUN YAN / BIHUAN CHEN  
*Department of Engineering , The University of Hong Kong, HongKong, China*

**PAPER TITLE:** APPLICATION OF SENTIMENT ANALYSIS AND EVENT CLASSIFICATION BASED ON XLNET IN THE FINANCIAL AREA

LUKE JOEL / WESLEY DOORSAMY / BABU SENA PAUL  
*University of Johannesburg, South Africa*

**PAPER TITLE:** ON THE PERFORMANCE OF IMPUTATION TECHNIQUES FOR MISSING VALUES ON HEALTHCARE DATASETS

Dr. VESELA TANASKOVIC GASSNER / D. SYMEONIDIS  
*Afforest for Future, Vienna, Austria and University of Nis, Nis, Serbia*

**PAPER TITLE:** 10X IMPROVEMENT OF SMALL MULTI DAM SYSTEMSPERFORMANCE AFTER APPLYING HYBRID MODEL DIAGNOSTICS

ANDREW KIM  
*Cresskill High School, New Jersey, USA*

**PAPER TITLE:** A SONG RECOMMENDATION SYSTEM USINGSENTIMENTANALYSIS BASED ON USER REVIEWS

STEPHEN AFRIFA & PROF. DR. VIJAYAKUMAR VARADARAJAN  
*University of Energy and Natural Resources, Sunyani, Ghana and Ajeenkya D Y Patil University, ADYPU, Pune, India*

**PAPER TITLE:** CYBERBULLYING DETECTION ON TWITTER USING NATURAL LANGUAGE PROCESSING AND MACHINE LEARNING TECHNIQUES

BA. SKERDI MULLAJ / Dr. ERALDA CAUSHI  
*Vodafone Albania & Canadian Institute of Technology*

**PAPER TITLE:** AUTOMATED CURRICULUM LEARNING FOR NEURAL NETWORK

BA. SKERDI MULLAJ / Dr. ERALDA CAUSHI  
*Vodafone Albania & Canadian Institute of Technology*

**PAPER TITLE:** SUCCESS EVALUATION THROUGH CV ANALYSIS USING MACHINE LEARNING

### Session 2

#### FINANCIAL ANALYSIS AND TRANSFORMATIONS IN ECONOMY - 2

**SESSION CHAIR:** Dr.. DENIS VELIU

Dr. (C). CENETA TELAK DURMISHI

**PAPER TITLE:** THE LATEST CONSUMER BEHAVIOUR TRENDS IN 'CONNECTED MARKETING' IN THE REPUBLIC OF NORTH MACEDONIA

FELIPE SILVA / SELMA R. OLIVEIRA  
*Fluminense Federal University, Brazil*

**PAPER TITLE:** CAPABILITY OF TECHNOLOGICAL INNOVATION TO EMERGE FROM DARK DAYS

### Session 3

#### DIGITALIZATION AND EDUCATION

**SESSION CHAIR:** PROF. DR. HABIB HAMAM

ÖZGE BÜYÜKDAÇLI / EMINE YAMAN AMAL MERSNI  
*International University of Sarajevo, Sarajevo, Bosnia & Herzegovina*

**PAPER TITLE:** STUDENT PERFORMANCE ANALYSIS USING DATA MINING TECHNIQUES: A CASE STUDY

ASSOC. PROF. ARTUR JAUPAJ  
*Canadian Institute of Technology, Albania*

**PAPER TITLE:** REVISITING VET AND CONTINUING EDUCATION: TOWARDS A KNOWLEDGE-BASED ECONOMY THROUGH BEST PRACTICES

Dr.. ALFONS HARIZAJ  
*Canadian Institute of Technology, Albania*

**PAPER TITLE:** LINEAR AND EQUIPERCENTILE METHODS FOR EQUATING OF TEST RESULTS FROM DIFFERENT YEARS TO RANK STUDENT CANDIDATES FOR UNIVERSITIES



09:00 AM - 9:30 AM

**RECEPTION AND REGISTRATION**

9:30 AM - 10:50 AM

ROOM : AUDITORIUM**KEYNOTE ADDRESS AND SPECIAL LSE SESSION****SESSION CHAIR:** PROF. DR. MERITA XHUMARI

09:30 AM - 10:00 AM

**PROF. WILL BARTLETT**

Deputy Director, LSE Research on Southeastern Europe (LSEE), European Institute, LSE, UK &amp; Professor and Editor-in-Chief, Economic Annals, University of Belgrade Faculty of Economics, Serbia

10:00 AM - 10:50 AM

**SPECIAL LSE SESSION**

THE EFFECTIVENESS OF NEW TECHNOLOGIES FOR TEACHING CODING IN COMPULSORY EDUCATION

**PROF. DR. MERITA XHUMARI & MEGI XHUMARI - Albanian Case****PROF. IVANA PRICA - Serbian Case****PROF. ARDIANA GASHI - Kosovo Case****Dr. DORINA RAPTI - Director of Curricula and Teacher Qualification Department Quality Assurance Agency of Pre-university Education, Ministry of Education and Sport, Albania**

10:50 AM - 11:00 AM

**COFFEE BREAK**

11:00 AM - 12:30 PM

MEETING ROOM

ZOOM LINK

**ROUND TABLE DISCUSSION "DIGITALIZATION AND ECONOMY IN WESTERN BALKANS- PROSPECTS AND CHALLENGES" (LIVE STREAMING EVENT)****ROUND TABLE MODERATOR :** ASSOC. PROF. FABIAN ZHILLA

12:30 PM - 01:30 PM

**LUNCH BREAK**

01:30 PM - 02:30 PM

ROOM : AUDITORIUM**KEYNOTE SPEAKERS****SESSION CHAIR:** ASSOC. PROF. DIMITRIOS A. KARRAS

01:30 PM - 01:50 PM

**DR. DAVIDE CARNEIRO**

Lecturer and Researcher on AI &amp; Data Science at CIICESI/Polytechnic of Porto, Portugal

**Speech title:** Our Role in the Data Revolution: Empowerment and Responsibility

01:50 PM - 02:10 PM

**ASSOC. PROF. DR. MAHDI H. MIRAZ**

Assoc. Professor of Communications Engineering, Xiamen University (Malaysia Branch), Malaysia

02:10 PM - 02:30 PM

**ASSOC. PROF. DR. ENG. NEYARA RADWAN**

Mechanical Dept., Faculty of Engineering, Suez Canal University, Egypt

**Speech title:** Digital Transformation: The Role of Adaptable Digital Transformation Framework

02:30 PM - 04:45 PM

ROOM: E2  
(TESLA)

GOOGLE MEET

ROOM : C2  
(ADAM SMITH)



GOOGLE MEET

ROOM : AUDITORIUM

## PARALLEL SESSIONS PAPERS PRESENTATION

### Session 1

#### SHAPING THE FUTURE - TRENDS

SESSION CHAIR: PROF. DR. VIJAYAKUMAR VARADARAJAN

ASSOC. PROF. ABDULSALAM ALKHOLIDI, ASSOC. PROF. DIMITRIOS A. KARRAS, Dr. DONALD ELMAZI  
Canadian Institute of Technology, Albania

PAPER TITLE: AN ADVANCED APPROACH TO ANALYZE VARIOUS INTERNET METRICS: A CASE STUDY

NELSON DUARTE / CARLA PEREIRA

ESTG, Politécnico do Porto, INESC TEC - Institute for Systems and Computer Engineering, Technology and Science, Portugal

PAPER TITLE: AN ECOSYSTEM TO SUPPORT DIGITAL TRANSFORMATION

NIKOLAY PADAREV

"Vasil Levski" National Military University, Veliko Tarnovo, Bulgaria

PAPER TITLE: INVESTIGATION OF DAMAGE FROM RADIOLOGICAL DISPERSAL DEVICE

DR. MAGED FAROUK, PROF. NEYARA RADWAN

Onaizah Colleges, Saudi Arabia and Workers University, Egypt & Faculty of Economics & Administration, King Abdelaziz University, Jeddah, Saudi Arabia and Mechanical Department Faculty of Engineering, Suez Canal University, Ismailia, Egypt

PAPER TITLE: APPLYING ARTIFICIAL INTELLIGENCE APPLICATIONS IN MOBILE HEALTH SECTOR (MHEALTH) FOR COMBATING COVID-19 IN SAUDI ARABIA: ROLES, CHALLENGES AND RECOMMENDATIONS

ASSOC. PROF. DIMITRIOS A. KARRAS

Canadian Institute of Technology, Albania

PAPER TITLE: ON A COMPARATIVE ANALYSIS IN INDEXED DATABASES OF RESEARCH PERFORMANCE TRENDS IN WESTERN BALKANS

ASSOC. PROF. DIMITRIOS A. KARRAS

Canadian Institute of Technology, Albania

PAPER TITLE: ON THE INTEGRATION OF ELECTRIC VEHICLES TO THE GRID: PROFILES, POTENTIAL BUSINESS MODELS AND CHALLENGES

MAJLINDA FETAJI, AFAN HASAN, FJOLLA FETAJI

South East European University and International Balkan University & S Cyril and Methodius University, Faculty FINK Informatics, North Macedonia

PAPER TITLE: ANALYSES OF POSSIBILITIES OF REDUCING THE NUMBER OF STATES OF AUTOMATA: CASE STUDY EXAMPLES

PROF. BEKIM FETAJI / MAJLINDA FETAJI / MIRLINDA EBIBI

Mother Tereza University, Skopje, North Macedonia

PAPER TITLE: ANALYSES OF DIGITALIZATION POSSIBILITIES IN EDUCATION AND ASSESSING THE IMPACT OF GAMIFICATION OF MATHEMATICS

### Session 2

#### FINANCIAL ANALYSIS AND TRANSFORMATIONS IN ECONOMY - 2

SESSION CHAIR: Dr.. EDMIRA CAKRANI

DR. ENRIKO CEKO

Canadian Institute of Technology, Albania

PAPER TITLE: A WORLDWIDE ANALYSIS OF THE ENGINEERING INDEX UNDER A QUALITY MANAGEMENT APPROACH

ASSOC. PROF. REIS MULITA

Canadian Institute of Technology, Albania

PAPER TITLE: CHALLENGING APPLICATION OF THE CIRCULAR ECONOMY THROUGH ARTIFICIAL INTELLIGENCE

DR.(C). GJERGJI Tafa / DR.(C). BESARTA Tafa

"Foodway" shpk / Canadian Institute of Technology, Albania

PAPER TITLE: FINANCIAL INSTITUTIONS BEFORE AND AFTER THE PANDEMIC OF COVID 19, AN EMPIRICAL MEASUREMENT OF THEIR FINANCIAL STABILITY

DR.. EUGEN MUSTA / DR.. BLENDAR MACKA

UBA Bank / Canadian Institute of Technology, Albania

PAPER TITLE: CHALLENGES AND OPPORTUNITIES OF ISLAMIC FINANCE IN ALBANIA

DR.. JONA PUCI / MSC. MEGI MULLALLI

Canadian Institute of Technology, Albania

PAPER TITLE: ANALYSIS OF BANKS' CAPITAL STRUCTURE. THE CASE OF ALBANIA

DR. EDMIRA CAKRANI / MSC. IBRAHIM CEKIRI

Canadian Institute of Technology, Albania

PAPER TITLE: AN ARIMA MODEL FOR FORECASTING THE EXCHANGE RATE OF THE ALL/EUR IN ALBANIA

DR.(C). ABOLI NIPHADKAR / DR. AJAY KUMAR MISHRA / PROF. DR. VIJAYAKUMAR VARADARAJAN

Faculty ADYPU University, Pune, Maharashtra / Faculty ADYPU University, Pune, Maharashtra / ADYPU India, Unsw Australia, Ssbm Geneva

PAPER TITLE: DIGITAL MARKETING AND ITS REPERCUSSION ON WHAT CUSTOMER PREFER TO BUY

### Session 3

#### STUDENTS SESSION

SESSION CHAIR: ASSOC. PROF. DR. VASIL QANO

DELOMIR EMINI / MSC. KLEA ÇAPARI / DR. DONALD ELMAZI

Canadian Institute of Technology, Albania

PAPER TITLE: ANALYSIS OF MULTI-USER WEB APPLICATION PLATFORMS

BRIKELDA LICAJ / ENG. SHEFQET MEDA / ASSOC. PROF. DIMITRIOS A. KARRAS

Canadian Institute of Technology, Albania

PAPER TITLE: THE INCORPORATION OF COMPLEX MACHINE LEARNING ALGORITHMS INTO IOT BASED SMART VESSELS AUTOMATION WITH ENHANCED SECURITY

ORESTI LEKA / ENG. SHEFQET MEDA

Canadian Institute of Technology, Albania

PAPER TITLE: REAL TIME SIGN LANGUAGE DETECTION WITH TENSORFLOW AND REACTJS TO ACCOMMODATE THE NEED OF PEOPLE WITH FEWER OPPORTUNITIES

ERASMIA VARFI / MSC. ANXHELA BARAJ / ENG. SHEFQET MEDA

Canadian Institute of Technology, Albania

PAPER TITLE: DEPLOYING A SCALABLE SERVERLESS WEB / MOBILE APPLICATION FOR A BUSINESS USING IOT CORE SERVICES

MSC. ZEJNEB OSMANI  
*Canadian Institute of Technology, Albania*  
PAPER TITLE: THE ROLE OF STRATEGIC PLANNING IN IDENTIFYING AND ASSESSING THE ENVIRONMENTAL FACTORS AFFECTING BUSINESSES

KAMILA HYKA / DR.(C). ERJONA DESHATI  
*Canadian Institute of Technology, Albania*  
PAPER TITLE: IMPACT OF SOCIAL MEDIA ON THE BRAND AWARENESS OF ALBANIAN COMPANIES

ODETA SIPRI / DR.. DITILA EKMEKCIU  
*Canadian Institute of Technology, Albania*  
PAPER TITLE: THE IMPACT OF DEBT ON PROFITABILITY. THE CASE OF ROSSMANN&LALA

VISELDA BEQIRAJ / MSC. KLEA ÇAPARI / ASSOC. PROF. DR. DIMITROS A. KARRAS  
*Canadian Institute of Technology, Albania*  
PAPER TITLE: SOFTWARE DEVELOPMENT USING .NET FRAMEWORK AND .NET CORE

ESTELA POGACE / ASSOC. PROF. DR. DIMITROS A. KARRAS  
*Canadian Institute of Technology, Albania*  
PAPER TITLE: ON A\* GRAPH SEARCH ALGORITHM HEURISTICS IMPLEMENTATION TOWARDS EFFICIENT PATH PLANNING IN THE PRESENCE OF OBSTACLES

**04:45 PM - 05:15 PM**  
ROOM : AUDITORIUM

**CLOSING CEREMONY – CONCLUDING REMARKS -  
COCKTAIL PARTY**

**ICITTB 2022**

**“INTERNATIONAL CONFERENCE ON INTELLIGENCE – BASED  
TRANSFORMATIONS OF TECHNOLOGY AND BUSINESS”**

SHAPING THE FUTURE: DIGITAL ECONOMY AND RECENT  
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