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This book includes abstracts of the 8th International Conference "Information Technology and Implementation (Satellite) – 2021". Philosophical, theoretical and applied aspects which describe the results, problems and prospects of the creation and use of intelligent computing methods and creating of information systems and technology on their basis are reviewing.

Main tracks of the conference are: Artificial Intelligence Technologies, Cyberspace Protection Technologies, Data Analytics, Digital Project Management Technologies, E-commerce, E-government and E-learning Technologies, Mathematical Foundations of Information Technology, Network and Internet Technologies.

До цієї збірки увійшли тези 8-ї Міжнародної конференції «Інформаційні технології та впровадження (сателітної) – 2021». Розглядаються філософські, теоретичні та прикладні аспекти, які описують результати, проблеми та перспективи створення і використання інтелектуальних обчислювальних методів та створення на їх основі інформаційних систем і технологій.

Основні напрямки конференції: Технології штучного інтелекту, Технології захисту кіберпростору, Аналітика даних, Технології цифрового управління проектами, Електронна комерція, Електронне урядування та Технології електронного навчання, Математичні основи інформаційних технологій, Мережеві та Інтернет-технології.

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## **DEVELOPMENT AND RESEARCH OF THE INTELLIGENT TECHNOLOGY FOR PREDICTING THE POPULARITY OF ANIMALS FROM THE SHELTER**

**Abstract.** Millions of stray animals are injured on the streets every day around the world. So, what can be done, to help these animals to get new home? Scientists and researchers can suggest improvements that will help shelter animals to have a higher chance to be adopted with the help of data science. One of the solutions for this problem can be called one that will also use artificial intelligence. We intend to use a computer vision apparatus based on neural networks.

**Keywords:** Computer vision, prediction, intelligent technology, artificial intelligence, neural networks, deep learning, data science, shelter animals

**Introduction.** Millions of stray animals are injured on the streets every day around the world [1]. Such animals feel alone and they cannot live happy and healthy life. It is a great problem that so many animals cannot find their loving homes. In addition, these animals face many problems during their life in shelters. As example, for most dogs, being relinquished to an animal shelter is a drastic change and a very stressful experience [2]. Such environmental changes are very stressful for the most of dogs. Stress may also affect a shelter dog's physical health, causing increased susceptibility to diseases and a longer recovery time from illness [2].

And all of them need love and a cozy home. So, what can be done, to help these animals to get new home? One picture is worth a thousand words and the photography can save thousand lives. It is obvious that pets with charming photos can generate more interest and they can be adopted faster [1].

Scientists and researchers can determine the appeal of pet pictures. Moreover, they can suggest improvements that will help shelter animals to have a higher chance to be adopted with the help of data science. There are many animal shelters & organizations that help animals to get their new loving homes all over the word.

For example, "PetFinder.my" is Malaysia's leading animal welfare platform with over 180000 animals, 54000 of which have been safely adopted [1]. "PetFinder" works closely with animal lovers, the media, corporations and international organizations that help to improve animal welfare [1].

Moreover, they have launched Kaggle Competition on the 23<sup>rd</sup> of September, 2021. That's why it is new to the world. Their aim is to help shelter animals to get their new home with the help of data science.

**Problem Formulation.** As it Kaggle Competition, the given problem is posted on the site kaggle.com [1]. The task is to predict engagement with a pet's profile based on the photography for that profile. Therefore, our aim is to analyze raw images and

metadata and, after that, create intelligent technology that will be able to predict the “pawpularity” of pet photos.

**Dataset.** As it said in [1], the data can be used for academic research and education. In addition, the owners of the task have included optional Photo Metadata, manually labeling each photo for key visual quality and composition parameters. These labels are not used for deriving their “pawpularity” score, but it may be beneficial for better understanding the content and co-relating to a photo's attractiveness. The example of images is given in Fig.1.

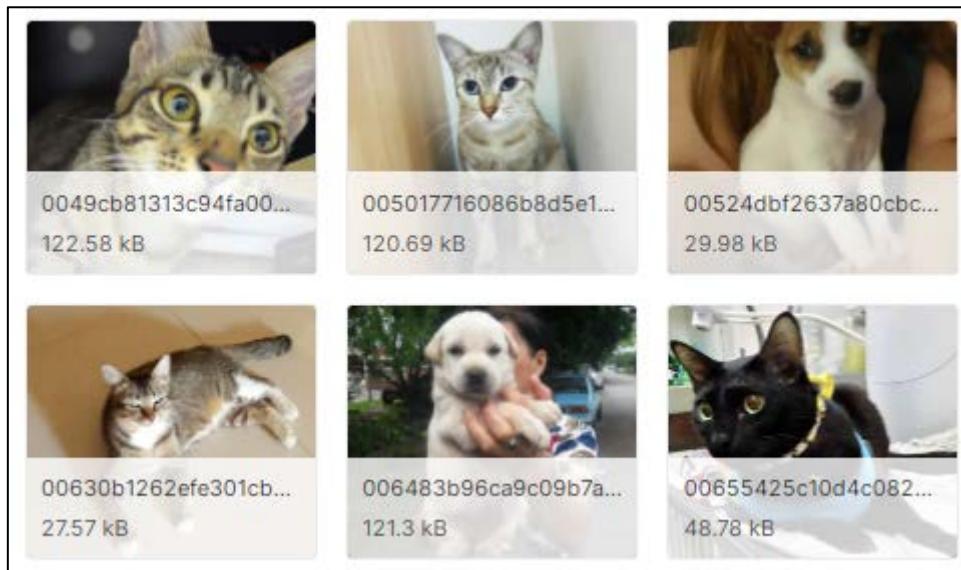


Figure 1 - Dataset

**Previous Decisions Achieved.** “PetFinder.my” currently uses a basic attraction counter for ranking pet photos. It analyzes image composition and other factors based on characteristics of thousands of pet profiles. The “pawpularity” score is derived from each pet profile's page view statistics at the listing pages, using the algorithm that normalizes the traffic data across different pages, platforms (web & mobile) and other various metrics. While this basic tool is useful, it is still in an experimental stage and the algorithm could be improved [1].

**Offered Approach.** One of the proposed solutions for this problem can be called the one that will use artificial intelligence (AI) technologies. As we have images in the dataset, so the solution belongs to the domain of the computer vision (CV) problems. CV is a field of AI that enables computers and systems to derive important information from digital images, videos and other visual inputs — and take actions or make recommendations based on that information. If AI enables computers to think, CV enables them to see, observe and understand [3].

For example, CV consists of such tasks as image processing, object detection, image recognition, image segmentation and so on.

Image processing is a method to perform some operations on an image, in order to get an enhanced image or to extract some useful information from it [4].

Object detection is a CV technique that allows to locate objects in an image or video. With this kind of identification and localization, object detection can be used to count objects in a scene and determine and track their precise locations, all while accurately labeling them [5].

Image recognition, in the context of machine vision, is the ability of software to identify objects in images [6].

Image segmentation is a method in which a digital image is broken down into various subgroups called “image segments” which helps in reducing the complexity of the image to make further processing or analysis of the image simpler. Segmentation in easy words is assigning labels to pixels. All picture elements or pixels belonging to the same category have a common label assigned to them [7].

All these tasks can be solved using such methods as: basic morphology operations (erosion, dilation, opening, closing etc.); machine learning methods (e.g. image segmentation can be done with the help of clustering methods [8], such as K-Means or evolutionary methods like genetic algorithms, MODS etc.); deep learning methods (e.g. Convolutional Neural Networks, Recurrent Neural Networks).

Therefore, we intend to use a computer vision apparatus based on neural networks for predicting the floating value of the “pawpularity” score.

### **References:**

1. PetFinder.my - Pawpularity Contest, 2021. URL: <https://www.kaggle.com/c/petfinder-pawpularity-score>
2. Center for Shelter Dogs, Transition and Stress. URL: <https://centerforshelterdogs.tufts.edu/dog-welfare/transition-and-stress/>
3. What is Computer Vision?, IBM, URL: <https://www.ibm.com/topics/computer-vision>
4. Digital Image Processing, University of Tartu, URL: <https://sisu.ut.ee/imageprocessing/book/1>
5. Object Detection Guide, FRITZ AI, ULR: <https://www.fritz.ai/object-detection/>
6. Image recognition, TechTarget, URL: <https://searchenterpriseai.techtarget.com/definition/image-recognition>
7. Image Segmentation: Part 1, Towards Data Science, URL: <https://towardsdatascience.com/image-segmentation-part-1-9f3db1ac1c50>
8. Maryna Antonevych, Nataliia Tmienova and Vitaliy Snytyuk, “Models and Evolutionary Methods for Objects and Systems Clustering”. Proceedings of the International Scientific Symposium “Intelligent Solutions” (IntSol-2021), Uzhhorod/online, Ukraine, 28-30 September 2021, pp.47-56.

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## **IDENTIFICATION OF CRITICAL INFORMATION INFRASTRUCTURE OBJECTS**

**Abstract.** To date, natural and man-made threats, the level of terrorism, the scale and complexity of cyberattacks have increased significantly. And the number of cyberattacks aimed at impressing various areas of critical infrastructure is growing steadily. These situations have increased the urgency of the problem of protection of critical infrastructure, especially information and communication technologies, which are strategically important for the existence and functioning of our state, as well as ensuring the security of the Ukrainian people. In addition, disruption of such facilities can lead to economic and social collapse of the state.

**Keywords:** critical infrastructure, critical infrastructure objects, critical information infrastructure, identification of critical information infrastructure objects.

The number of cyberattacks affecting critical infrastructure (CI) is growing every day. One of the recent attacks is the Petya virus, which has invaded the banking sector. These situations have increased the urgency of the problem of protection of CI facilities, which are strategically important for the existence and functioning of our state, as well as ensuring the security of the Ukrainian people.

In Ukrainian legislation, the term critical infrastructure (CI) is understood as a set of state infrastructure facilities that are most important for the economy and industry, the functioning of society and public safety and the decommissioning or destruction of which may affect national security and defense, natural environment, lead to significant financial losses and human casualties. Objects of CI are enterprises and institutions (regardless of ownership) of such industries as energy, chemical industry, transport, banks and finance, information technology and telecommunications (electronic communications), food, health care, utilities, which are strategically important for the functioning of the economy and security of the state, society and population [1].

The document [2] introduces new concepts of "critical information infrastructure" (CII) and is interpreted as "a set of critical information infrastructure" and "critical information infrastructure", which reveals more clearly the previous term, and means communication or technological system of a critical infrastructure object, a cyberattack which will directly affect the sustainable functioning of such a critical infrastructure object".

The source of threats is not only the unsatisfactory condition of infrastructure networks (their high wear, accidents) and the impact of natural factors (karst,

landslides, flooding, etc.), but also a set of economic factors manifested by the lack of interest operators of such networks to improve the situation. In general, this affects the inefficient management of critical infrastructure security, in particular life support systems. Thus, there is a significant threat of termination of the provision of vital services to the population due to unresolved issues of settlements between infrastructure network operators and their suppliers. The group of malicious actions also includes threats posed by intelligence services of other countries on the territory of Ukraine, aimed at damaging critical infrastructure [3].

There are currently several issues that need to be addressed immediately for the development of CI facilities:

1. Lack of an integrated system of CI protection;
2. Inferiority of the regulatory framework, especially the law on CI and protection of its objects;
3. The absence of a separate body of state power that is responsible for actions in the field of CI;
4. Uncertainty of general criteria and methods for identification and threat assessment of CI objects;
5. Lack of international cooperation and public-private partnership.

The first step in solving problems can be to create a list of CII objects that cannot be created without identifying them. Under the identification of the object of critical information infrastructure is understood the procedure of assigning the object of information infrastructure to the objects of critical information infrastructure [4].

Therefore, research in the field of detection and protection of critical infrastructure from cyber threats is relevant and necessary. That is why there is a need to develop a method of identification of critical information infrastructure, which will allow the identification of critical objects of a particular industry and determine the degree of their criticality, which systematizes critical infrastructure and facilitate the choice of means and ways to protect them from threats.

#### **References:**

1. Resolution of the Cabinet of Ministers of Ukraine Some issues of critical infrastructure № 1109 (2020, October 9). Vidomosti Verkhovnoyi Rady Ukrayiny.
2. Law of Ukraine on the basic principles of cybersecurity in Ukraine № 45 (2017). Vidomosti Verkhovnoyi Rady Ukrayiny.
3. Ivanyuta S.P. Threats to critical infrastructure and their impact on national security. Department of Energy and Technogenic Safety.
4. Resolution of the Cabinet of Ministers of Ukraine Some issues of critical information infrastructure № 943 (2020, October 9). Vidomosti Verkhovnoyi Rady Ukrayiny.
5. S. Toliupa, I. Parkhomenko and H. Shvedova, "Security and Regulatory Aspects of the Critical Infrastructure Objects Functioning and Cyberpower Level Assesment", 2019 3rd International Conference on Advanced Information and Communications Technologies (AICT), Jul. 2019.
6. D. Biriukov and S. Kondratov, Critical Infrastructure Protection: Challenges and prospects for implementation in Ukraine. Kyiv: NISS, 2012, 96 p.

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## CLASSIFICATION MODELS IN E-COMMERCE PROJECTS

**Abstract.** Reporting the relevance of the application of opportunities, modern analytics technologies in e-commerce projects. The classification model for the online store has been developed. The model is based on the method of k-nearest neighbors. There are 4 classes of customers: customers with numerous transactions compared to other customers, regular customers, customers who made their transactions much earlier than other customers, regular customers with medium and low check amounts.

**Keywords:** e-commerce, data analysis, k-nearest neighbors method.

E-commerce has become commonplace for most Ukrainians and residents of other civilized countries [1]. This is due to the development of information technology, which causes a "low threshold of entry" into E-commerce. You can quickly, inexpensively and independently create a full-fledged site, set up online advertising and start earning.

To run an effective online business, it is necessary to properly analyze the data generated in the process of conducting e-business to plan a business development strategy, optimize processes and increase profits.

An online store dataset was chosen for the research [2]. It is appropriate to collect data using web analytics tools.

The purpose of this study is to cluster the customer base of the online store based on a synthetic dataset.

RFM-analysis is often used for this purpose - customer segmentation in the analysis of sales by loyalty, which defines three groups:

- Recency - how recently did the customer purchase? - prescription of the transaction, the less time has passed since the last activity of the client, the greater the probability that he will repeat the action

- Frequency - how often do they purchase? - the number of transactions, the more actions the client performs, the more likely it is that he will repeat them in the future

- Monetary Value - how much do they spend? - the amount of transactions, the more money was spent, the more likely it is that he will place an order [3].

Using the method of k-nearest neighbors - a simple non-parametric method of classification, in which the distance to all other objects (usually Euclidean) is used to classify objects in the attribute space [4] - we can create a mathematical model for clustering existing and future customers.

Attribute characteristics selected: InvoiceNo, StockCode, Description, Quantity, InvoiceDate, UnitPrice, CustomerID, Country. After the process of data cleaning and

verification in accordance with the methodology of using the method of k-nearest neighbors, three additional attributes were created and normalized: Review, Frequency, Monetary and their values were calculated based on data from the dataset.

After all the procedures at the output we get a table with the results of clustering (Fig. 1)

	CustomerID	Amount	Frequency	Recency	Cluster_Id
0	12346.0	0.00	2	325	2
1	12347.0	4310.00	182	1	0
2	12348.0	1797.24	31	74	1
3	12349.0	1757.55	73	18	1
4	12350.0	334.40	17	309	2

Figure 1 – Clustering results table [5]

Based on the result of clustering, the following conclusions are made:

- Clients with Cluster ID 0 are clients with many transactions compared to other clients.
- Customers with Cluster ID 0 are regular customers.
- Cluster ID 2 - customers made their transactions much earlier than other customers.
- Customers with Cluster ID 1 are regular customers with medium and low check amounts.

Based on these findings, the online store can optimize current activities and adjust the development strategy.

### References:

1. Results of the e-commerce market in Ukraine according to EVO: UAH 107 billion for online purchases [Online] – 2020 - <https://ain.ua/2020/12/25/pidsumky-2020-evo/> – (Accessed 15.05.2021).
2. Online Retail Data Set [Online] – <https://archive.ics.uci.edu/ml/datasets/online+retail> – (Accessed 15.05.2021).
3. RFM (market research) - [Online] – 2021. – [https://en.wikipedia.org/wiki/RFM\\_\(market\\_research\)](https://en.wikipedia.org/wiki/RFM_(market_research)) – (Accessed 15.05.2021).
4. K-nearest neighbors algorithm - [Online] – 2021. – [https://en.wikipedia.org/wiki/K-nearest\\_neighbors\\_algorithm](https://en.wikipedia.org/wiki/K-nearest_neighbors_algorithm) – (Accessed 15.05.2021).
5. Online Retail K-Means & Hierarchical Clustering [Online] – 2019 - <https://www.kaggle.com/hellbuoy/online-retail-k-means-hierarchical-clustering/notebook> - (Accessed 15.05.2021).

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## DECENTRALIZED NETWORK IN IOT SYSTEMS

**Keywords:** IoT, decentralized networks, centralized networks, networks, P2P.

### 1. Introduction

The Internet of Things (IoT) describes the network of physical objects — “things” — that are embedded with sensors, software, and other technologies for the purpose of connecting and exchanging data with other devices and systems over the internet. IoT systems are becoming more and more popular these days. They are used in different ways and do different tasks. There’s a lot of noise at the moment about the Internet of Things (or IoT) and its impact on everything from the way we travel and do our shopping to the way manufacturers keep track of inventory.

Due to the impetuous growth of their popularity in IoT systems, there are a lot of problems and shortcomings. From them, it is possible to allocate the following:

1. weak data integrity;
2. no one can guarantee the anonymity of the data;
3. data is not protected from change.

To solve these problems it is offered to create IoT systems that are based on decentralized networks.

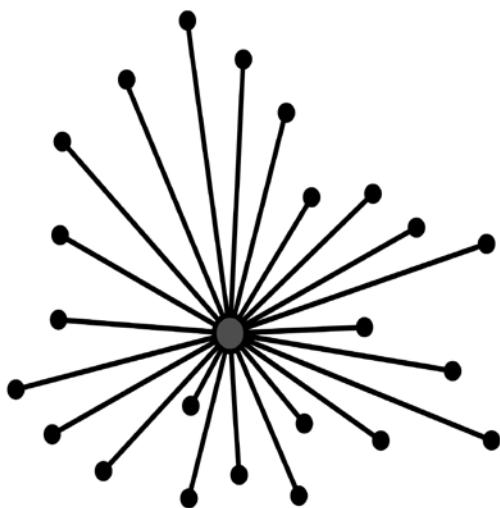
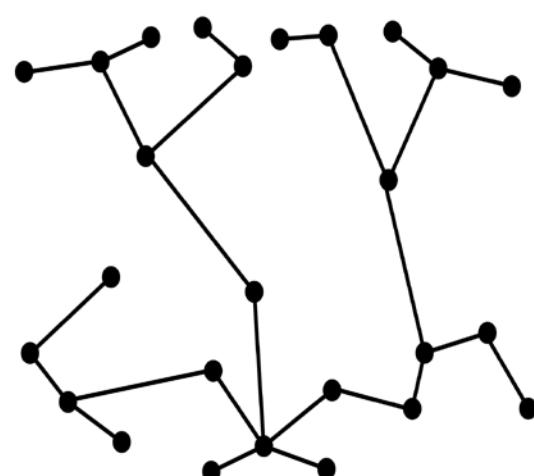
### 2. Materials and methods of research

The materials of this research were the experience of developing centralized and decentralized networks by IT companies and also articles comparing these two types of networks.

The methods of the research are comparing types of networks in terms of practicality, cost and also security. The important factor of comparing these two types was the ability of maximum compatibility of the network type with all the specifics of IoT systems in particular the speed of processing, reading and forwarding data, also the highest degree of data resistance to change.

### 3. Results and discussion

The simplest implementations of two types of networks were derived: centralized at Figure 1 and decentralized at Figure 2.

**Figure 1:** Centralized network**Figure 2:** Decentralized network

Ways of their implementation, in particular methods of achieving user anonymity, compliance with the integrity, immutability and anonymity of data. And also the comparative table of qualities of two types of networks were received (Table 1).

**Table 1**

Comparative of qualities of two types of networks

Features	P2P network	Centralized network
Data confidentiality	Yes	No
Data security	Yes	No
Easy to implement	No	Yes
Scaling	Yes	Yes
Anonymity	Yes	No

There were selected optimal technologies for developing software and based on described research was developed IoT system that consists of:

- NHS-server - the server that is used for checking which devices are active, checking that two or more devices not using the same certificate, getting the best suitable devices for sending and saving data for the requested device based on special metrics, created with Python 3;
- Devices Certification Server - server that is used for saving device certificate and realizing auth functionality, created with Python 3;
- Backend API - service that is used for communicating with web app and hub, created with Python 3;
- Hardware SDK - software development kit that is used for developing hardware firmware and that consist of based API methods for communicating with a decentralized network, created using C++;

- Node Software - software that is running on the everyone node of the network and realizing API for communicating with other nodes and NHS-server, created using Python 3;
- Web App - web interface for displaying all required data from all sensors in the local user area, created using JavaScript and Svelte.

#### 4. Conclusion

A study was conducted to determine the advantages of using decentralized networks over centralized networks for their use in IoT projects. On the basis of the conducted research the prototype of an IoT system with all auxiliary microservices on the basis of the decentralized network is constructed.

#### 5. Acknowledgements

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#### References:

An online document / world wide web resource [1, 2, 3, 4], a monograph (whole book) [5].

1. Introduction to Decentralized P2P Apps. URL: <https://www.youtube.com/watch?v=oCS05SQ-1k>
2. Qadir A. K. Peer-to-Peer Network. URL: <https://coinpedia.org/beginners-guide/peer-to-peer-p2p-network/>
3. What's the difference between peer-to-peer (P2P) networks and client-server? URL: <https://www.resilio.com/blog/whats-the-difference-between-peer-to-peer-and-client-server>
4. What is IoT? URL: <https://azure.microsoft.com/en-us/overview/internet-of-things-iot/what-is-the-internet-of-things/>
5. John Buford, Heather Yu, Eng Keong Lua. "P2P Networking and Applications", Elsevier Science, New York, NY, 2009.

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## BADUSB: OVERVIEW OF THE POSSIBLE ATTACKS WITH THE USAGE OF ARDUINO BOARD

**Abstract.** The introduced work covers the most feasible attacks that can be executed against the personal computers that have been left unblocked. As in most other cases: badUSB attacks still requires a lot of social engineering to work properly.

**Keywords:** BadUSB, Arduino, HID attack, Kali Linux.

Over the years, social engineering and the use of USB sticks for an attack have shown to be quite effective. People have been repeatedly warned not to connect mass storage devices that they have not acquired themselves. Computer defenses are developed to protect a system from USB attacks.

Computers, on the other hand, require keyboards and frequently do not regard the keyboard as an attacking instrument. As a result, a system can be exploited using a USB (badUSB) masquerading as a human interface device (such as a keyboard). BadUSB is an attack that takes advantage of a flaw in USB firmware. A USB device is reprogrammed to act as a human interface device in this attack, and the USB device is then used to silently execute instructions or launch malicious applications on the victim's computer.

Security researchers Karsten Nohl and Jakob Lell originally identified and revealed the BadUSB attack at the 2014 Black Hat conference [1]. The BadUSB code is presently available to the public via Github [2], which means that anybody may launch a full-fledged BadUSB assault, even if they have little or no experience.

Phison 2303 was the most popular USB storage chip at the time of its discovery. It was also vulnerable to being reprogrammed and used as a HID device. However, the chip was eventually abandoned, and several manufacturers addressed the flaw in following production lines.

The threat of badUSB attacks is at an all-time high, because to the growing popularity of Arduino boards. And, as a result of the vast array of options available on these boards, the attack vectors associated with their use have skyrocketed.

An employee can leave the computer alone for a brief printing job or a cup of coffee. This gives the attacker or penetration tester a window of opportunity to launch an assault.

The Arduino only has a limited amount of memory. As a result, downloading and executing a file can increase the attack's efficacy. FTP and HTTP are two methods for downloading files on a Windows 10 computer. The Windows Firewall blocks FTP by

default. The download of a malicious file through HTTP creates a security risk to the attack server since the file must be hosted publicly, allowing anybody to view it and attempt to hack the attacker system.

In order to protect both the attack server and the client, a third solution is used. On the victim, HTTP is used to download Secure FTP (SFTP) client (PSFTP) and securely log in to a remote machine and get the .exe file. SFTP requires the SSH service to be started on the remote machine and that there is an account that permits SSH. A good practice is to limit the capabilities of accessing this account [3].

The malicious executable file may be downloaded using Windows Powershell and saved in a folder to which the user has write and execute permissions. 'C:\Users\[Currentuser]\' is one example. The environment variable USEPROFILE can also be used to access the user directory.

Setting up remote control provides up a lot of possibilities for an assault. Remote access, unlike the Arduino's timing constraint, gives the hacker or pen-tester enough time to compromise the system. If the remote connection is to a Kali Linux system, all of the Kali Linux exploits may be remotely tested on the victim.

A possibility is to use Meterpreter [4] exploits, such as reverse TCP. Reverse TCP is a connection that begins on the victim's computer and ends on the hacker's machine. Because the connection is outgoing (from the perspective of the victim), incoming traffic firewall or router filters are bypassed. Filtering outgoing traffic is difficult, especially when personal computers are utilized.

On Windows 8.1, and Windows 10, there aren't many privilege escalation vulnerabilities or exploits. Local privilege escalation is conceivable, but it's not practical because it requires the user to have registry editing permissions, and if they're not removed correctly, the device is left vulnerable.

Kali Linux comes with a pre-installed version of mitmproxy [5]. Mitmproxy allows you to intercept, alter, and replay HTTP(S) traffic. On the fly, it produces fraudulent SSL certificates. It also creates a forgery of the root certificate. If the victim's computer has that certificate installed, the browser will not provide a warning and will trust it, typically displaying traffic within the SSL tunnel on the proxy machine. The command line program Certmgr may be used to install a certificate on a Windows PC.

Keyloggers, often known as keystroke loggers, are programs that record the keys that are pressed on a keyboard. It is a method of secretly monitoring what a person types, generally without the individual's awareness.

There are two methods that are thought to be viable: installing using Arduino or utilizing it from Kali. Physical hardware keyloggers are not considered since they are ineffective and easily detectable. Because keylogger software is frequently detected and blocked by antivirus software or intrusion detection systems, installing it from the Arduino is also not possible. On an exploited machine with remote access session, Kali Linux provides the keyscan tool [6]. This tool makes keystroke recording a feasible attack for implementation with Arduino.

Persistent backdoors allow access to machines that have been previously compromised. Penetrating the system can be stopped if patches are applied or the machine is simply rebooted if this stage is skipped.

Metsvc and persistence.rb are two Kali Linux solutions to examine (a Meterpreter script). Metsvc operates as a service, whereas Persistence begins when the user signs in or when the system boots. Both backdoors constitute security risks for the system they're installed on, thus they should be deleted once the penetration test is through.

It is a recommended practice to 'disguise' the exploit as another process in order to keep it undiscovered. This is accomplished by moving the process to another process (using the migrate Kali Linux tool). Because the assault is identified as a job of the operating system, it is difficult to detect. The process 'explorer', for example, can be migrated using the existing user permissions. With elevated rights, it is also possible to migrate to the Windows Login Process (winlogon), so that the attack is executed for every user that logs in [7].

Amongst the reviewed attack vectors there are a few that are feasible for the successful execution in the current state of antivirus protection: file download using keyboard only, persistent backdoor and remote access.

However, there are a lot more possibilities to develop the badUSB itself, besides using the pure Arduino board. Amongst them are: constructing Arduino with GSM or WiFi module for remote control, storing execution code directly on the phone and tricking the victim to plug it in. And combining with the mentioned attacks above it can become a serious threat even to the most secure system. But this options are left for the future investigation.

### References:

1. K. Nohl, J. Lell, BadUSB - On accessories that turn evil, 2014. URL: <https://radetskiy.files.wordpress.com/2014/08/srlabs-badusb-blackhat-v1.pdf>.
2. K. Nohl, A. Caudill, Phison 2251-03 (2303) Custom Firmware and Existing Firmware Patches (BadUSB), 2014. URL: <https://github.com/brandonlw/Psychson>.
3. Simon Tatham, PSFTP, 2008. URL: <https://www.chiark.greenend.org.uk/~sgtatham/putty/latest.html>.
4. Offensive Security Ltd., About the metasploit meterpreter, 2007. URL: <https://www.offensive-security.com/metasploit-unleashed/about-meterpreter/>.
5. A. Cortes, M. Hils, mitmproxy project, 2021. URL: <http://mitmproxy.org/doc/mitmproxy.html>.
6. Offensive Security Ltd., Using a keylogger with metasploit, 2014. URL: <https://www.offensive-security.com/metasploit-unleashed/about-meterpreter/>.
7. Raj Chandel, Windows Persistence using WinLogon, 2020. URL: <https://www.hackingarticles.in/windows-persistence-using-winlogon/>.

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## PHISHING DETECTION BASED ON UNSUPERVISED LEARNING METHOD

**Abstract.** Machine learning is widely used in the modern world to identify various forms of cyber-attacks. The issue is that typical machine learning methods may experience performance loss in these contexts due to their non-stationary nature. Due to the fact that traditional supervised machine learning-based phishing site detection approaches also suffer from these limitations, we propose in this study to employ a more holistic mode of scientific inquiry known as fuzzy clustering in the phishing sites detection.

**Keywords:** Fuzzy clustering technique, phishing detection, machine learning.

Today, the Internet is pervasive, and society relies heavily on web services for a variety of purposes. Simultaneously, malicious websites pose a significant threat to Internet users, and unaware users can become victims of malicious URLs that host undesirable content such as phishing and spam.

Phishing is a form of identity theft that occurs when a malicious Web site impersonates a legitimate one in order to acquire sensitive information such as passwords, account details, or credit card numbers [1].

There are two primary methods for detecting phishing attacks: user training and software classification. Users can be trained to recognize phishing and real sites by understanding the nature of phishing assaults. Software classification seeks to classify phishing and authentic sites more precisely and decreases human error or ignorance.

In terms of software classification, it is obvious from the black lists of phishing websites that phishing links have a tendency to register domains for a brief period of time. For instance, the majority of phishing domains were registered for one year, in contrast to benign domains, which are typically registered for ten years or longer. Concerning the secure connection, the vast majority of phishing links do not use the HTTPS protocol, making it a critical criterion for detecting phishing. Geolocation of domain registrars and hosting servers can also be considered when large samples are used.

As a result, the following attributes may be considered when evaluating the task of detecting phishing links: domain registrar, domain registration period, hosting server geolocation, and secure connection with a valid certificate.

With such a database of malicious and benign websites, the task of detecting phishing links is typically accomplished through the use of a binary classifier. It is sufficient to employ conventional categorization techniques or to develop a grading

system based on the statistical distribution of qualities between the two classes of links and on expert assessment. This type of machine learning is referred to supervised learning, because there is a data that is well labeled.

However, there is another method, called unsupervised learning, which despite its low accuracy, is now the most promising area of scientific research. Such models do not require labeled data and therefore have great potential for application, notably in the realm of cybersecurity.

Among the unsupervised learning techniques there is a fuzzy clustering, which is a technique for grouping multidimensional objects that is based on presenting the results of individual observations as points in a suitable geometric space and then selecting groupings as "clusters" of these points.

Thus, the main purpose of the analysis is to select in the original multidimensional data such homogeneous subsets so that the objects within the groups are similar to each other, and the objects from different groups are not similar. "Similarity" means the proximity of objects in a multidimensional space of features. Then the problem is reduced to the selection in this space of natural clusters of objects, which are considered homogeneous groups [2].

The article [3], represents an examining of Twitter posts to identify the leaders of terrorist networks and their followers based on fuzzy clustering. A big data architecture is provided for categorizing people based on their activity, ability to influence other users, and message content. The authors used graphs to examine how messages propagate over the network, and fuzzy clustering techniques to classify people into profiles, which is the proof that unsupervised learning can be used to detect phishing sites.

We propose to consider fuzzy clustering algorithm as a way of phishing sites detection. As future work, we are researching on the effectiveness of fuzzy clustering of indicators of compromise to detect phishing sites. In this method, indicators of compromise exemplify a clustering feature. Not only indicators of a compromise are quantitative, but there are also qualitative indicators, for that reason fuzzy clustering is applicable.

#### **References:**

1. Ram Basnet, Srinivas Mukkamala, Andrew H. Sung, “Detection of Phishing Attacks: A Machine Learning Approach”, Soft Computing Applications in Industry, pp. 373-383, 2008.
2. Бучик С.С., Герасимов Б.М. Нечітка кластеризації даних на основі принципу самоорганізації / Вісник ЖІТІ. – 2002. – №4(23). – С.177-185.
3. Cristina Sánchez-Rebollo, Cristina Puente, Rafael Palacios, Claudia Piriz, Juan P. Fuentes, and Javier Jaraiza, “Detection of Jihadism in Social Networks Using Big Data Techniques Supported by Graphs and Fuzzy Clustering”, Advances in Complex Systems and Their Applications to Cybersecurity, 2019.

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## **PASSWORD COMPLEXITY ANALYSIS OF DICEWARE PASSWORD GENERATION ALGORITHM MODIFICATION BASED ON PSEUDO-RANDOM SEQUENCES**

**Abstract:** The authors investigated main algorithms for generating passwords that exist in the market and analysed their advantages and disadvantages. The complexity of the generated passwords was estimated based on the finite entropy and the complexity of memorization. The resistance of the password to brute force attacks and dictionary attacks was also evaluated. A modified algorithm for generating Diceware passwords is recommended to use instead of the original one due to the higher entropy of the former.

**Keywords:** password authentication, password, password generation, Diceware, entropy, password strength estimation.

One of the security services that provides user data protection is the authentication service. Currently, each system uses some type of user authentication, most often – password based. However, without sufficient attention to user-generated passwords, such a system is quite vulnerable to hacker attacks. Users of the system often create easily crackable passwords, such as passw0rd, admin, etc. which can be guessed in a few seconds. Therefore, to improve the resilience of passwords to cracking, password generators are used based on random or pseudo-random number sequence generators, which can provide users with a complex password, that will be used in the system to verify the identity of the user.

Therefore, to improve the resilience of passwords to cracking, password generators are used based on random or pseudo-random number sequence generators, which can provide users with a complex password, that will be used in the system to verify the identity of the user. To improve the complexity of the password and make it easier to remember at the same time, it is recommended to use the Diceware random password generation algorithm.

The strength of a random password against a specific attack (brute force attack) can be calculated by calculating the information entropy of the random process that generated the password. If each character in the password is generated independently and with uniform probability, the entropy in bits is given by the following formula.

$$H = L \log_2 N = L \frac{\log N}{\log 2}, \quad (1)$$

where  $N$  is the number of possible characters and  $L$  is the number of characters in the password.

For comparison, a mechanical 72-character password generation algorithm, an algorithm using AES-256 PBKDF2-SHA256, a standard Diceware implementation, and a own modification of the latest were selected.

The mechanical generator is implemented using the ANSI X9.17 pseudo-random number generator and uses 72 characters, which include lowercase and uppercase English letters, numbers and some characters. Generation is performed by obtaining three pseudo-random numbers using a generator, which are used as indices in a three-dimensional array to access the desired character. The operation is repeated until the desired password length is reached.

As an example of a commercial product for generating passwords, an algorithm that uses AES-256 PBKDF2-SHA256 was chosen, which was provided by the software application LastPass [1].

Diceware is a method of creating password phrases, passwords and other cryptographic variables, using ordinary dice as a hardware generator of random numbers [2]. Each word in the passphrase requires five dice rolls. The resulting numbers 1 to 6 are added as a five-digit number, such as 43146. This number is then used to search for a word in the word list. By generating several words sequentially, you can build a long, easy-to-remember, and easy-to-choose password.

Modification of this algorithm involves generating a password not only by choosing words, but also by randomly changing a capital letter in each word and replacing the letters with some numbers, such as the letter "o" by 0.

The initial stage of the modified Diceware algorithm consists of reading a set of words from a file, by default - an English dictionary. The next step is word generation. First, a number from 0 to 7775 is generated, a word is selected from a set of words, the index of which corresponds to the generated number. A number from 0 to 1 is then generated, which determines whether the word will have a capital letter or not. The next step is to search for the remaining characters. If the symbol is "o", "i" or "l", then a number will be generated between 0 and 1, which determines whether the symbol will be replaced by "0", "1" or "7" respectively, or not. The process is repeated until the desired password length is reached. In this case, the length of the password is determined not by the number of characters, but by the number of words generated in the resulted password. The final step is to combine the resulting words into a single one, with the words separated by a hyphen.

In Ukraine, there is no legal framework that would regulate the requirements for the passwords used, because of this as the indicator of a good password the requirements of the standard NIST.SP.800-63b [3], which regulates the properties that a certified password must have, will be used. There is the section in this document designed for passwords that are to be remembered. The following requirements are put towards them:

- length from 8 to 64 characters;
- all ASCII and UNICODE characters must be present;
- for generated passwords approved random bit generators specified in the regulatory document NIST.SP.800-90Ar1 [4] must be used;

- passwords should not be previously compromised, in the database of light passwords, depend on the context and have repetitive characters, as well as use words from the dictionary.

Determining password complexity in a software application is determined by entropy and character entropy. Formulas 1 and 2, respectively, are used to calculate them.

$$H_{symbol} = \frac{H}{L}, \quad (2)$$

where H is the total entropy, L is the number of characters in the password.

The results of the analysis of entropy and entropy per symbol for passwords generated by each algorithm are given in table. 1.

The results show that using the modified Diceware algorithm, the entropy per symbol is 1.4 bits higher than the standard algorithm.

**Table 1**

Entropy values for different password generation algorithms and length

Algorithm	6 symbols	8 symbols	16 symbols	Entropy per bit
	Entropy, bit	Entropy, bit	Entropy, bit	
Mechanical	32,02	49,36	98,72	6,17
AES-256 PBKDF2-SHA256	39,33	52,44	104,87	6,55
Diceware	77,55	103,41	206,88	12,92
Diceware modification	85,94	114,58	229,16	14,32

The results show that increasing entropy has made it more difficult to read and remember a password, although it can still be remembered by the average user. It should be noted that this assessment is subjective.

#### References:

1. LastPass security model. URL: <https://www.lastpass.com/security/zero-knowledge-security>.
2. The Diceware Passphrase Home Page. URL: <http://world.std.com/~reinhold/diceware.html>.
3. Digital Identity Guidelines Authentication and Lifecycle Management, 2017. URL: <https://pages.nist.gov/800-63-3/sp800-63b.html#memsecret>.
4. Elaine Barker, Recommendation for Random Number Generation Using Deterministic Random Bit Generators, 2015. URL: <https://nvlpubs.nist.gov/nistpubs/SpecialPublications/NIST.SP.800-90Ar1.pdf>.

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## **COMPETITIVENESS FACTORS PROGNOSIS OF INTERNATIONAL EDUCATIONAL PROGRAMS OF CHINESE EDUCATIONAL ESTABLISHMENTS**

### **Systematic dynamic modeling and simulation of the Chinese supply network**

The financial supply chain is a financing regime that attracts support from the strength of key enterprises and is based on a relationship with the supply chain and collateral to provide financial support to SMEs. The use of supply chain finance can achieve a win-win situation for SMEs, core businesses and financial institutions. Thus, supply chain funding that increases social welfare has been supported by China's national policy. In February 2016, the Chinese government published an analytical article on financial support for stable growth, structural adjustments and industry efficiency.

It is noteworthy that the supply chain finance as a new model of financing - changed the original model of bank lending. The financial supply chain has adopted a new "core loan / debt loan" model for conducting credit inspections of SMEs, relying to future cash flow generated by transactions and core corporate loans. This can help increase the availability of credit to SMEs, while providing a new method of bank risk management [1]. Thus, the essence of supply chain financing is credit financing, and credit risk control remains a key aspect of financial risk management.

The credit risk of supply chain financing has a broad approach. Most researchers have focused on credit risk prevention and credit rating models that model the supply chain. A new integrated approach [2] of machine learning for forecasting the credit risk of SMEs in supply finance is proposed. [3, 4] LR model, ENN model and three types of two-stage Hybrid model for forecasting credit risk of SMEs for financial institutions in the field of supply finance. A credit model for SME assessment based on the principle of variable weight with its dynamic data has been created [7, 8] in order to increase the accuracy of credit risk assessment. In the supply chain, the supply chain of financial credit risk is studied from different angles. It has been studied [5] that when building multilevel connections of SMEs in the supply network, the availability of equity and debt capital can increase through the exchange of information; A new view [6] is proposed, when studying the trade credit preferences of suppliers through a horizontal channel.

From the existing literature, research on the financial credit risk supply network is mainly focused on credit rating and SME risk aversion. However, the financial supply chain is a complex system that includes many enterprises, financial institutions and so on. There are several studies on the factors influencing credit risk and the feedback mechanism of a complex system. The biggest difference between supply chain finance and traditional trade and credit finance is that the supply chain needs to find large core businesses for operations [7] and then move to SMEs to increase lending through trade and guarantee relationships with major businesses. . Thus, the level of

cooperation between major enterprises and SMEs has a major impact on the financial risk of the supply chain. Using the theory of system dynamics and Vensim software simulation, the team studied the factors of influence and feedback mechanism, which is a financial credit risk in terms of the supply system of the supply chain [8].

### Presentation of the main research results

Experiments of learning scenarios on simulation models of the AnyLogic system were conducted to determine the mutual influence of the competitiveness factors of the university [9].

The experiment was implemented to compare the competitiveness of specialized programs of two Chinese higher education institutions: Weihai Vocational College and Shanghai University of Transportation.

The initial state of the modeled system is determined by the values of parameters that determine market share and the number of potential students of the above institutions of higher education. The analysis was carried out with a relatively equal total number of potential students in the region - market segment, 1000 people per year.

For the initial data "teacher rating", "student performance", "university rating", "teacher qualification", "tuition price", the data that are in the public domain were taken.

To analyze the scenario, the input variables define parameters that set their target (required) values. In our case, they include: "cost" of education, "number" of the group, rating "university", "qualification" of teachers, "students" educational performance, "assessment".

By changing these parameters in a simple experiment mode, you can analyze the consequences of possible design decisions.

The result of the experiment of competitiveness of Weihai Vocational College with the initial conditions: 312 potential students per program (Fig. 1).

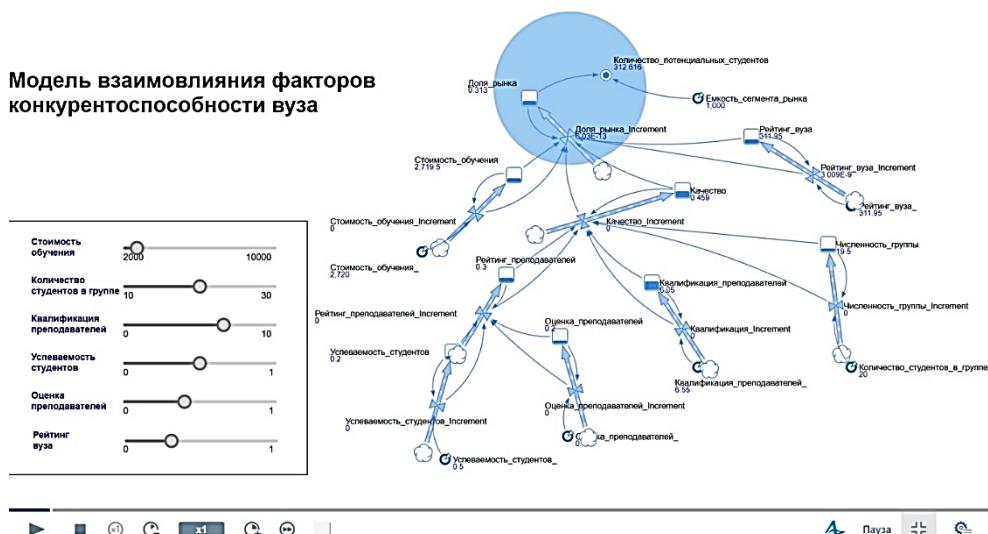


Figure1 – The result of an experiment to determine the competitiveness of Weihai Vocational College with the initial conditions

As the results show, with a significant level of teacher qualifications and university rankings, the increased tuition fee does not significantly affect the number of potential students. However, in the case of Weihai Vocational College, when the price of tuition increases to the level of universities with a higher rating and quality of educational services, the number of potential students is reduced by almost half.

The results allow us to conclude that in order to attract more funds by raising fees for educational services, we must first invest in improving the skills of their teachers, attract experts with an international name, work comprehensively to improve the rating of educational institutions.

### References:

1. Lei, L., Shi, J. Z., 2014. Review and Prospect of Supply Chain Finance Theory, East China Economic Management, (6), pp.158-162.
2. Zhu, Y., Xie, C., Sun, B., Wang, G. J., Yan, X. G., 2016. Predicting China's SME Credit Risk in Supply Chain Financing by Logistic Regression, Artificial Neural Network and Hybrid Models. Sustainability, 8(5), pp.433.
3. Begalinova, A., & Shintemirov, A. (2014). Embedded gesture recognition system for robotic applications. Eurasian Journal of Mathematical and Computer Applications, 2(4), 81-89.
4. A. Kuchansky, Yu. Andrushko, A. Biloshchytksyi, O. Danchenko, O. Ilarionov, I. Vatskel, and T. Honcharenko, "The method for evaluation of educational environment subjects' performance based on the calculation of volumes of M-simplexes," Eastern-European Journal of Enterprise Technologies, 2(4(92)), pp. 15-25, 2018. doi: 10.15587/1729-4061.2018.126287
5. Zhu, Y., Xie, C., Wang G. J., Yan, X. G., 2016. Predicting China's SME Credit Risk in Supply Chain Finance Based on Machine Learning Methods. Entropy, 18(5), pp.195.
6. A. Biloshchytksyi, A. Kuchansky, Y. Andrushko, S. Biloshchytksa and O. Danchenko, "Development of Infocommunication System for Scientific Activity Administration of Educational Environment's Subjects," 2018 International Scientific-Practical Conference Problems of Infocommunications. Science and Technology (PIC S&T), Kharkiv, Ukraine, 2018, pp. 369-37.
7. Su, Y., Zhong, B., 2017. The Credit Risk Assessment Model of Internet Supply Chain Finance: Multi-Criteria Decision-Making Model with the Principle of Variable Weight. Journal of Computer & Communications, 04(16), pp.1-11.
8. Ryzhakova, G., Chupryna, K., Ivakhnenko, I., Derkach, A., & Huliaiev, D. (2020). Expert-analytical model of management quality assessment at a construction enterprise. Scientific Journal of Astana IT University, 3, 71-82. <https://doi.org/10.37943/AITU.2020.69.95.007>
9. Song, H., Yu, K., Ganguly, A., Turson, R., 2016. Supply chain network, information sharing and SME credit quality. Industrial Management & Data Systems, 116(4), pp.740-758. A. Biloshchytksyi, S. Biloshchytksa, A. Kuchansky, O. Bielova and Y. Andrushko, "Infocommunication system of scientific activity management on the basis of project-vector methodology," 2018 14th International Conference on Advanced Trends in Radioelectronics, Telecommunications and Computer Engineering (TCSET), Slavsk, 2018, pp. 200-203.

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## **COMPARISON OF METHODS OF DEVELOPMENT OF COMPUTER VIDEO GAMES IN PROJECT MANAGEMENT IN THE GAME INDUSTRY**

The video game market has emerged relatively recently and has gradually expanded with the development of computing power. Gradually, technologies improved and products could better express the ideas and wishes of their authors, but at the same time it made them more difficult to develop, especially in small teams. Therefore, small groups of like-minded people were forced to grow into large companies, which set the vector for the development of the industry.

Naturally, there were other companies that did not have the necessary resources or were relatively young, so today there is a situation where the gaming industry market is divided into small indie-studios and large companies. The difference in the amount of work and resources used by these two abstract groups creates differences in the development processes, including the management of such projects.

Games have different phases and styles of development depending on the scale of goal. The game projects in such a large company as Ubisoft always have Conception phase, Pre-production, Production phase, and Operation phase. The Conception phase is where the general plan for the project is made together with broad decisions like genre, world design, and basic story elements.

In the Pre-production, the technical foundations are put in place, and the first playable parts are tested to ensure the project is on the right track in terms of engine and tools. In the Production phase, the teams are fully staffed, and the game is eventually finished. But before it's finished, the game must pass two major milestones during this phase: Alpha and Beta. Alpha means that the game must be playable from start to finish to allow for proper testing. Beta means that everything should be done, which adds precious time for polishing and bug fixes before the game is launched.

After the game is released, they move into an Operation phase to provide continuous support and produce additional content. During these phases, they work in so called Production Builds, which consist of two to three week long Sprints, with a planning phase at the start and review phase in the end. Production Builds allow them to keep track of the scope and makes sure there is time for reviews and iteration.

Regarding game development in small indie studios that specialize in creating mobile games. They operate in completely different categories. The project in such organizations is developed not from two to four years as in development companies, but from three to six months. In such studios, project management does not operate in phases but in "scopes of tasks".

As for the organizational structure of a large computer game development company, its scale cannot be ignored. For example, we will take the organizational structure of Massive Entertainment, during the development of Tom Clancy's The Division 2. The top of the structure is occupied by the producer, the Creative Director reports to him, who, in turn, six other directors: Art Director, Game Director, Narrative Director, Online Director, Audio Director, Realization Director. Also Producer has many Associate Producers who work directly with Project Coordinators, they are in contact with Leads of different departments. Leads are usually senior developers who are responsible for the results of their department and to whom a group of specialists reports. Massive Entertainment has the following departments: Level Art, Concept Art, Tech Art, Animation, Game Design, Gameplay Code, UI Design, Audio Design, Backend Code, Quality Control, Localization, Build Infra, Live Services, Analytics, Level Design, Character Art, Tech LD, Tech Animation, Narrative Design, AI Code, UI Code, Audio Code, Online Infra, VFX Art, Prop Art, UI Art, Music. And there are also support departments: Outsourcing, Engine, Brand, Consumer Experience, Community Managers, User Research.

There is a common practice that the PM has a background of a technical specialist with sufficient experience, which gives him broad knowledge in the subject area and the ability to autonomously analyze the project in the initial stages. The formation of PM in the development of game products differs significantly: even in the development of a small game there are many different technical areas, which complicates the understanding of the subject area and encourages close work with the team/

**References:**

1. <https://study.com/academy/lesson/project-management-in-game-development.html>
2. <https://intogames.org/role/project-manager-games>
3. <https://www.massive.se/blog/games-technology/project-management-in-game-development/>
4. <https://dev.by/news/PM-gamedev-devpedia>

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## ANALYSIS OF FORECASTING METHODS FOR FINANCIAL MARKETS

**Abstract.** This article describes different methods for predicting financial markets. The regression analysis, its properties, Gauss-Markov conditions, conditions of its application are described. Also described is exponential smoothing, variations of this method with its characteristics. The article describes the method based on the adaptive network based on the fuzzy inference system (ANFIS). Based on the results of the study, an analytics of these methods was made with their pros and cons, and as a result, the conclusions were made.

**Keywords:** forecasting, regression analysis, financial markets, method, exponential smoothing, ANFIS, hybrid system, time series.

In recent decades, financial markets have experienced a period of rapid development. Along with large national stock, futures, and foreign exchange markets, global markets have emerged. Many money market transactions are based on the forecasting of short-term stock price movements by market participants. Effective market analysis requires up-to-date methods. Thus, research in the field of predicting the behavior of stock markets is a relevant and promising area of activity and will remain so for a fairly long period of time.

Forecasting is a complex process, during which it is necessary to solve a large number of different issues. There are many methods for forecasting financial markets. In particular, regression analysis, decision trees, nearest neighbor method, neural networks, etc. Next, we will describe several methods for forecasting, and their features. It is worth noting that each of them is worthy of a separate study, and the study of options for its use.

One of the main questions when building a forecast is always in the amount of available data. For what period are they, are they relevant, is it necessary to consider the entire available time series, etc. Often for analysts, a dilemma arises that if you take a lot of data, then the relevance will be lost, due to older data (especially in very sensitive sciences to the novelty of data). If we take the most recent data, then the data may not be enough. Each situation must find its own way of solving. But it is worth taking into account the peculiarities of each method. For example, the regression analysis method we are considering is well suited for analyzing short time series. That is, where there is not enough data in other methods, then regression analysis may work better in this situation.

Regression analysis is a method of modeling measured data and studying their properties. Data consists of pairs of values for the dependent variable (response variable) and the independent variable (explanatory variable). The regression model is a

function of the independent variable and parameters with an added random variable. The parameters of the model are adjusted so that the model best fits the data. The criterion for the quality of the approximation (objective function) is usually the root-mean-square error: the sum of the squares of the difference between the values of the model and the dependent variable for all values of the independent variable as an argument. To confirm or disprove this hypothesis, statistical tests called residual analysis are performed.

It is worth noting that to study the quality of the model, additional tests of hypotheses, the coefficient of determination, etc., are used. To obtain the best estimates, it is necessary to fulfill the assumptions of the OLS (Gauss-Markov conditions).

A paired regression model is considered, in which observations  $Y$  are related to  $X$  by the following relationship:  $Y_i = b_1 + b_2 * X_i + e_i$ . On the basis of  $n$  sample observations, the regression equation is estimated  $\hat{Y}_i = \hat{b}'_1 + \hat{b}'_2 * X_i$ . The Gauss-Markov theorem states:

- If the data has the following properties:
  - The data model is correctly specified;
  - All  $X_i$  are deterministic and not all are equal;
  - Errors are not systematic, that is,  $E(e_i) = 0 \forall i$ ;
  - The variance of errors is the same and equal to  $\sigma^2$ ;
  - Errors are not correlated, that is,  $Cov(e_i, e_j) = 0 \forall i, j$ ;
- then under these conditions the least squares estimates are optimal in the class of linear unbiased estimates.

What should be said that if the autocorrelation of errors is violated, checking through the Durbin - Watson test, for example, then we should pay attention to another, autoregressive, model, such as the modern ARIMA method.

Building a high-quality regression model of activity. In the article [1] it is said that for successful execution it is necessary to use a lot of knowledge from different areas, which complicates the construction of the model. The emphasis of the work is made on the application of the process approach, from which the elimination of planning deficiencies comes out, etc.

The problem with this method is that it is not flexible. In the studied tasks, the trend, like seasonality, can change, and not be static as required by the regression analysis. In a time series where the above characteristics change more, another method is suitable. For example, in the further detailed analysis of the method as exponential smoothing, there is no such problem. Moreover, this method shows good efficiency. But there is a drawback in that it cannot predict well over longer time frames.

Exponential smoothing is a mathematical transformation technique that is used in time series forecasting. It got its name because at each subsequent iteration, all previous values of the series are taken into account, but the degree of accounting decreases exponentially.

Brown's simple method	Double smoothing	Triple smoothing
No trend, no seasonality $s_t$ - time series value	There is a trend, no seasonality The trend is linear, local	There is a trend, there is a seasonality The trend is linear, local

	$b_t$ - local value of the trend	Local seasonality T - period of seasonal deviations $S_t$ - local seasonal corrections
$s_0=x_0$ $s_t=s_{t-1} + \alpha(x_{t-1} - s_{t-1})$	$s_1=x_1$ $b_1=x_1-x_0$ $s_t=\alpha*x_{t-1}+(1-\alpha)*(s_{t-1}+b_{t-1})$ $b_t=\beta*(s_t-s_{t-1})+(1-\beta)*b_{t-1}$	$s_t=\alpha*(x_{t-1}-S_{t-T})+(1-\alpha)*(s_{t-1}+b_{t-1})$ $b_t=\beta*(s_t-s_{t-1})+(1-\beta)*b_{t-1}$ $S_t=\gamma*(x_t-s_{t-1}-b_{t-1})+(1-\gamma)*S_{t-T}$

Table 1 – Three types of exponential smoothing

Exponential smoothing is a relatively simple but effective forecasting method. The article [2] tells about a relatively simple but powerful and versatile method for forecasting time series data, about a simple method of exponential smoothing. From the article, you can come to an understanding of the operation of the method itself and its shortcomings, that the emphasis is on the latest observations (of course, it all depends on the coefficients) and with an increase in the smoothing constant to get a faster answer, it can lead to an increased sensitivity of the model to random fluctuations. Also, the article [3] describes different variations of using exponential smoothing to predict stock prices. Three types of the considered method are analyzed: single exponential smoothing, double exponential smoothing, and triple exponential smoothing. The article shows the efficiency of the method for forecasting prices, but it also expounds the idea from the conclusions that using only the last method, the most extensive, does not always lead to the best results, a simplified method can provide better characteristics based on various factors.

Combining forecasts from several different models is an effective technique. Combining multiple predictions can significantly reduce overall prediction errors by improving predictions.

Neural networks are also often used in forecasting. There are a large number of variations, but below we will briefly talk about the adaptive network based on the fuzzy inference system (ANFIS). Hybrid neuro-fuzzy systems have found a much wider field of application than all other methods of synthesis of fuzzy sets and neural networks. This is due to the fact that they allow the fullest use of the strengths of fuzzy systems and neural networks. A characteristic feature of hybrid systems is that they can always be considered as systems of fuzzy rules, while the adjustment of membership functions in the premises and inferences of rules based on the training set is performed using the neural network. There are several hybrid system architectures, each of which is designed to solve its own set of problems.

The article [4] describes the use of neural networks in financial markets. The article argues that the use of neural networks allows you to ensure profit in the financial markets. With the pros and cons. Also in the article [5] it is stated that while forecasting

the stock market is a very difficult action, because there are too many factors that can influence, the ANFIS method is an effective tool for forecasting, and the forecasting performance shows the advantages of this method.

According to the results of the study, a number of forecasting methods were considered. The results of the analysis are formed in table 2.

Method	Advantages	Disadvantages
Regression analysis	Shows good efficiency when configured correctly, suitable for analysis of short time series	Inflexible (trend and seasonality may vary), fulfillment of Gauss-Markov conditions to achieve model adequacy
Exponential smoothing	Good efficiency, flexibility	Can't predict well for longer periods
Adaptive network based on fuzzy inference system (ANFIS)	Harnessing the strengths of fuzzy systems and neural networks	Different architectures of hybrid systems to solve their range of tasks

Table 2 – Analytics of research methods for forecasting currency pairs

Based on the analysis of forecasting methods, it has been established that for good forecasting, it is necessary to correctly approach the choice of the method. In one case, one is better, such as using regression analysis for short time series, in the other, universal exponential smoothing. In addition, it should be said that each method has its own ranking, several variants of the method for different situations in the same exponential smoothing, or the analysis of the fulfillment of the Gauss-Markov conditions of regression analysis, which falls on the analyst. The correct setting of methods is also important, for example, the correct selection of factors in the same hybrid systems. And of course, the important point is the correctness and validity of the original data available. An effective method is to combine the forecasts available to obtain the best result.

#### References:

1. Lapach S.N., “Regression analysis. Process approach”, 2016
2. Eva Ostertagova, Oskar Ostertag, “Forecasting Using Simple Exponential Smoothing”, 2012
3. Yibin Ng, “Forecasting Stock Prices using Exponential Smoothing”, 2019
4. K. A. Malyshenko, M. V. Anashkina, “Using neural networks for forecasting stock market”, 2014
5. Jin Xue-bo, Wang Jiang-feng, Zhang Hui-yan, Cao Li-hong, “ANFIS model for time series prediction”, 2013

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## RANDOM FOREST ALGORITHM IN PREDICTING DIABETES (TYPE 2)

**Abstract.** The purpose of this paper is to present the relevance of predicting diabetes using machine learning technics, as well as to developed efficient deep learning model. During the research, we've trained model with random forest algorithm to determine patient status. We`ve used Iraqi dataset, having previously processed the data using outlier rejection, data normalization, and attributes selection. Due to research we`ve got a model for determining diabetes with high accuracy. We`ve determined that Iraqi dataset can be used in the following studies.

**Keywords:** Random Forest, Diabetes

Diabetes is a chronic disease that causes serious damage to the whole body without being identified in time. About 422 million people worldwide suffer from diabetes. And the trend has been steadily growing in recent decades [1]. In our research we focus on predicting type 2 diabetes due to the fact that researchers don't know exactly causes of type 1 diabetes. Type 2 is mixed from genetics and lifestyle factors. Since diabetes cannot be fully cured and it requires constant monitoring and adjustment of life, determining it at an early stage can help to adapt to new conditions. Also, a belated definition of diabetes leads to an increased risk of death from diabetes and related factors. Unfortunately, medical staff does not always look at the tests in the complex, and patients do not pass a number of tests annually. The availability of diabetes risk assessment tools for specific parameters is an open question today. Data science is close to solving this problem. Researchers are actively using data-driven machine learning techniques to determine patient status.

Today, machine learning methods are used to predict the onset of diabetes. Popular predictive health algorithms include linear regression, decision tree, logistic regression, SVM, Naive Bayes classifier, k-nearest neighbor algorithm, and more.

Quite a lot of work in this area has been written using the data set available in the UCI Machine Learning repository [2] based in India, the PIMA data set. The accuracy of the proposed models reaches 80%. Also, this is a fairly old data set. Therefore, we decided to use the latest data provided by the laboratory of the Medical City Hospital [Помилка! Джерело посилання не знайдено.]

The data were collected from the Iraqi society of 1000 patients. The data consist of: Gender, AGE, Urea, Cr (creatinine ratio), HbA1c (glycohemoglobin), Chol (cholesterol), TG (triglycerides), HDL (high density lipoprotein), LDL (low density lipoprotein), VLDL (very low density lipoprotein), BMI (body mass index), CLASS (the patient's diabetes disease class may be Diabetic, Non-Diabetic, or Predict-Diabetic).

Diabetes causes are not studied well. Exactly reason for diabetes is uncertain, but there are factors that can take role in this health issue. It is generally connected with genetic factors, obesity, blood pressure, cholesterol and more. Detecting of diabetes is crucial in fight with stroke [4]. As we can observe most of the factors in this dataset are present and we can expect their efficiency. Table 1 shows statistical summary for all instances in the data set.

Table 1

Dataset summary

	count	mean	std	min	25%	50%	75%	max
Gender	1000	0,435	0,496005	0	0	0	1	1
AGE	1000	53,528	8,799241	20	51	55	59	79
Urea	1000	5,124743	2,935165	0,5	3,7	4,6	5,7	38,9
Cr	1000	68,943	59,98475	6	48	60	73	800
HbA1c	1000	8,28116	2,534003	0,9	6,5	8	10,2	16
Chol	1000	4,86282	1,301738	0	4	4,8	5,6	10,3
TG	1000	2,34961	1,401176	0,3	1,5	2	2,9	13,8
HDL	1000	1,20475	0,660414	0,2	0,9	1,1	1,3	9,9
LDL	1000	2,60979	1,115102	0,3	1,8	2,5	3,3	9,9
VLDL	1000	1,8547	3,663599	0,1	0,7	0,9	1,5	35
BMI	1000	29,57802	4,962388	19	26	30	33	47,75
CLASS	1000	0,8705	0,315562	0	1	1	1	1

In the dataset there are eleven possible factors of causing diabetes. All instances are presented in 1000 values.

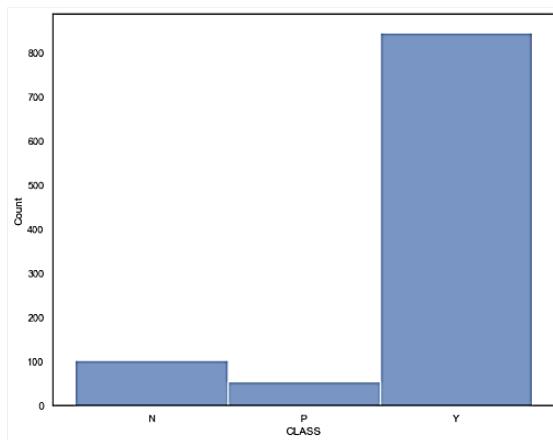


Figure 1. Histogram of diabetes status

Data are distributed in ratio: 844 people have diabetes status, 103 don't have and 53 have pre-diabetic status.

Study process includes pre-processing the dataset, splitting into train and test sets, applying ML algorithm, evaluating model. In this study to provide prediction we

use random forest technic as it proved its efficiency in health industry [5]. Implementation of the process have been conducted using machine learning library Sklearn, figure and graph have been done using Seaborn library.

The preprocessing includes: outlier rejection, filling missing values, data normalization, and attributes selection to improve the quality of data [6]. After outlier rejection using Scipy library, the dataset volume became 888 instances. Dataset has not missing values. We use Spearman's correlation method to find the most relevant attributes. We used 0.1 as a cut-off for relevant attributes. LDL, HDL, Cr are removed.

Table 2  
The correlation between attributes and diabetic status

HbA1c	0.583189
BMI	0.577069
AGE	0.489848
TG	0.225410
VLDL	0.205456
Chol	0.167350
Urea	0.087201
Cr	0.029766
HDL	-0.015395
LDL	-0.031030
Gender	-0.067325

Machine learning algorithms tend to perform better or converge faster when the different variables are on a smaller scale [7].

To normalize the data we used MinMaxScaler from Sklearn library. The dataset was divided on a ratio of 70:30 for creating training and test split.

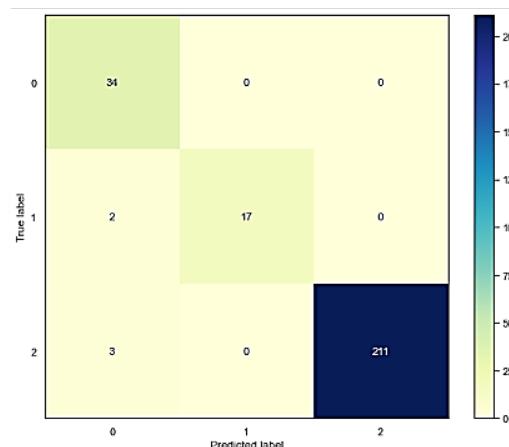


Figure 2. Confusion matrix resulted from test set evaluation

Table 3

## Classification report for precision, recall f1-score and accuracy

	precision	recall	f1-score	support
0 (no)	0.87	1.00	0.93	34
1 (pre-diabetes)	1.00	0.89	0.94	19
2 (diabetes)	1.00	0.99	0.99	214

Accuracy of model is 0.98. Precision is bad only in determination non-diabetics person, this fact provides a valid proof that diabetes of patients from Iraqi can be detected using Machine Learning techniques, mainly with random forest.

**Conclusions.** Early detection of diabetes is one of the main challenges in the health care industry. In our research, we used random forest method, which showed high accuracy. We preprocessed the data using the slicing outliers, normalization and correlation to find most significant values. We used eight input instances and one output (CLASS) in the dataset. We used random forest machine learning algorithm to predict diabetes and evaluated the performance of the method. Model shows high results for accuracy, precision, recall, and F-measure. Model provided accuracy near 98%. This dataset can be used in further research in the prediction of diabetes.

**References:**

1. Diabetes Overview by WHO. URL: <https://www.who.int/health-topics/diabetes>.
2. Pranto, Md Badiuzzaman & Mehnaz, Sk & Mahid, Esha Bintee & Sadman, Imran & Rahman, Ahsanur & Momen, Sifat. (2020). Evaluating Machine Learning Methods for Predicting Diabetes among Female Patients in Bangladesh. Information. 11. 374. 10.3390/info11080374.
3. Rashid, Ahlam (2020), “Diabetes Dataset”, Mendeley Data, V1, doi: 10.17632/wj9rwkp9c2.1
4. Symptoms & Causes of Diabetes by U.S. Department of Health and Human Services. URL: <https://www.niddk.nih.gov/health-information/diabetes/overview/symptoms-causes>.
5. Onesmus Mbaabu. Introduction to Random Forest in Machine. 2020. URL: <https://www.section.io/engineering-education/introduction-to-random-forest-in-machine-learning/>.
6. Jobeda Jamal Khanam, Simon Y. Foo, A comparison of machine learning algorithms for diabetes prediction, ICT Express, 2021, ISSN 2405-9595, <https://doi.org/10.1016/j.icte.2021.02.004>.
7. 2 Easy Ways to Normalize data in Python. URL: <https://www.journaldev.com/45109/normalize-data-in-python>.

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## COLLECTING FEEDBACK DURING ONLINE CONFERENCES AS A MEANS OF INCREASING TEAM PRODUCTIVITY

**Abstract.** The paper describes a way to improve the effectiveness of online conferences by collecting feedback from meeting participants online and then using it to improve team performance.

**Keywords:** Online conferences, Zoom, Development of team members.

An important role in the successful implementation of the project is the communication of people with each other. Unfortunately, due to current events related to the coronavirus pandemic, effective human communication has become threatened, as it has become unsafe for people to meet in the same room. Fortunately, information technology and the widespread use of computers and mobile devices have helped partially solve this problem through the use of video communication programs. Since the beginning of the pandemic, everyone from high school students to professors have started using video conferencing in their daily work and studies. One of the most popular applications for online conferencing is Zoom. So, according to this company's investor reports [1] (Fig. 1), the number of business customers (companies with more than ten employees) at the end of 2020 was up 470.33% from the end of 2019. The company sold 385,200 new licenses.

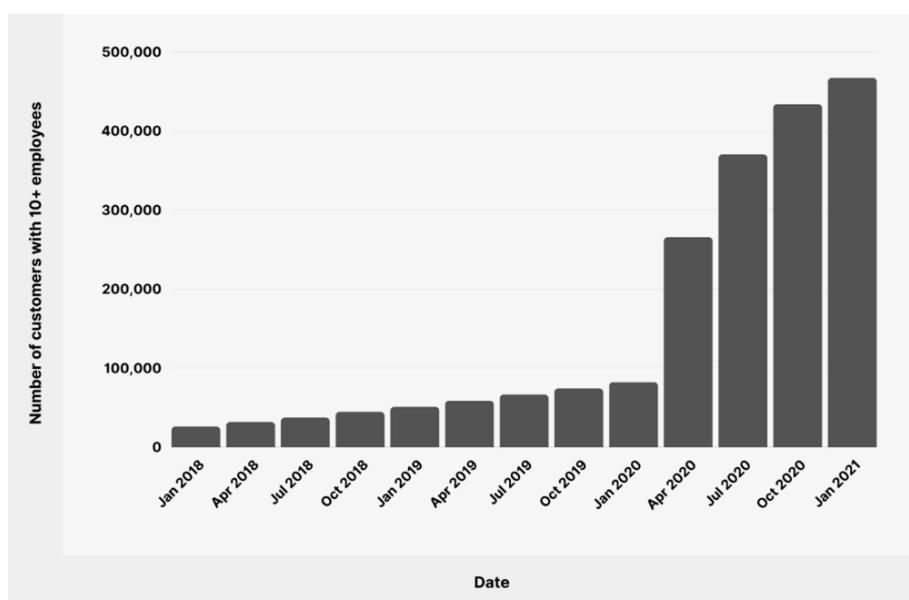


Fig. 1 – Zoom Business Customers

It has now become obvious to all that such communication tools are essential in a remote work or study environment. However, communication through video conferencing software has its disadvantages. The big disadvantage of such a tool is the lack of feedback between conference participants. After all, effective communication is not only the delivery of certain information, but also getting feedback from colleagues about the speech and the work done with the subsequent application of the recommendations received. A speaker who cannot get feedback from the audience cannot improve his or her performance in the future because he or she will not even know what he or she needs to work on. This in turn leads to ineffective meetings and leads to the fact that most workers begin to think that holding online meetings is a waste of time [2]. This is a big problem for project managers because the continued success of a project depends heavily on communication.

One solution to this problem could be the creation of the possibility of writing wishes, as well as evaluating the work of each of the participants directly in the meeting. Such system will help all the participants, without interrupting the speaker, to give their feedback at any moment of the meeting. And, thanks to anonymity, the employee will not feel uncomfortable when will leave feedback on the work of his boss or colleague, which promotes openness and honesty. Manager, who conducted the meeting, after it will be able to get detailed information about what employees think about the meeting as a whole, to get an assessment of the work done by each of its participants. Having analyzed this information, the manager will have a basis for further improvements in working with the team, decision making, optimization of communication processes in the company. Such an assessment of the meeting participants over a long period of time will help to objectively assess the strengths and weaknesses of each team member, thus becoming a reference point for their further development. According to Peter Drucker quote, "you can't manage what you can't measure".

Speaking about the possibility of implementing this system. In the previously mentioned Zoom, program for online conferences, there is Zoom Marketplace [3], where third-party developers can create their own applications, add-ons for the main program, and users can install and use them during the conference. That way, companies that don't have their own IT department to develop such an app for their company's needs can use a third-party solution. This can be a good start to implementing such a system and obtaining its benefits both for companies and educational institutions.

#### **References:**

1. Zoom, SEC filings, accessed 10.10.2021. URL: <https://investors.zoom.us/sec-filings>.
2. Insights team of CV-library.co.uk, Three-quarters of Brits believe virtual meetings are a waste of time, accessed 10.10.2021. URL: <https://www.cv-library.co.uk/recruitment-insight/virtual-meetings-waste-time/>.
3. Zoom, App Marketplace, accessed 10.10.2021. URL: <https://marketplace.zoom.us/>.

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## USE OF ONTOLOGIES AND GRAPHS OF KNOWLEDGE IN THE EDUCATIONAL PROCESS

**Abstract.** The work is devoted to modeling of educational systems with the use of ontologies and graphs of knowledge. Educational and research institutions work with large amounts of open data, which in many cases are not systematized and organized, the content of many concepts is not clear, the relationship between different concepts of the subject area is not defined. Ontologies allow you to display a semantic representation of data, and knowledge graphs allow you to use the Internet as a channel to access related data from a variety of sources.

**Keywords:** ontology, graph of knowledge, computer science, artificial intelligence

### Introduction

One of the basic directions of introduction of information technologies in educational activity is development and introduction of semantic methods which are based on use of ontologies in certain subject areas and models of Linked Open Data (LOD). Ontologies and knowledge graphs provide effective tools for building information systems. An example of an educational platform based on LOD technologies is the LinkedUp (Linking Web data for education), ECOLE (Enhanced Course Ontology for Linked Education) projects [1]. Open Educational Resources (OER) is digital content for educational purposes, available through websites that can be freely reused by teachers and students [2].

### Ontologies and graphs of knowledge in the educational process

The main directions of research conducted in the field of LOD use in education are related to the modeling of the educational process, educational specialties and educational materials, as well as the content of the subject area, its basic concepts and connections between them [3]. The specialty "Computer Science" and the educational program "Artificial Intelligence Technologies" are considered in the work as a subject area.

The ontological approach allows to form a complete and well-structured information base for solving the subject area. An ontology describes the types of entities that exist and form classes, the relationships between them that reflect properties, and the axioms that reflect logical dependencies. Any ontology involves the selection of its three interrelated components: a taxonomy of terms, descriptions of the meaning of terms, and rules for their use and processing. Ontology is used to structure information. RDFS and OWL languages have been developed to describe ontologies that are available through the Web.

Graphs of knowledge allow to solve intellectual problems, problems that are difficult to formalize, first of all performing the functions of data binding, data semantization. The main purpose of using LOD is to use the Internet architecture to exchange, disseminate and interconnect data from different sources into a common information space. Knowledge graphs allow you to move from disordered information to organized data, which is better to analyze, process, execute queries. Knowledge graphs allow you to return more complex results, semantically significant results, from a search query. Using RDF and RDFS allows you to identify objects and make them available, like web pages, through web addresses (URI).

### **Ontology and graph of specialty knowledge**

The approach to creating an ontology and knowledge graph in the specialty "Computer Science" and the educational program "Artificial Intelligence Technology", which is proposed in the work allows you to structure knowledge, determine the competencies provided by the specialty and educational program, includes a subject thesaurus, and includes the possibility of constant expansion of the content by adding a graph of knowledge. In order to interpret the knowledge of the subject area, an analysis of the curriculum, which regulates the field of computer science. It is assumed to maintain logical consistency between ontologies. The composition of the system is proposed to build on two levels:

- Ontology of professional competencies. This ontology should be based on information from educational standards, educational programs. Includes terminology, reflects the structure of the knowledge graph of the subject area.
- Graph of knowledge of the subject area. The knowledge graph should reflect the areas of Computer Science and Artificial Intelligence Technology. It is possible to constantly expand the knowledge graph with new terms and connections.

When all the necessary relations are established between all the terms of ontologies, different sources are combined by a graph of knowledge, then a single information space of the subject area is created.

### **References:**

1. Mathieu d'Aquin. On the Use of Linked Open Data in Education: Current and Future Practices, Springer, 2016.
2. Rosa Navarrete, Sergio Luján-Mora. 14th International Conference on Information Technology Based Higher Education and Training (ITHET 2015), p. 1-6, Caparica (Portugal), June 11-13 2015. ISBN: 978-1-4799-1756-3.
3. Цифровые двойники знаний и онтологии для высшего технологического образования Ю.И. Волокитин, О.В. Гринько, В.П. Куприяновский, А.В. Корзун, А.А. Алмазов, О.Н. Покусаев, М.Г. Жабицкий International Journal of Open Information Technologies ISSN: 2307-8162 vol. 9, no.1, 2021

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## DEVELOPMENT OF METHODS FOR ENVIRONMENTAL POLLUTION MONITORING

**Abstract.** Multifactor analysis of the formation of the level of pollution in combination with the operational forecast of the level of pollution is an effective way to help partially solve the problems of environmental pollution.. The importance of the technical component in ensuring monitoring is shown. By the task of monitoring the state of the environment, the structure of the information system for monitoring the state of the environment is proposed.

**Keywords:** Environmental pollution, monitoring, sensor, information system

The relevance of research on monitoring the state of environmental pollution is confirmed by the fact that the governments of all leading countries spend, on average, from 1% to 3% of their budgets on environmental protection measures. The automated information system of ecological monitoring is a system with the distributed organization of collecting, processing, documentation, and analyzing the parameters of the environment.

It is an essential element and is designed to collect, process, operational and long-term storage of information, forecasting the state of the environment based on specific methods. The function of the system is to provide information to local information centers, management of enterprises and their departments for environmental protection, etc. The automated information system of ecological monitoring provides the performance of the following functions:

- automatic measurement of air, water, and soil parameters;
- information collection and primary information processing;
- control of deviation of current values of parameters from their control levels;
- visualization of information and formation of the operational state of affairs about specific parameters;
- forecasting changes in the state of pollution by various environmental indicators;
- transfer of information to interested parties, other information systems, and documentation of information.

To ensure effective environmental monitoring, an important issue is a technical component of obtaining data on the state of the environment. The article [1] classifies known monitoring networks based on server characteristics into three classes: Static Sensor Network (SSN), Community Sensor Network (CSN), and Vehicle Sensor Network (VSN). Comprehensive reviews and comparisons of these three types of sensor networks were also conducted. Their significant limitations are revealed.

Also popular are services that analyze air quality and visualize it on maps. For example, Fig. 1 shows a visualization of the level of air pollution over China and some other East Asian countries based on the results of the analysis of the AirVisual service [2].

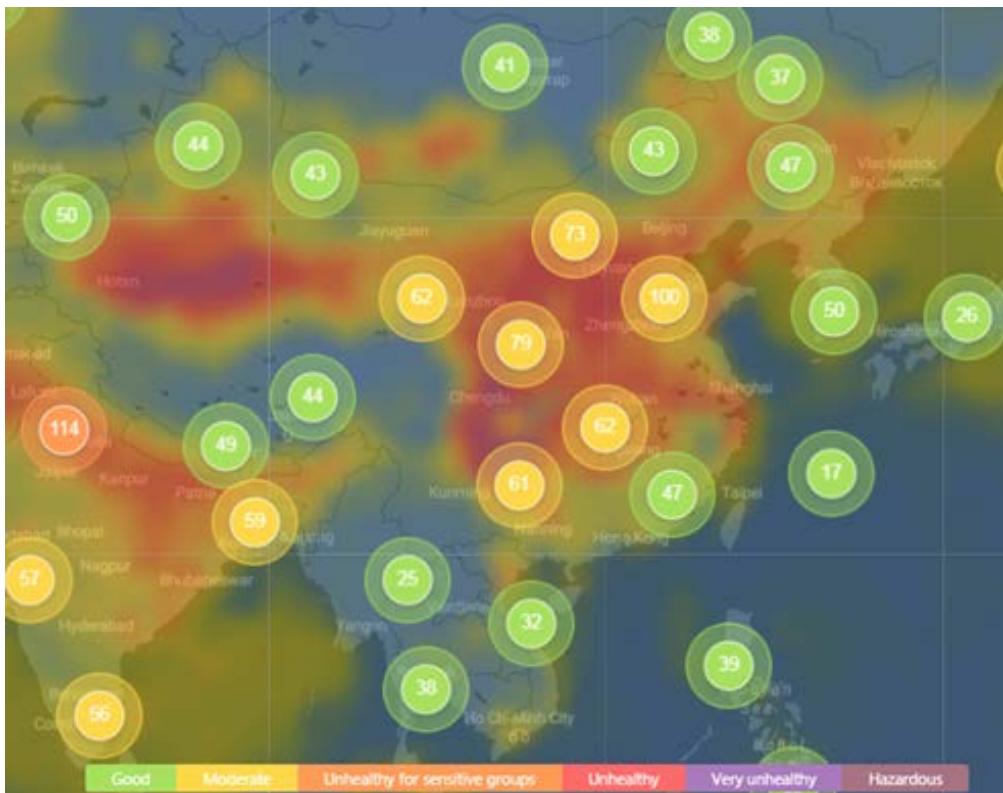


Figure 1 – Visualization of the level of air pollution over China and some other East Asian countries.

Proposals for solving the problem of monitoring pollution are given in [3]. One of the essential components of effective monitoring is the conclusion about the state of pollution and its consequences in the future. To do this, a useful tool can be forecasting the state of environmental pollution based on unique methods. Articles [4] describe some of these methods. In works [5], information technologies of forecasting with the use of neural networks, fuzzy expert systems, etc. are described.

Consider the problem of assessing environmental pollution in two productions. Suppose you need to assess environmental pollution at a certain point. Environmental pollution can be assessed by a set of its indicators [1]. Let

$$R = (r_1, r_2, \dots, r_n) \quad (1)$$

is a vector of real numbers that describes the state of the environment, where  $n$  is the number of indicators. Each coordinate of the vector corresponds to a specific indicator (concentration of sulfur dioxide in the air, concentration of nitrates in water, etc.). You can get the appropriate indicators both with the help of appropriate technical means (weather stations, mobile and stationary sensors, etc.) and with the help of specific services.

The state of the environment is not a stationary quantity and changes over time. Therefore, indicators of the state of the environment should be considered as time-dependent functions. That is

$$R(t) = (r_1(t), r_2(t), \dots, r_n(t)) \quad (2)$$

where  $t$  is the time. We believe that the indicators are updated at discrete

moments (hourly, daily, monthly). That is  $t_i = t_0 + i\Delta t$ , where  $t_0$  is the starting point of time,  $\Delta t$  is the frequency of observation, a  $i = \overline{1, m}$ , where  $m$  – this is the number of observations. Let us mark  $r_j(t_i)$  by  $r_j^i$ . Then

$$R(t_i) = (r_1(t_i), r_2(t_i), \dots, r_n(t_i)) = (r_1^i, r_2^i, \dots, r_n^i) \quad (3)$$

Solving the problem of environmental pollution assessment consists of the following stages:

Collection of data on the state of environmental pollution in the past.

Monitoring the current state of the environment.

Forecasting the state of environmental pollution in the future.

To find a solution to the first problem, it is necessary to build a database with a history of the state of environmental pollution. It can store both a one-dimensional and multidimensional version of the time series (for several indicators that are evaluated).

The task of assessing environmental pollution in the setting on the plane is in common with the point set. Similarly, the task consists of three stages: collection, observation, and forecasting.

The key difference in this statement is the need for an observation network. Then the information about the state of the environment can be described as a set of tuples

$$\langle R_i, C_i \rangle \quad (4)$$

where  $R_i$  is a vector that reflects the state of pollution indicators at a time  $t_i$ ,  $i = \overline{1, m}$ , a  $C_k$  is information about data locations  $k = \overline{1, l}$ .

### References:

1. W. Yi, K. Lo, T. Mak, K. Leung, Y. Leung, M. Meng, A survey of wireless sensor network based air pollution monitoring systems, Sensors, 15(12), 2015, pp. 31392-31427.
2. Explore the air quality, 2020. URL: <https://www.iqair.com/world-air-quality>
3. Y. He, Formalization of the problem of evaluation of pollution of the environment, Management of development of complex systems, 38, 2019, pp. 168-172. doi: 10.6084/m9.figshare.9788702
4. A. Kuchansky, A. Biloshchytskyi, Yu. And rashko, S. Biloshchytska, Ye. Shabala, O. Myronov, Development of adaptive combined models for predicting time series based on similarity identification, Eastern-European Journal of Enterprise Technologies, 1(4(91)), 2018, pp. 32-42. doi: 10.15587/1729-4061.2018.121620
5. V. Morozov, O. Kalnichenko, M. Proskurin, M. Mezentseva, Investigation of Forecasting Methods of the State of Complex IT-Projects with the Use of Deep Learning Neural Networks, in: Proceedings of International Scientific Conference “Intellectual Systems of Decision Making and Problem of Computational Intelligence”, 2019, pp. 261-280.

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## MATHEMATICAL MODEL FOR DETERMINATION OF PRIORITIZING SERVICES WHEN ALLOCATING LIMITED RESOURCES

**Abstract.** In this process, the problem of fair determination of the cost of living of different categories of students in dormitories for a certain deficit of this resource is considered. Quotas for settlements are introduced for certain categories and an algorithm for determining those who have the primary right to housing is provided. Additional criteria for organizing student sets by category are rating lists based on the performance of students of different courses.

**Keywords.** Limited resources, priority, quotas, equitable distribution, heuristic.

**Introduction.** The problem of equitable prioritization of tasks, the consistency of performing functions, ranking alternatives, ordering the importance of objects is a classic problem of many sectors of the national economy [1]. In addition, this problem is classical for the theory of decision-making, which is a comprehensively studied and at the same time an urgent problem for many situations of decision-making. Resource constraints are a fundamental challenge facing humankind. The issue in question can be formalized in the class of problems of allocation of limited resources, which is a key problem for large and small teams.

The procedure for settling students in university dormitories in the context of a shortage of the university's housing stock is of great social importance, therefore there is a high probability of receiving negative feedback when incorrect, non-transparent and unfair results. Therefore, risks and possible misunderstandings in the allocation of resources should be minimized. The algorithm and procedure for allocating resources should be unambiguous, well-documented and not allow for different interpretations. It is necessary to exclude corruption risks in advance, and hence the subjective component at the decision-making stage. The latter should be clearly regulated and stipulated.

**Formulation of the problem.** Let some organizational system, the structure of which is known, needs limited resources allocated at a higher level of management. Resource consumers are interconnected and different approaches to modeling and solving the problem can be proposed. This organizational system consists of several subsystems with different status and, accordingly, different rights to the share of resources allocated to partially meet the needs of the organization. Will model the problem in terms of allocating limited resources. Such problems are well studied, but they have a range of uses and in every practical situation cannot be easily and without changes be adapted to practical goals.

Note that the values of the indicators characterizing the organizational system are unknown and dynamically change within some acceptable limits. In such cases, heuristics can be applied to make a decision.

**Model of faculty.** A quota mechanism can be proposed: a fair determination of quotas and determination of the satisfaction of those in need of using the resource. Each situation is individual, but general approaches can be applied that allow to digitize the state and need for a settlement and will give an overall view and advice on making a decision, changing quotas, redistributing between faculties, etc.

To model the problem of allocating limited resources, a mathematical model of the faculty should be built. To describe the structure of the faculty and the quantitative characteristics of the problem, we use the following notation:

$Q^0$  – a plural of faculty students eligible for priority housing needs;

$Q^i, i = 1, \dots, 6$ , – a set of nonresident students of relevant courses in need of housing;

$Q = \bigcup_{i=1}^6 Q^i$  – a set of faculty students applying for housing,  $Q^0 \subset Q$ ;

$k$  – a number of categories into which everyone who wants to get a place in the dormitories should be divided in order to distribute limited resources as fairly as possible to students;

$q = (q_1, \dots, q_k)$  – a plural of quotas set for different categories of students;

$\Theta^{2021}$  – the possibilities of the university for the settlement of students of the faculty in the current year.

**Solution Algorithm.** The settlement of nonresident students in dormitories is carried out according to the following criteria:

$f_1$  – priority provision of beds for nonresident students of preferential categories of all courses of educational level (EL) "Bachelor" and EL "Master" - from set  $Q^0$ ;

$f_2$  – establishing a quota for such categories of students:  $Q^0$  – preferential categories of EL "Bachelor" and EL "Master",  $Q^1$  – first course EL "Bachelor";

$f_3$  – distribution of empty beds for the settlement of students from set  $Q^1$  – the first course of EL "Bachelor" according to the entrance rating score;

$f_4$  – establishment of a quota for categories of students: from the set of  $Q^2$  and  $Q^3$  courses EL "Bachelor" and EL "Master";

$f_5$  – distribution of empty beds for the settlement of 2nd and 3rd year students of OR "Bachelor" by academic score for the last year of study from the combined rating list  $Q^2 \cup Q^3$ .

In this way, priorities have been introduced in relation to the settlement, which can formally be written in this form:  $Q^0 \succ Q^1 \succ Q^2 \approx Q^3 \succ Q^4 \approx Q^5 \approx Q^6$ .

Note that the above criteria must be made public in advance, information about available places, applicants and rating lists is available, and the procedure used for distribution is transparent. To justify the decision on the equitable location of beds and to simplify the allocation procedure, we will introduce additional heuristics.

Heuristic E1. Living conditions in all dormitories provided by universities are relatively the same.

Heuristic E2. The students' declared wishes for the need to settle in a dormitory reflect the real need of nonresident students for a resource for living.

**Equity model.** To model the concept of fairness as applied to this particular task, the following factors should be taken into account in the determination of quantitative indicators:

- the ratio of the number of applicants and places in dormitories;
- the cost of paying for an apartment in the city and the cost of paying for a dormitory;
- functions that reflect student success in learning;
- introduce heuristics about the fairness of the settlement of different categories of students;
- functions of the influence of the introduced quotas on the level of fairness;
- indicator of the integral satisfaction of students with the results of the settlement.

**Prospects for further research.** To improve the described approaches to modeling the problem of allocating limited resources, further research requires:

- approaches to rating students from sets  $Q^2, Q^3$  with the aim of equitably combining these groups into one  $Q^2 \cup Q^3$ ;
- determination of the quality and validity of rating, taking into account the types of measurement scales;
- in-depth study of statistics and dynamics of changes in the structural units of the organizational system;
- modeling and substantiating the concept of fairness of satisfaction with a resource of various departments and the organizational system as a whole;
- reaching a compromise;
- investigation of the complexity of resource allocation algorithms;
- building a mathematical model for the distribution of a heterogeneous resource.

#### **References:**

1. Hnatienko H.M., Snytyuk V.Y. Expert decision making technologies: Monograph. – K.: PLC «Maclaut», 2008. – 444 p.

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## MATHEMATICAL MODELING OF FUNCTIONAL STABILITY OF ORGANIZATIONAL SYSTEM

**Abstract.** Considering the problem of ensuring the functional stability of the organizational system. Presenting the mathematical model of nominal resource needs and the main parameters that contribute to the study of sustainability. The concept of substituting the functions of some elements of the system in the event of an emergency situation is also introduced.

**Keywords:** functional stability, nominal resource requirements, replacement of functions, staffing situation.

**Introduction.** With the development of society and technology, attention is paid to the reliability, security and stability of complex organizational systems. At the same time, the system must ensure the sustainable operation of the facility, timely, reliable and comprehensive prevention of security threats, the functional stability of all departments and the system as a whole. For critical systems, the cost of verification and certification is extremely high and can reach half the total cost of the system.

The objects of corporate security of the organization are management technologies, personnel of the organization, financial resources, material values, production technologies, business processes, information resources, etc. One of the essential features of organizational systems is the a priori existence of subjectivism - both in the construction of such systems and at all stages of their operation.

One of the essential indicators of the level of safe operation of the system is functional stability. Functional stability is the ability of a system to perform its functions during a given time interval under the influence of the flow of operational failures, intentional damage, interference in the exchange and processing of information, as well as in case of errors of service personnel.

**Formulation of the problem.** Suppose you set a set of indexes of functions that the system should provide. We will assume that such functions  $n$ . Denote the set of all functions performed by the system through  $A = \{a_1, \dots, a_n\}$ ,  $J = \{1, \dots, n\}$ . Functions performed by different elements of the system are not duplicated, that is  $n = \sum_{i \in J} n_i$  -

each function in the system is unique:  $A^{i_1} \cap A^{i_2} = \emptyset, i_1, i_2 \in J$ , where  $\emptyset$  - empty set. This means that the optimization of business processes in the organizational system. It

should be noted that the modeling of functional stability has been considered in many works, in particular, in [1-5].

**Mathematical model of nominal resource needs in a staffing situation.** We can build a matrix of functions performed by elements of the system:

$$F^i = (f_i^0, f_i^1), \text{ where}$$

$$f_i^0 = (f_{ij}^0, j = 1, \dots, n_i), i \in I - \text{vector of basic functions } i - \text{element of system},$$

$$f_i^1 = (f_{is}^1, c_{is}, s \neq j \in \{1, \dots, n_i\}, s = \{1, \dots, v_i\}), i \in I - \text{matrix of related functions } i - \text{element of system},$$

$$c_{is}, s \neq j \in \{1, \dots, n_i\}, s = \{1, \dots, v_i\}, i \in I - \text{level of performance quality } s - \text{related function } i - \text{element of system}.$$

Let's denote by  $A^i, i \in J$ , a subset of the functions performed  $i - \text{element of system}$ .

Each task ensures the quality and safe operation of the information system from a variety of tasks  $A = \{a_1, \dots, a_n\}$  characterized by two parameters:

$$c_i^0 - \text{nominal cost of execution or resource requirements, } i \in I;$$

$$t_i^0 - \text{nominal execution time, } i \in I.$$

Each element of the system in normal mode performs the tasks assigned to it and has limited ability to perform the entire subset of its tasks:

$$\sum_{a_i^j \in A^j} c_i^j = C^j, \quad j \in J,$$

$$\sum_{a_i^j \in A^j} t_i^j = T^j, \text{ for } \forall j, j \in J.$$

Note that restrictions may be imposed on some tasks

$$\sum_{a_i^j \in A^j} t_i^j = T^j, \quad j \in J,$$

when for each element of the system or group of elements, resource limits are set for the time of the task. As we approach these limits, the quality of information security of any element of the system decreases significantly and there are threats to the information security of the entire system.

Nominal tactical and technical characteristics of the system of functional stability is characterized by the need for a variety of resources, the most important of which in many organizations are:

$$\sum_{i=1}^n c_i^{0i} = C^0 - \text{system operating budget,}$$

$$\sum_{i=1}^n t_i^{0i} = T^0 - \text{the total need for time to perform system functions.}$$

**Model of substitution of functions performed by some element of the system in a normal situation.** Substitution of functions between elements of the system can be done according to the matrix of relationships only between those elements that can perform these tasks, according to their qualifications, available certificates, etc. In this case, the following heuristics should be considered. Assume, that the  $i - \text{system}$

element is missing and the subset problem  $A^i, i \in J$ , executes an element with an index  $j, j \in J$ , or multiple items ( $k_i, k_i < k$ ,) with indexes  $j_t \in J \setminus \{i\}, t = 1, \dots, k_i$ . In this case, according to accepted heuristics, the quality of subset tasks  $A^i, i \in J$ , may be about 80% of nominal. And due to the additional load on items with indexes  $j_t \in J \setminus \{i\}, t = 1, \dots, k_i$ , the quality of subset tasks  $A^{j_t}, j_t \in J, t \in J \setminus \{i\}, i \in J$ , will also decrease significantly.

**Directions of development of modeling of functional stability of organizational system.** Some additional tools can be used to improve the described approaches to modeling the task of ensuring the functional stability of the organizational system. In particular, the following should be considered:

- model for determining the level of critical elements of the organizational system.
- generating options for replacing the functions of missing elements;
- assessing the quality of replacement options and the impact of replacement functions on the quality of functioning of the elements;
- determining the integrated quality of the system as a whole;
- assessment of system resourcefulness based on identifying the number of sources of possible options for substituting functions;
- determining the impact of the multiplicity of replacements on the reliability of the system and the stability of operation.

### References:

1. Hnatienko H., Vialkova V. Model-Based Analysis of the Estimation of Integral Level of Security of the Information System // Scientific and Practical Cyber Security Journal (SPCSJ). Vol.2, No.4, December, 2018. Pp. 95-103.
2. Babenko Tetiana, Hnatienko Grygorii, Vialkova Vira /Modeling of information security system and automated expert assessment of integral quality of system functional stability// in the X Inter-University Conference "Engineer of the 21st Century". 11 December 2020 at the University of Bielsko-Biała (ATH) in Bielsko-Biała, Poland. Pp.121-124.
3. Babenko, T., Hnatienko, H., Vialkova, V. Modeling of the integrated quality assessment system of the information security management system / CEUR Workshop Proceedings, Volume 2845, 2021, Pages 75-84 // 7th International Conference ""Information Technology and Interactions"", IT and I 2020; Kyiv; Ukraine; 2 December 2020 through 3 December 2020; Code 168286.
4. Babenko, T., Hnatienko, H., Vialkova, V. Modeling of information security system and automated assessment of the integrated quality of the impact of controls on the functional stability of the organizational system // Selected Papers of the XX International Scientific and Practical Conference "Information Technologies and Security" (ITS 2020), Kyiv, Ukraine, December 10, 2020 / CEUR Workshop Proceedings, 2021, 2859, pp. 188–198.
5. Babenko, T., Hnatienko, H., Ignisca, V., Iavich, M. Modeling of critical nodes in complex poorly structured organizational systems // Proceedings of the 26th International Conference on Information Society and University Studies (IVUS 2021), Kaunas, Lithuania, April 23, 2021 / CEUR Workshop Proceedings, 2021, 2915, pp. 92–101.

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## MATHEMATICAL SUPPORT OF THE RATING VOTING PROCEDURE

**Abstract.** The problem of determining the resulting ordering of objects on the basis of incomplete rankings or multiple comparisons is considered. It is proposed to apply the algebraic approach to substantiate and formalize the problem. A short list of classical voting methods and a scheme for solving the problem are given.

**Keywords:** rating voting, priority, algebraic approach, Cook's metrics.

**Introduction.** Among the goals facing the researcher should be noted [1]:

- selection of the best object;
- selection of a disordered subset of the best objects;
- ranking (ordering) of the whole set of objects;
- finding the resulting (collective, group) ranking of objects according to individual rankings set by experts.

Based on traditional approaches, it is possible to build a combined examination, which is easy to implement, but its analysis requires adequate and sound methods of calculating the results. Methods of processing expert information are divided into three main groups [1]:

- statistical methods;
- scaling methods;
- algebraic methods.

The essence of algebraic methods is that on the set of admissible estimates the distance is set and the resulting estimate is defined as such, the distance of which to the estimates of experts on a certain selected criterion is minimal. Based on the algebraic approach, we will determine the coefficients of relative competence of experts.

An important way of presenting expert information is the ranking of alternatives[1]. In many practical problems there is a need to use multiple comparisons or incomplete rankings. Incomplete rankings were studied, for example, in [2-4]. In the monograph[2], the classical methods of voting theory were used to determine the generalized ranking of alternatives. However, in such cases, the use of algebraic methods of calculating the median, which reflects the collective opinion of experts, is promising.

### Formulation of the problem.

Let  $k$  the experts carry out a preliminary examination  $n$  of some projects, objects or applicants for the position. Under the terms of the examination, the members

of the expert group at the first stage must specify incomplete rankings or multiple comparisons of  $V$  objects, and  $V \ll n$ . It is necessary to develop algorithms for calculating the resulting ranking of alternatives, consistent with the given incomplete rankings of experts, taking into account different metrics and different criteria [5].

In [4, 5] the concept of incomplete ranking was introduced: it is a binary relation given on a subset of alternatives  $A'$ ,  $A' \subset A$ , which satisfies the properties of completeness, antisymmetry, transitivity: but only on a subset  $A'$ ,  $A' \subset A$ , and not on the whole set  $A$ .

The distances between the rankings of alternatives are determined using metrics [5]:

- Cook's metrics of mismatch of ranks (places, positions) of alternatives,

$$d(R^j, R^l) = \sum_{i \in I} |r_i^j - r_i^l|, \quad (1)$$

where  $r_i^l$  – rank  $i$  – alternatives in ranking  $l$  – expert,  $R^l$ ,  $l \in L$ ,  $1 \leq r_i^l \leq n$ ,

- Heming's metrics;
- Euclid's metrics;
- preference vector, the elements of which are the number of alternatives that precede each alternative in the ranking.

Criteria that are most often used in the following cases:

- additive;
- minimax.

### **Formalization of the problem of determining the resulting ranking**

The most common method of finding the resulting ranking of alternatives is to calculate the median of the given rankings. This group of methods for generalizing expert information is the most reliable and mathematically sound. The solutions of the problem, which are determined by applying different metrics and different criteria, are the medians of the linear orders given by the experts.

Cook's metric is popular in the ranking of alternatives [1, 3, 5]. To apply it in solving the problem of analysis of incomplete rankings, we introduce heuristics and determine on their basis the distances from the rankings set by experts to the reference ranking.

Due to the peculiarities of the calculation of generalized ranking with incomplete initial information, in [3, 4] it is proposed to use a number of heuristics. In particular, the distance components for incomplete object rankings are described as follows.

Heuristics E1. Distance from incomplete rankings set by experts  $R^{iH}, i=1, \dots, k$ , to any ranking  $R^{*(0)}$  consists of two components: a certain part of the distance and probabilistic.

Heuristics E2. An alternative not specified by an expert creates an unknown relationship between all other alternatives and does not participate in the ranking, ie this

alternative is not represented in the incomplete ranking. Thus, when setting incomplete rankings for each expert, we have a number of alternatives:

–  $n_i$  – given by him alternatives in the ranking  $R^{iH}, i=1, \dots, k$ , which will be a certain part of the distances;

–  $(n - n_i) = v_i$  – non-expert alternatives in ranking  $R^{iH}, i=1, \dots, k$ , which make up the probabilistic part of the distances.

Heuristics E3. Probabilistic part of the distance from the ranking set by the expert  $R^{iH}, i=1, \dots, k$ , to any reference ranking is always equal to  $v_i, i=1, \dots, k$ , for Cook's metrics.

The determined part of the distances [6,7] is calculated by formula (1).

### **Using classical methods to determine the solution**

Classical methods of choice theory (Condorcet, Bord, Simpson, Copeland, Nanson, Kemeni-Young, Taideman, Schulze, Baldwin, alternative voices, relative majority, etc.) can also be used to a limited extent in determining the resulting ranking [8]. The application of some rules in such a problem is described, for example, in the monograph [2]. The study of ways to apply the classical methods of choice theory to determine the weights should be carried out in the further development of the method described in this paper.

*Board rule.* Each voter announces their preferences, ranking  $m$  candidates from best to worst (indifference is prohibited). The candidate does not receive points for the last place, receives one point from each candidate for the penultimate, receives  $m - 1$  points for the first place. The candidate with the highest sum of points wins.

*Condorcet's rule.* For a given voting results table (warning table), the Condors winner is the candidate who beats any other candidate by pairwise comparison by a majority rule. If paired comparisons form a cycle, then there is no winner for Condors, and they say that there is a so-called Condor paradox.

*Copeland's rule.* Let's compare the candidate  $a$  with any other candidate  $x$ . Assign it  $K(a > x) = +1$ , if for the majority  $a > x$ ,  $K(a > x) = -1$ , if for the majority  $x > a$  and  $K(a > x) = 0$  with equality in the evaluation of candidates. Copeland's estimate for candidate  $a$  is the sum of  $K(a) = \sum_x K(a > x)$ . The candidate with the highest Copeland score is selected.

*Simpson's rule.* Consider candidate  $a$  and any other candidate  $x$ . Let  $S(a > x)$  denote the number of voters for whom  $a > x$ . Simpson's estimate for the candidate  $a$  is called the minimum of the numbers  $S(a > x)$ :  $S(a) = \sum_x S(a > x)$ . The candidate with the highest score of Simpson is selected.

### **Scheme for solving the problem.**

1. Selection of task parameters.
2. Provide anonymous voting, for example, using Google spreadsheets.

3. Determining the winners and eliminating such projects that did not receive any votes.
4. With a large dimension of the task of screening such projects that received the minimum number of votes.
5. Graph connectivity analysis.
6. Prompt researchers about additional voting or other heuristics to overcome dichotomy.
7. Application of multi-round voting.
8. Study of the number of options for different numbers of projects in multiple comparisons.

**Conclusions.** The problem of ordering a subset of objects is considered. Based on this examination, an algebraic approach to the analysis of incomplete rankings is proposed. A comparison of classical methods of group selection with the algorithm for determining the median with incomplete initial information. The scheme of solving the problem in the given statement is described.

**References:**

1. Гнатієнко Г.М., Снитюк В.С. Експертні технології прийняття рішень: Монографія. – К.: ТОВ «Маклаут», 2008. – 444с.
2. С.В. Каденко, В.В. Щиганок, О.В. Андрійчук, О.В. Карабчук, «Аналіз інструментарію підтримки прийняття рішень у контексті вирішення задач стратегічного планування», Реєстрація, зберігання і обробка даних, Т. 22, № 2, С.77-91, 2020.
3. H. Hnatiienko, N. Tmienov, A. Kruglov, «Methods for Determining the Group Ranking of Alternatives for Incomplete Expert Rankings». in: Shkarlet S., Morozov A., Palagin A. (eds) Mathematical Modeling and Simulation of Systems (MODS'2020), Advances in Intelligent Systems and Computing, vol 1265. Springer, Cham. [https://doi.org/10.1007/978-3-030-58124-4\\_21](https://doi.org/10.1007/978-3-030-58124-4_21), 2021, 1265 AISC, pp. 217–226.
4. И.М. Макаров, Т.М. Виноградская, А.А. Рубчинский, Теория выбора и принятия решений, Наука, Москва, 1982, 328 с.
5. В.С. Снитюк. Прогнозування. Моделі. Методи. Алгоритми: Навчальний посібник, «Маклаут», Київ, 2008, 364 с.
6. Гнатієнко Г.М., Тмєнова Н.П. Визначення пріоритетності заходів кібербезпеки при неповних експертних ранжуваннях / Безпека інформаційних систем і технологій. – 2020. – №1(2), с. 9-15.
7. Гнатієнко Г.М, Круглов О.І., Тмєнова Н.П. Обчислення результуючого ранжування альтернатив на основі використання неповних експертних ранжувань // Безпека інформаційних систем і технологій. – 2020. №3-4, с.27-37.
8. Dodonov, A., Lande, D., Tsyanok, V., Andriichuk, O., Kadenko, S., Graivoronskaya, A.: Information Operations Recognition. From Nonlinear Analysis to Decision-Making. Lambert Academic Publishing, (2019).

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## DEVELOPMENT OF GIS USING FOR MONITORING CROP YIELDS

**Abstract.** The development of geographic information systems is an important prerequisite for the effective implementation of information systems in agriculture. The paper describes the objects and subjects of the environment in which the geo-information system operates. A mathematical model for describing the problem of crop yield monitoring is also proposed. The model is based on the analysis of the crop image and the use of time series analysis.

**Keywords:** IS, agriculture, multi-objective optimization

In recent decades, the use of digital images of geographical areas for agricultural purposes has become relevant. The rapid development of this area is facilitated by the development of wireless technology, digital photography technology, image display devices, operating systems, and services for storing and processing these images. These opportunities have become a prerequisite for the intensive development of geographic information systems and technologies in general.

Paper [1] describes the hypothesis that inhomogeneities can directly determine crop yields in field images. The processing of digital images of fields provides valuable information about the state of agricultural crops, allows you to assess plant health and predict the yield, timing, quantity, and quality of products in the future.

The image of sown areas can be presented in the form of time series, which allows them to apply appropriate methods of their forecasting [2]. The works [3] describe the methods and technologies of processing time series of digital images for decision-making in agriculture.

The main phenological indicator in the analysis of images of sown areas is the normalized differential vegetation index. This is a quantitative indicator of active photosynthetic biomass used to quantify vegetation, which is calculated by the formula:

$$NDVI = \frac{N - R}{N + R} \quad (1)$$

where R is the intensity of the light reflected from the surface of the spectrum in the visible red region (630-690 nm), N is the intensity of the light reflected from the surface of the spectrum in the infrared region of the spectrum (760-900 nm).

The input data for the information system is the image of the site. The image can be represented as some size matrix. The image shows culture on certain pixels, others show a soil that is not culture. The intensities for each image have an intensity distribution close to the normal distribution (See fig.1).

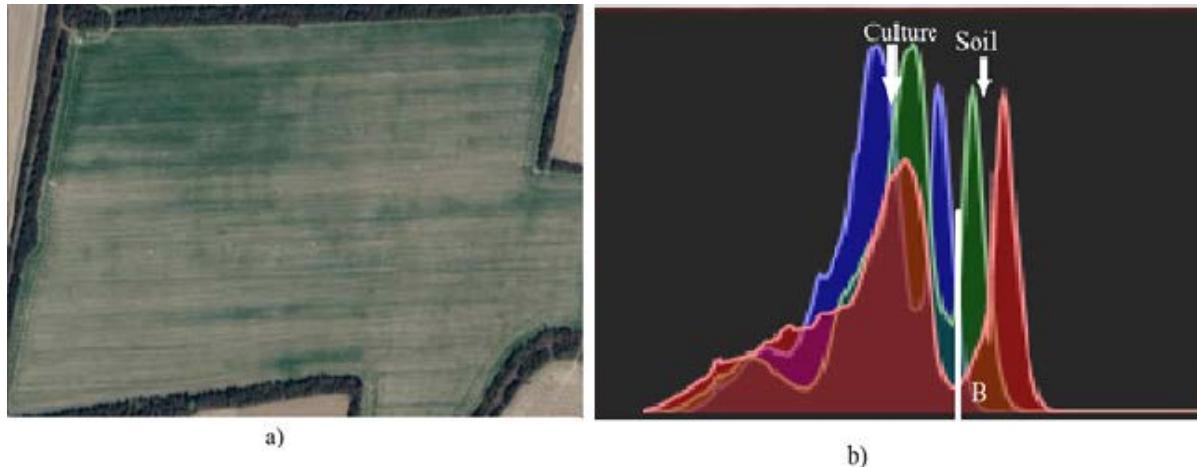


Figure 2 – a) The image of the fled with growing corps retrieved from Google maps b) Color histogram.

Therefore, a threshold function can be introduced

$$\delta(x, y) = \begin{cases} 1, & \text{if } \beta(x, y) \geq B \\ 0, & \text{if } \beta(x, y) < B \end{cases} \quad (2)$$

where  $x, y$  are the coordinates of the pixel in the image,  $\beta$  is the value of the NDVI in a particular pixel, and  $B$  is some threshold value.

Then the yield of the site is described by the following model:

$$\beta(x, y) = \delta(x, y) p(x, y) + (1 - \delta(x, y)) \bar{p}(x, y) \quad (3)$$

where  $p$  the distribution density of the culture in the image,  $\bar{p}$  the distribution density of the culture. Yield can be estimated by finding a two-dimensional integral of crop density.

The model of forecasting based on phenological indicators is based on the definition of critical points in the NDVI trajectory. Sequential measurements of NDVI for one site at specified intervals (day, week, two weeks, etc.) form a discrete-time series of estimates

$$\beta = \{\beta_1, \beta_2, \dots, \beta_n\} \quad (4)$$

Using prediction methods for time series [2], predict NDVI values for subsequent periods. And using the model of yield forecasting (3) - to estimate future yields.

### References:

1. A. DeJoia, M. Duncan, What is «Precision Agriculture» and why is it important, 2015. URL: <https://soilsmatter.wordpress.com/2015/02/27/what-is-precision-agriculture-and-why-is-it-important>
2. A. Kuchansky, A. Biloshchytskyi, Yu. Andrashko, S. Biloshchytska, Ye. Shabala, O. Myronov, Development of adaptive combined models for predicting time series based on similarity identification, Eastern-European Journal of Enterprise Technologies, 1/4 (91), 2018, pp. 32–42. doi: 10.15587/1729-4061.2018.121620
3. H. Eerens, D. Haesen, F. Rembold, F. Urbano, C. Tote, L. Bydekerke, Image time series processing for agriculture monitoring, Environmental Modelling and Software, 53, 2014, pp. 154–162.

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## **DEVELOPMENT OF METHODS FOR DECISION-MAKING FOR AGRICULTURE UNDER UNCERTAINTY**

**Abstract.** In the context of growing human needs for food, an important issue is to increase the efficiency of agricultural enterprises. A modern tool for efficiency is the informatization of all processes, including the introduction of information systems to support decision-making. The objects and subjects of the environment in which the information system operates are determined, two mathematical models of the description of the decision-making problem in the conditions of uncertainty are offered. Criteria for evaluating the effectiveness of decisions are defined.

**Keywords:** decision making, uncertainty, information system.

The growth of the planet's population leads to an increase in food needs. Initially, these needs could be met by using extensive methods to increase the area of land used in agar production. Now, this method cannot be applied in the vast majority of countries. Therefore, the first role is to increase the efficiency of available resources. To increase the efficiency of agricultural enterprises, there are two areas: technology and management.

Management involves making more optimal and timely management decisions. Informatization of agricultural production processes gave an extraordinary impetus to the development of management. This process has begun recently and is undergoing a stage of exponential growth. Thus, according to BI Intelligence, the number of high-tech solutions in the agricultural sector, such as IoT, doubles every three years [1]. The amount of data that should be taken into account in decision-making is overgrowing, so there is a need to use information systems to support the decision making [2].

In [3], the authors considered the literature on the introduction of technology in agriculture with an emphasis on the role of uncertainty and learning. Factors influencing the benefits for farmers' adoption and their connection with the innovation process have been identified. The positive consequences of innovation and acceptance of welfare for farmers and consumers are also substantiated. The authors formalized the problem of decision-making in conditions of environmental uncertainty [4] proposed a conceptual information system that can be used to solve this problem [5].

We will divide the construction of the model of the information system of decision support in the agricultural sphere in the conditions of ecological uncertainty into four components:

1. The goal-setting component.
2. The principles component.
3. Functionality component.
4. Diagnostic component.

The component of functionality primarily includes those mathematical models

and methods that ensure the functioning of the information system to support decision-making in the agricultural sector in conditions of environmental uncertainty.

We can consider two main approaches to determining the optimal solution.

The first approach is to formulate the problem of decision making as a problem of multicriteria optimization:

$$\begin{aligned} c_i(s(x)) &\rightarrow \max, i = \overline{1, m}, \\ G_j(x) &= 0, j = \overline{1, r}, \end{aligned} \quad (1)$$

where  $x$  is a fuzzy vector value that represents the factors of the environmental conditions and economic conditions,  $s(x)$  is some strategy of the agricultural enterprise functionality,  $c_i$  are criteria based on which the strategy can be evaluated,  $m$  is the number of criteria for evaluating the strategy of the agricultural enterprise functionality,  $G_j$  are functional restrictions that determine the feasibility of implementing a suitable strategy of the agricultural enterprise in terms of available resources and  $r$  is the number of restrictions/

Appropriate methods should be used to solve this problem of multicriteria optimization. The traditional approach is to use one of a family of local search methods. This method makes it possible to find local optimal solutions of the optimization problem. [6]. It is also traditional to use subgradient methods [7]. A more modern approach to solving optimization problems is simulation [8].

The second approach to decision making is to minimize risks [9]. To do this, first, there is the identification of risks, which consists in compiling a complete list of risks that may positively or negatively affect the activities of the agricultural enterprise. For this model, all fuzzy input parameters, namely environmental and economic conditions, are risk factors. Next is the analysis of risk distribution functions. The functions of losses or gains in the event of a relevant risk situation are assessed.

Let  $f$  is a function of estimating losses or gains at a certain fixed value of some risk factor  $x$ . Then the overall expected effect from the activities of the agricultural enterprise can be calculated as a mathematical expectation:

$$M(x) = \int_{x_{\min}}^{x_{\max}} f(x) \mu(x) dx \quad (2)$$

where  $x_{\min}$  and  $x_{\max}$  are the minimal and maximal possible values of the factor  $x$  and  $\mu(x)$  is a membership function.

The risk of the activity is determined by the standard deviation:

$$\sigma(x) = \sqrt{\int_{x_{\min}}^{x_{\max}} (f(x) - M)^2 \mu(x) dx} \quad (3)$$

Since there are many risk factors, integration should be carried out for each of the risk factors.

To find the optimal solution in terms of risk management is the solution of such a problem of minimizing the coefficient of variation

$$\frac{\sigma(x)}{M(x)} \rightarrow \min. \quad (4)$$

Requirements for the properties of the final product and the result of the implementation of an information system to support decision-making in the agricultural sector in conditions of environmental uncertainty are described in [5].

Particular attention should be paid to the requirements for the modularity of the system. The advantage of using the modular structure of the system is the ability to expand and modify each of the modules independently of the others. This structure significantly increases the stability and flexibility of the system. A modern approach to software development such as the use of microservices should also be considered. Each module must be implemented as an independent microservice.

### References:

1. BI Intelligence. The Internet of Everything, 2016. URL: <http://bewiser.eu/admin/resources/internetofeverything2016-2.pdf>
2. F. Guerrini. The future of agriculture? Smart Farming, 2015. URL: <https://www.forbes.com/sites/federicoguerrini/2015/02/18/the-future-of-agriculture-smartfarming/#84d0ef13c42c>
3. J. P. Chavas, C. Nauges, Uncertainty, Learning, and Technology Adoption in Agriculture, *Applied Economic Perspectives and Policy*, 2020, 42(1), pp. 42-53.
4. C. Ji, Decision making in agricultural sector in view of the environment, *Management of development of complex systems*, 37, 2019, pp. 160–163. doi: 10.6084/m9.figshare.9783224
5. C. Ji, Y. V. Andrushko, Conceptual model of information system for supporting decision making in the agrarian sphere, *Scientific Bulletin of Uzhhorod University. Series of Mathematics and Informatics*, 2(35), 2019, pp. 156-161. doi: 10.24144/2616-7700.2019.2(35).156-161
6. A. Kuchansky, A. Biloshchytskyi, Y. Andrushko, S. Biloshchytska, T. Honcharenko V. Nikolenko, Fractal Time Series Analysis in Non-Stationary Environment, in: Proceedings of 2019 IEEE International Scientific-Practical Conference Problems of Infocommunications, Science and Technology (PIC S&T), Kyiv, Ukraine, 2019, pp. 236-240, doi: 10.1109/PICST47496.2019.9061554
7. J. D. C. Neto, G. J. P. Da Silva, O. P. Ferreira, J. O. Lopes, A subgradient method for multiobjective optimization, *Computational Optimization and Applications*, 54(3), 2013, pp. 461-472.
8. G. Xu, J. Feng, F. Chen, H. Wang, Z. Wang, Simulation-based optimization of control policy on multi-echelon inventory system for fresh agricultural products, *International Journal of Agricultural and Biological Engineering*, 12(2), 2019, pp. 184-194.
9. J. Antón, S. Kimura, R. Martini, Risk management in agriculture in Canada, *OECD Food, Agriculture and Fisheries Working Papers*, 40, 2011, OECD Publishing, doi: 10.1787/5kgj0d6189wg-en.

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## THE CONCEPTUAL PROJECT MANAGEMENT MODEL IN THE SPHERE OF E-COMMERCE BASED ON A PERSONALIZED ANALYSIS

**Abstract.** Management of e-commerce projects, aimed at individual orders, is becoming increasingly valuable due to the transformation of business and consumer requirements. Combining project management methods and e-commerce tools to improve project management and implementation processes is most prioritized. For this purpose, a project management model of creation of an online business based on personalized analysis of the project information space was developed. The proposed approach can be used by companies that focus on innovative development.

**Keywords:** E-commerce projects; Project management methodology

The market for goods and services expresses a tendency to focus on the quality of the product or service itself due to increasing customer requirements. The growth of small business, which is aimed at meeting the individual needs of consumers, innovation, in terms of both new products or services, and from the standpoint of a new method of management force large companies to change their market strategies. This approach naturally follows from the market demand for product recognition among consumer buyers. Accordingly, in order to take a stable position in the market, it is necessary to apply advanced technologies to ensure the highest quality and provide effective positioning – branding, which relies solely on creating a unique image of the company.

With the growth of e-commerce, it has become much easier to distribute goods and services and to obtain statistical information about consumers (customers) and their preferences. Due to the globalization of the Internet and the growing customer confidence in the field of e-commerce, local businesses have unlimited opportunities to promote their products or services and automate the receipt of orders for unique products. For example, a significant number of foreign companies have transformed their projects into a network, abandoning many traditional methods [1].

However, in the small business market, companies rarely utilize "smart" websites that would speed up the processing of customer orders and use the accumulated site statistics. The main reason of course is that it is usually associated with additional costs. Thus, ordinary websites do not contain order constructors, recommendations, and stakeholders face the procedure of long telephone interactions. Management becomes complicated without a clear information space of small business projects in the current conditions of e-commerce. Therefore, the field of e-commerce project management is becoming increasingly valuable because of the transformation of doing business.

The current situation raises the need to form the approach for development of

online business creation projects that is aimed at personalized orders. The proposed approach can be used by companies that focus on innovative development. Such projects are based on information analytics – the study of project management methodologies particularities, technological processes of production, and e-commerce tools utilization.

The main goals of the project management methodology are effective planning, implementation, monitoring, and control, as well as bringing the project to successful completion, providing the project with the necessary set of methods [2, 3].

Project management methodology determines the direction of project development and helps to comply with the time and budget of the project, to form customer requirements, etc. Therefore, it is vital to choose a suitable project management methodology, to maximize the effectiveness in solving project tasks.

Historically formed and functioning modern methodologies can be divided into traditional (rigid), agile (adaptive), and their synergy – hybrid methodologies [2-7].

It is advisable to use agile methodologies in the sphere of software development, as opposed to the confectionery industry, where both traditional and flexible methodologies can be used. The development of an ideal recipe and ingredients cost calculation to expand the range is peculiar to confectioneries that follow the traditional approach. As such, the traditional approach doesn't consider the client's wishes. As opposed to the traditional approach, agile allows maintaining a floating assortment based on product features and gathered statistical information.

Therefore, the relationship of project management models and methods with e-commerce processes in projects of personalized online orders is proposed to consider from the standpoint of the knowledge triad (Fig. 1).

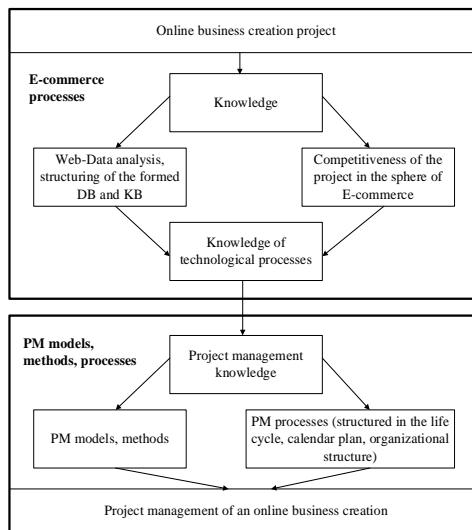


Figure 1 – Triad of knowledge in the development of a project of personalized orders

It is advisable to form a specific methodology for project management to manage e-commerce projects characterized by distributing unique products through sites [8].

The conceptual project management model of the creation of an online business based on personalized orders and project information space analytics is presented in

figure 2. The proposed model includes not only the processes of structuring the life cycle, project schedule, and organizational structure but also is based on information analysis – the study of project management methodologies, production processes, and e-commerce tools (Fig. 1 and 2).

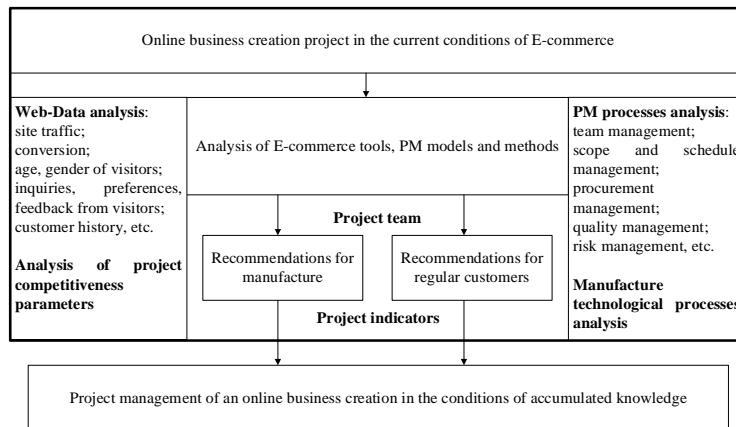


Figure 2 – Conceptual project management model of creation of an online business based on personalized orders

**Conclusion.** The proposed project management model of creation of an online business based on personalized analysis of the project information space will allow to vastly reduce the project uncertainty. The application result of this model will be the analytics of personalized data for project quality management. Analytics will allow forming valuable recommendations for improving the production and operation of the website and offers on the range, price, etc., for potential consumers. The estimation of recommendations can be carried out by the reaction of the project – the conversion of the site – the number of purchases.

### References:

1. Y. Chen, D. Hui, J. Seong, Click by click: How consumers are changing China's e-commerce landscape. Consumer and Shopper Insights, McKinsey & Company, 2012.
2. Y. Derenska, Analiz metodolohii upravlinnia proektamy, URL: <http://dspace.nuph.edu.ua/bitstream/123456789/11783/1/57-64.pdf>
3. S. Bushuev, M. Dorosh, N. Shakun. "Innovatsiine myslenia pry formuvanni novykh metodolohii upravlinnia proektamy". Management of Development of Complex Systems 26 (2016): 49-57.
4. L. Dovhan, H. Mokhonko, I. Malyk, Upravlinnia proektamy, Igor Sikorsky Kyiv Polytechnic Institute, 2017.
5. V. Butkevych, T. Polska. "Evoliutsiia metodolohii upravlinnia IT-proiektamy v suchasnykh ekonomichnykh umovakh". Black Sea Economic Studies 11 (2016). URL: [http://nbuv.gov.ua/UJRN/bses\\_2016\\_11\\_53](http://nbuv.gov.ua/UJRN/bses_2016_11_53)
6. D. West, M. Gilpin, T. Grant, A. Anderson, Water-Scrum-Fall Is The Reality Of Agile For Most Organizations Today, Forrester Research, Inc. 2011.
7. Hybrid project management manifesto. URL: <https://www.binfire.com/hybrid-project-management-manifesto>
8. I. Teslia, O. Yehorchenkov, I. Khlevna, A. Khlevnyi. "Development concept and method of formation of specific project management methodologies". Eastern-European Journal of Enterprise Technologies 5(3 (95)): 6-16. doi:10.15587/1729-4061.2018.142707.

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## HOW HUMAN RESOURCES PROCESSES HAVE CHANGED DURING THE PANDEMIC

**Abstract.** During the pandemic and quarantine, office workers were forced to switch to full or partial remote work. This has affected employee motivation and processes that have changed in the context of remote work. That is why the importance of HR (Human Resources) specialist has increased significantly during this period.

**Keywords:** Human Recourses; Management System

According to the Colliers International report [1], 23% of respondents said that motivation of employees has decreased. The achievement of the company's business performance and the competitiveness of the organization as a whole depend on the efficiency of the Human Resources (next - "HR") department. That is why great attention is paid to talent management and linking the goals of each employee to the strategic goals of the company, and thus increasing overall productivity.

Today in Ukrainian companies most internal processes directly depend on the presence in the office, HR processes are no exception. For example, to sign a vacation application or a business trip, it is necessary to collect the physical signatures of the people involved in the process with an analogue copy of the document or order. With the onset of the pandemic, this became impossible.

A similar example can be given about the recruitment process. In large companies, this process is performed by the HR department, reducing the share of tasks that affect employee motivation and the efficiency of the company as a whole. This process also requires a lot of approval through mail or messengers, which often leads to the loss of important information.

To respond quickly to all the challenges and needs of society, as well as increase efficiency, companies must implement digital solutions that automate processes, including those related to HR. The automation of these processes should apply not only to primitive processes, such as payroll. These processes should maximize the unique potential of each employee and ensure the relevance of the personnel management system in the long run.

If you analyze the IT infrastructure of companies and their needs, most of it can be reduced to the automation of document management and the implementation of appropriate systems. That's why more and more systems are appearing on the market that can increase efficiency and digitize all the processes that now work in companies only in physical offices.

Consider one of the document automation tools. M-Files is an intelligent information management system [2] that implements powerful tools for finding,

editing, sharing and organizing company content and information, with built-in artificial intelligence that can analyze data and build specific processes by analyzing them. It stores all the information in one place, which allows HR employees to always have the necessary document at hand, rather than looking for it among dozens of resources. HR specialists can search for documents not only by name but also by content, and be sure that their information is stored in complete security.

The implementation of such systems requires careful preparation, as processes need to be set up appropriately so that data stored in multiple locations is available in a single repository. However, the implementation of such systems should not stop the company's work, as it may also bring additional losses.

If we analyze the recruitment process in the company, you can identify the main stages, which can be automated the next way:

1. An internal customer, like a manager in a company, who wants to find a new employee in his department, creates a request, which must be approved by the CEO. In the request, he indicates the basic information about the vacancy: who they are looking for, the necessary experience, skills, salary, etc. This application is approved by the head - the general manager.
2. After approval, all the necessary information is automatically passed to the HR specialist, who collects the information that will be needed when searching for a candidate and publishes vacancies on job portals.
3. The HR specialist gathers the database of candidates and initially processes them.
4. If the candidate has successfully passed the screening, the HR specialist plans a technical interview with the internal customer - the manager of the department to which the candidate applied.
5. Upon successful completion of all stages of interviews - the HR specialist generates a job offer for the candidate.
6. The HR specialist prepares all the necessary documents for the enrollment of the specialist in the company, conducts the onboarding process and prepares the material and technical support for the start of the specialist's work.

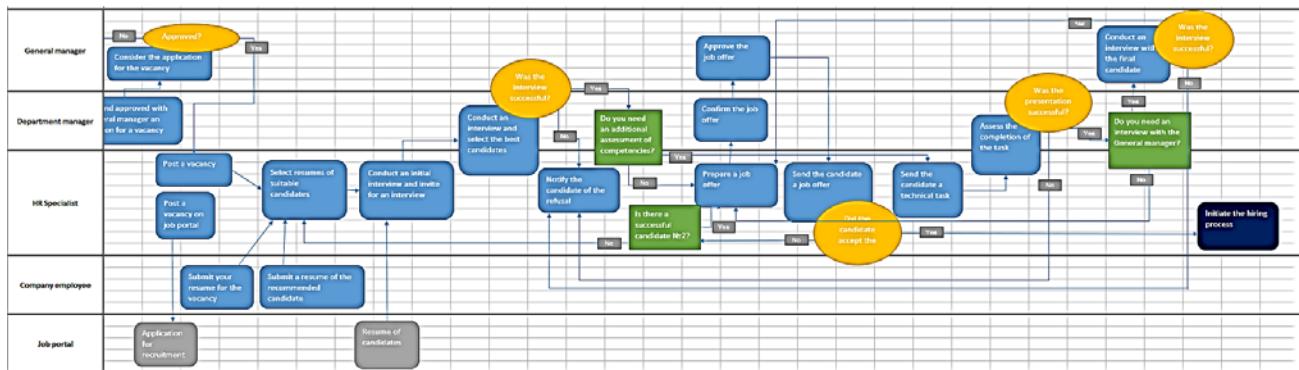


Figure 1 – Recruitment process algorithm

With each new vacancy the search begins on a clean slate - usually HR specialists simply do not have a single system with already collected resumes of candidates from previous times. The approving process of interviews, preparing an offer and contract, enrolling a candidate could be with errors and loss of important data.

That's why there are several automation tools. Among specialized systems, the market leader is the HURMA service. HURMA - system for automation of HR processes and recruitment in a single structure [3]. But if the company has a corporate subscription to Microsoft 365, this process can be integrated into the existing IT infrastructure. Because Microsoft 365 [4] has many capabilities for communication (Microsoft Teams), data storage (OneDrive, SharePoint) and even analytics (PowerBI), additional system setup can automate the recruitment process described above.

Conclusion. Thus, after analyzing the current situation, given the pandemic and the transition to remote work, the need for services to ensure the efficiency of business processes is necessary. Much of the work with documents, processes and people in the company falls on the shoulders of the HR-specialist, so it is especially important to optimize his work. There are quite a number of services and solutions that can reduce working hours, and therefore are the right tool on the way to digitalization of society.

#### **References:**

1. Exploring the post COVID-19 workplace, 2020. URL: <https://www.colliers.com/en-fr/research/2020-exploring-the-post-covid-19-workplace>.
2. M-Files: Intelligent Information Management, 2021. URL: <https://www.m-files.com/>
3. Огляд популярних систем для HR: BambooHR, Zoho People, CakeHR i Hurma, 2020. URL: <https://www.work.ua/articles/employer/2308/>
4. Microsoft has found we're working longer and collaborating less during COVID-19, 2021. URL: <https://www.weforum.org/agenda/2021/10/microsoft-study-covid19-work-hours/>

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## **PECULIARITIES OF PROJECT TEAM MANAGEMENT IN A REMOTE WORK CONDITIONS**

**Abstract.** With nowadays tendencies to switch to remote or hybrid work format, IT companies and projects face troubles and ineffectiveness when using the same methods of team project management, as when their employees worked offline. This paper proposes and describes actions that should be taken by remote team project managers to increase efficiency and probability of success of a project with a remote working team.

**Keywords:** Digital project management, remote work, organizational structure.

Since the beginning of the coronavirus pandemic, most IT companies have begun to view remote or hybrid work formats as acceptable.

Globally, 16% of companies are fully remote according to an Owl labs study [1]. This same study found that about 62% of workers aged 22 to 65 claim to work remotely at least occasionally.

In May 2021, a Mercer study found that 70% of companies said they were planning to adopt the hybrid model [2]. Many companies have already made the switch, including prominent brands such as Adobe, Salesforce, Spotify, and Twitter. Figure 1 shows the frequency of remote work after COVID-19 in the United States in 2020 [3].

However, the established management system in most cases was unprepared for such drastic changes, which led to a loss of communication efficiency within teams and departments of the company, reduced productivity, misunderstandings and the decline of team processes.

Such changes have led to the need to create an effective remote management system for project teams, changes in approaches to communication, planning, reporting and more.

The main problems faced by remote teams:

Communication. The most common form of communication in remote work is text. But the text does not convey emotions well, the same phrase can be interpreted in dozens of ways. Misunderstandings, numerous edits and even conflicts are possible only because one of the employees did not read the letter or misunderstood it.

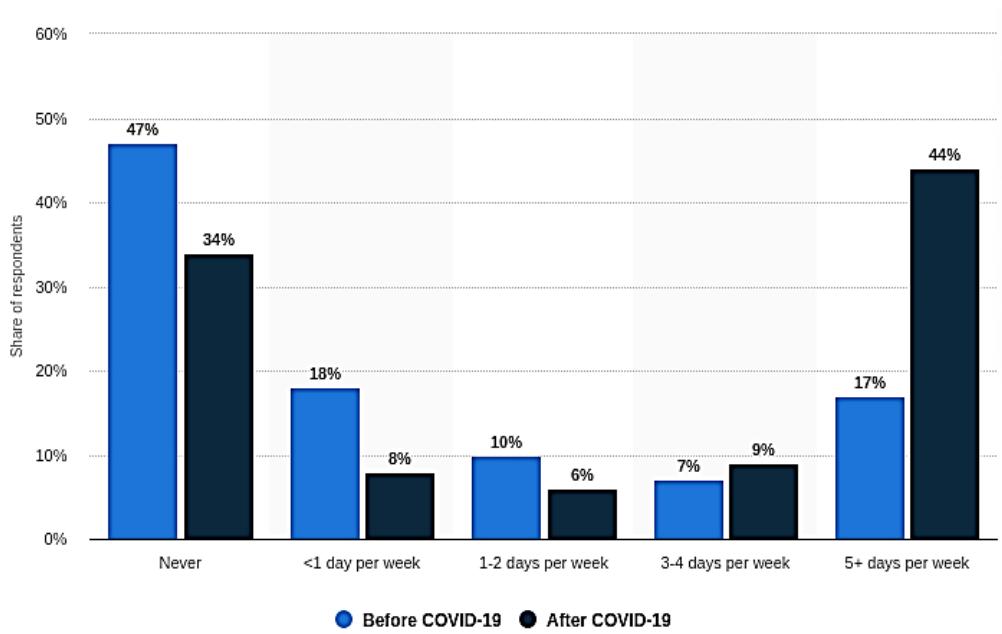


Figure 1 - Remote work frequency before and after COVID-19 in the United States 2020 [3]

Working day and work organization. We all live in different rhythms, and when a team starts working distributed, it is likely that each of its members will try to organize the working day in the most convenient way. When colleagues do not have the opportunity to contact each other at any time, the overall pace of the project slows down. This creates certain problems and delays the workflow. In addition, customers are often dissatisfied with not being able to receive prompt feedback.

There are several key steps that will bring a project manager closer to effective remote team management [4].

### 1. Knowledge Base

It consists of checklists for every task that all departments have or will have. All tasks that are repeated more than 2 times must be documented and described.

Creation of the Knowledge Base basically includes two steps:

- Make a list of tasks for all departments;
- Create a checklist (instruction) for each task.

What is the main goal of checklists?

- Optimize work;
- Improve the quality of the task (when filling in checklists in detail);
- Reduce the time to complete the task;
- Speed up and simplify the process of training new employees (thus a new employee learns faster and more independently);
- If an employee quit, he leaves his experience (all the employee's work is documented).

Who creates checklists?

- The specialist who performs the task;
- Checklist should be checked by the teamlead or head of the department, as it is in his competence;
- Checklists constantly need to be updated.

### 2. Timeline of work

Timeline of work on projects should be created after a list of tasks was drawn up. It is determined separately with the leader of each department.

- Time to complete tasks (deadlines) is determined jointly with the head of the department; it can be adjusted according to practice;

- Ordering and prioritization of tasks. At this point best practice is to use Gantt diagram;
- Formation and sorting of main tasks and subtasks;
- Appointment of responsible people for each task;
- All this is adjusted / optimized in operation;
- Team building.

### 3. Team recruitment

Next, a list of specialists should be formed from which the team will be built. The most important thing is that recruitment needs to go from tasks to hiring people, and not vice versa from recruiting a team to “inventing tasks for them”.

### 4. Work planning

Planning work for remote team has a number of nuances:

- Each employee has his own work plan for the day, week, month;
- CRM has tasks according to previously composed Timeline;
- In shared calendar there are all the main calls and work schedule;
- Weekly team call on Monday morning;
- Separate calls with each team lead at the beginning of the week to discuss all plans and results;
- Team leads call their specialists directly;
- Team meetings.

### 5. Meetings

Meetings are good and necessary, but they often can be a waste of time. Protracted meetings lead to demotivation and ineffective waste of time for employees and company or department leaders.

Steps to optimization of meetings:

- Meetings should be held as little as possible. For example: once a week with each department head or team lead. Team leads are already working closely with their team.
- Work on optimizing the team's work (here: team structure, checklists, training, etc.), then there will be less of what needs to be said every time;
- Learn to delegate.

### 6. Personal conversations

Personal conversations as a form of team communication should be considered on a regular basis. Each employee should have an opportunity to share their feedback about team members, team lead, management, and make suggestions for improving their workflow and environment.

In general, the use of the proposed approaches in team management of remote teams is aimed at improving the efficiency of project teams that work separately during the COVID-19 pandemic. The above helps to increase the probability of success of a project with a remote or hybrid work model and describes steps to building effective and optimised project team management.

### **References:**

1. Owl Labs, State of Remote Work study, 2020.  
<https://resources.owllabs.com/state-of-remote-work/2020>
2. Mercer, Flexible Working Policies & Practices Survey, 2021.  
<https://www.imercer.com/products/flexible-working-policies-practices-survey>
3. Kimberly Mlitz, Remote work frequency before and after COVID-19 in the United States, 2020.  
<https://www.statista.com/statistics/1122987/change-in-remote-work-trends-after-covid-in-usa/>
4. Matt Gavin, 12 Tips for Managing Remote Teams, 2020.  
<https://online.hbs.edu/blog/post/managing-remote-employees>

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## AN APPROACH TO BUILD A DECENTRALIZED COLLECTION OF BUSINESS PROCESS MODELS

**Abstract.** In this study we have proposed the approach to organization of decentralized blockchain-based business process model repository that could be used to provide secure software solution to store and access the business process model collection in a tamper-resistant manner.

**Keywords:** Business Process Model, Blockchain, Repository, Knowledge Sharing, Smart Contract.

Current trend of the digital transformation encourages large enterprises, medium-size companies, and even small businesses to focus on detection, analysis, and improvement of their business processes by deploying BPM (Business Process Management) suites that automate routine activities. Such approach is known as BPM, while described cycle of continuous process improvement is referred as BPM lifecycle. Business processes are considered as structured sequences of activities performed by employees and other stakeholders in order to transform raw information or materials into products or services valuable for customers, either external or internal. For example, sick leave application is processed to satisfy an internal customer – an employee who requested the sick leave, while order processing serves to an external customer – a company’s client or a counter-party organization, which requires order fulfilment. Each of such business scenarios are called as business processes and, traditionally for BPM projects, are represented using graphical models (similar to flowcharts used to describe algorithms) in order to capture, store, and share knowledge about organizational activities. Captured knowledge about ongoing business processes represented in the form of graphical schemes could be used to train new employees (future process participants) or to detect inefficiencies in workflows to improve organizational activities through business process automation (replacing manual routine tasks with scripts) or re-engineering (rebuilding whole business process scenarios from scratch).

Thus, it is natural for big enterprises to have extremely large collections of hundreds or even thousands [1] of business process models. Keeping and accessing such volumes of business process models could be possible with the use of enterprise-level techniques and software solutions. Since availability, integrity, and security are crucial features for enterprise collections of business process models, in this paper we consider usage of a blockchain technology to keep and manage business process models in the secure and stable manner.

According to Yan et al. [1], managing enormous collections of business process models is a complex problem indeed, which requires special software tool to store, search, and manage business process model versions [1]. Such software was called a “business process model repository” [1] and, according to Elias [2], it should correspond to the particular requirements, e.g. support of a standard business process modeling notation, displaying of both graphical and textual process descriptions, provision of multiple model versions for the same process, model search and categorization, model analysis and comparison, support of relationships between business process models etc. However, there are external access and security [2] requirements, which fulfillment is critical for corporate assets. Access control and integrity control features were also mentioned by La Rosa et al. [3], as capabilities of an advanced business process model repository software named “APROMORE” [3]. Also, access, integrity, and, in addition, transaction management features were mentioned as part of the framework for business process model repositories proposed by Yan and Grefen [4]. Researches made in this time period are devoted to efficient querying of business process models, stored in a repositories, using graph-based data structures and indexing approaches similar to search engines [5, 6], and comparison of business process models using various similarity measures based on business process structure and semantic [7, 8]. Nevertheless, all of these studies have mentioned accessibility and security as repository features, but not as their main research objectives.

Since the crypto-boom of 2017, a blockchain technology went far beyond the Bitcoin cryptocurrency, even though it was initially designed to fit digital currency requirements, such as forgery resistance, immutability, and decentralized community-backed governance [9]. Originally created to implement cryptocurrencies, the blockchain technology works with transactions (e.g. containing recipient's address, number of coins to be sent, and sender's signature), which are consolidated into blocks that contain hash values of blocks generated before, by which creating a chain of irreversible and immutable blocks [10]. Therefore, data authenticity and consistency could be proven by checking conformity of hash values back to the initial block of the whole blockchain [10]. Thus, blockchain transactions do not need a “trusted entity” for processing, they could be executed fast and at low cost, cannot be tampered, and could be easily traces [11].

Such benefits could not be unnoticed by industry and to support business process execution on top of blockchains, “smart contracts” were introduced as the computer programs that run in the blockchain platform and record results of their execution as immutable transaction into the blockchain [11]. Being a blockchain platform, Ethereum represents a peer-to-peer network of nodes that maintain a distributed ledger of transactions, whereas its main purpose is a “world computer” that runs smart contracts as general-purpose computer programs created using Solidity language similar to JavaScript by means of its syntax [12]. Unlike Bitcoin, Ethereum and other platforms that support smart contracts are called as “programmable blockchains”, which are used to create decentralized applications or “DApps” [12].

DApps use smart contracts as back-end code and blockchains as databases in

contrast to traditional applications backed by centralized servers, whereas the frontend of DApps is usually created with traditional combination of HTML (HyperText Markup Language), CSS (Cascading Style Sheets), and JavaScript together with the “web3.js” library is used to access Ethereum API (Application Programming Interface) [12]. By April 2021, there are five leading smart contract platforms that could be used as “programmable blockchains”: Ethereum, Polkadot, Solana, EOS, and Binance Smart Chain, however, Ethereum is still the major player and its future development may cement it as the dominant smart contract platform once and for all [13].

Considering relatively young age of a blockchain-based BPM, there are mostly proof-of-concept or experimental solutions currently exist (i.e. Caterpillar and others [14]). These solutions consider cross-organizational performance of business processes supported on top of blockchain platforms.

However, for our best knowledge, the enterprise knowledge sharing approach using a blockchain platform and the BPMN (Business Process Model and Notation) process modeling standard was not proposed yet. Hence, using programmable blockchain platforms, such as Ethereum, there could be created a decentralized application to store and manage collections of business process models as part of the inter-organizational repository of corporate knowledge (see Figure 1).

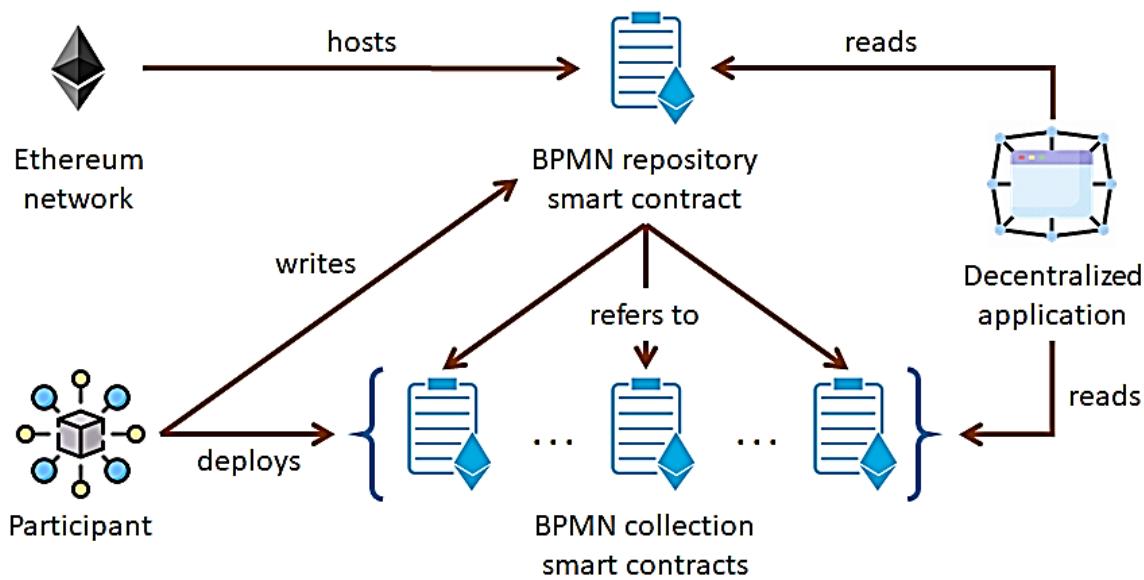


Figure 1 – Conceptual model of a blockchain-based business process model repository

According to the conceptual model shown above in Figure 1, a blockchain-based repository of BPMN models could be implemented as multiple smart contracts: a main smart contract, which addresses one or several smart contracts that represent collections of business process models.

As the frontend should be created a decentralized web application that will get the registry of process model collection from the main smart contract and access respective collections of BPMN models. Therefore, such repository may contain multiple business process models collections owned by different organizations or individuals supporting this enterprise knowledge sharing initiative.

We have selected the Ethereum blockchain platform for smart contract implementation because of its dominance in the area [13], Turing complete programming language Solidity [12], and availability of development tools: Remix IDE (Integrated Development Environment), Ropsten Ethereum test network, MetaMask wallet for interaction with the Ethereum network. Created web application prototype shows a decentralized application that uses HTML, CSS, and JavaScript together with the “web3.js” library to work with the smart contract. The source code of developed decentralized application is available at [15].

**References:**

5. Yan, Z., Dijkman, R., Grefen, P., Business process model repositories—Framework and survey. *Information and software technology* 54(4) (2012) 380–395.
6. Elias, M., Design of business process model repositories: requirements, semantic annotation model and relationship meta-model. Stockholm University, 2015.
7. La Rosa, M. et al., APROMORE: An advanced process model repository. *Expert Systems with Applications* 38(6) (2011) 7029–7040.
8. Yan, Z., Grefen, P., A framework for business process model repositories. In *International Conference on Business Process Management*. Springer, Heidelberg, 2010, pp. 559–570.
9. Sakr, S., Awad, A., A framework for querying graph-based business process models. In *Proceedings of the 19th international conference on World wide web*, 2010, pp. 1297–1300.
10. Dijkman, R., La Rosa, M., Reijers, H., Managing large collections of business process models-current techniques and challenges. *Computers in Industry* 63(2) (2012) 91–97.
11. Dijkman, R. et al., Similarity of business process models: Metrics and evaluation. *Information Systems* 36(2) (2011) 498–516.
12. Becker, M., Laue, R., A comparative survey of business process similarity measures. *Computers in Industry* 63(2) (2012) 148–167.
13. Macdonald, M., Liu-Thorrolld, L., Julien, R., The blockchain: a comparison of platforms and their uses beyond bitcoin. *COMS4507-Adv. Computer and Network Security*, 2017.
14. Fundamentals of Blockchains. URL: [https://www.researchgate.net/publication/351116382\\_Fundamentals\\_of\\_Blockchains](https://www.researchgate.net/publication/351116382_Fundamentals_of_Blockchains).
15. Zheng, Z., An overview on smart contracts: Challenges, advances and platforms. *Future Generation Computer Systems* 105 (2020) 475–491.
16. Oliva, G. A., Hassan, A. E., Jiang, Z. M. J., An exploratory study of smart contracts in the Ethereum blockchain platform. *Empirical Software Engineering* (2020) 1–41.
17. The Best Smart Contract Platforms. URL: <https://academy.shrimpy.io/post/the-best-smart-contract-platforms>.
18. López-Pintado, O. et al.: Caterpillar: A Blockchain-Based Business Process Management System. In *BPM (Demos)*, 2017.
19. GitHub repository. URL: <https://github.com/andriikopp/blockchain-repository>.

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## **THE CHOICE OF INFORMATION TECHNOLOGY ON IMPROVING THE ACCURACY OF THE SIGNAL SYNCHRONIZATION RECEIVED BY THE RADIO TECHNICAL SYSTEM**

Improving the efficiency of communication systems largely depends on the quality of operation of systems and devices that are part of them, as well as on the processes and methods of transmission, reception and processing of useful signal, which are directly related to signal modulation - changing carrier parameters in depending on the level of the transmitted signal.

Satellite communication systems mainly use angular modulation, which is free from the disadvantages associated with the technical complexity of systems that use amplitude modulation. When angular modulation, the transmission of information is carried out by changing the phase and frequency of the carrier. However, a serious disadvantage of angular modulation should be considered that the transmission of a unit of information requires a wider range of frequencies than amplitude modulation.

Angular modulation can be in the form of frequency or phase modulation. Regardless of the type of angular modulation, its implementation requires synchronization of the input signal, which is carried out by the corresponding synchronization systems. For example, in phase-coherent telecommunications and control systems, they are used to restore carrier and clock frequencies and for coherent demodulation of analog and digital signals with angular modulation [1].

The choice of information technologies of optimization and substantiation of the rational scheme of synchronization which would provide to reduce a dispersion of constant and transient errors in the course of tracking of carrier frequency in the presence of noise in the communication channel at angular demodulation of a signal. the problem to which this work is devoted [2].

The paper presents the results of selection and substantiation of information technologies for the construction and application of the scheme of synchronization of the input signal by the phase-coherent communication system in the angular demodulation of the signal transmitted by the satellite communication system [3,4].

As an information technology for the construction of synchronization systems, the article proposes an invariant approach, which determines the possibility of the schemes of construction of the synchronization system presented in the article to increase the order of astatism.

The analysis of closed and combined synchronization systems carried out in the article, on the basis of the offered information technology, showed expediency of application of the specified approach at the decision of a problem on increase of accuracy of synchronization of carrier frequency of a signal at angular demodulation.

Analysis of closed synchronization systems showed that when designing such a system with a minimum of phase error in the angular demodulation of the signal, such a system is characterized by a large transient error [5].

It is shown that taking into account the additive Gaussian noise and instability of generators, the desire to minimize the variance of the phase error in the class of closed synchronization systems causes a deterioration of the system dynamics and does not increase the order of astatism.

The combined synchronization system with open communication is a synthesized invariant system, has the ability to increase the order of astatism, and is able to minimize the phase error in the angular demodulation of the signal.

It is established that in the conditions of instantaneous phase or frequency change it is possible to improve the system dynamics and reduce the transient component of the phase error variance by selecting the parameters of the open link in the direction of suppressing their values of the corresponding roots of the transient characteristic equation.

The selection of open communication parameters in combined synchronization systems can affect the transmission function and thus ensure the minimization of constant and transient errors of the system without affecting the dynamics of the system.

The direction of further research initiated in this article may be the synthesis of open communication in combined synchronization systems in the presence of restrictions on input coordinates and the assessment of the sensitivity of such a system to the deviation of open channel parameters during input signal synchronization.

#### **References:**

1. Humpback I.V. "Remote sensing systems of the Earth from space": a monograph. Lviv: SPOLOM, 2011. 612 p.
2. Shakhtar B., "Analysis of synchronization systems in the presence of interference". 2nd ed., Revised and added. Moscow: Hotline - Telecom, 2016. 360 p.
3. Oleksandr Turovsky, Yurii Khlaponin, Muhi-Aldin Hassan Mohamed et al, "Combined system of phase synchronization with increased order of astatism in frequency monitoring mode", CEUR Workshop Proceedings, 2020, Vol-2616, Session. 1, pp. 53–62.
4. Turovsky O.L. Estimation of the possibilities of the combined synchronization system with open-link to minimize the dispersion of the phase error when tracking the carrier frequency under the conditions of the influence of additive noise. Technology audit and production reserves. 2020. Vol 3, No 4, pp. 16-22.
5. O. Turovsky V. Kozlovskyi, Y. Balaniuk, Y. Boiko. Minimization of phase error dispersion in closed type phase synchronization systems in carrier frequency tracking mode. CEUR Workshop Proceedings (ISSN 1613-0073). Vol. 2845, Pages 382 – 390, 2021. [http://ceur-ws.org/Vol-2845/Paper\\_35.pdf](http://ceur-ws.org/Vol-2845/Paper_35.pdf).

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## **TAKING INTO ACCOUNT A PRIORI UNCERTAINTY IN THE MODEL OF MAINTENANCE OF OBJECTS WITH TIME REDUNDANCY**

**Abstract.** The processes of functioning of technical renewable objects of continuous use, restored and serviced, in which time reservation is provided. The problem of obtaining analytical relations for the limit values of the optimal periodicity of service and the corresponding extreme values of quality indicators in conditions of a priori uncertainty (limited source information) is formulated. A general approach to solving the problem is proposed, which will allow to obtain results that are convenient for practical calculations.

**Keywords:** Maintenance, prior uncertainty, temporary redundancy.

The analysis of a number of publications of domestic and foreign specialists indicates a decrease in attention to the issues of researching the reliability and maintenance of complex technical systems, in particular telecommunications equipment of communication networks [1]. The results known in this subject area are devoted to the study of mainly traditional methods of maintenance and are obtained, as a rule, without a complex consideration of a set of factors that significantly affect the efficiency of maintenance. These factors include the usage of various types of redundancy, which is a necessary condition for ensuring the reliability of the functioning of almost any technical system. In well-known publications, such factors are not always taken into account that characterize the modes of usage of objects for their intended purpose, as well as the parameters of the flows of failures and equipment recovery. All this leads to results that are difficult to use in practice.

The subject of the study are technical facilities with time redundancy (systems "object time"), which provide for periodic maintenance [1, 2, 3]. In contrast to the work [4], the article considers continuous use systems, examples of which are

telecommunication systems of communication networks, automated control systems (ACS) for various purposes and other systems. In addition, the study of these systems is carried out in conditions of a priori uncertainty, which means incomplete source information about the laws of distribution of determinants of random variables, when the exact type of these distribution functions is not specified, and only some numerical characteristics of random variables are known.

The purpose of the article is to substantiate a general approach to the study of maintenance of the mentioned above class of technical objects under conditions of limited initial information about the distribution function of the object recovery time and the distribution function of the maintenance execution time (only two initial moments of these random variables are known), which allows one to obtain design relations for two-way estimates (lower and upper bounds) of the optimal frequency of maintenance and the corresponding extreme values of quality indicators, values of service quality indicators: the maximum value of the coefficient of technical utilization of the facility and the minimum value of the average unit costs.

The given theoretical research of process of maintenance of objects with time reservation allows to draw the following conclusions: the proposed approach to take into account the a priori uncertainty (incompleteness of the source information) when building a model of maintenance of objects of continuous use allowed to obtain relatively easy analytical formulas for quality indicators of maintenance, convenient for practical use. These relationships establish a relationship between the quality indicators and reliability characteristics of the object, the values of periodicity and duration and the parameters of time redundancy; taking into account in the developed model the parameters of time redundancy (allowable time of recovery and maintenance) the ability of objects to function normally under the influence of various destabilizing factors (failures, equipment failures, etc.). It is the presence of time reserve, which is a system parameter, that can in many cases explain why objects perform their functions more successfully than is the result of equipment failure.

### References:

1. DSTU 2860-94. Nadiinist tekhniky. Terminy ta vyznachennia [NSU 2860-94. Reliability of technology. Terms and definitions], 1995. URL: [http://ksv.do.am/publ/dstu/dstu\\_2860\\_94/3-1-0-1102](http://ksv.do.am/publ/dstu/dstu_2860_94/3-1-0-1102). (In Ukrainian).
2. Saleh J.H. & Caster J.-F. Reliability and Multi-State Failures: A Statistical Approach, First Edition. NJ.: John Wiley & Sons, 2011. 206 p.
3. N.Tandon, N. Patel. An Efficient Implementation of Multichannel Transceiver for Manet Multinet Environment // 10th International Conference on Computing, Communication and Networking Technologies (ICCCNT). IEEE, (2019): 1-6. DOI: 10.1109/ICCCNT45670.2019.8944505.
4. V.Lipaev. "Nadezhnost i funkcionanaya bezopasnost kompleksov programm realnogo vremeni" [Reliability and functional safety of real-time software complexes] Institute for System Programming of the Russian Academy of Sciences, 2013. 176 p. (In Russian).

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## **PROJECT MANAGEMENT OF CREATION AND IMPLEMENTATION OF ELECTRONIC DOCUMENTATION SYSTEM**

**Abstract.** This thesis contains a consideration of document management automation problems and an exploration of electronic document management implementation.

**Keywords:** project management, automation, document flow, digital signature.

In the age of internet technology, all processes are being automated. Not so long ago, it was impossible to imagine a world where an email was sent to a friend in two clicks on one's smartphone and a reply arrived in a matter of seconds. This is exactly how the process of correspondence was once automated. Getting rid of paper documents is an urgent need every year, as important documents get damaged and lost over time, severely impacting business processes. The solution to this problem is the transition to electronic document management which allows you to exchange any documents with your counterparts and also gives legal effect to the documents by signing them with digital signature. With the help of an electronic document management service, time and money for sending documents will be saved significantly, as everything will happen in a matter of minutes and there will be no costs for paper, printing or delivery services.

At the moment there are several services in Ukraine that implement electronic document management. [1,2] However, after analyzing the competitors presented in Table 1, it became clear that they have a number of disadvantages and none of them allows secure document exchange without a software download and with the possibility of integration with other systems.

**Table 1**

<b>Competitor</b>	<b>Disadvantages</b>	<b>Advantages</b>
M.E.Doc	<ul style="list-style-type: none"> <li>1. The software has to be downloaded in order to work;</li> <li>2. Inconvenient integration setup (need to use a separate service and configure for each type separately)</li> <li>3. Problems with coding</li> <li>4. Lack of consignment note.</li> </ul>	<ul style="list-style-type: none"> <li>1. A set of functions for any organization: both public and private, regardless of size and type of activity;</li> <li>2. Support for all electronic document formats;</li> <li>3. Transmission of a counterparty document is encrypted;</li> </ul>

1C	<p>1. 1C has absolutely no possibility to work with graphics (i.e. to draw lines, other geometrical figures given in size).</p> <p>2. In the overwhelming majority of cases for "1C:Accounting" to solve all the tasks assigned to it, the program has to be upgraded. When migrating to 1C:Accounting software from another accounting program, you may face serious difficulties when transferring information from one database to another (often you have to transfer most of the information manually).</p> <p>3. In 1C:Accounting it is difficult to find errors made when processing documents.</p> <p>4. The "1C:Accounting" program is quite difficult to master and requires special training for users.</p>	<p>1. Ability to carry out enterprise automation.</p> <p>2. Ease of maintaining tax liabilities.</p> <p>3. Ability to obtain any information quickly.</p>
Vchasno	<p>1. Need to download software.</p> <p>2. Lack of integration.</p>	<p>1. Cheap EDI service provider in Ukraine.</p> <p>2. The exchange of a full package of required messages with the trade network.</p> <p>3. Electronic document flow of primary documents consignment note</p> <p>4. Online exchange of files of any format by digital signature.</p>

Thus, there is an urgent issue of project management for the creation and implementation of an electronic document management system that would provide an electronic document exchange service in Ukraine.

The product of the project [3] is expected to be a website and a mobile application for Android and iOS aimed at legal and natural persons who have access to the Internet and need to exchange legally relevant documents. Among the list of the main tasks of the project to be solved to achieve the set objectives are: to justify the necessity and expediency of this service, to analyze competitors; to make a series of presentations to attract investors; to raise capital for the project implementation; to develop a convenient website design and implement the link between the website and the application; to analyze existing software development technologies and determine the quality standard of the product; to conduct an advertising campaign; to form a team to develop the service

with minimum labor costs; ensure effective communication within the team; implement electronic document management at 2 sites within the first 6 months.

This project will solve a number of problems encountered when working with paper documents, namely their damage due to weather conditions or human error; their complete loss. By working on the site, users will be able to work anywhere in the world. Integration with other systems will be available to quickly switch to our service.

The project is divided into phases that create the project life cycle in order to ensure that the project is carried out within the given constraints. It consists of 5 phases: Initiation, Project Planning, Development, Progress Control, Project Closeout.

In the project inception phase (project initiation and planning), the following tasks are identified: start-up organization (conducting problem analysis and identification; problem tree construction; impact analysis); formulation of project alternatives; development of project certificate and project statute.

The main phase in the life cycle is development. During this phase, the main task is to develop the service, to monitor the work done, project managers present a monthly report with a list of changes for investors, conduct training to improve the skills of employees, conduct presentations to achieve the goal of implementing the product in 2 companies, and launch an advertising campaign to attract users.

With the development and implementation of this service, customers can order a package of 100 documents free of charge and experience all the benefits of electronic document management, thus attracting more users.

It is planned to get profit from sales of the package of documents, besides enterprises have an opportunity to order special functions, which will improve work with the service, for additional payment.

The analysis shows that there are already services in place that implement electronic document management. The main problem is that they need to download software to do this. We, on the other hand, offer to work on a website, which allows exchange even in their smartphones.

Consequently, this service will be useful for both individual users and large enterprises.

**Conclusions.** The analysis presented on Ukrainian market electronic document management systems showed that they have shortcomings. Implementation of the proposed project will create a competing information system with unique functionality. In the paper the strengths of the project and opportunities for further development was determined. However, it is necessary to pay attention to the weaknesses of the project and try to solve them with the strengths, as well as build appropriate response strategies to prevent the emergence of risks.

#### References:

1. Переваги та недоліки 1С [Електронний ресурс] – Режим доступу до ресурсу: <https://1c.programs93.ru/articles/pljusy-i-minusy-1s/>.
2. Про сервіс M.E.Doc [Електронний ресурс] – Режим доступу до ресурсу: <https://medoc.ua/faq>.
3. Морозов В.В. Управління проектами: процеси планування проектних дій: Підручник / В.В. Морозов, І.В. Чумаченко, Н.В. Доценко, А.М. Чередніченко. - К.: Університет економіки та права «КРОК», 2014. – 673 с.

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## **FEATURES OF THE PROJECT TO DEVELOP AN APPLICATION TO DETECT FAKE COUNTERFEITS**

**Abstract.** The article describes the problem of combating counterfeiting and offers a solution by developing a project to detect counterfeits.

**Keywords:** Counterfeit, Brands, Black Market, Original, Manufacturers, Sellers.

The market of resale of goods is very developed and gaining momentum. People want to buy quality products at attractive prices and excellent quality. But it is not always possible to find the necessary products on the official websites of brands, or a particular brand may not be officially represented in some countries. Therefore, people often turn to reliable resellers (people who buy branded items and resell them). But at this point there is an urgent question about the quality of goods, because resellers can confirm this only in their own words. It is well known that there is a large proportion of sellers who sell counterfeits and pass them off as authentic goods. At the same time, counterfeiters make goods that are difficult to distinguish from authentic ones [3]. This problem in the reselling market raises an important question: how to determine the authenticity of goods and assure customers of their quality [2].

The project involves the creation of a mobile application to identify authentic branded products, which will help users to check things before buying for originality, ie whether it is counterfeit [1].

The coronavirus pandemic has become a catalyst for e-commerce. Quarantine, self-isolation, curfew, restrictions on movement - all these measures have led to the fact that the lion's share of goods humanity now orders online. Clothing, appliances, cosmetics, food and even medicine - all this is now bought online, as evidenced by numerous studies to increase the share of e-commerce in the global market, but at the same time, the market has become more fraudulent, who brazenly sell counterfeits under the guise of quality and original products [2].

This problem can be solved by creating a tool that will determine the authenticity of goods. This tool will serve as a means of determining quality for buyers, as well as a means of quality assurance for sellers [1].

Since the need to purchase quality goods is high, this area is quite promising. The application will not lose its relevance due to the fact that the number of counterfeits is dynamically increasing, and their similarity with authentic goods complicates the analysis of buyers for originality and quality [3].

So, in times of rapid development of e-commerce, when buyers are not physically able to verify the authenticity of the product before buying, our application "Pal`off" comes in handy (fig. 3).

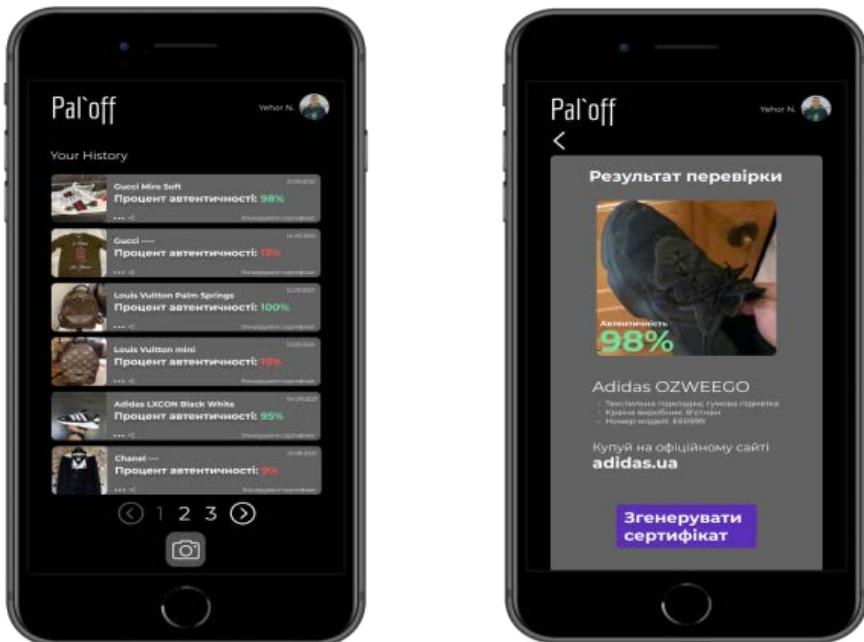


Figure 4 – The prototype of the product

It will help both buyers who can scan the product in the application to verify its authenticity, and bona fide sellers who will be able to add a certificate of analysis of the product for authenticity, because such certificates are generated by our application.

After analyzing the subject area and market of similar products and technical solutions, we can conclude that our product is unique because it allows you to test specific clothes in real time using artificial intelligence (without waiting for manual verification).

However, the Legit App, which is presented on the market, has the option of forming a certificate of quality assurance, which can be used when selling things. This functionality is interesting because this confirmation can be used by resellers as a sign of quality, so that the user does not verify the authenticity of the thing further.

#### **References:**

1. Forgeries on marketplaces: the experience of the EU and the situation in Ukraine [Electronic resource] - 2019. Access mode: <https://rau.ua/e-commerceuk/poddelky-na-marketplejsah/>
2. Counterfeits on marketplaces: how to fight them in the EU and what to do to Ukrainian buyers [Electronic resource] - 2019. Access mode: <https://ain.ua/2019/03/21/poddelki-na-marketplejsax/>
3. How many fakes in Kyiv boutiques [Electronic resource] - 2016. Access mode: <https://biz.nv.ua/ukr/experts/skilki-pidrobok-u-kijivskih-butikah-253480.html>

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## **FEATURES OF PROJECT MANAGEMENT OF DEVELOPMENT AND IMPLEMENTATION OF THE SYSTEM USING CLOUD CALCULATION FOR REMOTE GAMING**

Currently, the field of gaming in Ukraine and around the world is going through difficult times. First of all, due to the introduction of strict regulation of many plants and production lines, as well as disruption of supply chains has led to a shortage of products containing semiconductors, such as: automotive multimedia systems, home appliances, and computer hardware, on which, of course, remains in extremely high demand [1]. This situation, caused by the COVID-19 pandemic, is exacerbated by the increased demand for video cards, which, although an integral part of any gaming station, have recently been increasingly used to extract virtual cryptocurrencies, the extraction process of which is highly dependent on the capacity of the computing power or the number of video cards.

Third, most video game development studios, including Ukrainian ones, are also forced to suffer losses due to unwillingness to optimize the development process in the mode of partial or complete isolation of teams [2], which forces publishers to increase prices for their products, for example, the AAA-game price last year increased by an average of 16% [3].

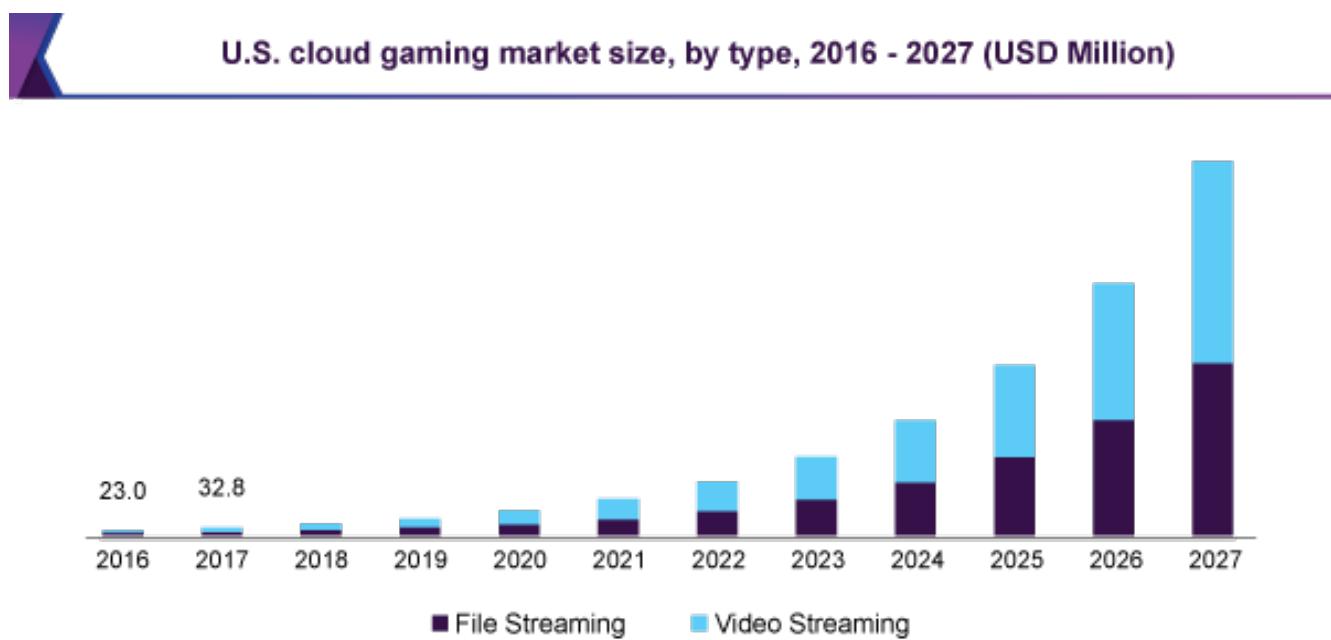
The fourth reason is an ideological continuation of the third. Unfortunately, a very attractive way out of this situation for many is piracy, which exacerbates the problem even more. The increase in prices for digital products, as well as for hardware, determines the price insolvency of a potential customer who will be looking for alternatives. The secondary gaming market may be a good alternative, but there is currently no specialized service among Ukrainian marketplaces that would be geared towards gamers.

Analyzing the above reasons for the decline of the gaming industry in Ukraine, we can highlight the following [4]:

- Lack of hardware at recommended retail prices in electronics stores causes shortages of components
- Rising game prices are repelling potential buyers

The project envisages the creation of an Internet service that will provide users with remote protocols and firewalls protected access to virtual capacity through a cloud computing infrastructure. Each player will be allocated a separate slot from the entire cluster. Access to the functionality of the service will be provided on various platforms, including: from a browser, from a mobile device on the Android platform using the application, from an iOS device using Progressive Web Application technology, and from a desktop application on Linux, MacOS and Windows platforms.

The service supports several monetization options and offers users the following usage options: free access, in which the game session is limited to 1 hour of gameplay, monthly subscription, and annual subscription, which offer the best graphics settings and priority in the queue.



Source: [www.grandviewresearch.com](http://www.grandviewresearch.com)

Figure 1. Forecasting the market share of cloud gaming services in the United States

The COVID-19 pandemic has had a positive impact on the growth of the cloud gaming market. The majority of the population is quarantined at home due to the pandemic, and search engines offer many interactive games on their home page, trying to entice users. Publishers and developers are taking initiatives to encourage the development of remote gaming services, while promoting social distancing.

#### **References:**

1. Xue, Zheng, et al. "Playing high-end video games in the cloud: a measurement study." *IEEE Transactions on Circuits and Systems for Video Technology*, v. 25, n. 12, p. 2013-2025, 2015.
2. Anders Drachen "Guns, Swords and Data: Clustering of Player Behavior in Computer Games in the Wild" 2012 IEEE Conference on Computational Intelligence and Games (CIG'12).
3. Yuri Demchenko, Cees de Laat "Defining Architecture Components of the Big Data Ecosystem" IEEE 2014.
4. Grandviewresearch. Cloud Gaming Market Size, Share & Trends Analysis Report By Type (File Streaming, Video Streaming), By Device, By Gamer Type, By Region, And Segment For Forecasts, 2021 - 2027 [Електронний ресурс] / Grandviewresearch // GVR-4-68038-847-3 – Режим доступу: <https://www.grandviewresearch.com/industry-analysis/cloud-gaming-market>.

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## DEVELOPMENT OF A SYSTEM OF PROTECTION AGAINST SALE OF COUNTERFEIT DRUGS IN PHARMACIES

**Annotation.** The article describes the problem of combating drug falsification and proposes its solution by developing a system for detecting counterfeits.

**Keywords:** system, pharmacies, datamatrix, protect, counterfeits, Waterfall

**1. Introduction.** According to the World Congress of Pharmacy and Pharmaceutical Sciences FIP, the issue of counterfeit drugs is global. Poor quality and counterfeit medical devices can harm patients and not cure the diseases for which they are intended. It is estimated that 1 in 10 medical devices in low- and middle-income countries are substandard or counterfeit. They lead to a loss of confidence in medicines, healthcare professionals and healthcare systems [2].

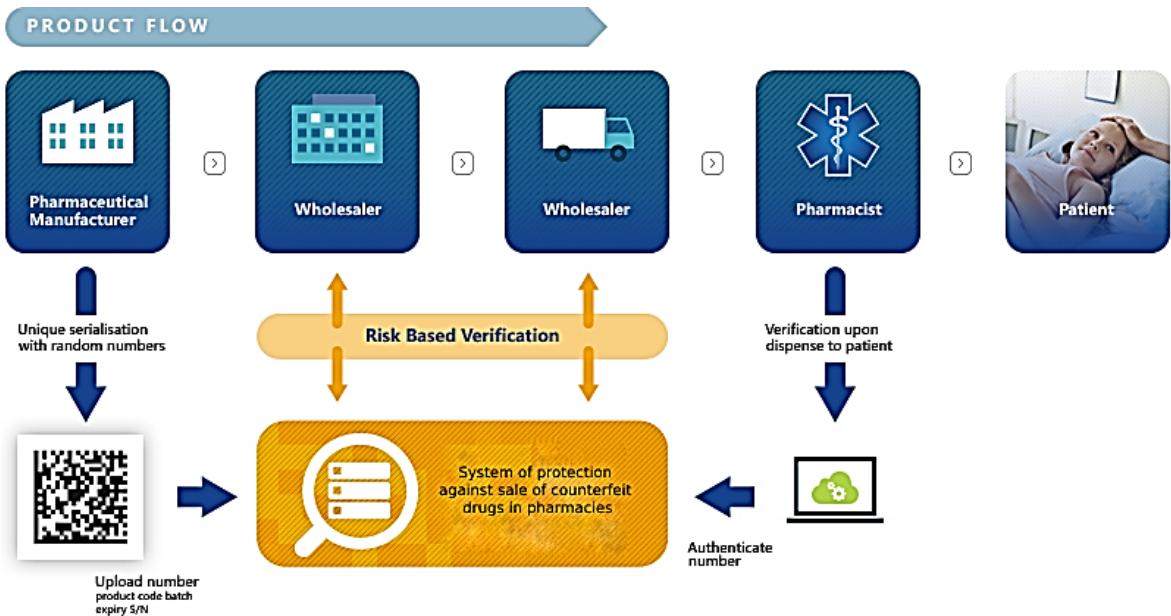
**2. The aim of the research.** The research will reveal the topic of developing an information system for protection against counterfeiting of medicines, which has no analogues in the world. The purpose of this work is to develop a system of protection against the sale of counterfeits in pharmacies. The system should provide for the use of unique identification keys to identify drugs. Therefore, the research of such processes seems relevant and appropriate, and the goal requires its solution.

**3. Basic material.** Poor quality and counterfeit medical devices are difficult to detect by nature. They are often designed to look identical to the real product and may not cause an obvious side effect, but they often cannot properly treat the disease or condition for which they were intended and can lead to serious health consequences, including death [2].

The best way to actually protect yourself from counterfeiting in the future is to create a system that will address this issue quickly and efficiently.

Description of the system:

Before placing batches in the market, the drug manufacturer must provide the drug codes to be entered into the system database, print a 2D code (DataMatrix) that includes a unique identifier and apply an anti-counterfeiting device on the outer packaging of all drugs for each package. Before selling each package, the pharmacist has to scan the barcode of the medication. The information is sent to the database and the code is checked [Figure 1].



**Figure 1: Product flow**

**4. Conclusions.** Therefore, the system of protection against counterfeiting in pharmacies favors stakeholders in terms of drug quality. The pharmacy will receive quality drugs, thereby increasing its reputation and the number of customers. Manufacturers will increase competitiveness in the market through the sale of its own original drugs. The state will increase the level of health care in the country. Customers will be able to be confident in the quality of their medicines and avoid health risks.

The system design project involves a long development period and the presence of a development team. The Waterfall methodology has been assigned for the planned process of marketing. This model is used in the medical development field, as it is a strictly disciplined domain. Waterfall is easy to manage due to the rigidity of the model – each phase has specific deliverables and a review process, and phases are processed and completed one at a time [3].

In the future, it is possible to consider additional ideas for the development team, such as creating a mobile application, desktop application and web-application based on the developed system. If the system is successful, and it is decided to expand it, new development teams may appear and work in parallel.

In this way, the system of protection against counterfeiting in pharmacies as an idea will be able to protect the health of consumers and the reputation of manufacturers and pharmacies. With quality medicines on the market, consumers will be able to be sure that there are no counterfeits in the pharmacy and to avoid harm to health.

#### References:

1. PMBOK Guide. URL: <https://www.pmi.org/pmbok-guide-standards/foundational/PMBOK>
2. <https://www.who.int/news-room/fact-sheets/detail/substandard-and-falsified-medical-products>
3. SDLC and the Waterfall Model. URL: <https://poddtoppen.se/podcast/1446544379/pharmacy-it-me-your-informatics-pharmacist-podcast/192-sdlc-and-the-waterfall-model>

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## **ALGORITHM FOR INCREASING THE STABILITY LEVEL OF CRYPTOSYSTEMS**

**Abstract.** The article considers the types of DSA and ECDSA cryptosystems affected by side channel attacks. A method for identifying the type of impact based on lattice attacks has been developed, which showed that if there are common bits in ephemeral keys, the sender's private key can be restored in polynomial time. As countermeasure this attack an ephemeral key generation algorithm was developed, using a deterministic signature and a constant-time modular inverse algorithm.

**Keywords:** lattice, shared bits, modular inverse, constant-time, deterministic signature, cryptosystems

### **Introduction**

For some encryption systems, an ephemeral key (nonce) is used, which is needed to add more complexity to the encryption algorithm, the main requirement for it, the ephemeral key must be used only once. For DSA, ElGamal, ECDSA [1, 2] encryption systems - when creating encrypted messages, an ephemeral key is additionally used, which in turn leads to attacks on side channels, FLUSH+RELOAD ephemeral key data [3], attacks on the pseudo-random number generator [4], using oscillograph for timings attack [5], using masked digital signal [6]. All of these attack types result in the substitution or interception of individual bits of ephemeral key data, giving third parties access to encrypted messages, which in turn compromises the sender's secret key. A particularly dangerous cryptoattack types are side channel attack, which allow, by analyzing the time of generation of the ephemeral key, to find the most or least significant bits of the ephemeral key. Then using special methods the sender's private key is searched.

The aim of the work is to increase the degree of protection of the process of information exchange in system networks on the basis of the developed effective data encryption algorithm.

To achieve this goal it is necessary to determine the vulnerability type of cryptosystems to sidechannel attack, as well as to develop an effective method protection cryptosystems from sidechannel attack to prevent unauthorized access to encrypted information.

Assume that an attacker was able to collect  $n$ -number encrypted messages  $m_i$  ( $i=1, \dots, n$ ) with the associated signatures  $(r_i, s_i)$ , where all the corresponding ephemeral keys  $k_i$  shared total  $\square$  bits between more significant (MSB) and less significant (LSB) bits independent of  $i$ . In this way, they will meet the following dependency for all  $i=1, \dots, n$ :

$$k_i = k + 2^t \tilde{k}_i + 2^{t'} k', \quad (1)$$

where  $0 \leq k < 2^t, 0 \leq k' < 2^{N-t}, \delta = N - t + t, 0 \leq \tilde{k}_i < 2^{N-\delta}$ , with  $k$  and  $k'$  common for all  $k_i$ .

It should be noted that the values of the variables  $k_i, k, \tilde{k}_i, k'$  are unknown. In the  $n$ -oï of equations (2), which define the signature:

$$\begin{cases} m_1 + ar_1 - s_1 k_1 \equiv 0 \pmod{q}; \\ m_2 + ar_2 - s_2 k_2 \equiv 0 \pmod{q}; \\ \dots \\ m_n + ar_n - s_n k_n \equiv 0 \pmod{q}, \end{cases} \quad (2)$$

where  $m_i$  – message,  $a$  – signer private key,  $r_i$  – numerical value of the first part of the signature,  $s_i$  – numerical value of the second part of the signature,  $k_i$  – ephemeral key,  $i$  – message index.

If in the system of equations (2) replace the parameters  $m_i, r_i, s_i$  with the value (1) and eliminate common variables  $k$  and  $k'$ , then we obtain:

$$\begin{cases} (s_1^{-1}m_1 - s_2^{-1}m_2) + a(s_1^{-1}r_1 - s_2^{-1}r_2) - 2^t(\tilde{k}_1 - \tilde{k}_2) \equiv 0 \pmod{q}; \\ (s_1^{-1}m_1 - s_3^{-1}m_3) + a(s_1^{-1}r_1 - s_3^{-1}r_3) - 2^t(\tilde{k}_1 - \tilde{k}_3) \equiv 0 \pmod{q}; \\ \dots \\ (s_1^{-1}m_1 - s_n^{-1}m_n) + a(s_1^{-1}r_1 - s_n^{-1}r_n) - 2^t(\tilde{k}_1 - \tilde{k}_n) \equiv 0 \pmod{q}. \end{cases} \quad (3)$$

Let  $\alpha_i, \beta_i, \kappa_i \in Z$  be such that:

$$\begin{cases} \alpha_i := 2^{-t}(s_1^{-1}m_1 - s_i^{-1}m_i) \pmod{q}; \\ \beta_i := 2^{-t}(s_1^{-1}r_1 - s_i^{-1}r_i) \pmod{q}; \\ \kappa_i := \tilde{k}_1 - \tilde{k}_i. \end{cases} \quad (4)$$

Then, system of equalities (3) becomes:

$$\begin{cases} \alpha_2 + a\beta_2 - \kappa_2 \equiv 0 \pmod{q}; \\ \alpha_3 + a\beta_3 - \kappa_3 \equiv 0 \pmod{q}; \\ \alpha_n + a\beta_n - \kappa_n \equiv 0 \pmod{q}, \end{cases} \quad (5)$$

where  $a, \kappa_i$  and  $\alpha_i, \beta_i$  - are known value and unknown value.

The set of solutions is:

$$L = \{(x_0, x_1, \dots, x_n) \in \mathbf{Z}^{n+1} \mid x_0\alpha_i + x_1\beta_i - x_i \equiv 0 \pmod{q}\}, \quad (6)$$

forms an  $(n+1)$ -dimension lattice spanned by the row vectors of the following basis matrix:

$$M = \begin{pmatrix} 1 & 0 & \alpha_2 & \dots & \alpha_n \\ 0 & 1 & \beta_2 & \dots & \beta_n \\ 0 & 0 & q & \ddots & 0 \\ \vdots & \vdots & \vdots & \ddots & \vdots \\ 0 & 0 & 0 & 0 & q \end{pmatrix}. \quad (7)$$

To find the short vector in the matrix (7), LLL or BKZ algorithms can be used. If the system of equations (3) has a solution (determining the value of a short vector  $\bar{v}_0$  with elements  $v_0 = (1, a, \kappa_2, \kappa_3, \dots, \kappa_n)$ , which will be identical to the element of the system

of solutions (6), then the value of the signer's private key  $a$  will be obtained.

However, the norm  $\bar{v}_0$  is lower bounded by secret key  $a$ , which can be an integer of approximately  $N$  bits. Then the next element of the vector  $\bar{v}_0$  is much larger than the next ones, which are  $N - \square$  integers.

The developed approach to obtaining access to private keys from signed messages proves that the DSA (ECDSA) algorithm is vulnerable to side-channel attack, in case when the ephemeral keys of each encrypted message have shared bits in less and/or more significant bits.

To prevent these types of attacks, it is necessary to change the existing ephemeral key generation algorithm to deterministic to avoid generating similar or the same ephemeral keys that would immediately compromise the signer's private key. To achieve this goal, a new function for generating an ephemeral key which will receive a message ( $m$ ) and private key of the sender ( $d$ ), is proposed. This function use of additional hash function that follows the integrity of the data, and mixes the ephemeral key for greater randomness.

Also, one of the vulnerable points in the creation of signatures is a modular inverse operation in the algorithm 2 [9].

The execution time of the algorithm 2 depends on both values  $a$  and  $b$ , namely the number of iterations of the While cycle, as well as the degree of two, which should be removed in the end of the algorithm, are significantly different for input data. Therefore, to convert an algorithm 2 into an algorithm performed by a constant time for a given  $wn$  bit module  $m$ , it is necessary to save the following requirements:

One iteration is always calculated by the same amount of time, it means to calculate all four branches from the algorithm 2 and select the correct values for a constant time. This ensures that the time of execution of one iteration does not depend on the branch taken, but means that the calculation time increases until the calculation of all branches;

The algorithm must perform the one-time number of iterations (for a constant time), which means that it is necessary to calculate the worst number of  $2wn$  iterations. This can be realized by determining when the algorithm 2 is completed (when  $v = 1$ ). Depending on this condition, we create a bit mask and choose the input value for this iteration (when  $v = 1$ ), or the value, calculation with iteration with constant time ( $v \neq 1$ ).

### **Conclusions**

The vulnerability type of cryptosystems is determined for side channel attack, which is concluded in blocking the bits of the ephemeral key or determining the signature time of each message. Using the developed method, the signers private key can be determined in the presence of a sufficient number of messages in less than a minute, bypassing a discrete logarithm problem, which in turn fully compromises the stability of cryptosystems.

Was developed a effective method for protecting cryptosystems to attack by side channels to prevent unauthorized access to encrypted information, based on a new ephemeral key generation algorithm to prevent attacks by side channels, which increases the count a mathematical operation to  $2^N$ .

The use of the developed constant time algorithm of modular inverse, provides a constant number of clock cycles, namely, the number of bits of 256, the number of cycles will not be constant 50-60. When using this algorithm, the number of clock cycles is always 486, which provides resistant to the attack.

**References:**

1. Roman N. Kvyetnyy, Olexander N. Romanyuk, Evgenii O. Titarchuk, Konrad Gromaszek, and Nazarbek Mussabekov "Usage of the hybrid encryption in a cloud instant messages exchange system ", Proc. SPIE 10031, Photonics Applications in Astronomy, Communications, Industry, and High-Energy Physics Experiments 2016, 100314S (28 September 2016); 7 p. <https://doi.org/10.1117/12.2249190>.
2. Roman N. Kvyetnyy, Yevhenii A. Titarchuk, Volodymyr Y. Kotsiubynskyi, Waldemar Wójcik, Nursanat Askarova. Partially homomorphic encryption algorithm based on elliptic curves.- Proc. SPIE 10808, Photonics Applications in Astronomy, Communications, Industry, and High-Energy Physics Experiments 2018, 108082H (1 October 2018); 8 p. doi: 10.1117/12.2501583; <https://doi.org/10.1117/12.2501583>.W. Wójcik, R. N. Kvyetnyy, Y. A. Titarchuk, V. Y. Kotsiubynskyi, and N. Askarova, "Partially homomorphic encryption algorithm based on elliptic curves," 2018, doi: 10.1117/12.2501583.
3. A. I. Gomez, D. Gomez-Perez, and G. Renault, "A probabilistic analysis on a lattice attack against DSA," Des. Codes, Cryptogr., vol. 87, no. 11, 2019, doi: 10.1007/s10623-019-00633-w.
4. P. A. Fouque, M. Tibouchi, and J. C. Zapalowicz, "Recovering private keys generated with weak prngs," in Lecture Notes in Computer Science (including subseries Lecture Notes in Artificial Intelligence and Lecture Notes in Bioinformatics), 2013, vol. 8308 LNCS, doi: 10.1007/978-3-642-45239-0\_10.
5. Y. Ivanchuk. Mechatronic Systems II. Applications in Material Handling Processes and Robotics, edited by Leonid Polishchuk, Orken Mamyrbayev, Konrad Gromaszek, (2021), Taylor & Francis Group, CRC Press, Balkema book Boca Raton, London, New York, Leiden, 352 P. ISBN 978-1-032-10585-7, DOI: 10.1201/9781003225447.
6. A. A. Yarovyy, L. I. Timchenko, N. I. Kokriatskaia, "Parallel-Hierarchical Computing System for Multi-Level Transformation of Masked Digital Signals," Advances in Electrical and Computer Engineering, vol.12, no.3, pp.13-20, 2012, doi:10.4316/AECE.2012.03002.
7. P. Q. Nguyẽn and D. Stehlé, "Floating-point LLL revisited," in Lecture Notes in Computer Science, 2005, vol. 3494, doi: 10.1007/11426639\_13.
8. C. P. Schnorr and M. Euchner, "Lattice basis reduction: Improved practical algorithms and solving subset sum problems," in Lecture Notes in Computer Science (including subseries Lecture Notes in Artificial Intelligence and Lecture Notes in Bioinformatics), 1991, vol. 529 LNCS, doi: 10.1007/3-540-54458-5\_51.
9. B. S. Kaliski, "The Montgomery Inverse and Its Applications," IEEE Trans. Comput., vol. 44, no. 8, 1995, doi: 10.1109/12.403725.

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## **PROJECT MANAGEMENT PLATFORM FOR INTERNATIONAL RESEARCH AND DEVELOPMENT**

Implementing an agile method means that you will not abandon actual project operation processes, but the nature of project implementation may eventually alter dramatically [1].

Is a essential aspect of agile models, which is utmost useful for all types of business projects. An venture project is often characterized by the fact that it is challenging to accurately predict in advance. Some areas of activity later in the project are relatively impossible to assess a foretime the project participants have seen the decisions and projects made earlier. As a result, attempts to be predictive on a large scale are often a high risk for such projects. From the other hand, an adaptive approach to evolving early stages and returns to improve the project over and over again manage to be much farther effective. Returning to the approach of moving wave planning, as outlined in the PMBOK® Guide [2, 3], has the potential to be of big benefit.

The Yanchen Polytechnic Institute is no exception, which integrates the latest accomplishments in project and program operation with educational and scientific processes.

The Agile mechanism - iterative and gradual evolvement - is widely used to implement international joint projects. This approach is very significant in the context of national differences and the location of project executors in different countries. In particular, when performing cooperative research for client companies.

There is a project operation structure - Kanban [4].

### **Main research results**

One of the main challenges for project managers using the Agile methodic is to take human factors into account, focusing on the talents and skills of individuals. If the people in the project are qualified enough, they can use different approaches to complete the assignment. Agile is aimed at contingentwork, with maximum use of individual talents to effectively achieve the goal [5].

For Agile methodic , it is practiced to use a workflow visualization tool to display the status of project assignments. The Odoo complex is used for joint projects between Ukrainian research institutions and the Yanchen Polytechnic Institute. Odoo is a set of open source software that covers all the company's needs: CRM, e-commerce, accounting, warehouse, point of sale, project operation and farther. The uniqueness of Odoo lies in the ease of use and full integration [6-13].

Figure 1 The menu for creating project assignments in the Odoo complex, which was used to implement a simple scientific topic "Development of a gas cleaning device for ventilation complexes of industrial premises." The assignments are detailed in a specialized menu, which is presented in Figure 2.

The Kanban board of the simple scientific topic "Development of a gas cleaning

device for ventilation complexes of industrial premises" is presented in Figure 3.

As an example, the article presents a assignment board for the implementation of a simple scientific topic "Development of a gas cleaning device for ventilation complexes of industrial premises", which is commissioned by a Chinese company. The main performers are two parties - Chinese and Ukrainian. The client is directly involved in the project as a party with whom every result of the sprint - backlog.

Using an integrated project operation platform minimizes backlog approval time. Performance on the project by contingents in different parts of the world is without delay, which makes the implementation of such projects competitive in the international market of research services.

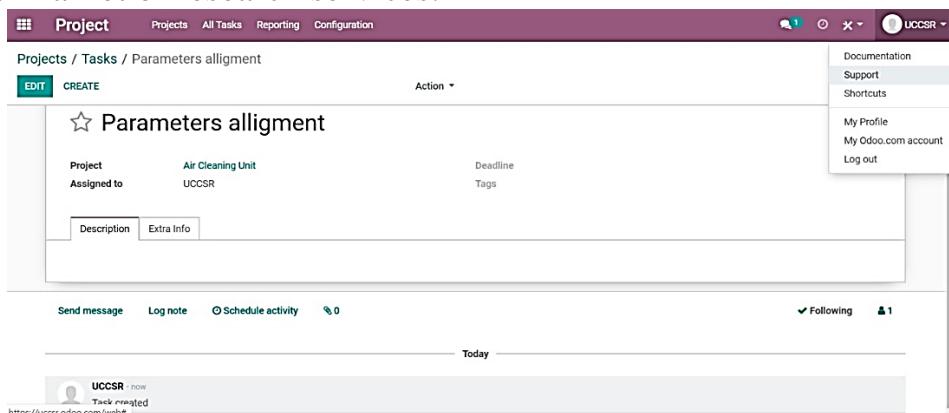


Figure 1 – Menu for creating project assignments in the Odoo complex

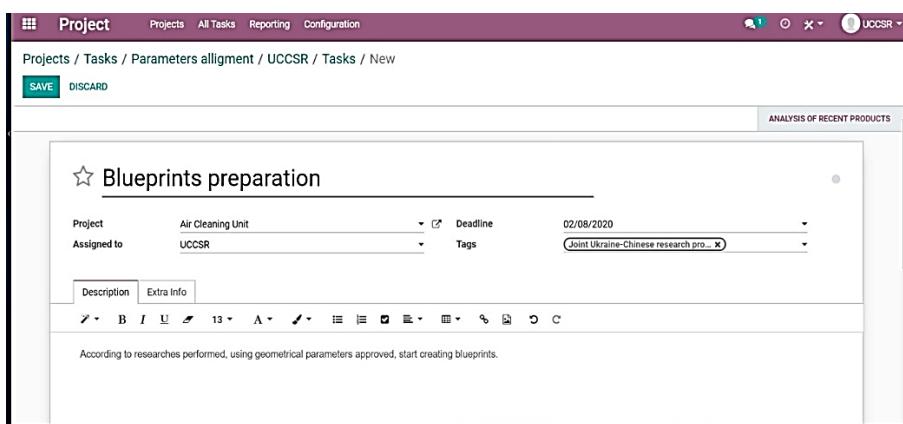


Figure 2 – Menu detailing project assignments in the Odoo complex

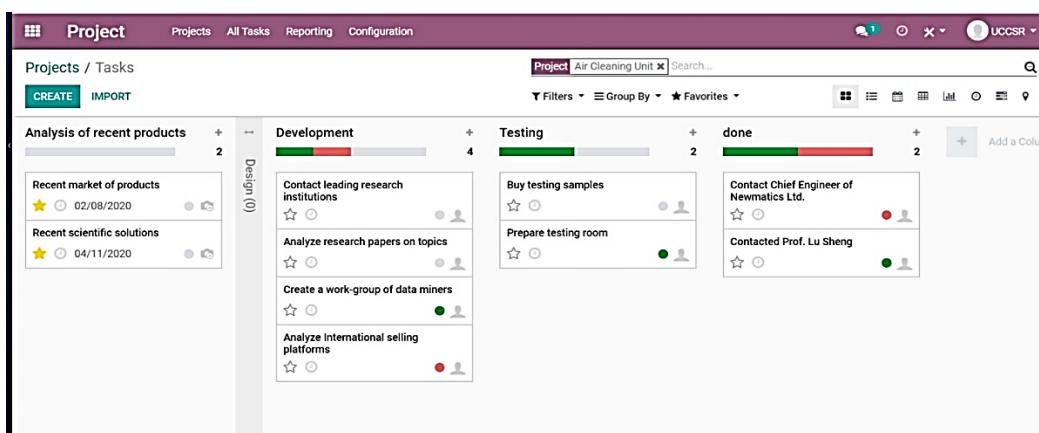


Figure 3 – Kanban board of simple scientific theme

**Conclusion.** For Agile methodic , it is practiced to use a workflow visualization tool to display the status of project assignments. The Odoo complex is used for joint projects between Ukrainian research institutions and the Yanchen Polytechnic Institute.

As an example, the article presents a assignment board for the implementation of a simple scientific topic "Development of a gas cleaning device for ventilation complexes of industrial premises", which is commissioned by a Chinese company.

Using an integrated project operation platform minimizes backlog approval time. Performance on the project by contingents in different parts of the world is without delay, which makes the implementation of such projects competitive in the international market of research services.

**References:**

1. Vandersluis, C. (2014). Apply agile methodology to non-software enterprise projects. Paper presented at PMI® Global Congress 2014—North America, Phoenix, AZ. Newtown Square, PA: Project Management Institute.
2. A. Kuchansky et al., "Combined Models for Forecasting the Air Pollution Level in Infocommunication Systems for the Environment State Monitoring," 2018 IEEE 4th International Symposium on Wireless Systems within the International Conferences on Intelligent Data Acquisition and Advanced Computing Systems (IDAACS-SWS), Lviv, 2018, pp. 125-130, doi: 10.1109/IDAACS-SWS.2018.8525608.
3. PMBOK® Guide – Sixth Edition (2017) / FOUNDATIONAL STANDARDS, <https://www.pmi.org/pmbok-guide-standards>.
4. Kuramshina, G. M., & Yagola, A. G. (2017). Applications of regularizing algorithms in Structural Chemistry. Eurasian J. Math. Comp. Appl, 5, 53-72.
5. A. Kuchansky et al., "Combined Models for Forecasting the Air Pollution Level in Infocommunication Systems for the Environment State Monitoring," 2018 IEEE 4th International Symposium on Wireless Systems within the International Conferences on Intelligent Data Acquisition and Advanced Computing Systems (IDAACS-SWS), Lviv, 2018, pp. 125-130, doi: 10.1109/IDAACS-SWS.2018.8525608.
6. A. Biloshchytskyi, S. Biloshchytksa, A. Kuchansky, O. Bielova and Y. Andrushko, "Infocommunication system of scientific activity management on the basis of project-vector methodology," 2018 14th International Conference on Advanced Trends in Radioelectronics, Telecommunications and Computer Engineering (TCSET), Slavsk, 2018, pp. 200-203, doi: 10.1109/TCSET.2018.8336186.
7. Li Ming. Zastosuvannia hnuchkoi (Agile) metodoloii dla vykonannia mizhnarodnykh spilnykh naukovykh proektiv // Upravlinnia rozvytkom skladnykh system. 2019. 38, 103 – 111.4.
8. A. Biloshchytskyi, A. Kuchansky, S. Paliy, S. Biloshchytksa, S. Bronin, Y. Andrushko, Y. Shabala, and V. Vatskel, "Development of technical component of the methodology for projectvector management of educational environments," Eastern-European Journal of Enterprise Technologies, 2(2)(92), pp. 4-13, 2018. doi: 10.15587/1729-4061.2018.126301.
9. Ryzhakova, G., Chupryna, K., Ivakhnenko, I., Derkach, A., & Huliaiev, D. (2020). Expert-analytical model of management quality assessment at a construction enterprise. Scientific Journal of Astana IT University, 3, 71-82. <https://doi.org/10.37943/AITU.2020.69.95.007>
10. Cockburn, A., & Highsmith, J. (2001). Agile Software Development, the People Factor. Computer, 34(11), 131–133.
11. A. Biloshchytskyi, A. Kuchansky, S. Paliy, S. Biloshchytksa, S. Bronin, Y. Andrushko, Y. Shabala, and V. Vatskel, "Development of technical component of the methodology for projectvector management of educational environments," Eastern-European Journal of Enterprise Technologies, 2(2)(92), pp. 4-13, 2018. doi: 10.15587/1729-4061.2018.126301
12. OODOO: An app for every need (site). // URL: <https://www.odoo.com>
13. A. Kuchansky, A. Biloshchytskyi, Y. Andrushko, S. Biloshchytksa, T. Honcharenko and V. Nikolenko, "Fractal Time Series Analysis in Non-Stationary Environment," 2019 IEEE International Scientific-Practical Conference Problems of Infocommunications, Science and Technology (PIC S&T), Kyiv, Ukraine, 2019, pp. 236-240, doi: 10.1109/PICST47496.2019.9061554.

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## **DEVELOPMENT OF METHODS FOR DIVERSIFICATION STRATEGIES CHOICE IN BUILDING ENTERPRISE**

**Annotation.** The diversification of construction companies is relevant due to the significant development of the construction industry in the last decade in Ukraine, China, and the world. The article describes some well-known decision-making methods for the problem of choosing diversification strategies. The article defines the general requirements for the development of information technology strategy selection. Problems that need to be addressed in future research have also been identified.

**Keywords:** decision making; building enterprise; multi-objective optimization.

It was found that the main factors influencing the activities of a construction company are:

- environmental factor (presence of competitors, partnerships with other companies, joining regional clusters);
- the factor of the enterprise's strategic management, particularly the productivity of the enterprise, organizational structure of the enterprise, etc.

The analysis of construction companies in Ukraine reveals 40% of companies operating in the framework of horizontal diversification strategies, 27% there are invisible strategies, 9% are vertical strategies, and almost 24%, but there is no strategy of interaction. The article [1] states that the theory of adaptive strategic management is broad and exists in the corresponding diversification strategy. This theory includes several tools that allow to dynamically regulate the activities of enterprises, taking into account those that are necessary. The calculation of these indicators is a complex task associated with the conditions of risk and uncertainty in which the construction company operates. Globalization of markets and unstable economic conditions are conditions that complicate the process of choosing a diversification strategy. However, without this choice, the company may eventually lose revenue and eventually lose resources to operate. That is why the task of choosing strategies for diversification of construction companies, which would provide the opportunity to obtain the maximum economic effect, is an urgent task of the study.

One of the effective methods of multi-criteria decision-making is the method of analysis of hierarchies [2]. The method is simple but requires a large amount of additional information, which is challenging to implement under uncertainty. Article [3] describes the use of the MAUT (Multi-Attribute Utility Theory) method for multi-criteria decision-making and risk assessment. The method can be used to select diversification strategies, as it considers the uncertainty of the data, but the advantages of alternatives in pairwise comparison must be strict.

Consider the conceptual model of choice of diversification strategies, the scheme of which is shown in Figure 1.

The main components of the conceptual model are the definition of criteria for selecting diversification strategies, the application of a multi-criteria optimization method, building the benefits of diversification strategies, decision-making on the choice of strategy by the decision-maker.

According to the presented concept, the main stages of deciding on the choice of diversification strategies are as follows:

Formation of a preliminary list of diversification strategies.

Defining criteria for selecting diversification strategies.

Application of the method of multi-criteria optimization to select a set of optimal diversification strategies.

Formation of advantages of diversification strategies. Defining a ranked list of potential diversification strategies.

The final choice of diversification strategies for implementation at the construction company.

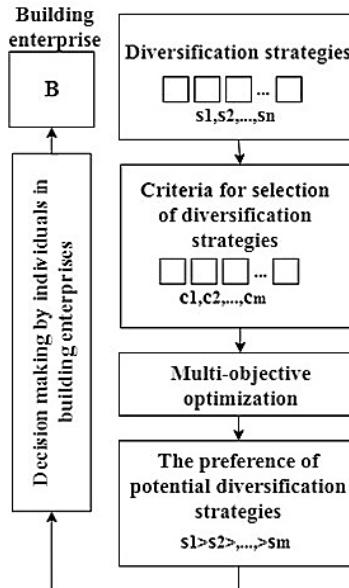


Figure 5 – The conceptual scheme for solving the problem of choosing diversification strategies.

Let  $B$  be a construction company that builds real estate and organizes the appropriate processes. Company  $B$ 's organizational structure, peculiarities of activity, and history of the creation of projects and construction objects are known. We believe that the company's activities take place in conditions of uncertainty and risk. Let Company  $B$ 's research show that some diversification strategy is needed to increase profits and reduce risks. Many diversification strategies or acceptable alternatives have been developed:

$$S = \{s_1, s_2, \dots, s_n\}. \quad (1)$$

The company can implement strategies, i.e., company  $B$  has sufficient financial and human resources,  $n$  is the number of possible diversification strategies [5]. To evaluate the strategies, consider the vector criterion

$$c(s) = (c_1(s), c_2(s), \dots, c_m(s)), \quad (2)$$

where  $s \in S$ ,  $m$  is the number of criteria for evaluating alternatives. Each of the criteria

can have  $w_1, w_2, \dots, w_m$ , determining the importance of each criterion in evaluating alternatives,

$$\sum_{i=1}^m w_i = 1. \quad (3)$$

The aim is to determine a rational diversification strategy from a set of acceptable alternatives

$$s_j^* \in \{s_1, s_2, \dots, s_n\}, \quad (4)$$

$j = \overline{1, k}$ ,  $k < n$  over a given criterion space, given the uncertainty. The result can be a rational strategy of diversification  $s^*$ . The result can also be an ordered set of strategies [4]:

$$\{s_1^*, s_2^*, \dots, s_k^*\}. \quad (5)$$

If  $s_j$  are diversification strategies,  $j = \overline{1, n}$ ,  $c_i$  are criteria,  $w_i$  are weighting factors of criteria,  $i = \overline{1, m}$ ,  $e_{ij}$  are evaluations of diversification strategies according to certain criteria. That is, estimates are functions

$$e_{ij} = c_i(s_j). \quad (6)$$

If  $I = \{1, 2, \dots, m\}$  is the set of all indices,

$$I^+ = \{1, 2, \dots, p\} \quad (7)$$

is the set of indexes of objective functions that are maximized,

$$I^- = \{p + 1, p + 2, \dots, m\} \quad (8)$$

is the set of indexes of objective functions that are minimized,  $I = I^+ \cup I^-$ . Then the problem can be written as follows [20]:

$$\begin{aligned} \sum_{i \in I^+} w'_i c_i(s) &\rightarrow \max, \\ \sum_{i \in I^-} w''_i c_i(s) &\rightarrow \min, \\ \sum_{i \in I^+} w'_i = 1, \sum_{i \in I^-} w''_i &= 1, \end{aligned} \quad (9)$$

Therefore, to solve the problem of making a multi-criteria decision in choosing strategies for diversification of construction companies, it is necessary to develop the following multi-criteria method or decision-making methods.

### References:

1. Y. Li, Multi-criteria methods for selection of rational strategies of diversification of building enterprises in uncertainty, Management of development of complex systems, 38, 2019, pp. 173-178, doi: 10.6084/m9.figshare.9788705
2. T. Saaty, K. Peniwati, Group Decision Making: Drawing out and Reconciling Differences, Pennsylvania: RWS Publications, 2008.
3. J. Gomez-Limon, M. Arriaza, L. Riesgo, An MCDM analysis of agricultural risk aversion," European Journal of Operational Research, 151(3), 2003, pp. 569-585.
4. Y. Li, S. Biloshchytka, The problem of choosing a diversification strategy for a building enterprise in risk condition, Scientific Bulletin of Uzhhorod University, 2(35), 2019, pp. 119-126. doi: 10.24144/2616-7700.2019.2(35).119-126

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## **PROTECTION OF THE AUTHENTICATION PROCESS IN BANKING INFORMATION SYSTEMS**

**Abstract.** Today, technology is evolving at an incredible rate. As a result, life has changed significantly over the last 20 years. Today, it is impossible to imagine a day without the Internet and the use of gadgets that make life much easier. All important things people can do without leaving home, just a few clicks. Since all information about our lives are stored online the delinquents have the opportunity to obtain personal data and use them at its discretion: steal identity, take out a loan to another person, steal money from a bank account, re-register property and more.

**Keywords:** authentication, two-factor authentication, identification, unauthorized access, one-time password, information safety, safety, security

The incredible advantages of making online payments can be listed for a long time, but you must also keep in mind the disadvantages. Throughout history, there have been people who wanted to earn in dishonest ways, and today is no exception. Now you can rob a bank without leaving home, for this you only need to find out the login and password of the bank's client and transfer money from his account.

That is why it is so important for online banking to take the most reliable measures possible to ensure the reliability of data storage. A mobile application or web page requires a login and password to authenticate the user to ensure the integrity of customer data.

In fact, when considering authentication, it should be noted that it is at this stage that most breaches of privacy occur, as the main purpose of thieves is access to the user's personal account. Accordingly, banks, for their part, must provide the maximum level of security when entering the user's personal account.

Ensuring reliability at the entrance is achieved in different ways. When a user logs in, first of all it is authenticated. If the entered login and password match those stored in the system on the server, the user successfully logs in, otherwise he is denied access.

```
$ authentication = new Authentication(); // Create an authentication model.
$ authentication->setPseudo ("pseudo"); // Set a couple login / password.
$ authentication->setPass ("pass");
$ authentication->setAccessToken ("accessToken"); //or use an access token.
```

For a more reliable procedure of entering the personal account during the authentication stage, aids are used, such as captcha, confirmation calls, one-time

passwords in SMS. It is these tools that help prevent intruders and protect customer data.

In this period, the most reliable, easiest to implement and the most user-friendly tool are one-time passwords using SMS confirmation. Many online banking platforms use this tool to safely use the resources of their customers.

One-time passwords are used to confirm transactions on the Internet, such as in a remote banking system. In the banking industry, the most common way to provide a one-time password is an SMS message that the bank sends to a customer who conducts a transaction in the Internet banking system. If you do not enter a password or enter an incorrect password, you will not be able to log in or send payment. This service is almost always provided by the bank automatically.

One-time passwords work as follows: when the bank sets actions with the client's finances or when entering the personal account, the previously specified user number receives an SMS message indicating a one-time password, which is limited to a certain number of seconds. The user must enter the password sent to him within the specified time.

```
// Create the API provider.
$ provider = new ApiProvider (new Authentication ());

// Set a couple login / password.
$ provider-> getAuthentication () -> setPseudo ("pseudo");
$ provider-> getAuthentication () -> setPass ("pass");

// or use an access token.
// $ provider-> getAuthentication () -> setAccessToken ("accessToken");

// Create a Sending SMS
$ message model. = new SendingSMSMessageRequest ();
$ model $ model-> setMessage ("message");
$ model-> addNumber ("33600000001");
$ model-> addNumber ("33600000002");
// ***

// Call the API and get t he response.
$ response = $ provider-> sendingSMSMessage ($ model);

// Handle the response.
$ response-> getCode ();
$ response-> getDescription ();

$ response-> getSmsID ();

*****
// Create the API provider.
Sprovider = new ApiProvider (new Authentication ());

// Set a couple login / password.
$ provider-> getAuthentication () -> setPseudo ("pseudo");
$ provider-> getAuthentication () -> setPass ("pass");

// or use an access token.
// $ provider-> getAuthentication () -> setAccessToken ("accessToken");
```

```

// Create a Sending unicode SMS model.
$ model = new SendingUnicodeSMSRequest ();
Smodel-> setMessage ("message");
$ model-> addNumber ("3360000001");
Smodel-> addNumero ("3360000e02");

// Call the API and get the response.
$ response $ provider-> sendingUnicodeSMS ($ model);

// Handle the response.
$ response-> getCode ();
Sresponse-> getDescription ();

$ response-> getSmsID ();

```

This practice prevents the declassification of the user's password or its selection by using a mechanical method.

One-time passwords can provide complete protection for the authentication mechanism when logging in from replay attacks. This is a one-hundred-percent means of protection, because the way to change the password each time prevents both the ability to see the password and pick up the search method. The time required to select passwords by brute force is too long, and at this time a new password is already generated and all efforts will be in vain. Undoubtedly, this method makes it impossible to provide thieves with private information and is very effective.

When using Internet banking when sending SMS messages directly to the user, the chance of intrusion into the authentication procedure and unauthorized access (unauthorized access) to customer information is reduced. This message ensures that you can log in from any device only if you have a customer's phone, which greatly reduces the ability to enter the office from different devices without the user's knowledge.

Also an additional measure of protection is often to use a time timer for a one-time password, i.e. give a limited number of minutes to enter the generated sequence of characters that were used as a one-time password.

The ability to receive one-time passwords via SMS is objectively rational, at least because it is as accessible as possible to a wide range of users and does not require special skills to use. The user only needs to open the received text and copy the sent password for input. In terms of usage, this procedure is maximally customer oriented.

Considering the issue of information transfer in this context, the only drawback is the issue of the price side, because to send SMS messages requires funds.

The method of protection of one-time passwords by means of SMS messages is very progressive and relevant for today. It is safe to say that even the cost of sending an SMS is worth the security of each user's personal data.

### **References:**

1. Bertino, E., & Ferrari, E. (2004). Information security. In The Practical Handbook of Internet Computing (pp. 26-1-26-18). CRC Press. <https://doi.org/10.1201/9780203507223>
2. Huang, Y., Huang, Z., Zhao, H., & Lai, X. (2013). A new One-time Password Method. IERI Procedia, 4, 32–37. <https://doi.org/10.1016/j.ieri.2013.11.006>

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## IMPACT OF THE COVID-19 ON SOCIAL ENGINEERING IN UKRAINE

**Abstract.** The COVID-19 pandemic made a big impact on social engineering all over the world. The goal of study in the paper is to make an analysis of how the sphere of social engineering is being changed with the pandemic.

**Keywords:** COVID-19, phishing, social engineering, malware.

The COVID-19 pandemic is one of the biggest problems of our time. The disease has severe consequences and the worst of them is death. Because of this COVID-19 is being used in a variety of malicious campaigns including email spam, malware, ransomware, and malicious domains. Fear is the main weapon in this case. It is aggravated by the stressful situation due to the strengthening of quarantine measures in Ukraine, fear for life and health (both his own and relatives), distrust of statistics on the number of patients and deaths from COVID-19 disease, various types of COVID-19 strains, confusion about the quality, availability and side effects of vaccination against this disease etc. So, people are ready to believe in anything to protect themselves from a real or potential threat. And that is immediately used by criminals. [1]

As of October 2021, the number of vaccinated people is increasing and the number of deaths is decreasing [2]. However the number of social engineering attacks is not decreasing, but only changing the vector. Now the main theme for criminals is vaccination.

Group-IB [3] is a global threat hunting and adversary-centric cyber intelligence company that specializes in investigating and preventing hi-tech cybercrimes. It has released a comprehensive analysis of fraud schemes on a global scale. In total, fraud accounts for 73% of all online attacks: 56% are scams (deceit resulting in the victim voluntary revealing sensitive data) and 17% are phishing attacks (bank card details theft). By using patented Digital Risk Protection (DRP) technologies, Group-IB experts detected over 70 scam groups employed only in one of the fraudulent schemes, Classiscam, 36 of which target Europe. It was established that in one year Classiscam threat actors alone swindled users out of €7,750,000.

According to Group-IB analysis, the number of phishing attacks has more than doubled during the pandemic. Phishing is used to steal personal data and install malware. Hackers disguise their mailings to the addresses of reputable organizations: for example, the WHO, tax services, the Center for Disease Control and Prevention or Ministry of Health in case of Ukraine.

Phishing attacks from the fake Ministry of Health on the topic of vaccination were recorded by the National Coordination Center for Cyber Security under the National Security and Defense Council of Ukraine [4]. This phishing attack was aimed

at Ukrainian Internet users, the main topic of which was the beginning of vaccination against COVID-19 in Ukraine.

During the attack a fake web page was created on a popular hosting platform that mimicked the website of the Ministry of Health of Ukraine. To place the page, the attackers registered several domains that resembled the official domain of the Ministry of Health of Ukraine - moz.gov.ua. This fake page contains information about the start of the mandatory vaccination against COVID-19 on January 25 with a proposal to download a file (Word document) with details. This document has built-in malicious code which downloads and executes another malicious script that provides remote control of the infected computer. In this way, the attackers gained full access to the victim's computer.

ENISA Threat Landscape (ETL) 2020 report [5] published by the European Union Cyber Security Agency (ENISA) highlights key aspects and trends related to the threat landscape:

- During the COVID-19 pandemic, the number of fake websites for online shopping and fraudulent online sellers increased.
- With the COVID-19 pandemic, the number of cases of cyberbullying and extortion has also increased.
- Attackers use social media platforms to increase the effectiveness of targeted attacks, and financial rewards are still the main motivation for most cyberattacks.
- The number of phishing victims in the EU continues to rise when criminals use the COVID-19 theme to lure "customers". COVID-19 thematic attacks include messages that contain malicious file attachments and messages that contain malicious links that redirect users to phishing sites or malware.
- Many cases of cybersecurity still go unnoticed or are detected for a long time. The number of potential threats in the virtual or physical environment continues to expand as a new phase of digital transformation emerges.

We see that pandemic has a negative impact on people. It is caused by different reasons but the consequences are the same - the number of attacks has increased. In order not to get phished people should not open unknown links, not download files from unknown senders and check all the information they get by mail. Using these simple rules can prevent a person from becoming a victim of social engineering.

### **References:**

1. Shramko S. Criminal-legal and criminological threats in the Internet space during the pandemic / S. Shramko, A. Kalinin. // Bulletin of the Association of Criminal Law of Ukraine. – 2021. – pp. 226–240.
2. Developing Story: COVID-19 Used in Malicious Campaigns // Trend Micro. – 2020. – URL: <https://www.trendmicro.com/vinfo/us/security/news/cybercrime-and-digital-threats/coronavirus-used-in-spam-malware-file-names-and-malicious-domains>.
3. Global Scamdemic: Scams Become Number One Online Crime // Group-IB. – 2021. – URL: <https://en.prnasia.com/releases/apac/global-scamdemic-scams-become-number-one-online-crime-321938.shtml>.
4. Phishing attacks from the fake Ministry of Health on the topic of vaccination were recorded in Ukraine // Ukrainian Pravda. – 2021. – URL: <https://www.pravda.com.ua/news/2021/02/12/7283229/>.
5. The threat of cyberattacks is growing due to the pandemic: EU report // Juridical Newspaper. – 2020. – URL: <https://yur-gazeta.com/golovna/zagroza-kiberatak-zrostae-cherez-pandemiyu-zvit-es.html>.

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## USING AGILE TOOLS TO DEVELOPMENT THE PROJECT OF CREATING A “MY CITY” MOBILE APPLICATION

**Annotation.** The abstract is devoted to the issues of using Agile tools in the development of a mobile application for the "My City" project. The structuring of internal development processes has been done. The use of the Scranban hybrid framework is substantiated as the best tool for developing a mobile application.

**Keywords:** mobile application, communal service, software development project, Agile, ScrumBan

The most important subsystem of the city's economy is housing and communal services. At the present stage of socio-economic development of Ukrainian cities, the reform of housing and communal services as a system of life support of the city, is aimed at creating an effective management mechanism, attracting investment and reducing costs for services.

Due to the low level of regulation and control, housing and communal services have almost no incentives for high-quality housing and communal services, productivity growth, introduction of new technologies, management, investments in modernization and reconstruction of facilities and engineering networks.

Housing and communal services of cities are characterized by low investment attractiveness and require large investments for modernization and development. Housing reform should ensure its technological and managerial modernization, long-term investment, increase the potential for effective forms of management.

In economically developed countries, housing management is provided through project management tools and is based on information technology, methods of continuous improvement of environmental management, stakeholders and value for the formation of models and effective management mechanisms.

Among the tools that can speed up these processes, one of the main ones may be the development of a mobile application that will provide communal services with up-to-date information on emergencies and existing problems. This, in turn, will help communal services to solve the problems of the city and communities faster and better.

The capabilities of modern gadgets and the availability of the Internet are forcing the market for smartphone applications to grow rapidly. Already in 2015, statistics showed that 14% of Internet users use only phones or tablets to access the World Wide Web.

The pandemic has had a huge impact not only on millions of people, but also on the global economy and business processes. The mobile application industry has also changed - the balance of power in this highly competitive market has shifted. The

processes that are taking place now will determine its development for decades to come. COVID-19 has led to a phenomenal growth in the mobile application market.

Mobile phones now account for more than half of the time (50.1%) that people aged 16-64 spend online. Back in 2016, this share was only 33%. Now people use mobile applications in almost all walks of life [1].

Today, mobile applications are becoming more widespread, which allows solving community problems. However, although analogues were created in Ukraine, they were not developed with sufficient quality and therefore did not gain popularity.

The research shows that the project of developing a mobile application “My City” for the management of public communal services has a fairly high assessment of experts and little risk for implementation. Emphasis will be placed on the communication of communal services with society. This will allow you to quickly and effectively eliminate existing problems in the field of housing. Today, mobile applications are becoming more widespread, which allow to solve community problems. However, although analogues were created in Ukraine, they were not developed with sufficient quality and therefore did not gain popularity.

A detailed description of the problem will help communal services to respond quickly to problems and solve them with maximum efficiency. The use of modern software development will save man-hours in the performance of work and improve logistics.

With the help of the “My City” mobile application, anyone will be able to register a problem or emergency situation and send information to the utility service. Also, the user will be able to check the progress of the work. Upon acceptance of the application, the communal service will have complete information about the problem, its location, photo and video information.

The developed project can be implemented in companies that are directly involved in the development of special software. It should be an organization that uses modern software development tools, has well-established business processes and highly qualified staff. It is desirable that the company's order book has already implemented projects of national importance. Also, to implement the project it is necessary to have a team of development specialists who will be able to implement the project on time and in accordance with the budget.

Based on the specifics of the project, you can choose the ScrumBan framework for its implementation. ScrumBan is a state-of-the-art hybrid method that uses Kanban's continuous workflow along with the useful elements of Scrum, and solves the problems of both approaches. This tool allows you to control the time frame of project tasks and quickly adapt to change. Table 1 shows the application of the ScrumBan framework in the project.

Table 1  
**Application of the hybrid ScrumBan method**

<b>Scrum</b>	<b>Kanban</b>
Roles (Project Manager, Business Analysts, Software Developers, etc.)	An opportunity to follow the progress of tasks

Prioritizing the backlog	Estimating the need to implement tasks from both business (customer) and technical side
Agility	Adding the tasks according to changes on the external market
Release of the Product and its Support	Constant addition of the tasks
Daily Meetings, Retrospectives, Planning Sessions, Demos	

Application of Scrumban in the process of mobile application development described on Fig.1.

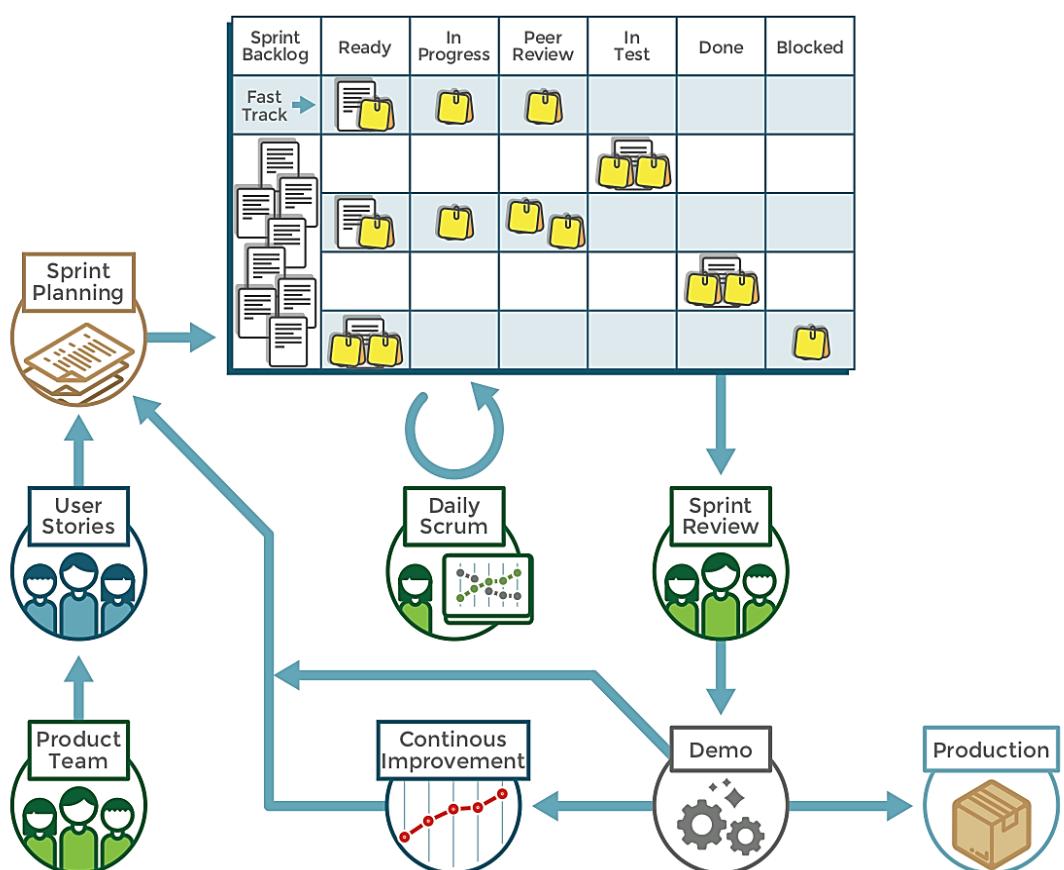


Figure 1 – Application of Scrumban in the working process (according to [2])

ScrumBan uses a cyclical development process and continuous product improvement. This approach allows you to analyze previous work and improve them, if necessary. Applying this approach also helps reduce the risks associated with product sales.

ScrumBan has its own implementation model for each team. The general Scrumban model will be used to implement the “My City” project. Under this model, the development team will use a waterfall software development model [3]. This approach will help to structure the internal development processes and clearly separate the iterations of functional development: planning; development; retrospective; release.

Each of the iterations will minimize the risks over time, and each participant will be able to see a clear picture of following the plan.

The sprint will last no more than 2 weeks: 1 week - active development of tasks; Week 2 - Testing and bug fixes.

The above approach will help solve the problem of testing, as well as give developers time to fix bugs. Frequent releases will allow stakeholders to see all the activities of the project and progress in its course. As a result, users will be able to get exactly the functionality they need.

A daily stand-up was introduced to track the daily progress of the tasks. At this meeting, developers and project participants talk about changes in tasks and problems.

Tasks must be presented in the form of User Stories [4]. Any changes must be reflected in the control and visualization system (Jira or Trello). These software products [5] help to track the progress in the implementation of tasks, provide an opportunity to obtain statistics on the work of the team, set priorities for tasks, fill in the backlog and keep records.

### **References:**

1. How COVID-19 has affected the mobile application market. URL: <https://asomobile.net/blog/digest2020/>
2. How Scrumban can help URL: <https://www.practicallogix.com/scrum-and-kanban-how-scrumban-can-help/>
3. ScrumBan by Corey Ladas. URL: <https://www.agilealliance.org/what-is-scrumban/>
4. User Story Mapping: Discover the Whole Story, Build the Right Product, 2014, 324 p.
5. Project Tracking Software. URL: <https://trello.com/en>

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## **DESCRIPTION OF THE STAGES OF EXAMINATION A DEPENDENCE BETWEEN CRIMINAL'S APPEARANCE AND THEIR OFFENSE WITH CONVOLUTIONAL NEURAL NETWORK**

**Annotation.** The main purpose of this paper is to describe a solution method of investigation dependence between person's offense and their facial features. During the description, firstly, is shown how the process was divided into stages, then, detailed each of them based on the experience of previous researches.

**Keywords:** convolutional neural network, Criminal's facial features, Offense

People with their embedded instincts can process nonverbal information about other people and make right conclusions about their personality with some accuracy. Sometimes to figure out information about person's character is significant, for example in cases when a person is inclined to do illegal actions. As noticed in previous study, the purpose is to discover associations between the features of criminal's facial image and type of their offence. The process of examination is organized in five phases: data extracting, customize feature detector, developing convolutional neural network, draw conclusions and prepared them in a visualized format.

The first step is a database formation. The database has to contain information about crime and photo of person who committed it. All the data divides into 2 datasets: train (90%) and test (10%). A testing dataset is required to make conclusions about accuracy of the results. An initial data extracts from website of Interpol from "Red Notices" category with a website parser.

Next, it is needed to extract faces from pictures and normalize them [1]. As the facial recognition exist for some time, there are some ready solutions for this stage. Usually, a mechanism of aligner is also a neural network. It takes a picture that was taken from a camera, detects all the faces on it which it can find, "cuts" and "align" them.

The third step is developing a convolutional neural network for examination dependence between facial images and crimes. The task of this investigation is pretty similar to a task of facial recognition. Facial recognition became very popular last years because of using in security systems, law enforcement apps and commercial use. That is why in this area experts use a lot of technologies, but the most useful is convolutional neural networks [2]. It can be explained by one remarkable benefit of CNN – ability to extract features, the most valuable information, pretty accurate. After data is processed we have an accuracy of the experiment that confirms or deny dependency between criminal's appearance and their offense.

Then, if dependency is confirmed, we can work with results. The fourth step is making conclusions based on the previous stage. The result has the following view: for every offense there is a set of facial characters, which are inherent for this particular act.

The last step is to make result of the examination more visual. For this cases every set of characteristics can be presented as artificial image of person, that is a potential criminal for particular offense.

**Conclusions.** After analyzing already existed concepts, that are used for image recognition and working with faces, a work plan was developed according to the best practices. For better concentration on the main task - scientific research, it was decided to customize almost all other processes, except the development of the main mechanism for the investigation of facial features and its interpretation. The development can be useful in different areas of life, but the main emphasis is on psychology, since the basic task is to explore the features of the psyche that can be described by the face.

In the future examination can be repeated with a bigger amount of labeled data. Also research can be improved by examination not the whole appearance of criminals, but the particular features, which are responsible for the Big Five personality traits according to [3].

#### **References:**

1. Shilpi Singh, S.V.A.V. Prasad, Techniques and Challenges of Face Recognition: A Critical Review, 2018. URL: <https://doi.org/10.1016/j.procs.2018.10.427>.
2. Salama AbdELminaam D., Almansori A.M., Taha M., Badr E., A deep facial recognition system using computational intelligent algorithms, 2020. URL: <https://doi.org/10.1371/journal.pone.0242269>.
3. Osin E., Novokshonov A., Shutilov K., Davydov D., Kachur A., Assessing the Big Five personality traits using real-life static facial images, 2020. URL: [https://www.researchgate.net/publication/341568689\\_Assessing\\_the\\_Big\\_Five\\_personality\\_traits\\_using\\_real-life\\_static\\_facial\\_images](https://www.researchgate.net/publication/341568689_Assessing_the_Big_Five_personality_traits_using_real-life_static_facial_images).

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## **BIOMETRIC IDENTIFICATION IN MOBILE OPERATING SYSTEMS**

**Abstract.** At the moment, the issue of information security is becoming increasingly important in society. Reliable storage and protection of information is currently relevant not only for businesses to maintain trade secrets, but also for ordinary users. Theft of confidential information, for example, to gain access to bank accounts, personal messages or other materials that can be used for malicious purposes and disrupt the financial or psychological state of its owner, is becoming more widespread every year.

**Keywords:** identification, two-factor authentication, biometric authentication, password, confidentiality, information security.

In order to ensure reliable protection of confidential user data, various means of information protection are used. Comparative analysis shows that the most reliable information access systems that do not use a regular password, which consists of letters, numbers and symbols, are biometric information access control systems. At present, such systems are increasingly used in banks, firms, information departments of firms, and so on.

In recent years, it has become apparent that biometric technology is most effective in the application of methods of identification and control of access to information. These findings are explained by the fact that biometric security features have a high reliability of identification and are becoming increasingly accessible to ordinary users.

Biometric identification is the identification of a person by unique, unique to their biological characteristics. In the modern world, such systems of biometric information protection are used as: checking the shape of the hand, fingerprints, retina or iris, model or photo of the face, the dynamics of the signature or voice. Such information security systems are used on their own before the data used in them cannot be lost by the owner, stolen or copied.

Biometrics has continued the inevitable migration from desktop to mobile devices. Both the mobile and biometric industries continue to strive for smaller and more powerful devices. The last few years have seen the accelerated introduction of biometric data on mobile devices. More recently, iris biometrics have been added to Samsung devices as a logical extension of their current fingerprint support.

Several biometric hardware devices have been introduced to the market, and size and computing power have increased with each generation. With the introduction of Cross Match SEEK, SEEK Avenger and Verifier Sentry, the size of these devices has

decreased. A new set of Android processors and small, low-power fingerprint devices has allowed Amrel, Credence and Northrup Grumman to enter the market and compete directly with traditional Intel-based systems.

With the help of the Qt platform, an application has been developed for storing user passwords, which is protected by biometric means, which will be installed and used in the Android mobile operating system.

Qt is a platform for developing applications between platforms for desktop, embedded and mobile. Supported platforms include Linux, OS X, Windows, VxWorks, QNX, Android, iOS, BlackBerry, Sailfish OS and others.

Qt is not a stand-alone programming language. This is a frame written in C++. The preprocessor, MOC (Meta-Object Compiler), is used to extend the C++ language with features such as signals and slots. Before the compilation step, the MOC analyzes the source files written in C++, extended Qt, and generates standard C++ sources from them. Thus, the framework itself and the programs / libraries that use it can be compiled by any standard C++ compiler, such as Clang, GCC, ICC, MinGW, and MSVC.

Implementation of biometric authentication in the developed application:

— Connecting C++ and QML Library for biometric authentication (e.g. Touch ID):

```
QLocalAuthenticator authenticator;
authenticator.setReason("Acces your private information!");
authenticator.setPolicy(QLocalAuthenticator::PolicyWithBiometricsOrPassword);

connect(&authenticator,&QLocalAuthenticator::authenticationFinished
,&myFancyClass, &MyFancyClass:: authenticationFinished);
```

— Creating the LocalAuthenticator class:

```
void MyFancyClass::authenticationFinished(bool success,
                                         QLocalAuthenticator::AuthenticationFailureReason reason)
{
    if (success)
        qWarning("Authentication was successful!");
    else
        qWarning("Authentication failed! Reason = %d", reason);
```

— Connecting QML module:

```
import fsee23.authenticator 0.1
```

— Using the LocalAuthenticator class and connecting it to a UI object:

```
LocalAuthenticator {
    id: authenticator
    reason: "Get access to your private information!"
```

```

policy: LocalAuthenticator.PolicyWithBiometricsOrPassword
onAuthenticationFinished: {
    if (success)
        console.log("Authentication was successful!");
    else
        console.log("Authentication failed! Reason = " + reason)
}
}

```

Considering the processes of authorization, authentication, verification and research of biometric means of protection of confidential information, we can conclude that the biometric protection system has a high level of reliability, compared to conventional passwords or PIN codes. This is because biometric protections focus on who a person is, not what he or she knows. It is difficult to forge this method of authentication, because some biometric security tools collect information that is unique to an individual user, such as the most popular - a fingerprint or face model.

### **References:**

1. M. Brown and S.J. Rogers. User Identification via Keystroke Characteristics of Typed Names using Neural Networks. *International Journal of Man-Machine Studies*, 39(6):999-1014, 1993.
2. D. Gunetti and C. Picardi. ACM Transactions on Information and System Security 8(3):312-347, August 2005.
3. Marsters, J. D. (2009). Keystroke dynamics as a biometric (Doctoral dissertation). Retrieved September 17, 2018, from <https://eprints.soton.ac.uk/66795/>
4. A. Awad and I. Traore. IEEE Transactions on Dependable and Secure Computing 4(3):165-179. August 2007.
5. Shen L, et al. (2010) Prediction of quantitative phenotypes based on genetic networks: a case study in yeast sporulation. *BMC Syst Biol* 4:128
6. Zheng A, et al. (2011) Crystallization and preliminary X-ray crystallographic analysis of eIF5BΔN and the eIF5BΔN-eIF1AΔN complex. *Acta Crystallogr Sect F Struct Biol Cryst Commun* 67(Pt 6):730-3

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## **METHODS TO INCREASE THE EFFECTIVENESS OF PROTECTION OF EXTERNAL MEDIA FROM UNAUTHORIZED ACCESS AND MODIFICATION**

**Abstract.** Today, Internet technologies are evolving faster and faster. We use social networks to communicate and transfer a lot of information. More and more data is transmitted via the Internet. There are more and more hacking methods, so there is a high probability of unauthorized use of personal data, information for the benefit of the attacker. There are also more and more viruses and spyware that can be secretly installed on computers, collect and modify data, and use your device's resources.

Thus, the issue of transmission and storage of information is one of the most important issues of human security and personal data.

**Keywords:** External storage media, virtual disk, confidential information, access distribution, invisibility

Attackers can connect to a mobile device and steal personal data through the Internet resources or/and social network. One phone left without a password gives an attacker the opportunity to make a purchase for a significant amount, format all data, including from the cloud storage and even destroy a person's social life. Transmission and storage of information requires detailed consideration and finding a reliable way to implement it.

It is better to use external media to transmit confidential information than the Internet or cloud storage. Since, access to the second one does not involve direct access to the system. This can be done from anywhere with Wi-Fi, mobile or any other wireless network.

There are currently many types of external media. The most popular are floppy disks, CDs, hard drives, memory cards, and flash drives. Some of them are outdated, have relatively little memory today, or are simply out of date.

Today, USB flash drives, hard drives, and memory cards are used to store and transfer data. However, they all have their advantages and disadvantages.

Memory cards are too small. To use them on a computer, you should use special card readers - card readers. In addition, they are easy to lose.

External hard drives, with large amounts of memory for stored information, are not easy to physically carry. Their dimensions and weight are too large to constantly move from one place to another.

Flash media is probably the most appropriate option for everyday use. It can

store many documents. Nowadays, USB drives can contain terabytes of information. Most personal computers support this format.

There are various data protection tools on USB drives. One of the main steps to protect information is using encryption [1]. Passwords are set to ensure accessibility. Binding to information about the user / serial number of the components of his computer is often used. To protect against copying, most often used methods are: recording information in unused sectors and checking the location and content of "failed" sectors. These methods are practically useless due to the possibility of taking the full copy from the device using the appropriate application software [2].

The basic idea of external media security in this work is to divide the memory into two parts. One of them will be hidden for the user and for the system.

A comparison of key files on both parts of memory will be used to access the hidden storage. That is, in a closed area there is a sample key, which must be identical to a specific file on an open disk. For example, we can have a folder – “RIZNE”. To open a closed part, a similar folder with the same content must be created. The great advantage of this is the extremely large variability of the key. It can be a file of any format with a variety of content. This can be a text document or an image or any program file [3].

When it used on third-party devices, it will be a normal flash drive, without the attributes of a protected flash drive. That is, the average user will not even have a clue about the hidden information. Even with its loss and full formatting, the closed area remains intact and inaccessible.

If your password is lost, it's possible to use computer serial number information checks or something like that.

Thus, the use of the proposed method of data protection on external mobile media will provide the basic properties of information: confidentiality, integrity and accessibility.

#### **References:**

1. Zadiraka V.K., Kudin A.M., Lyudvychenko V.O., Oleksyuk O.S. “Комп'ютерні технології криптографічного захисту інформації на спеціальних цифрових носіях”: TextBook – Kyiv; Ternopil: Pidruchnyky i posibnyky, 2007. – 272 p.
2. Petrenko A. B. “Протидія витоку інформації через з'ємні носії в автоматизованих системах” / A. B. Petrenko, E. V. Byetanov //VII mizhnarodna nauk.-tekhn. konf. — Donets'k: 2011. — p. 259—260.
3. Brailovs'kyj M.M., Tkachenko A.S. “Захист та приховування інформації в графічних та мультимедійних об'єктах на базі стеганотехнологій” // “Проблеми кібербезпеки інформаційно-телекомунікаційних систем”; Kyiv, 05-06 april 2018; Taras Shevchenko National University of Kyiv: Oksiyuk O.H. 2018. – 510 s. S.444-447.

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## ANALYSIS OF POTENTIAL VULNERABILITIES IN IOT SYSTEMS

**Abstract.** The fourth industrial revolution put on new rails processes of automation in industry, healthcare, home and other areas of human life through the mass integration of the concept of the Internet of Things into these areas. However, this concept leaves a number of potential bottlenecks in the security of such systems for attackers. Third-party access to data collected by smart devices in, for example, a smart home can lead to a variety of emergencies, the degree of danger of which will depend solely on the will of the owner of the intercepted data. In this paper we had analyzed the treats based on the fundamental principles of IoT systems: the interdependence, interconnectedness, and constant communication of IoT devices.

**Keywords:** IoT, Threats, vulnerabilities, Cyberattacks, Network Traffic

### 1. Introduction

The growing popularity of IoT (or "Internet of Things") provides large opportunities to improve, plan and automate our lives. IoT allows you to network and manage multiple devices that provide data collection, analysis and transmission. The scope of IoT continues to expand every year, covering new areas of life, from smart homes, cities to healthcare.

However, along with the obvious benefits and conveniences of using IoT, the concept of the Internet of Things leaves a number of potential security bottlenecks for attackers. Personal data collected by IoT devices is always of value to hackers and thieves of confidential information. In addition, a cyberattack on an IoT solution has the potential to damage physical services and physical infrastructure. For example, hackers successfully attacked a Jeep Cherokee while driving on the highway under the driver's control. Therefore, timely detection and resolution of such vulnerabilities are priority areas in the development of the entire IoT industry.

### 2. Vulnerabilities and attacks on IoT networks

From year to year, the attackers try to compromise and stole the private information by hacking the local and corporate networks. From the point of view of IoT networks, the specifics of their work reveal even more vulnerabilities and existing

bottlenecks for attacks in contrast with "conventional" network. The most important reasons why criminals choose to attack IoT devices, in particular smart homes, are their constant availability on the Internet, limited computing capabilities, which makes it impossible to install security systems directly on the devices themselves, vulnerabilities related to authorization / authentication devices on the network, heterogeneity of the devices and their communication environment, vulnerabilities in web interfaces, lack of proper attention from end users ("put and forget", which often manifests itself in leaving standard logins and passwords, lack of checking for updates, etc.). The combination of these factors leads to considerable interest among criminals who are trying to implement more and more cyber-attacks.

Any device connected to the network can be potentially vulnerable [1-3]. An attacker can attack any part of the IoT information system, including physical devices (collection of confidential information, attack on capturing nodes), network services (DoS, jumong-attacks), cloud services (SQL injection, SYN-flood), web applications (viruses, ransomware attacks) and vulnerabilities that are unique to IoT systems.

Although IoT devices mimic the concept of client-server architecture that underlies LANs, there are a number of vulnerabilities that are unique to IoT systems. Such vulnerabilities are based on the fundamental principles of IoT systems: the interdependence, interconnectedness, and constant communication of IoT devices. Consider them in more detail.

## 2.1 Threats related by an interdependent IoT environment

With the rapid increase in the number of objects implemented in the IoT system, communication between them has become increasingly automated and tends to reduce human intervention. IoT devices no longer simply interact with each other like conventional devices on a network. Currently, many IoT devices are designed from the standpoint of smart city vision, so that many of these devices are controlled by other devices or depend on the internal state of other devices or the environment.

For example, if the GPS sensor is aware of the traffic situation on the way from the user's home to work and the user's known health condition (e.g. asthma), then the GPS should choose the route that best suits his health condition (less traffic and pollution). atmospheric air) based on health data and motion sensors and air pollution. Another example that illustrates the vulnerability of IoT due to the interdependence of the environment is the situation in which a window is opened in the event that the room temperature is elevated and the air cooler is turned off. Such interdependent processes are common in applications that use IoT devices to achieve a fully automated process. In this environment, the target IoT device may not be available to the attacker, but the attacker may change the mode of operation of another device or its parameter through an environment that has a direct interdependence to activate the threat.

Therefore, an attack on one place, such as lowering the temperature or manipulating contamination data, can have serious consequences for other sensors, whose operations depend on the information of these sensors. In such an interdependent environment, an attacker can select the weakest links in the system to disrupt the entire system.

## 2.2 Threats related by an interconnected IoT environment

At the present stage of technology development, millions of devices can be connected to IoT systems. With these highly connected devices, an infected Internet item can become a destructive tool of attack that can infect many things on a large scale, thus affecting the entire system (such as a smart city).

The work [2] show that IoT devices, even with secure standard cryptographic methods, can be used by attackers to create a new security risk category that can be spread from a single IoT device to all physically connected devices over an IoT connection.

Thus, an attacker can launch rapid and destructive attacks, which can be difficult to control. To illustrate the impact of this scenario, an experimental study was conducted in which the spread of infection was simulated using Philips Hue smart lamps, which can be one of the components of a smart city.

Malicious software was distributed by moving directly from one lamp to an adjacent lamp via a ZigBee wireless connection. Researchers [2] have found that the AES-CCM global key can be used to encrypt and authenticate a new firmware without knowing the actual smart lamp updates. This situation shows how vulnerable such devices are, even if they use strong cryptographic security methods. Such attacks can start at one point, and can end up infecting the entire city system, thus allowing attackers to control city lights or use IoT lamps in DDoS attacks [2]. Thus, it can be stated that the interconnected environment opens wide opportunities for the rapid spread of threats in IoT systems.

## 2.3 Threats caused by tracking the nature of changes in network traffic

Analysis of traffic metadata sent from IoT devices can provide information about the habits and lifestyle of the owner. According to a study [3], an attacker who uses network traffic interception can use passive network monitoring methods to collect metadata that IoT devices exchange with remote control servers.

Even if traffic from IoT devices is encrypted or transmitted through a VPN tunnel, an attacker has the ability to identify the device owner by using DNS queries and device MAC addresses [4-5].

Another method of identification is to determine the intensity of network traffic, ie the frequency of repeated requests to remote control servers and the first six digits of the MAC address, which are a unique identifier. To implement such a scenario, an attacker must have access to the victim's local network, because MAC addresses are not available for traffic at the ISP level.

To simulate the scenario of obtaining metadata from network traffic, the authors reviewed four popular smart home devices, including a Hello Sense alarm clock and sleep controller, a video surveillance camera, a Belkin WeMo switch, and an Amazon Echo speaker.

The study found that the attacker was able to determine the time when the owner of the device was at home, which is manifested in bursts of activity from devices such as Amazon Echo and Wi-Fi switches. In addition, the researchers were also able to determine when the owner was asleep. At this time, there was increased activity on the

part of Sense Sleep Monitor. The device became more active when it had to collect and send data about the user's activity during sleep. The activity of CCTV cameras Nest can determine when the owner leaves the house. The cameras were activated only when a person left the house and turned on the video surveillance system, which manifested itself in sending pictures from the cameras to a remote with a certain interval. The analysis showed that the success of such attacks is due to the principle of IoT-devices and the need for a permanent Internet connection.

### Conclusion

Thus, developers of IoT systems very often take to the background the issue of security of IoT devices, thus giving attackers a wide range of possible attacks on a particular network infrastructure. Given that IoT systems follow the concept of client-server architecture that underlies LANs, many vulnerabilities are common to both LANs and IoT systems. However, there are a number of vulnerabilities that are unique to IoT systems: interdependence, interconnectedness, and constant communication between IoT devices. Therefore, the development of new approaches to improve the security of IoT-systems is an important promising area.

### References:

1. M. A. Al-Garadi, A. Mohamed, A. Al-Ali, X. Du, M. Guizani, A Survey of Machine and Deep Learning Methods for Internet of Things (IoT) Security, arXiv:1807.11023, (2018).
2. E. Ronen, A. Shamir, A.-O. Weingarten, C. O'Flynn, IoT Goes Nuclear: Creating a ZigBee Chain Reaction / E. Ronen, A. Shamir, A.-O. Weingarten, C. O'Flynn, Proceedings of the IEEE Symposium on Security and Privacy, San Jose, CA, USA, 2017, pp. 195-212.
3. N. Aphorpe, D. Reisman, N. Feamster, Smart Home is No Castle: Privacy Vulnerabilities of Encrypted IoT Traffic, arXiv:1705.06805, (2017).
4. J. Bugeja, A. Jacobsson and P. Davidsson, On Privacy and Security Challenges in Smart Connected Homes, Proceedings of the 2016 European Intelligence and Security Informatics Conference (EISIC), IEEE, Uppsala, Sweden, 2016, pp. 172-175
5. S. Albishi, B. Soh, A. Ullah et al., Challenges and Solutions for Applications and Technologies in the Internet of Things, Proceedings of the 4th Information Systems International Conference 2017 (ISICO), Proceedings Computer Science, Bali, Indonesia, 2017, pp. 608-614.

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## USAGE OF N-GRAMS FOR PREDICTIVE SEARCH

**Abstract.** The subject of this publication is predictive search. We reviewed the advantages of using n-grams and edge n-grams. Also, we reviewed how fuzziness can be introduced using cosine similarity and Jaccard similarity. The relevance of this work is associated with utilization of predictive search for user queries in many use cases.

**Keywords:** Predictive search, token, n-gram, edge n-gram, fuzziness, cosine similarity, Jaccard similarity.

Autocompletion of queries is widely used nowadays. It can be observed while looking up a question in a search engine, typing a name of a place in a taxi app, or a name of a product on a marketplace platform. Predictive search helps users to type less to find what they needed. Most commonly predictive search is implemented using n-grams.

### N-grams

N-gram is a sequence of tokens, such as words or characters. For example, the word “fuchsia” can be broken down into next n-grams: ‘f’, ‘u’, ‘c’, ‘h’, ‘s’, ‘i’, ‘a’. Such n-grams made of one unit are called unigrams. N-grams containing two and three units are called bigrams and trigrams respectively.

N-gram	Items
Unigram	‘f’, ‘u’, ‘c’, ‘h’, ‘s’, ‘i’, ‘a’
Bigram	‘fu’, ‘uc’, ‘ch’, ‘hs’, ‘si’, ‘ia’
Trigram	‘fuc’, ‘uch’, ‘chs’, ‘hs’, ‘sia’

Table 1. N-gram tokenization by variations

Similarly, we can break down a sentence into n-grams containing words. The sentence ‘clair de lune’ has the following unigrams: ‘clair’, ‘de’, ‘lune’.

N-grams are useful in cases where user’s queries can represent any part of a text they are looking for: song lyrics, part of a news title, etc.

### Edge N-grams

There are cases where we expect that the user won't start a query from any part: name of a city, product, etc. Edge n-grams will be more beneficial than n-grams here. Edge n-gram is also represented as a sequence of tokens, but unlike regular n-grams, they are built from the beginning of a given word or sentence. So for the word "fuchsia", the following n-grams would be produced: 'f', 'fu', 'fuc', 'fuch', 'fuchs', 'fuchsi', 'fuchsia'. Despite edge n-grams consume more space, results are more precise in the cases they are used for.

### Fuzziness

Users often make mistakes in their queries. N-grams can be efficiently used for fuzzy matching. There are multiple approaches that apply for n-grams.

1. Count matches

In this options matching n-grams of query and a candidate are counted. For example, state of Pennsylvania and its misspelled variant "Pensilvania" have eight common bigrams: 'Pe', 'en', 'ns', 'lv', 'va', 'an', 'ni', 'ia'.

2. Cosine similarity

N-gram sequences can be converted to vectors to calculate cosine similarity. It is defined by the cosine of the angle between two vectors. The lower the distance, the more words are similar. For example, words "ubiquitous" and "ubiquous" have a distance of approximately 0.24. $A \cdot B = \|A\| \|B\| \cos\theta$

3. Jaccard similarity

N-gram sequences can be converted to sets to calculate Jaccard similarity. It is defined by the ratio of size of the intersection over size of the union of two sets. This ratio equals to 0.6 for words "happiness" and "happyness". Words are likely to be similar if the ratio is high.

$$J(A, B) = \frac{|A \cap B|}{|A \cup B|}$$

### Implementation

N-gram and Edge N-gram tokenizers example of an implementation is given in Python code.

```
def ngram_tokenizer(token, ngram_length):
    ngrams = []
    for i in range(len(token) + 1 - ngram_length):
        ngrams.append(token[i:i+ngram_length])
    return ngrams
def edge_ngram_tokenizer(token):
    ngrams = []
    for i in range(len(token)):
        ngrams.append(token[:i+1])
    return ngrams
```

### References:

1. Daniel Jurafsky, James H. Martin – Speech and Language Processing, Third edition, 2021.
2. Doug Turnbull, John Berryman – Relevant Search: With applications for Solr and Elasticsearch, First edition, 2016.

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## **CISCO NETWORK RESOURCES PROTECTION USING PYTHON LANGUAGE SPECIFICS**

**Abstract.** The rapid increase of amount of data today has led to constant threats to information security. Increasing computing power has made it possible to connect many devices to the Internet. Due to the fact that it is rapidly gaining momentum, all areas of business are prone to face numerous vulnerability issues. The need to protect against threats to systems and sensitive data is constantly growing. Cybersecurity is the combination of software and hardware with organizational activities, and if organizational activities may not change over the years, software and hardware are constantly being upgraded.

**Keywords:** information security, network security, cyber security, network administration, cisco, data confidentiality, cyber security software.

### **Python as a cybersecurity tool**

For several years, Python has been the dominant language in cybersecurity. This is a server-side scripting language, so the resulting script does not need to be compiled by encoders. This language is general purpose and is more commonly used in cybersecurity than others.

Python integrates many security tools. Python scripts can help easily automate and search for files and ports, especially when analyzing malware. [1]

However, not all Python experience is the same in security. To create an effective portfolio, develop effective software, and properly demonstrate your value, you need to focus on using the right Python libraries and frameworks for the industry.

Python provides two levels of access to network services. At a low level, you can access basic socket support in the base operating system, which allows you to implement clients and servers for both connection-oriented and offline protocols. Python also has libraries that provide higher-level access to certain application-level network protocols, such as FTP, HTTP, and more.

Many Cisco network devices come with a built-in Python interpreter that you can use to run scripts and programs directly on them. In addition to the interpreter, Python libraries are included, which provide direct access to operations with devices to execute CLI commands or monitor events.

### **Python libraries for network security**

CLI Python Module is a Python module that allows users to interact with Cisco IOS using the CLI. Cisco IOS (Internetwork Operating System) is software used in

Cisco switches and network routers. The code example below shows how to import the CLI library and execute some standard Cisco commands.

```
#!/usr/bin/python
import cli #library import
print cli.execute('show version') #system version check
cli.configure('ip route 10.0.0.129 255.255.255.255 10.80.1.55')
#static routing setup
```

This allows you to run any command to verify or configure the device.

Netmiko is an open source Python library that simplifies the management of SSH network devices. It is a common and easy-to-use library that supports network devices with multiple providers. Network automation is primarily about collecting results from display commands and making configuration changes. [2]

Netmiko installation command:

```
pip install netmiko
```

The dictionary that defines the parameters of the device:

```
cisco_router = {
    'device_type': 'Router1',
    'host': '192.168.0.1',
    'username': 'user',
    'password': 'cisco',
    'secret': 'secret'
}
```

Examples of commands for working with the device:

```
ssh = ConnectHandler(**cisco_router)
ssh.enable()
ssh.exit_enable_mode()
```

### **Netmiko sending commands methods**

`send_command` - send one command

Example: `result = ssh.send_command('show ip int br')` #show ip interface brief

`send_config_set` - send one or several commands in configure terminal

Example: `commands = ['router ospf 1',
 'network 10.0.0.0 0.255.255.255 area 0',
 'network 192.168.100.0 0.0.0.255 area 1']
result = ssh.send_config_set(commands)`

`send_config_from_file` - send command from file (uses method `send_config_set`)

Example: `result = ssh.send_config_from_file('config_ospf.txt')`

`send_command_timing` - send a command and wait for the output based on the timer

The following is a full-featured Python script that demonstrates how to automatically configure a device with a single file:

```
import netmiko
from netmiko import ConnectHandler
```

```

iosv_12 = {
    'device_type': 'cisco_ios',
    'ip': '192.168.1.50',
    'username': 'cisco',
    'password': 'cisco',
    'secret': 'cisco'
}

net_connect = ConnectHandler(**iosv_12)
net_connect.enable()
output = net_connect.send_command('show ip int brief')
print(output)

config_commands = [ 'int loop 0', 'ip add 1.1.1.1
255.255.255.0', 'no sh']
output = net_connect.send_config_set(config_commands)
print (output)
output = net_connect.send_command('show ip int brief')
print (output)

```

The script connects to the device via SSH with the specified login data, displays brief information about the interfaces of the device, configures the address of one interface and includes it. Then again displays information about the interfaces to obtain fresh data.

Measures to strengthen cybersecurity have become extremely mandatory with the increasing severity of cyber attacks and technological progress. As an inventive language, Python has become extremely useful in the field of information security, as it supports and performs many cybersecurity functions, such as malware analysis, scanning and intrusion testing. In addition, the flexibility and simplicity of the language have made it possible to interpret online tools from a leading Cisco vendor.

With Python, you can implement a large pool of applications for tasks such as malware detection, scanning and analysis of cyber threats, automation of penetration tests, hardware configuration, security checks of programs, systems, and more.

Python has a large number of libraries and frameworks for the cybersecurity, the use of which in appropriate combinations creates good conditions for the implementation of software protection of information systems.

### **References:**

1. The Best Programming Languages for Cybersecurity in 2021. February 02, 2021. Ahmed Faizan. URL: <https://flatironschool.com/blog/best-programming-languages-cyber-security>.
2. Multi-vendor library to simplify Paramiko SSH connections to network devices URL: <https://pypi.org/project/netmiko/>

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## A SMART DUST TECHNOLOGY STRUCTURE AND APPLICATIONS OVERVIEW

**Abstract.** The issues of using neural networks in modern information retrieval systems are considered. A structure and applications on the smart dust network are performed.

**Keywords:** sensors, sensor networks, smart dust.

Nowadays IoT and IoE take great part in all spheres of human activities [1]. These concepts consist of different technologies, one of which is “smart dust”. Smart dust is a system of millimeter-sized devices such as sensors, robots, or other devices, that can detect, for example, light, temperature, vibration, magnetism, or chemicals. They are usually operated on a computer network wirelessly and are distributed over some area to perform tasks, usually sensing through radio-frequency identification [2]. Nodes of smart dust network called mots. Smart dust network consists of mots (sensor nodes), gateway, data, data processing technology (internet), database and observer [2] (Fig. 1).

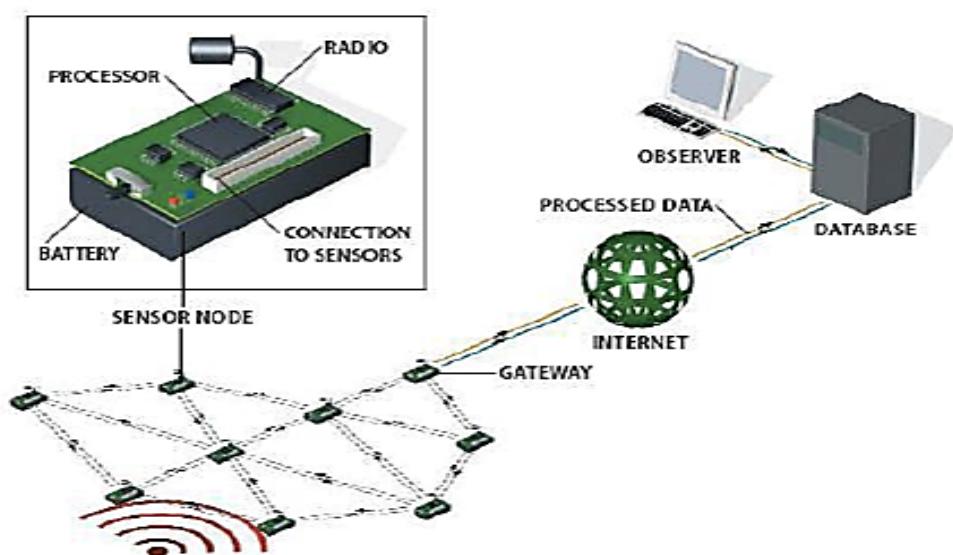


Figure 1 – Smart dust network.

Each mote consists of battery, connection to sensors, radio and processor. The main functions of motes include:

1. Wirelessly processing the data with a computer system;
2. Storing the data (memory);
3. Wirelessly communicating the data to the cloud, a base, or other MEMS.

Smart dust can be used in different areas of human activities. Some smart dust applications presented on the next figure (Fig. 2):

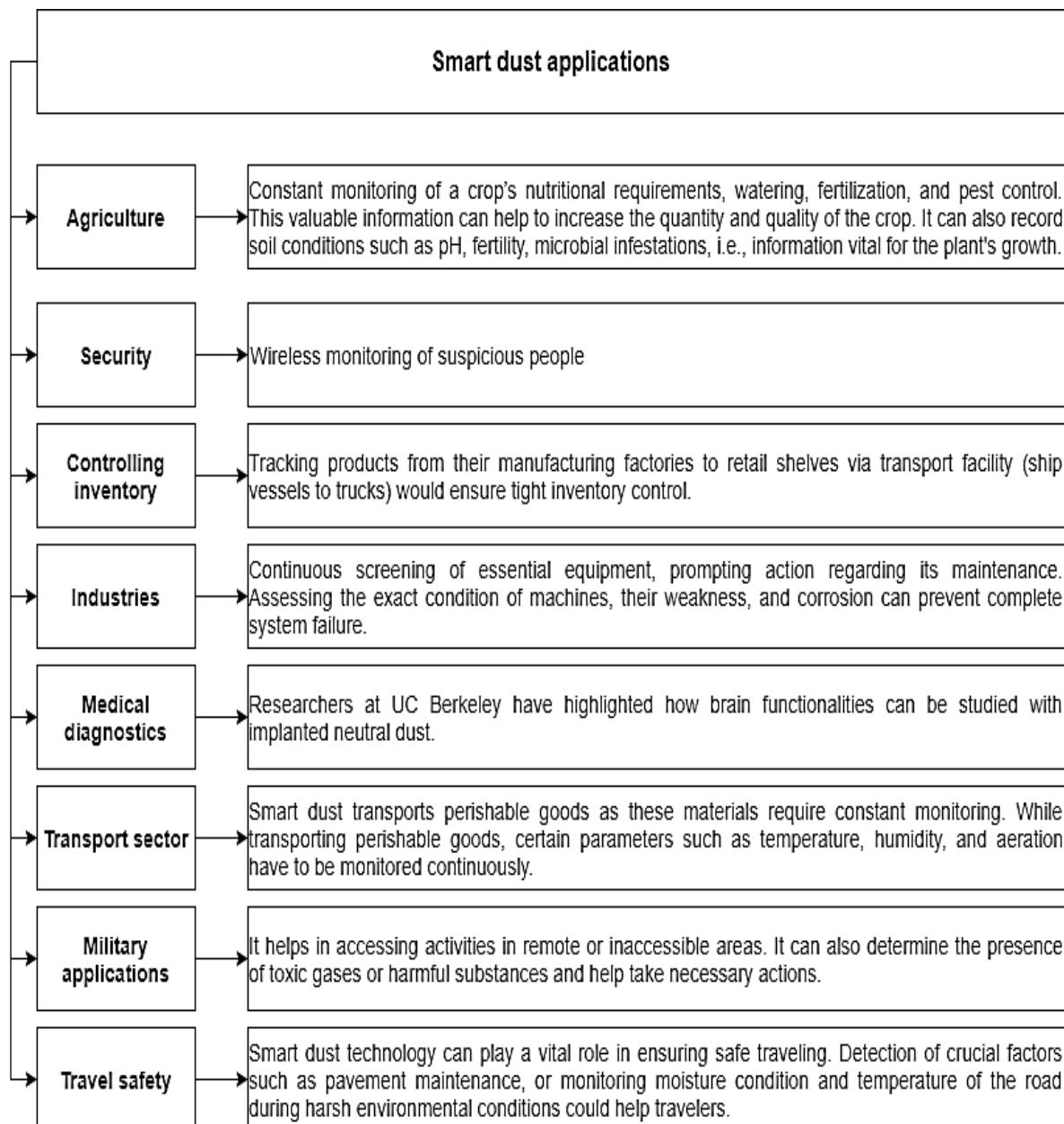


Figure 2 – Smart dust applications.

### References:

1. Evans D. Internet of Everything in Action: Today and Tomorrow #IoE / Dave Evans. – 2012. – Access on: <https://blogs.cisco.com/digital/internet-of-everything-in-action>.
2. What is smart dust. – 2018. – Access on: [https://www.tadviser.ru/index.php%D0%A1%D1%82%D0%B0%D1%82%D1%8C%D1%8F:%D0%A3%D0%BC%D0%BD%D0%B0%D1%8F\\_%D0%BF%D1%8B%D0%BB%D1%8C](https://www.tadviser.ru/index.php%D0%A1%D1%82%D0%B0%D1%82%D1%8C%D1%8F:%D0%A3%D0%BC%D0%BD%D0%B0%D1%8F_%D0%BF%D1%8B%D0%BB%D1%8C).
3. Bose P. Advancements in Nanotechnology-Based Smart Dust / Bose. – 2020. – Access on: <https://www.azonano.com/article.aspx?ArticleID=5560>.

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## **RESEARCH OF DETECTION METHODS OF STEGANOGRAPHY APPLYING IN CYBERATTACKS AND SPYING SOFTWARE**

**Annotation.** The dynamics of the use of steganographic methods during the development of malware and cyberattacks is analyzed. The analysis identified the reasons for the frequent use of steganographic methods in cyberattacks, as well as the effectiveness for attackers. Some methods of finding filled stegocontainers were investigated, and the effectiveness of each was determined in a particular situation.

**Keywords:** message, key, stegochannel, stegosystem, container (stegocontainer).

**Introduction.** The problem of reliable protection of information from unauthorized access is one of the oldest and not yet solved problems. Computer steganography is one of the effective methods of information protection. Computer steganography is the hiding of a message or file in another message or file. For example, steganographers can hide an audio or video file in another informational or even large graphic file. Currently, computer steganography continues to develop. A theoretical base is being formed and new stable methods of message embedding are being developed. The main reasons for the growing interest in steganography are restrictions in some countries on the use of strong cryptography, as well as the problem of copyright protection for works of art in digital global networks [1]. Computer steganography is widely used in the exchange of secret messages, the development of virus software, copyright protection, data hiding from copying, etc. It has gained popularity among both malware creators and cyber-attacks [2].

Therefore, the problem of studying the methods and methodology of steganography is an urgent scientific task.

**Steganography identification methods.** The use of steganography was noticed in the following malware and cyber espionage methods: Microcin (AKA six little monkeys), NetTraveler, Zberp. Enfal (its new loader called Zero.T), Shamoon, KinS, ZeusVM. Triton (Fibbit) [3].

After analysis, we can identify three main reasons for the active use of steganography by malware authors:

- it allows them to hide the fact of uploading the data, not just the pieces of data itself;
- it helps to bypass DPI-systems, which is relevant in corporate networks;
- steganography allows bypassing the test in AntiAPT-products, because such systems can not process all graphic files (there are too much of them in corporate networks, and analysis algorithms are quite expensive).

There are several statistical methods of data analysis for the content hidden in them steganographic methods of various kinds of information. Consider a few of them.

The histogram method of statistical analysis is also known as the "chi-squared" method. Raster is being fully analyzed, each color is quantified by the number of dots of this color in the raster (to make it simple, we are talking about an image that has one color plane). The method is based on the assumption that the number of dots of two adjacent colors ("adjacent" colors stand for colors that differ by the least significant bit only) differs significantly for a normal, regular image (empty container) and the number of pixels of such colors is approximately the same for a filled container. Based on that, for zones that have the quantified value of the chi-square less than the threshold, we can accept the initial hypothesis "the frequency distribution of adjacent colors is the same, therefore, it is a filled stegocontainer."

If you look at the image for a visual attack, you can easily identify that these areas contain the embedded message. Thus, the method works for embedded messages with high entropy.

Another method is called the RS method, where RS means "regular-singular". All images are divided into many pixel groups, then a special flipping procedure is used for each group. Based on the value of the discriminant function before and after the application of flipping, all groups are divided into regular, singular and unused. The algorithm is based on the assumption that the number of regular and singular groups of pixels in the original image and in the image after the flipping should be almost equal. If the number of such groups changes significantly during the application of flipping, it means that the investigated image is a filled container.

**Acknowledgements.** The results of tests on the correctness of the mentioned methods have shown that in images with low entropy "chi-squared" attack can not be used - the results are either unsatisfactory or not quite accurate. Thus, RS-attack has worked perfectly: in both cases the hidden message was identified. But what if automatic analysis methods showed the absence of the embedded message, but we still suspect its presence? Specific procedures can be used to obtain the payload, designed for specific families of malware.

More and more malware developers start to use steganography to hide software communication with the command center and to download various modules. This brings effective results, as the procedures for containers analyzing are quite expensive. Mostly, defensive solutions are not able to handle every object that could potentially be a filled container.

However, there are solutions, that are based on a combination of different methods of analysis, high-speed predicates, the metadata investigation of a potentially filled container, etc. A number of methods for finding filled stegocontainers were investigated, and the effectiveness for using each of them in a given situation was determined.

### References:

1. Khoroshko V. Computer steganography / V. Khoroshko, Y. Yaremchuk, V. Karpinets. – Vinnytsia: VNTU, 2017. – 155 p.
2. Konakhovich G. Computer steganography. Theory and practice / G. Konakhovich, A. Puzyrenko., 2006. – 288 p.
3. Karpinets V. Analysis of the influence of digital watermarks on the quality of vector images / V. Karpinets, Y. Yaremchuk., 2011. 72 – 82 pp.

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## **PROJECT MANAGEMENT OF INFORMATION SYSTEM PICK BY VOICE IMPLEMENTATION FOR WAREHOUSE PROCESSES AUTOMATION**

**Abstract.** This thesis contains a consideration of warehouse logistics automation problems and an exploration of information system Pick by Voice implementation.

**Keywords:** project management, automation, warehouse logistics, voice-controlled system.

Today the world is in the active development of various technologies that provide our lives with all the needs. Using all the benefits of the modern world gives us the opportunity to move comfortably anywhere in the world, get things from different parts of the world, and most importantly - simplifies our lives every day more and more.

Logistics gives an opportunity for optimal process management in the transportation, storage and handling of any items. An important part of the goods delivery to the consumer and maintaining its original condition is provided by warehouse logistics.

Automation of warehousing processes will be provided by the implementation of the information system Pick by Voice, which will effectively manage the stages of goods receiving, sending and searching.

As a result of the project, we will have 3 products [1]: an implemented system for warehouse management by voice, which allows voice control, a system that provides communication with the operator and an information site with the necessary information about the system. Consider the products in more detail:

1. An implemented system for warehouse management by voice. The warehouse operator has a specific device with which he can give commands and receive voice answers regarding the receipt, dispatch, inspection or searching of goods in the warehouse. The device has a specific screen, that displays data, speaker and microphone. The system is built in such a way as to recognize the operator's commands and perform certain actions with goods.

2. The system (program) that provides communication with the operator is used to connect Pick by Voice technology and the operator. It contains several screens that are displayed on the device (screen for entering the serial number of the product, quantity and other characteristics). This program is developed individually for each client.

3. Information site. The structure of the site is divided into the following main sections:

- Full product description
- System description and instructions for use
- Section where you can order the purchase of the system implementation
- Promotions and offers
- Updates

Among the project main tasks list that need to be solved to achieve the goals, we can note the following: providing the necessary machinery and equipment, development of a system prototype, development of technology implementation, launch of system implementation, development and implementation of product processing functions, website creation, providing high-speed communication of the system with the operator, organization of interaction with stakeholders and promotion of the system, providing the opportunity to purchase the implementation of the system and supporting information about the use of the system.

This project solves not so much a need or problem as the ability to facilitate the process of receiving, sending and searching for goods by developing a convenient interface. The implementation of the system will allow you to synchronize information between your own customer systems and Pick by Voice.

From a constructive point of view, the project life cycle can consist of eight standard phases (project definition, project organization, quality management, team building, project planning, execution management, project tracking, project completion).

In the first phase the main tasks are defined:

- conversation with the project initiator;
- office market research;
- analysis of the competitive environment;
- analysis of available information;
- passport preparation;
- creation of the project charter.

The economic model is of great importance in the project, where costs and revenues are analyzed [2]. Also net capital, loan disbursements, income and cash flow are investigated. It is worth noting that this section determines the sales of the product, taking into account the price and projected volumes.

The implementation of a voice-controlled system will create a new need for potential customers, provide a platform for integration with various programs and applications, create new ideas for the development of warehousing logistics in the future.

The analysis [3] shows that each warehouse system requires process automation, which will allow to manage all product functions quickly, smoothly and efficiently. Therefore, the implementation of the Pick by Voice system will create additional opportunities in warehousing logistics management.

Therefore this implementation will be useful for customers with different product monitoring systems, because Pick by Voice has a data integration function, which allows you to get all the detailed information about the available items in the warehouse.

### **References:**

1. Морозов В.В. Управління проектами: процеси планування проектних дій: Підручник / В.В. Морозов, І.В. Чумаченко, Н.В. Доценко, А.М. Чередніченко. - К.: Університет економіки та права «КРОК», 2014. – 673 с.
2. Проектне фінансування: Навч. посіб. для студ. вищ. навч. закл. / В.В. Жуков; Харк. нац. екон. ун-т. – Х.: ВД “Інжек”, 2006. – 248 с.
3. Morozov V., Development Of The Model Of The Proactive Approach in Creation Of Distributed Information Systems // V. Morozov, O. Kalnichenko, S. Bronin. - Charkiv: Eastern-European Journal of Enterprise Technologies, № 43/2 (94), 2018. – pp. 6-15.

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## **THEORETICAL BOUND OF THE COMPLEXITY OF SOME ALGORITHMS FOR VARIATIONAL INEQUALITIES**

**Abstract:** This work is devoted to the study of three new extragradient type algorithms for solving monotone variational inequalities in a Banach space. A complexity bound are proved in terms of the gap function for variational inequalities with monotone Lipschitz continuous operators acting in a 2-uniformly convex and uniformly smooth Banach space.

**Keywords:** variational inequality, extragradient algorithms, gap function, complexity, 2-uniformly convex Banach space, uniformly smooth Banach space.

Areas of operations research, data analysis, and mathematical physics produces many problems, which can be written in the form of variational inequalities. With the growing popularity of generative adversarial networks (GANs) and other adversarial learning models, a steady interest in algorithms for solving variational inequalities has arisen among specialists in the field of machine learning.

This report is devoted to the study of three new extragradient type algorithms for solving monotone variational inequalities in a Banach space.

The first two algorithms are natural modifications of Tseng method [1, 2] and “Extrapolation from the Past” method [3] for problems in Banach spaces using the generalized Albert projection [4]. Iteration of each of these algorithms is more economical than iteration of the extragradient method, because the first one uses single projection on iteration, and the second one needs only one operator calculation.

The third algorithm, called operator extrapolation method, is a variant of the forward-reflected-backward algorithm, proposed by Malitsky and Tam [5]. Operator extrapolation method also uses generalized Albert projection onto the feasible set. An attractive feature of the algorithm is only one computation at the iterative step of the operator value and the generalized projection.

Let us describe the studied algorithms for variational inequality

$$\text{find } x \in C : \langle Ax, y - x \rangle \geq 0 \quad \forall y \in C,$$

where  $C \subseteq E$  is a convex and closed set,  $A: E \rightarrow E^*$  is a monotone and Lipschitz continuous operator.

### **Algorithm 1. Modified Tseng method.**

Select  $x_1 \in E$ ,  $\lambda_n > 0$ . Set  $n = 1$ .

1. Calculate

$$y_n = \Pi_C J^{-1}(Jx_n - \lambda_n Ax_n).$$

2. If  $y_n = x_n$ , then STOP. Else calculate

$$x_{n+1} = J^{-1}(Jy_n - \lambda_n(Ay_n - Ax_n)).$$

3. Set  $n := n + 1$  and go to step 1.

**Algorithm 2. Extrapolation from the past.**

Select  $x_1 = y_0 \in E$ ,  $\lambda_n > 0$ . Set  $n = 1$ .

1. Calculate

$$y_n = \Pi_C J^{-1}(Jx_n - \lambda_n A y_{n-1}).$$

2. Calculate

$$x_{n+1} = \Pi_C J^{-1}(Jx_n - \lambda_n A y_n),$$

if  $x_{n+1} = y_n = x_n$ , then STOP. Else set  $n := n + 1$  and go to step 1.

**Algorithm 3. Operator extrapolation.**

Select  $x_0 = x_1 \in E$ ,  $\lambda_n > 0$ . Set  $n = 1$ .

1. Calculate

$$x_{n+1} = \Pi_C J^{-1}(Jx_n - \lambda_n A x_n - \lambda_{n-1}(A x_n - A x_{n-1})).$$

2. If  $x_{n-1} = x_n = x_{n+1}$ , then STOP. Else set  $n := n + 1$  and go to step 1.

The  $O(\frac{1}{\varepsilon})$  complexity estimations are proved in terms of the gap function for variational inequalities with monotone Lipschitz operators acting in a 2-uniformly convex and uniformly smooth Banach space.

**References:**

1. P. Tseng, A modified forward-backward splitting method for maximal monotone mappings, *SIAM Journal on Control and Optimization* 38 (2000) 431–446.
2. Y. Shehu, Single projection algorithm for variational inequalities in Banach spaces with application to contact problem, *Acta Math. Sci.* 40 (2020) 1045–1063. doi:10.1007/s10473-020-0412-2.
3. D. A. Nomirovskii, B. V. Rublyov, V. V. Semenov, Convergence of Two-Stage Method with Bregman Divergence for Solving Variational Inequalities, *Cybernetics and Systems Analysis* 55 (2019) 359–368.
4. Y. I. Alber, Metric and generalized projection operators in Banach spaces: properties and applications. in: Theory and Applications of Nonlinear Operators of Accretive and Monotone Type, vol. 178, Dekker, New York, 1996, pp. 15–50.
5. Y. Malitsky, M. K. Tam, A Forward-Backward Splitting Method for Monotone Inclusions Without Cocoercivity, *SIAM Journal on Optimization* 30 (2020) 1451–1472.

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## **THE ANALYSIS OF THE APPROACH TO THE REMOTE IMPLEMENTATION OF THE INFORMATION SYSTEMS INTO THE PROJECT-ORIENTED ORGANIZATIONS**

**Abstract.** The article addresses the challenges associated with the remote implementation of information technologies. The article contains an analysis of existing approaches to the organization of remote software implementation, recommendations for improving the implementation of information systems for remote project management, and prospects in terms of methodological, organizational, and technical components. A model of the remote software implementation project is proposed.

**Keywords:** implementation, methodologies, information technologies, remote work, management.

The trends in the development of information technologies are aimed at the transition to the digital transformation and integration of all the aspects of project-oriented enterprises. In essence, it means that all management processes are completely transferred to the digital environment. This is a requirement of today's realities. At the same time, the transition to a new dimension, which is associated with remote work, leads to challenges for the implementation of information systems (IS) in the practice of project-oriented enterprises. Since the transition to online work was established not so long ago, approaches to the management of the remote implementation of information technologies are not yet fully formed and require more detailed studies.

The implementation of information systems into the practice of enterprises can be characterized by a period of change when the enterprise moves from its usual management methods to a new level. About 70% of all enterprise change initiatives fail. Most of these failures are caused by hasty changes, hasty implementation of management information systems when managers delve into lots of initiatives. In the work [1], an approach to the implementation of corporate project management systems (CCMS) within development companies and their project portfolios is outlined. But the works do not address the issue of conditions for remote implementation, the impact of remote tools on the success of the project. This issue is partially covered in the paper [6], which presents the factors that negatively affect remote work, in particular the

problems that can be influenced by the project manager for a more efficient organization of work. Continuation of the idea of communication management to achieve effective work is described in [8]. The focus of the work is the importance of organizing data, roles, keeping the necessary documentation online, and using common platforms for management. The evaluation of the effectiveness of the use of certain approaches and tools to ensure communication and interaction of participants in the online process is formed in [2]. But there is no instrumental component in these works. This problem is addressed in [5]. The article describes the effectiveness of using software that helps to remotely plan and manage project implementation. The description of the tools is presented in more detail in the works [3, 4], in particular, attention is paid to the tools that can be used during the organization of remote software implementation. Namely, S. Jain's book describes an approach to automating the entire process of software installation and maintenance, which will significantly reduce time and human effort. The work of A. K. Kichigina reveals the features of remote installation of operating systems in the modern world.

Thus, the remote implementation of information systems into the work of project-oriented enterprises should be considered in terms of the project. In particular, there is a problem of combining existing organizational, methodological tools in project management with the means of remote work. The result of this combination is the development of a project model for remote IS implementation.

Traditionally, project management is a specialized organizational structure - the project management office, which concentrates the functions of professional support of project management processes in the organization. The authors propose the creation of a separate department for remote implementation of IS, in which the labor resources are: manager, methodologist, IT groups, which are divided into three:

- software development team;
- software implementation team;
- software support team.

The first one is responsible for the development of the information system, which will be implemented in the future. The development team controls the quality of the developed software and its compatibility with the client system. The second one deals directly with the remote implementation: installation and configuration of the software. The specialists of this group are involved in the project for a limited time and ensure the functionality and stability of the implemented system on remote devices. The third group, in turn, deals with customer issues and solves problems that arise after the implementation of the software. Such a team should be in touch with customers around the clock, responsibilities include analyzing problems and providing ready-made solutions. Each team has its own manager who coordinates its actions.

At the same time, in terms of the organizational component, it is appropriate to highlight the interaction of stakeholders - the communicative component. The communicative component aim is to determine the completeness, reliability, and

efficiency of information exchange between those involved in the project on the remote implementation of IS. To implement this component, the following principles are identified:

- accessibility;
- simplicity;
- logging of information exchange;
- systematization;
- the ability to quickly find the information you need and provide it at the right time.

Establishing communication within the team is implemented by creating communication channels according to the specifics of the work. Particular attention should be paid to video conferencing and trying to make most of the interaction in video format. As there may be difficulties with hardware or software during the remote work, it is necessary to involve additional staff to organize the effective work of all team members, in particular, to set up remote communication channels and be responsible for data security. In addition, these staff should monitor the provision of appropriate conditions for the remote deployment of all team members. Specific technologies should be discussed in advance to assure customers of the safety of the selected tools.

Using the example of the selected organizational structure and established roles, the next stage for remote software implementation is appropriate to choose a methodology of work. It is proposed to use a concretized project management methodology [8].

Before starting a remote deployment, you need to check the availability of the necessary software on your own and the client's side for remote interaction. Next, the technical expert should be able to remotely connect to the client-server, download and configure the software. After that, you will need to make sure that the software was installed without errors and can be launched without problems on the client-side without the help of a technical expert. Upon completion, it is necessary to inform the team and clients about the success and remind them of the communication channel with the support team in case of problems.

It is recommended to use the following principles to successfully manage this component:

- using only secure communication channels;
- using CAD / CAM / CAE, CAPP, and PDM systems;
- selection or development of information technologies that would satisfy the use of methodological documentation templates.

In the process of organizing the implementation of a project, you should not neglect special information technologies. As with classic project management, it is worth implementing the Microsoft Project platform or similar to identify problems and attract staff and implementation partners to complete their tasks. It is recommended that

you set up a project management software or Kanban board that contains specific tasks for carrying out projects to implement systems.

**Conclusions.** The main problem of the organization of remote control is revealed. After analyzing the available work and research in the direction of organizing the remote implementation of information systems, it was found that they are now presented in insufficient quantities. There is a very small number of works where approaches to the remote implementation of information technologies are studied. The analysis of the triad: organizational - methodological - technical component in the project of remote implementation of information systems is presented. Highlighted the principles that contribute to the implementation of the project for the remote implementation of information technologies.

### References:

1. Tesla Y.M. Models and methods of implementation of corporate project management system in development / Y.M. Tesla , I.I. Oberemok, O.G. Timinsky // Project Management and Production Development: Collection of scientific papers - Luhansk: published by SNU. V. Dalya, 2009. - № 1 (29). - P. 28-35.
2. Riordon R. Remote Implementation is a Reality. Here's How To Do It. / Robin Riordon. // QAD. – 2020. – C. 2.
3. S. Jain, M. Gupta, Rakesh, A. Baunthiyal and V. Agarwal, "IHMU: Remote installation of OS/ system software/ application software/ patch installation/ version anomaly detection and system health monitoring in distributed system," 2017 3rd International Conference on Computational Intelligence & Communication Technology (CICT), 2017, pp. 1-3, doi: 10.1109/CIACT.2017.7977267.
4. A. K. Kichigina. REMOTE INSTALLATION OF OPERATING SYSTEMS IN THE MODERN WORLD / A. K. Kichigina, I. V. Sviridova. – Belgorod: Belgorod State Institute of Arts and Culture, 2016. – 113 c. – (2).
5. LaGore R., Top 7 Remote Project Management TMS Implementation Essentials, 2020. URL: <https://blog.intekfreight-logistics.com/remote-tms-system-implementation-essentials-for-success>.
6. Trident: 5 Best Practices for Successful Remote Implementations, 2020. URL: <https://www.tridant.com/5-best-practices-for-successful-remote-implementations/>.
7. Thomson A. How To Make Remote Project Management A Success / Allan Thomson. // Resources for Project Management. – 2021.
8. Khlevna Y.L, Methodology of influences on the creation of project management systems. Abstracts of the V International Scientific and Practical Conference "Information Technology and Interaction", November 8-10, 2018 / Ministry of Education and Science of Ukraine, KNU. Taras Shevchenko and others. - K .:, 2018. - P. 155 - 157.

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## **SOLVING SYSTEMS OF LINEAR ALGEBRAIC EQUATIONS BY CRAMER'S RULE AND EXCEL TABLE PROCESSOR**

Solving many practical problems requires finding solutions of systems of linear algebraic equations. But it is often difficult to find the exact solution of such systems manually. To do this, the developers of the Excel table processor offer a function to calculate the determinants used in the Cramer's rule. Consider in more detail the implementation of this method of solving a system of linear algebraic equations using an Excel table processor.

Suppose we have a system of linear algebraic equations

$$\mathbf{A} \mathbf{x} = \mathbf{b}, \quad (1)$$

where

$$\mathbf{A} = \begin{pmatrix} a_{11} & a_{12} & \dots & a_{1n} \\ a_{21} & a_{22} & \dots & a_{2n} \\ \dots & \dots & \dots & \dots \\ a_{n1} & a_{n2} & \dots & a_{nn} \end{pmatrix}, \quad (2)$$

$$\mathbf{b} = \begin{pmatrix} b_1 \\ b_2 \\ \dots \\ b_n \end{pmatrix}, \quad \mathbf{x} = \begin{pmatrix} x_1 \\ x_2 \\ \dots \\ x_n \end{pmatrix}. \quad (3)$$

System (1) has a unique solution when the determinant  $\det \mathbf{A} = A \neq 0$ . To solve such a system of linear algebraic equations, we use Cramer's rule: *If  $\det \mathbf{A} = \Delta \neq 0$ , i.e., the matrix  $\mathbf{A}$  has an inverse  $\mathbf{A}^{-1}$ , then system (1) has a unique solution  $x_i = \Delta_i / \Delta$ ,  $i=1, 2, \dots, n$ , where  $\Delta_i$  is the determinant obtained from the determinant  $\Delta$  by replacing the  $i$ -th column with a column of free members  $\mathbf{b}$*  (3).

It should also be noted that for completeness of the analysis, except for the case considered above ( $\det \mathbf{A} = \Delta = |A| \neq 0$ ), when the system (1) has a unique solution, consider the case  $\det \mathbf{A} = \Delta = |A| = 0$ . For this case, system (1) has many solutions when all  $\Delta_i = 0$ ,  $i = 1, 2, \dots, n$ , and system (1) is incompatible, i.e. there are no solutions when at least one of  $\Delta_i \neq 0$ ,  $i = 1, 2, \dots, n$ .

To implement the Cramer's rule and the cases described in the previous paragraph, the Excel table processor (Russian version) should use the function to

calculate the determinant  $\text{МОПРЕД}$  ( $MDETERM$ ). For more information, you can use the help for this function.

We show how the solution of systems of linear algebraic equations is realized using the Cramer's rule and the cases described below by examples, i.e. we solve the following systems of equations:

$$1. \begin{cases} x_1 + x_2 + 2x_3 = 0 \\ 2x_1 - x_2 + 3x_3 = -2 \\ 4x_1 + 3x_2 + 7x_3 = 0 \end{cases} \quad (4) \quad 2. \begin{cases} x_1 + 2x_2 + x_3 = -1 \\ 2x_1 - x_2 - x_3 = 1 \\ 4x_1 + 3x_2 + x_3 = 0 \end{cases} \quad (5) \quad \begin{cases} x_1 + x_2 - x_3 + x_4 = 1 \\ -2x_1 - x_2 + 3x_3 - 2x_4 = 2 \\ 2x_1 + 3x_2 + x_3 - 5x_4 = 0 \\ x_1 + 3x_2 + 3x_3 - 6x_4 = 3 \end{cases} \quad (6)$$

The solution of the system of equations (4) will look like this

AJ2		$=\text{МУМНОЖ}(\text{C2:E4};\text{AG2:AG4})$																																		
A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V	W	X	Y	Z	AA	AB	AC	AD	AE	AF	AG	AH	AI	AJ	
1																																				
2		1	1	2						0	1	2					1	0	2					1	1	0						x <sub>1</sub> =	$\Delta_1/\Delta=$	1	Verification	0
3		$\Delta=$	2	-1	3	=	2	$\neq 0$		$\Delta_1=$	-2	-1	3	=	2	$\Delta_2=$	2	-2	3	=	2		$\Delta_3=$	2	-1	-2	=	-2	$x_2=$	$\Delta_2/\Delta=$	1			-2		
4		4	3	7						0	3	7					4	0	7					4	3	0					$x_3=$	$\Delta_3/\Delta=$	-1		0	

For system (5) we have

G3		$=\text{МОПРЕД}(\text{C2:E4})$																											
A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P														
1																													
2		1	2	1						-1	2	1																	
3		$\Delta=$	2	-1	-1	=	0			$\Delta_1=$	1	-1	-1	=	-1	$\neq 0$													
4		4	3	1						0	3	1					0	3	1										
5																													
6		The system is incompatible, i.e. there are no solutions																											

The sequence of solving the system of equations (6) will look like this

H3		$=\text{МОПРЕД}(\text{C2:F5})$																																					
A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V	W	X	Y	Z	AA	AB	AC	AD	AE	AF	AG	AH	AI	AJ	AK	AL	AM	AN
1																																							
2		1	1	-1	1					1	1	-1	1				1	1	-1	1				1	1	1	1					1	1	1	1				
3		$\Delta=$	-2	-1	3	-2	=	-0		$\Delta_1=$	2	-1	3	-2	=	0	$\Delta_2=$	-2	2	3	-2	=	0	$\Delta_3=$	-2	-1	2	-2	=	0	$\Delta_4=$	-2	-1	2	2	=	0		
4		2	3	1	-5				0	3	1	-5				2	0	1	-5				2	3	0	-5					2	3	0	0					
5		1	3	3	-6				3	3	3	-6				1	3	3	-6				1	3	3	-6					1	3	3	3					
6																																							
7		The system has many solutions																																					

Thus, thanks to the Excel table processor, systems of linear algebraic equations (4), (5) and (6) are easily and visually solved. To check the solutions of system (4) we use formula (1). Next, select the range of cells AJ2:AJ4, enter the formula  $=\text{МУМНОЖ}(\text{C2:E4};\text{AG2:AG4})$  (MMULT) and press **Ctrl+Shift+Enter**. As you can see, the values of the cells of the selected range coincide with the values of the vector of free members **b** of system (4).

#### References:

- Сорока П.М., О.С. Іларіонов Розв'язування систем лінійних алгебраїчних рівнянь за допомогою інструменту «Поиск решения» табличного процесора Excel. – Тези доповідей VII Міжнародної науково-практичної конференції «Математика. Інформаційні технології. Освіта», Луцьк-Світязь, Східноєвропейський національний університет імені Лесі Українки, 3-5 червня 2018 р. – С.107-109.
- Сорока П.М., Тмєнова Н.П. Засоби обробки таблиць. Навч.-метод. посіб. з дисципліни «Сучасні інформаційні технології». – К.: Вид-во ТОВ «Гліф Медіа», 2017. – 185 с.

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## ANALYTICS OF AUTOMATED SYSTEMS IN THE CONTEXT OF PERSONNEL MANAGEMENT

Working with staff is an important and time-consuming part of any business. Effective personnel management is critical not only for the company [1], but also for interaction with regulatory authorities.

Personnel management systems have many components. This includes the management of internal and external motivation, the use of methods of material incentives or sanctions, payment of wages, maintenance of discipline, determining the level of responsibility for each employee, and maintaining appropriate documentation [2].

Staff rotation and inefficient personnel management can negatively affect a company's efficiency.

Currently, there is a trend towards significant changes in the field of personnel management by automating HR-processes [3]. Among the reasons: reloading of applications, significant time spent on approving the requirements for candidates during the recruitment process, a large number of information flows, the human factor during the analysis, which leads to errors in reports, inefficiently organized adaptation program for employees, as a result of which a new team member has a discrepancy between the actual and the expected, misunderstanding of the requirements and incorrect judgment about the purpose of the company.

The result of one of the studies conducted by Deloitte was the conclusion that by implementing an automated system, the company can save more than 20% of costs per employee [4].

In the HR-department you can automate a range of business processes aimed at recruitment and staff development: hiring, onboarding, payroll, accounting, performance appraisal, tracking the resumes of potential applicants, the formation of personnel reserves, compensation payments and bonuses, data analysis and employee reporting.

There is already a wide range of systems aimed at organizing the work of the personnel management department. Such systems provide an opportunity to staff the employees so that a long-term development strategy is built, the creation of a personnel reserve, a hierarchy of succession among managers, the ability to direct staff to achieve production goals, ensure optimal accounting in HR, plan and control the process of staff training so that it meets business objectives [2].

In addition, modern developments make it possible to integrate HR management

systems with cloud services, which potentially increases efficiency, reduces the time for the organization of interaction between data, and allows you to automatically process certain information [5]. Automated systems also have functionality that helps analyze and visualize large amounts of data for further forecasting and decision making.

Automation requires resources on the part of HR staff, because it is not the transfer of all paper documents in electronic form, it is a complete change of existing processes, their clear formalization, structuring and standardization. It is also customary to implement enterprise automation projects as a project portfolio, so that there is a clear connection between them, which will help to move smoothly from recruitment to onboarding, then to learning and goal management, and so on.

However, if you pay attention to the prospects of the company in the case of organized management of human experience, the cost of implementation pays off over time by reducing the number of employees for the HR department in the future, automation increases employee loyalty to the company and reduces staff turnover. It is in turn saves the cost of recruitment and onboarding of employees, provides the opportunity to transfer knowledge.

Nowadays, there are many systems that can simplify and improve HR performance, some of which can provide quality management for only one process, such as recruitment, while others may include multiple modules and qualitatively cover the requirements for multiple processes. The task of this work is to analyze existing systems and identify factors of system selection for the HR department.

SAP SuccessFactors is an automated talent management system. This system consists of modules that cover all aspects of work in HR. Any module can be used as a separate solution [6].

The system consists of modules that can be implemented in turn as needed. These modules work in synergy when implemented, i.e. it is possible to use additional functions. Also, a feature of this system is the onboarding to customer requirements, i.e. the implementation team can modify the templates in order to improve the customer experience. It is a cloud solution that allows you to work from any device with access to the Internet through any browser and mobile application.

A distinctive feature is the availability of a secure HR-portal for new employees undergoing onboarding. That is, users at the stage of onboarding get acquainted with the system, which conducts all personnel operations, goal setting and daily tasks.

The use of this system implements efficiency on a scale, i.e. the larger the company - the greater the savings from the use of this product.

Hurma System is a program for optimizing the routine work of the HR department.

One of the disadvantages of the system is the limited functionality, compared to SAP SuccessFactors. This system does not cover all the needs of HR employees, as there are no document reconciliation processes, which would allow a greater transition to electronic document management and speed up decision-making processes [3].

PeopleForce is a modular online platform for personnel management. The cost of use depends on the number of employees and modules that will be implemented at the

enterprise.

It is proposed to take into account the following factors when choosing an automated system for the HR department: the number of employees in the company, the budget for the implementation project and the annual subscription costs, the reliability of data confidentiality. Today, there are many solutions, platforms to simplify the work of HR-managers, but you must first form the basic requirements for the system and only then look for programs that will meet the needs [7].

### **Conclusion**

The systems discussed in the article have an intuitive interface that provides a good user experience. Each of the systems provides reporting and analytics to enable strategic decisions based on these documents. The SAP SuccessFactors solutions positions flexibility, as it contains a very large number of tools that can be adapted to the needs of the customer company. Automation requires resources on the part of HR staff, because it is not the transfer of all paper documents in electronic form, it is a complete change of existing processes, their clear formalization, structuring and standardization. The following powerful tools for automation and optimization of talent management processes were considered in the article: SAP SuccessFactors, Hurma, PeopleForce.

Companies are looking for innovative solutions that will significantly reduce the burden on the human resources department.

### **References:**

1. HR and software: programs for personnel management, 2020. URL: <https://www.syssoft.ru/softpower/hr-i-soft-programmy-dlya-upravleniya-personalom/>
2. HRM (human resources management) - personnel management. URL: <https://www.it.ua/knowledge-base/technology-innovation/human-resources-management-hrm>
3. HR System or HRIS/HRM – Automation of HR processes. URL: <https://hurma.work/en/capabilities/hr/>
4. 6 HR trends 2021: expert opinions, 2021. URL: <https://hurma.work/blog/6-hr-trendiv-2021-dumki-ekspertiv/>
5. Riya Sand. HR and Cloud Computing: How the Cloud is Transforming HR. URL: <https://www.hrtechnologist.com/articles/digitaltransformation/hr-and-cloud-computing-how-the-cloud-is-transforming-hr/>
6. SAP SuccessFactors solution. URL: <https://sap-sf.com.ua/>
7. PeopleForce. Smart HR platform. URL: <https://peopleforce.io/en/>

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## USING LSTM-METHOD IN SUPPLY CHAIN PLANNING

**Abstract.** The relevance of building a high-quality customer profiling process and sales forecasting using recurrent neural networks using the LSTM-method is considered. The limitations in the process of using forecasting methods and the limitations of recurrent methods are described. Recommendations for eliminating the restrictions are given. A brief description of the LSTM-method operation process is given.

**Keywords:** Supply Chains, forecasting, Neural Networks, Recurrent Neural Networks, LSTM.

**1. Introduction.** The functioning of supply chains is a complex multicriteria task, at the head of which is the prediction of customer buying behavior [1]. Once the forecast is built, organizations make plans to provide production with the necessary resources and define supply chains. Given the probabilistic nature of each of the processes, and especially sales, there is a threat of accumulation of forecast errors. The main task for management is to ensure high-quality profiling of clients and the construction of predictive models [2]. The complexity of the forecasting problem grows with the increase in the product range and the expansion of the product parameters. As a result, the forecast comes down not only to determining the number of future sales, but also predicting consumer preferences within the product range and identifying patterns of consumer behavior.

**2. The relevance of the introduction of new methods.** A dynamic environment subject to rapid scientific and technological progress and globalization of markets does not allow obtaining a high-quality solution using traditional methods of forecasting and classification. One of the ways to solve this problem is to use new types of neurons, for example, recurrent neural networks [3]. This type of networks has by the presence of a number of significant disadvantages: the disappearance or off-scale gradients in the learning process. When a problem of the first kind occurs, gradient approaches zero at an exponential rate, which makes it impossible to study long-term events [4]. A problem of the second kind is characterized by the presence of a rapid increase in the value of the gradient, and the algorithm “goes off scale” and stops. To solve this problem, it is possible to use one of four methods:

1. changing the number of layers (it is recommended to reduce it);
2. control of the rate of change of the gradient and artificial limitation of the rate of its change;
3. control and adjustment of weights;
4. use of LSTM-methods.

Experience has shown that using LSTMs is effective for learning complex patterns without having to design functions. Applications using the LSTM method can handle large networks (from 100,000 to millions). Parallel computing and graphics processing units (GPUs) are recommended to keep training times realistic.

**3. Overview LSTM-method.** The LSTM-method uses LSTM memory blocks and Gated Recurrent Units (GRUs) [5]. The content of the memory cell is modeled by the input gate and the forgetting gate. If both gates are closed, then the content information remains unchanged when moving from the previous time step to the next. The gate structure makes it possible to store information over several time slices. This ensures that gradients work overtime, which compares favorably with other traditional algorithms.

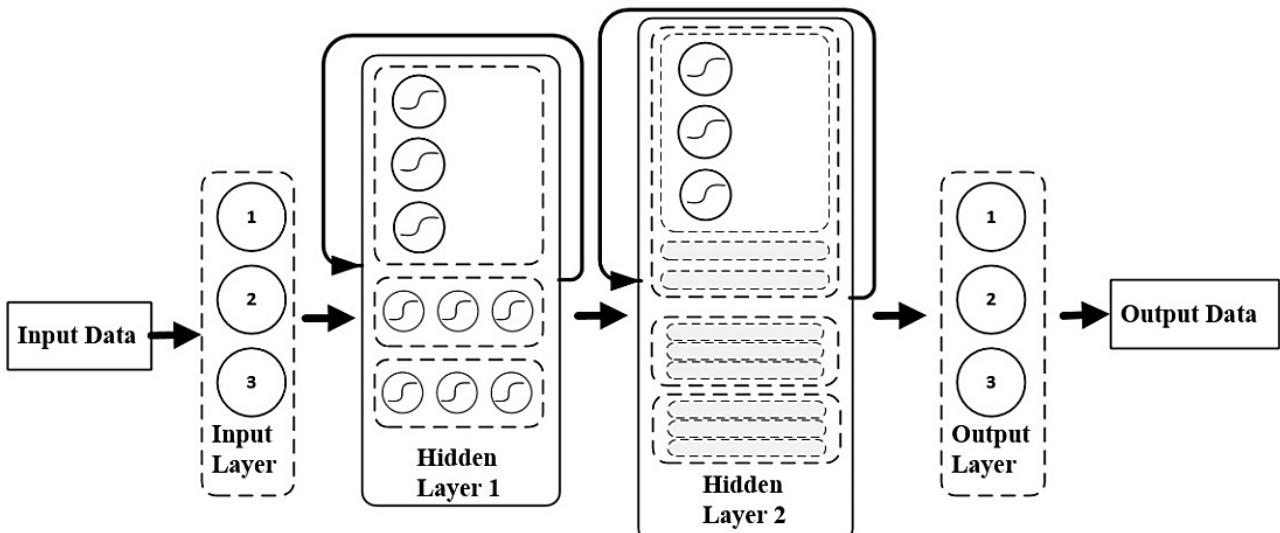


Figure 6: Simplified diagram of a recurrent network

As can be seen in Figure 1, the block output is recursively connected to its inputs by all block gates, where sigmoid activation functions are used in the range of values [0,1]. The network uses three types of gates, among which three functions are clearly distributed: input - protects the block from events below threshold values; forget gate - clears the memory buffer; output - transfers the memory value at the block output. To update the weights in LSTM networks, the supervised learning method is used. For this, one vector is fed to the input of the algorithm, which later become activators of the input blocks. All blocks calculate the parameters of their current state, the value of which is a non-linear function, at each time step. The vector error can be calculated as the sum of the deviations of the activator value from the regulatory values. All outputs from hidden layers of neurons are transmitted with a one-time delay at each step. The signal is transmitted to all neurons in the hidden layer.

**4. Summary.** Changes to the traditional approach to forecasting sales and subsequent planning of purchases can significantly improve the quality of forecasts. This will have a positive effect on the result of the functioning of supply chains. The use of the LSTM method allows us to bring the quality of forecasts to a new level, but at the same time a full-fledged implementation of the application is available and expedient only for large companies. This is due to the requirement for a large amount of data to train the model.

#### References:

1. Д.І. Симонов .Алгоритм визначення оптимального потоку в ланцюгах постачання з урахуванням багатокритеріальних умов та стохастичності процесів. Вісник Київського національного університету імені Тараса Шевченка, випуск №2, 2021, Серія фізико-математичні науки
2. Symonov D. Usage of mathematical modeling on the industrial enterprises. Do desenvolvimento mundial como resultado de realizações em ciência e investigação científica: Coleção de trabalhos científicos «ΛΟΓΟΣ» com materiais da conferência científico-prática internacional (Vol. 3), 9 de outubro de 2020. Lisboa, Portugal: Plataforma Científica Europeia. P. 9-11. DOI 10.36074/09.10.2020.v3.02
3. Gers FA, Schraudolph NN, Schmidhuber J (2002) Learning precise timing with LSTM recurrent networks. J Mach Learn Res 3:115–143.
4. Mathur, R., Pathak,V., Bandil, D. (2019) Stock market price prediction using LSTM RNN. Springer, Singapore.
5. Greff, K., Srivastava, R.K., Koutník, J., Steunebrink, B.R., Schmidhuber, J. (2016) LSTM: a search space odyssey. IEEE Trans. Neural Netw. Learn. Syst.

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## **DEVELOPMENT AND FEATURES OF PROJECT MANAGEMENT TO CREATE AN INTERACTIVE MAP FOR SOLVING ECOLOGICAL PROBLEMS AND AIR POLLUTION**

Unfortunately, the field of monitoring emissions of harmful substances into the atmosphere in our country is extremely poorly developed. Nevertheless, the problem of lack of software and hardware to meet these goals, on the contrary, is quite acute. Consider the main problems in this area. First of all, the unsatisfactory condition and increase of pollutant emissions into the air is due to the obsolescence of equipment to prevent emissions into the atmosphere from the territories of large enterprises with high emissions of harmful substances.

At the same time, at some enterprises, apparently such equipment either does not work at all according to the current requirements, or is completely absent. Therefore, we see the second problem - the presence of a corruption component that helps unscrupulous dealers to evade the sanctions of the responsible audit authorities.

The third reason is the large number of personal vehicles in the population, which, in the process of their work also contribute a large share to the total amount of emitted harmful substances. The third problem is complicated by the fourth - improper and outdated road planning, especially the local road space, which leads to frequent and long traffic jams during "rush hour", which force large numbers of cars to work even longer, thereby increasing emissions.

The proposed project is an Internet service - an interactive map that will show the level of air pollution in Ukraine, information that will be displayed on the interactive map in the future, is collected from statistical sites that monitor relevant indicators and have open ARI. This approach, in particular, ensures the transparency of the data presented and complicates the impact on them for stakeholders (unscrupulous managers of pollutants (large enterprises), or corrupt officials (officials of relevant state supervisory authorities)). In addition to the map, on the given graphic materials, we can observe the possibilities of the platform for expressing data in the form of various graphs, which serves to facilitate the perception of the information obtained.

The developed Internet service, being an interactive map, provides fast and stable access of each interested user to data on air pollution. The solution of the form of the interface "interactive map" has shown its relevance and convenience around the world in connection with the epidemic COVID-19, this is the form of reporting the number of diseases in some areas used by many countries. This type of interface is much clearer than a list, even a TOP list, which allows a wide range of people to receive and work with information: from ordinary people to journalists and officials, not environmental experts. This leads to an increase in the likelihood of positive changes: in addition to

raising awareness of the official responsible for this area, it facilitates reasonable public pressure on such an official (public protests, media coverage, concern about the state of affairs of the responsible official). A simple form of displaying information can serve the direct purposes of education, due to low requirements for recipients, it can be used in particular in interactive lessons in schools, which will positively serve the development of responsibility and environment-oriented consciousness in future generations of Ukrainian youth. In addition, the Internet service allows you to obtain information much faster than by direct analysis of relevant Internet resources, which has a positive effect on the efficiency and quality of the final data received by the user.

The importance of the project is illustrated by two sources of sociological data: a nationwide survey "Environmental protection in the public opinion of Ukrainians" of the Foundation for Democratic Initiatives. Ilka Kucheriva from October 26, 2021 and the press release of one of the sections of the all-Ukrainian public opinion poll of the Kyiv International Institute of Sociology from May 2018. Respondents from all regions of Ukraine took part in both surveys, except for the Autonomous Republic of Crimea and the occupied territories of Donetsk and Luhansk oblasts at the age of 18. The number of respondents in the first survey was 2001 people, in the second - 2025, so we can say about the representativeness of the views expressed.

#### **References:**

1. Захист довкілля в громадській думці українців [Електронний ресурс] // Головна - Фонд «Демократичні ініціативи» ім. Ілька Кучеріва. – Режим доступу: <https://dif.org.ua/article/zakhist-dovkillya-u-gromadskiy-dumtsi-ukraintsv> (дата звернення: 28.10.2021).
2. Новікова Л. прес-релізи та звіти які проблеми турбують українців, травень 2018. [Електронний ресурс], Режим доступу: <https://www.kiis.com.ua/?lang=ukr&cat=reports&id=772> (дата звернення: 28.10.2021).
3. Morozov V., Kolomiiets A. Investigation of optimization models in decisions making on integration of innovative projects. Advances in Intelligent Systems and Computing, 2021, 1246 AISC, pp. 51–64.
4. Morozov V., Mezentseva O., Proskurin M. Trainable neural networks modelling for a forecasting of start-up product development. Proc. of the 2020 IEEE 3rd International Conference on Data Stream Mining and Processing, DSMP 2020.

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## LEAD NURTURING IMPLEMENTATION PROJECT MANAGEMENT TO OPTIMIZE MARKETING COMMUNICATIONS IN THE B2B SEGMENT

Building communication in the B2B segment is very different from B2C. First, there is a much longer decision cycle and user path. Relationships with customers need to be built for the future: through relevant and timely content to fuel interest in the product, to form loyalty and the image of an expert in the field. It is also much more difficult to segment the audience and clearly target its message [1]. In the case of B2B, it is advisable to segment by professional interests and level of interest in the company's products and services.

Given the above features of this segment, the optimal strategy is to use the technique of Lead nurturing. First, such a communication strategy fully meets the needs of companies in the B2B segment, makes their communication as effective as possible, helps to automate the process through the use of CRM system. At the same time, domestic companies, in contrast to foreign counterparts, are not yet very active in its use, and therefore it will provide the project a difference from others and a significant competitive advantage [2]. The fact is that "ice growing" involves the creation of a large number of diverse expert content and considerable time, while the lion's share of entrepreneurs, not understanding the features of B2B, want to see results here and now.

Secondly, it allows to make the project relevant, in line with the latest trends in online communication. Lead nurturing is the process of interacting with potential customers, which is to create relevant content in order to conclude a deal in the future. This technique involves the transition from mass communication to mass personalization, ie allows the brand to talk not about themselves but about customer problems.

Its effectiveness is proven by Forrester Research, whose study showed that organizations that use effective Lead Nurturing programs generate 50% more "ready to buy" potential customers, while reducing costs by 33%. At the same time, according to the Annuitas Group, grown ice buys 47% more than usual [3].

This strategy involves working with all relevant platforms and creating relevant content for them. The choice of platform and content depends on the professional interests of the CA and the willingness to enter into an agreement. To determine this readiness, it is appropriate to use ice-scoring technology [4]. This is a method of crushing the lead base by assigning them certain points, according to predefined criteria that show how ready the customer is to enter into a deal. In short - this is a way to segment ice into hot and cold. The task of any sales manager is to identify such "hot" customers and give them maximum attention.

We can see the dependence of the need for a certain type of content on the sales funnel stage in Ben Hunt's "Stairs of Recognition" model [5].

It is also advisable to use banner advertising with a unique sales offer that may interest a potential buyer to go to the site. Such banners should be placed on those information resources, where there are often representatives of CA. It is important to note that due to the large number of advertisements on the Internet, users are paying less and less attention to it, the so-called "banner blindness" has appeared. It can be overcome only with the help of non-standard solutions that the user does not expect to see.

The chosen strategy allows you to start communicating with a representative of the CA, even when he does not have a clearly defined task to purchase a particular type of product, but this topic is generally interesting to him. At this stage, we offer him content on topics related to his professional interests and place it both on our own website and social media pages, and on information resources as guest publications or expert materials [6]. There are thematic blogs, forums, conferences, etc. in any field of activity. You need to partner with these people or companies. Create content for them and get traffic. In addition, you can and should organize webinars, online conferences and panel discussions.

#### **References:**

1. Стратегічний маркетинг: зб. ст. / Harvard Business Review. - М: Видавництво Альпіна, 2016.
2. Агєєв, А. Інтернет-маркетинг і digital-стратегії. Принципи ефективного використання: навч, посібник / А. Агєєв, О. А. Кожушко, І. Чуркін та ін.; Новосиб. держ. ун-т, Компанія «Інтелсіб». - Новосибірськ: РІЦ НГУ, 2015.
3. Lead Nurturing Basics: How to Nurture the B2B Buyer's Journey in 5 Steps [Електронний ресурс] // Act-on – Режим доступу до ресурсу: <https://act-on.com/blog/lead-nurturing-basics-how-to-nurture-the-b2b-buyers-journey-in-5-steps/>.
4. Гавриков, А.В. Інтернет маркетинг. Настільна книга digital-маркетолога / А.В. Гавриков, В.В. Давидов, М.В. Федоров - М: Видавництво ACT, 2020.
5. Пейн, Е. Керівництво по CRM. Шлях до вдосконалення менеджменту клієнтів / Е. Пейн - Мінськ: Гревцов Букс, 2007.
6. Сенаторов, А. Контент-маркетинг. Стратегії просування в соціальних мережах / А. Сенаторов - М: Видавництво «Альпіна», 2019.

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## CRYPTOGRAPHY MODULE SOLUTION FOR ACS

**Abstract.** In recent years E-commerce gained a exceptional growth due to its assets. Even though benefits of E-commerce are considerable, it creates some security hazards such as debit, credit card fraud, phishing etc. In this paper we introduce a system that provides an unrivalled security using quantum cryptography. Visual cryptography [1] hides the details of customer by generating shares whereas quantum cryptography secures the transmission of one-time password.

**Keywords:** Cryptography, 3D-Secure, transactions, ACS.

Paying attention to the current payment security threads, next conditions must be met in any of the modern payment systems [2]:

1. Confidentiality. Customer data, such as credit card number, should be known only to the relevant organizations involved in the payment process.
2. Preservation of the integrity of the information. Information about the purchase and transaction data must be protected from unauthorized changes.
3. Authorization. Both parties should be confident that they are dealing with exactly the person it claims to be. Checks the authenticated user of the transaction (e.g. solvency).
4. Wide range of means of payment. The buyer may pay any transaction available funds.
5. Guarantee risks. The seller must have a warranty from the many risks associated with the use of the payment system.
6. Minimization of the payment transaction. Payment order processing, obviously, will be included in the cost of operation and should be minimized. Payment must be paid even in the case when the buyer refuses to accept the purchased goods.

Most payment systems act as a security guarantee by demanding their participants of using 3D-secure technology [3] in which user's authentication takes place at card issuer's access control server (ACS) [4].

The ACS contains the authentication rules and is controlled by the Issuer. ACS functions include [5]:

- Verifying whether a card number is eligible for 3-D Secure authentication
- Verifying whether a Consumer Device type is eligible for 3-D Secure authentication
- Authenticating the Cardholder or confirming account information

While these functions may belong to a single logical ACS, implementations may divide the processing by function or other characteristics among multiple physical servers.

For the App-based protocol, the direct link between the 3DS SDK and the ACS is only established if the transaction requires a challenge. It is initiated by the 3DS SDK using the URL provided to it in the ARes and established using a TLS protocol with ACS (server) authentication by the 3DS SDK [6].

- Protocol—TLS Internet
- ACS public key—commercial. Certificate format: commercial
- CA signing ACS key—commercial

The challenge and Cardholder response data is encrypted and MACed using the session keys previously established between the ACS and the 3DS SDK.

- Protocol—secure channel.

If the CRes message contains a URL(s) directing the 3DS SDK to fetch data from an external server, an additional link is established using a TLS protocol [7], with server authentication by the 3DS SDK [8] based on a commercial server certificate.

Proposed payment system solves the problem that payment system is not secure since any eavesdropper can act as customer by hacking information submitted by customer [9]. The problem is solved by using two cryptographic techniques visual cryptography and quantum cryptography. In proposed method snapshot of text containing customer's account number and debit and credit card information is taken. From the snapshot image two shares are generated using visual cryptography. one share will be in the hand of customer and other one will be in database of bank [10]. Merchant and customer agrees on a sessional key at the start of the payment. After that customer select the desired items and transfer blinded list of items with encrypted account number to bank. This blinded list is generated by encrypting list of items with sessional key between customer and merchant [11].

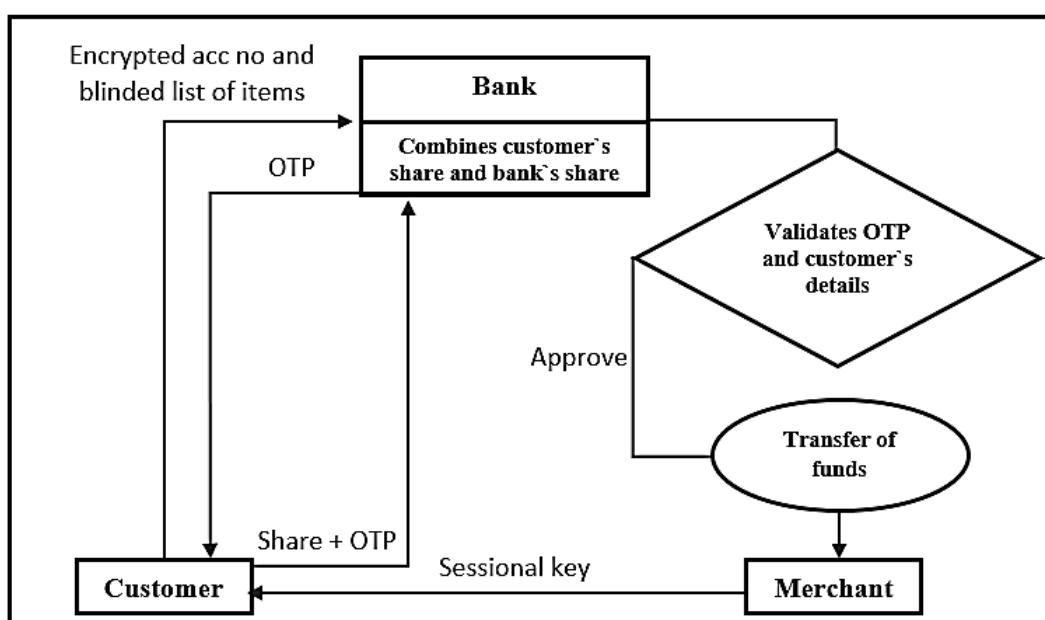


Figure 7 - Transactions in proposed payment system

The proposed payment method provides considerable improvements on security than the existing approaches. In proposed method customer's authentication details are hidden by using visual cryptography [12]. Embedding of one-time password in customer's share prevents an eve from masquerading as customer by hacking share. Use of quantum cryptography secures the transmission of one-time password. Consider an eavesdropper has hacked the customer's share embedded with one time password during transmission of share to bank [13]. Eavesdropper [14] can't reuse this share for acting as customer since one-time password, which varies for each transmission is embedded in share. So, when an eavesdropper sends this hacked share to bank for transaction, validation of one-time password gets failed, and transaction gets rejected. Also, eavesdropper cannot be able to gain user authentication details from share because in order to gain information of customer from customer's share both the customer's share and bank's share should be combined. Quantum cryptography used in proposed payment method prevents an eavesdropper from measuring and cloning the one-time password [15]. So, an eavesdropper cannot guess the function used for generating one time password. Thus, the proposed system guarantees unconditional security [16] using visual cryptography, quantum cryptography and image steganography [17].

In this paper E-payment method using quantum and visual cryptography and image steganography is proposed. The proposed system based on two cryptographic provides unconditional security by preventing man in the middle attack. Visual cryptography used in this system safeguards the customer's data whereas quantum cryptography and image steganography prevents security threats such as phishing, identity theft. Proposed method for E-shopping can be extended for other bank applications.

### **References:**

1. EU Council: Directive (EU) 2015/2366 (2015), [https://ec.europa.eu/info/law/payment-services-psd-2-directive-eu-2015-2366\\_en](https://ec.europa.eu/info/law/payment-services-psd-2-directive-eu-2015-2366_en)
2. Ahmad, Z., Francis, L., Ahmed, T., Lobodzinski, C., Audsin, D., Jiang, P.: Enhancing the security of mobile applications by using TEE and (U)SIM. In: 2013 IEEE 10th International Conference on Ubiquitous Intelligence and Computing and 2013 IEEE 10th International Conference on Autonomic and Trusted Computing. pp. 575–582 (Dec 2013). <https://doi.org/10.1109/UIC-ATC.2013.76>
3. Ali, M.A., Arief, B., Emms, M., van Moorsel, A.: Does the online card payment landscape unwittingly facilitate fraud? IEEE Security and Privacy 15(2), 78–86 (2017)
4. CardinalCommerce: Use of consumer authentication in ecommerce, annual survey 2017: The fraud practice (2017), <https://www.cardinalcommerce.com/news-and-events/press-releases/2017/march/fourth-annual-cardinal-survey>
5. Emms, M., Arief, B., Freitas, L., Hannon, J., van Moorsel, A.: Harvesting high value foreign currency transactions from EMV contactless credit cards without the PIN. In: Proceedings of the 2014 ACM SIGSAC Conference on Computer and Communications Security. pp. 716–726. CCS

'14, ACM, New York, NY, USA (2014). <https://doi.org/10.1145/2660267.2660312>, <http://doi.acm.org/10.1145/2660267.2660312>

6. EMVCo: Protocol and Core Functions Specification (2021), <https://www.emvco.com/emv-technologies/3d-secure/>

7. Herley, C., Van Oorschot, P.C., Patrick, A.S.: Passwords: If we're so smart, why are we still using them? In: International Conference on Financial Cryptography and Data Security. pp. 230–237. Springer (2009)

8. Mastercard: Merchant SecureCode implementation guide (2014), [https://www.mastercard.us/content/dam/mccom/en-us/documents/SMI\\_Manual.pdf](https://www.mastercard.us/content/dam/mccom/en-us/documents/SMI_Manual.pdf)

9. Marcin Niemiec and Andrzej R. Pach, AGH University of Science and TechnologyManagement of Security in Quantum Cryptography ,IEEE Communications Magazine August 2013

10. Jrgen Cederlf and Jan-ke Larsson Security Aspects of the Authentication Used in Quantum Cryptography,IEEE TRANSACTIONS ON INFORMATION THEORY, VOL. 54, NO. 4, APRIL 2008

11. Ter Louw, M., Venkatakrishnan, V.: Blueprint: Robust prevention of cross-site scripting attacks for existing browsers. In: Security and Privacy, 2009 30th IEEE Symposium on. pp. 331–346. IEEE (2009)

12. Sood, A.K., Zeadally, S., Enbody, R.J.: An empirical study of HTTP-based financial botnets. IEEE Transactions on Dependable and Secure Computing 13(2), 236–251 (2016)

13. RedTeam Pentesting: New banking security system iTAN not as secure as claimed. Tech. rep. (2009), <https://www.redteam-pentesting.de/en/advisories/rt-sa-2005-014/-new-banking-security-system-itanc-not-as-secure-as-claimed>

14. Naor M. and Shamir A., 1995. Visual Cryptography. EUROCRYPT'94, 950, pp.1-12.

15. Roy S. and Ventakeswaran P., 2014. Online Payment System using Steganography and Visual Cryptography. In: Maulana Azad National Institute of Technology Bhopal, 2014 IEEE Students' Conference on Electrical, Electronics and Computer Science (SCEECS). Bhopal, India 1-2 March 2014. IEEE.

16. Akolkar S., Kokulwar Y., Neharkar A., and Pawar D., 2016. Secure Payment System using Steganography and Visual Cryptography. International Journal of Computing and Technology, 3(1), pp.58-61.

17. Thomas, S.A., dan Gcharge, S., 2017. Review on Various Visual Cryptography Schemes. In: 2017 International Conference on Current Trends in Computer, Electrical, Electronics and Communication (CTCEEC). Mysore, India 6 Sept 2018. IEEE.

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## COMPARATIVE ANALYSIS OF WELL-KNOWN SECURITY SCANNERS (WITH NESSUS)

**Abstract.** For checking the security of information resources, specialists increasingly resort to tools such as a security scanner or even a full-fledged vulnerability management platform, which includes a security scanner, and integration with infrastructure, and integration with other systems. This article includes a list of such tools and their institutional comparison with each other (according to the main factors on vulnerability).

**Keywords:** security, scanners, vulnerability, Nessus.

**Introduction.** The presence of vulnerabilities in information systems, infrastructure nodes or components of the complex is not disputed as a big problem for information security systems. Of course, you can manually search for gaps, but it will be an extremely labor-intensive process that will take a lot of time with a high probability of missing something.

The global vulnerability market itself is already quite scanned. These are system systems tools for managing vulnerabilities. Vulnerability tracing projects contain, in which representatives of various structures participate. Also, scanners perform integration with risk management systems or patch management, platforms for manufacturers of incidents, secure, without using the already mentioned SIEM.

An urgent task of choosing a solution for managing vulnerabilities. This work contains statistics of testing various solutions and a conclusion why one or another scanner is suitable for its purposes.

**Base for statistics.** The results of the comparison of network security scanners were obtained through penetration tests with nodes at the network perimeter. At the same time, the following were evaluated [1]:

- number of vulnerabilities found;
- false positives;
- false negatives;
- reasons for missing;
- completeness of the database of checks (in the context of this task);
- quality of inventory mechanisms and software version detection;
- the accuracy of the scanner (in the context of this task).

The listed criteria together characterize the "suitability" of the scanner for solving the task assigned to it, in this case it is the automation of routine actions in the process of monitoring the security of the network perimeter.

The scanners presented in Table 1 were selected to participate in the tests [2].

Table 1. Selected scanners

Name	Version	Link
Nessus	3.2.1	<a href="http://www.nessus.org/download">http://www.nessus.org/download</a>
Max Patrol	8.0	<a href="http://www.ptsecurity.ru/maxpatrol.asp">http://www.ptsecurity.ru/maxpatrol.asp</a>
Internet Scanner	7.2.58	<a href="http://www-935.ibm.com/services/us/index.wss/offering/iss/a1027208">http://www-935.ibm.com/services/us/index.wss/offering/iss/a1027208</a>
Retina Network Security Scanner	5.10.2.1389	<a href="http://www.eeye.com/html/products/retina/index.html">http://www.eeye.com/html/products/retina/index.html</a>
Shadow Security Scanner	7.141	<a href="http://www.safety-lab.com/en/products/securityscanner.htm">http://www.safety-lab.com/en/products/securityscanner.htm</a>
NetClarity Auditor	6.1	<a href="http://netclarity.com/branch-nacwall.html">http://netclarity.com/branch-nacwall.html</a>

Three PCs were selected as a network node within the same network and similar parameters.

**Second level heading.** The first place according to all the criteria of this comparison (table 2) goes to the MaxPatrol scanner, the second place is taken by the Nessus scanner, the results of the other scanners are significantly lower.

Table 2. The results of the tests

Index	MaxPatrol	Internet Scanner	Nessus Tenable	Shadow	NetClarity Auditor	Retina
Vulnerabilities found, total	163	51	81	69	57	38
False positives	8	3	7	36	14	4
Found correctly (out of 225 possible)	155	48	74	33	43	34
False negatives	70	177	151	192	182	191
Of these, due to the absence in the database	63	170	59	150	179	170
Of these, caused by the need for authentication	0	6	36	0	0	16

In fact, there is nothing unexpected or surprising in the result obtained. It is no secret that the MaxPatrol and Nessus scanners are popular among security professionals [2].

Let's try to analyze the reasons for the clear leadership of MaxPatrol and Nessus Scanners, as well as the reasons for the "loss" of other scanners.

First of all, it is a high-quality identification of services and applications. Inference-based checks are highly dependent on the accuracy of the information collection [3].

The second reason for their success is the completeness of the base and its adequacy to the task at hand and in general to "today". According to the results, it is noticeable that the base of checks in MaxPatrol and Nessus has been significantly expanded and detailed, it is "put in order", while the obvious "bias" towards web applications is compensated by the expansion of checks in other areas.

The third reason is a qualitative analysis of application versions, taking into account operating systems, distributions and various "branches". You can also add and use different sources (vulnerability databases, notifications and "vendor" bulletins).

Finally, we can add that MaxPatrol and Nessus have a very convenient and logical interface that reflects the main stages of the work of network security scanners.

**Disadvantages of Nessus.** The main reason for the lag in Nessus is missing vulnerabilities, but not because of the lack of checks in the database, as in most other scanners, but because of the implementation specifics. Firstly (and this is the reason for a significant part of the omissions), there is a tendency in the Nessus scanner towards "local" or system checks, which involve connecting with an account [4]. Secondly, the Nessus scanner took into account fewer (in comparison with MaxPatrol) sources of information about vulnerabilities [5].

**Conclusions.** The work doesn't show that Tenable is necessarily much better than the rest of the products. It's just that in this context, this solution coped better than the rest.

Tenable's products offer a wide range of capabilities to identify and effectively address many security threats in real time. Companies that are considering using vulnerability scanners in their infrastructure should decide on the required capabilities of the product (whether flexible configuration of the reporting subsystem is required or basic enough, whether continuous monitoring of the network or determination of behavior anomalies is needed, etc.), as well as the types and amount of information assets in the organization. Despite the large number of possibilities for security analysis, all the solutions presented lack built-in support for domestic standards, because the company recently entered the domestic market, which is partially offset by the ability to create its own reports. For the same reasons, the products have not yet been certified by the State Communications Service of Ukraine. Nevertheless, the solutions allow you to fully protect the organization from vulnerabilities, erroneous settings and malware, which positively affects the overall security of the infrastructure and allows you to assess and mitigate information security risks [6].

#### References:

1. Vulnerability scanning and secure development. URL: <https://habr.com/ru/post/444534/>
2. Vulnerability scanners - an overview of the global and Russian markets. URL: [https://www.anti-malware.ru/analytics/Market\\_Analysis/Vulnerability-scanners-global-and-Russian-markets](https://www.anti-malware.ru/analytics/Market_Analysis/Vulnerability-scanners-global-and-Russian-markets)
3. Vulnerability scanners. Comparison of network security scanners Programs for scanning networks for vulnerabilities. URL: <https://beasthackerz.ru/wi-fi-ethernet/skanery-uyazvimostei-sravnenie-setevyh-skanerov-bezopasnosti-programmy-dlya.html>
4. Programs for scanning the network for vulnerabilities. Best Pen Tester Tools: Security Scanners. How a LAN Network Scanner Keeps It Secure. URL: <https://bookfix.ru/programmy-dlya-skanirovaniya-seti-na-uyazvimosti-luchshie/>
5. Overview of Tenable products for analyzing the security of corporate infrastructure, 23.11.17. URL: <https://www.anti-malware.ru/reviews/tenable-analysis-security-corporate-infrastructure>.
6. Overview and comparison of vulnerability scanners. Best Vulnerability Scanners for Linux Check Local Network for Vulnerabilities. URL: <https://olacom.ru/security/obzor-i-sravnenie-skanerov-uyazvimostei-luchshie-skanery-uyazvimostei-dlya-linux/>

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## THE POTENTIAL DANGER OF SHODAN SEARCH ENGINE

**Annotation:** Shodan has been called “the most dangerous search engine in the world”. That’s a pretty strong claim, but why would a search engine bring so much harm? Shodan has been around for just over ten years now, and the massive threat it was made to represent is yet to materialize. Still, that doesn’t mean it won’t be the source of various dangers.

**Keywords:** Shodan, IoT, network, security, search engine, SCADA.

Shodan is a search engine that indexes all the IoT (Internet of Things) devices on the Internet, making them easy to discover and access. Shodan indexation works by searching open ports of any service or device. This means that Shodan, unlike any normal search engine, does not focus on searching web pages but on collecting the banners of the services (server response to a request). These services include HTTP, HTTPS, FTP, SSH, Telnet, SNMP and SIP protocols. Then, the user can search for devices by regions or geographic areas applying specific filters. Moreover, when Shodan performs a deeper search, it gives back results with information such as what type of device is connected to the Internet, where is located and who uses it [1]. Search results usually include cameras, web-connected medical devices, smart home hubs, and so on. That’s it. So why is it so “dangerous”?

Shodan removes “security through obscurity”. Obviously, that the IoT security provided by confidentiality in most. If someone thinks their IoT device is safe just because it isn’t a website or crawled by Google, then Shodan removes that illusion [2].

“When people don’t see stuff on Google, they think no one can find it. That’s not true.”, said John Matherly, the creator of Shodan search engine [3].

There are numerous cases where IoT devices that aren’t secure are sold to consumers. For example, an IP-camera may not have a unique per-unit password. Since so many users don’t bother to change the default passwords on cameras and other similar devices, it means hackers can easily access these devices. With the explosion of vulnerabilities in smart devices inside homes, in our cars, and every business, lack of security is a recipe for disaster [2]. Shodan operates for 24 hours, during 7 days a week, and every month collects information about 500 million connected devices and services.

However, there are much more sensitive and dangerous machines connected to the Internet than smart home devices: power station control systems, traffic lights, lab equipment, assembly lines, and many more. Even a smart garage door opener could pose a potential threat if taken over by an attacker.

Things we can find with a simple search request in Shodan is stunning. Countless

traffic lights, security cameras, home control systems and heating – all of them are connected to the Internet and all of them are easy to detect. We can access almost a half of the devices on the Internet using the default password. Thus, a quick search with "password default" filter finds thousands printers, servers and device management systems that use "admin" phrase as a login and "1234" as a password. In some cases, connected systems even do not require authorization at all – we just need a browser to connect to them.

But why does such a number of IoT devices have no protection? The main trick is that many of these devices should not be online at all. Companies often buy systems that allow to control, for instance, the system of thermostats using a computer. How do they connect this computer to the heating system? Instead of connecting that directly, many IT-units simply connect both systems to the web server, opening it, for their negligence, to the rest of the world. And of course, there is no protection in such systems. These devices, first of all, should not belong to the Internet conceptually.

Basically, Shodan tracks public access devices, preferably in SCADA systems (Supervisory Control and Data Acquisition). SCADA systems are used to control and supervise industrial processes remotely in real time [1].

Shodan uses automated search tools which allow massive queries. One of these tools is Shodan Diggity. This tool is powered by a database known as Shodan Hacking Database that works as a kind of dictionary to locate different devices connected to the Internet: printers, webcams, routers, transit systems and, of course, industrial control systems [1].

Also with the help of Shodan the fuel station, wine refrigerator wine in the hotel, crematorium and, what is the most dangerous, the control systems of the nuclear power plant could be detected.

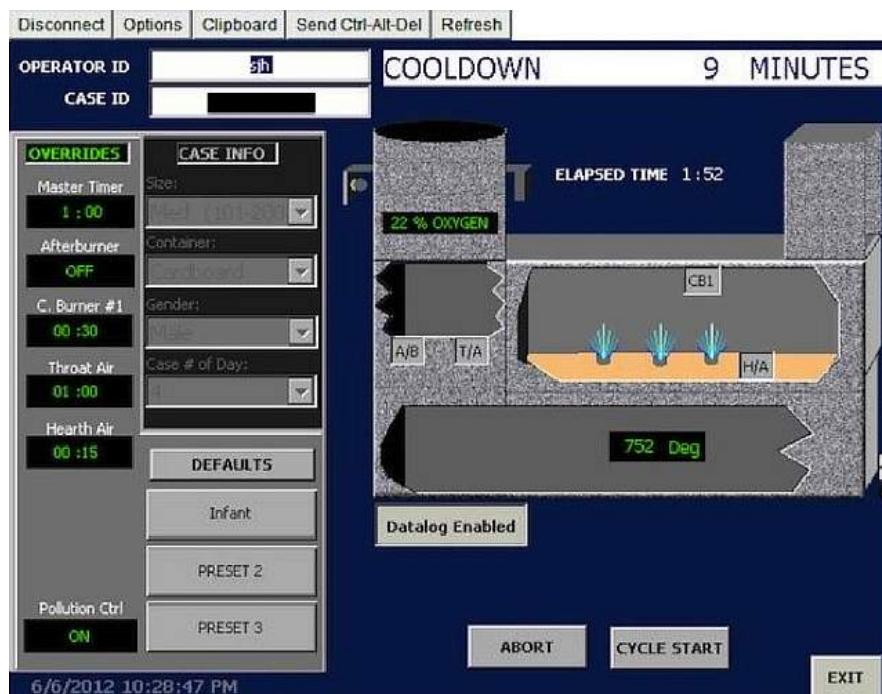


Figure 1 – The web-panel of crematorium control system with full access due to credentials from Shodan

If the machines that run our lives today are exposed to anyone who can type a search into Shodan, that's a huge problem – traffic accidents, explosions, serious product defects, and any of a million things the imagination can conjure up. Think of the Stuxnet worm and how it was used to halt the Iranian nuclear program. Those systems weren't connected to the Internet, which meant the malware had to be smuggled inside somehow. With Shodan, that won't even be necessary [2].

It's easy to point fingers at a tool like Shodan and blame it for being reckless. However, if the standard of security and privacy in the IoT industry was up to scratch, a tool like Shodan would be harmless. If the author of Shodan had not invented it, someone else would have. If a network of exposed IoT devices weren't connected to the Internet, Shodan is neutered.

Moreover, anyone who creates an engine like this doesn't have to do it in an open, public-facing manner as Shodan has been done. It could be like those search engines hidden on the dark web, with anonymous authors. In the end, this is a case of shooting the messenger rather than listening to the message itself [2].

Unfortunately, Shodan still attractive to cybercriminals and hostile nations interested in activating a large-scale war similar to a cyber-Blitzkrieg. If Shodan is capable of tracking SCADA systems as we mentioned above, the national security of many countries could be compromised since an attack on their infrastructure is already possible [1].

But, in other hand, Shodan promotes the use of the search engine among medium and large companies. For instance, Shodan can help to do empirical market intelligence because it provides the information about those electronic products connected to the Internet that people use the most. Shodan is also useful to monitor the computers of your network with Internet access [1].

By the way, Shodan has a younger and even more dangerous successor – Censys. This search engine is able to find devices vulnerable for an APT [4].

As with new technologies such as smartphones, facial recognition, or social media, we need to figure out the rules and standards as we go. While there aren't enforces minimum standards and regulations or industry alliances to that end, people are going to connect insecure IoT devices to the network [2].

The least we can expect from governments and large corporations who keep our data is to do it in proper way so that a tool like Shodan is useless against those measures. It doesn't matter whether it's the DMV or the Pentagon, IoT security has to be taken seriously [2].

When it comes to regular customers, there is such a thing as responsible IoT use. We can get started with setting of custom strong passwords on all smart devices. Also there is a huge need to secure the internal network, partially by using a VPN. It is worth buying devices from reputable brands that aren't likely to have backdoors. Of course, Chinese no-name analogues could cost cheaper, but breaking

them in – just a piece of cake. Generally, for appropriate protection of all IoT devices it would be highly useful to:

1. set a complex password for the control panel of the smart home, as well as the home Wi-Fi network and the router itself;
2. update software on smartphones, tablets and smart gadgets regularly;
3. implement two-factor authentication where possible;
4. use specialized controllers (for example, based on Raspberry PI) to control the smart home;
5. configure the appropriate filtering in the region of the home network access;
6. encrypt traffic inside home network.

The list goes on, but the point is that we should never use IoT devices as simple plug-and-play machines. So, taking control of the privacy and security is a major key for safe use of IoT technologies.

#### **References:**

1. The MasterDC's Blog, Get to know Shodan, the scariest Search Engine on the Internet, October, 2018. URL: <https://www.masterdc.com/blog/what-is-shodan-search-engine/>
2. S. Butler, Why Is the Shodan Search Engine Potentially Dangerous, June 25, 2020. URL: <https://www.technadu.com/why-is-the-shodan-search-engine-potentially-dangerous/105440/>
3. D. Goldman for CNN Business, Shodan: The scariest search engine on the Internet, April 8, 2013. URL: <https://money.cnn.com/2013/04/08/technology/security/shodan/>
4. The Xakep's Blog, What Can The Censys Do, January 8, 2016. URL: <https://xakep.ru/2016/01/08/censys>

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## HOW TO PROTECT YOUR CARD ON THE INTERNET

**Abstract.** The security of online shopping is very important today. Thousands of online transactions occur every day, each of which could be a target for a hacker. The need to develop modern and effective solutions for protecting the data of plastic cards becomes obvious.

**Keywords:** card, 3D Secure, visa, mastercard, browser, online, transaction, scammer, CVV2

Probably, there is not a single active Internet user who has never bought or paid for something online. And every time a person enters their bank card details, they are exposed to potential danger. [1].

Not only cardholders are interested in the security of Internet and browser transactions, but also banks, online stores and payment systems, which are developing ever new, more advanced and at the same time expensive methods of securing online payments and protecting against scammers. All participants in the transaction risk their money, and stores, banks and systems also risk their reputation.

Oddly enough, in the terminology of payment systems there is no such thing as an Internet transaction. From the point of view of Visa and Mastercard, a transaction on the Internet is no different from a transaction in a terminal, by phone or IVR.

Payment systems consider the Internet only as a transaction method. And this introduces some confusion when the owner of the card communicates with the bank that issued the card.

Probably, many people who regularly use cards have come across a situation where the card seems to be open for payment on the Internet, but payments on some sites do not go through. The opposite situation is also possible, when the issuer does not indicate in the agreement for opening a card about the possibility of payment on the Internet, and payment on some sites can still go through [2].

At the bank that serves you, you must indicate the exact information for communication when paying for purchases with a bank card in online stores. For example, an email address is usually used to send payment confirmation, which you can later use to track your order. A mobile phone number is required in order to contact the client for order confirmation, or inform him of any difficulties, for example, flight cancellation or loss of goods.

Please be aware that not all banks allow the use of certain types of cards, such as Visa Electron or Maestro, to pay for online purchases.

This is all related to the types of transactions that are allowed on the bank side. The type of transaction depends on the parameters involved in authorization: CVV2, magnetic stripe, PIN, 3D Secure password, presence of a chip. As well as the type of terminal: traditional POS terminal, e-commerce, Mail Phone order, ATM.

There is no such property that would indicate the environment of the transaction, in particular - the Internet.

In view of the above, you need to always be careful with your salary, credit, business, corporate or any other card that has available funds.

It is possible to recommend not to use these cards on the Internet, despite the convenience, where there is always an available amount, as a rule, many types of transactions are allowed.

Also, do not show the card number and the reverse side of CVV2 in queues at the terminals and do not let the card out of sight, handing it over to the cashier, waiter or other staff. In some cases, the amount from the card can be debited even without entering CVV2. It will be enough for an attacker to spy on your card number and expiration date in order to make a payment on the Internet.

Also, one of the means of protecting the card, now technical, is the 3D Secure protocol - the Visa Secure program for the Visa payment system and Mastercard SecureCode for the Mastercard [3].

Despite attempts to promote the 3D Secure protocol by payment systems, banks in Ukraine are in no hurry to implement it and continue to invent their own methods of protection against fraud.

In short, 3D Secure is a protocol of Visa and Mastercard payment systems, which allows you to additionally authenticate the owner of the card by redirecting him during an online purchase to the website of the issuing bank. At the same time, the issuing bank checks the entered password and gives an answer about the consent or refusal to carry out the transaction.

To summarize, how to warn yourself against the actions of fraudsters, after all, they still use simple rules, how not to infect a computer with viruses, how not to let a thief into an apartment, and there is nothing burdensome in observing the rules for using cards [2]

- do not reach the card in public places
- do not lose sight of the card when paying for goods and services
- use on the Internet only cards that are specially open for this purpose
- connect the card to the 3D Secure protocol
- do not transfer card data to a third person
- enter card details only on verified sites, preferably with the Visa Secure and Mastercard SecureCode logos
- set an individual Internet payment limit on the Internet card
- use antivirus
- use two-factor authentication during payments
- contact the bank security service at the slightest suspicion of theft of information or funds

Visa and Mastercard payment systems establish uniform rules for handling claims, which usually protect the user and guarantee a refund in case of fraud, if there was no fact of compromise and transfer of data to a third party [4].

This may not always work in the current legislation, but this is a significant advantage over non-refundable local virtual payment systems.

#### References:

1. Anton Mordvintsev, Online security: how to protect your payments?, 2017. URL: <https://www.forbes.ru/finansy-i-investicii/346943-bezopasnost-v-internete-kak-zashchitit-svoi-platezhi>
2. Dmitry Barbin, How to protect your card online, 2016. URL: <https://fondy.ua/ru/blog/how-to-protect-your-credit-card-on-the-internet/>
3. Natalia Ilyina, Protection version: banks allowed online shopping without SMS code, 2020. URL: <https://iz.ru/1040601/natalia-ilina-versiia-zashchity-banki-razreshili-delat-pokupki-v-internete-bez-sms-koda>
4. Safe purchases with a payment card, 2021. URL: <https://www.eduklgd.ru/dogovor/bezopasnye-pokupki-s-pomoshhyu-platezhnoj-karty.html>

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## **MANAGEMENT OF CREATIVE PROJECTS IN TOURISM**

**Abstract.** Tourism is one of the leading areas of Ukraine's economy, which provides budget revenues, creates jobs, develops a positive image of the state, increases the competitiveness of national tourism products, has a significant impact on Ukraine's economy.

Today, a promising area is the use of creative tourism management technologies within Ukraine. Creativity has the most significant impact on the development of political, economic, social, cultural relations and interpersonal relations on an international scale, becoming the content and lifestyle for millions of people in the information society.

**Keywords:** project management, tourism sector, creative project.

Tourism is one of the leading areas of Ukraine's economy, which provides budget revenues, creates jobs, develops a positive image of the state, increases the competitiveness of national tourism products, has a significant impact on Ukraine's economy.

Today, a promising area is the use of creative tourism management technologies within Ukraine. Creativity has the most significant impact on the development of political, economic, social, cultural relations and interpersonal relations on an international scale, becoming the content and lifestyle for millions of people in the information society.

The following leading domestic and foreign scientists made a significant contribution to the study of this issue: Boychuk I. [1], Morozov V. [2], Sidun O. [3], Legeida E. [4], Tsirat A. [5], Hayes J. [6], Bisio R. [7].

The leaders in the market of tourist services of Ukraine are tour operators "Join UP!", "Annex tour" and "Colar travel", which serve the majority of tourists in Ukraine. These firms operate as franchises.

Table 1

Number of tourists served by tour operators [8]

Years	Total	Foreign tourists	Outbound tourists	Domestic tourism
2000	290899	97874	70731	122294
2001	504347	128817	162890	212640
2002	549644	142849	174786	232009
2003	746899	193239	248415	305245
2004	1009909	263120	421351	325438
2005	935918	170865	539989	225064
2006	1498794	207468	901269	390057
2007	1814052	286901	1116582	410569

Years	Total	Foreign tourists	Outbound tourists	Domestic tourism
2008	2088369	315984	1393126	379259
2009	1589834	257893	1024464	307477
2010	2047329	279141	1442252	325936
2011	944917	65725	786656	92536
2012	1768532	123703	1425459	219370
2013	2171181	97711	1855499	217971
2014	1850748	10658	1693363	146727
2015	1501985	8649	1333928	159408
2016	1841021	21143	1643728	176150
2017	2006088	27139	1758200	220749
2018	3550090	60062	3261115	228913
2019	4862129	74303	4528927	258899
2020	1739496	9737	1641509	88250

The main parameters of the franchise agreement are the amount of the lump sum  $Fr$ , term of the contract  $T$  and royalty ratio  $R_0$ . The optimization of the problem is reduced to maximizing profits for both the franchisor and the franchisee.

We describe the mathematical expectation of profit as a function of demand (1) - (2). For the franchisor ( $NPV_{Fr}$ ) is calculated as:

$$NPV_{Fr} = -I_0 + \sum_{j=1}^n \left( Fr + \sum_{t=1}^T \frac{\int_0^p R_0(r*D - M_1(r*D)*f(D)dD - \sum_{k=1}^n (n*M_0)}{(1+d)^t} \right) \quad (1)$$

For the franchisee ( $NPV_f$ ) is calculated as:

$$NPV_f = -Fr + \sum_{t=1}^T \frac{\int_0^p (r*D - M_1(r*D)*f(D)dD - \int_0^p R_0(r*D)*f(D)dD)}{(1+d)^t} \quad (2)$$

Where:

$I_0$  – the investment is made by the franchisor;  $n$  – number of franchisees;

$d$  – rate of return (discount rate);  $R_0$  – royalty;

$M_1$  – costs paid by the franchisee (to the insurance fund, advertising, training, taxes, etc.);

$M_0$  – the cost of maintaining and monitoring the system paid by the franchisor;

$f(D)$  – the law of distribution of demand for products;

$T$  – number of periods (10);

$r$  – profit from the sale of a unit of production;

$D$  – demand for products.

The flow of domestic tourists is much smaller, due to inefficient and irrational use of natural resource potential, poor transport infrastructure. There is no clear strategy for the development of the tourism industry, which negatively affects the development of the tourism sector in Ukraine [8].

In the GDP of our country, the total contribution of tourism is only 5.4%, while in countries where tourism is well developed, it reaches 10%.

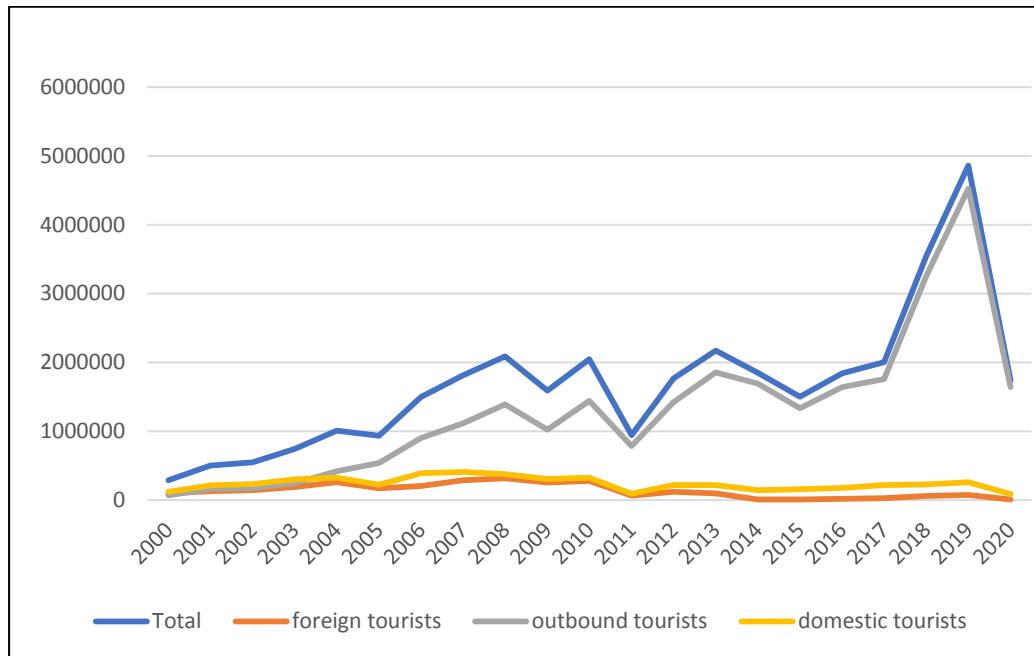


Figure 1 – Number of foreign, outbound and domestic tourists in 2000-2020

As a result of the analysis of the situation in the field of tourism, it is proved that Ukraine has great opportunities for the development of creative types of tourism (extreme, historical and cultural, scientific, business, green). It is necessary to expand tourist routes. Improving information systems in tourism and methods of creative management of such projects.

#### References:

5. Boichuk I.V. Dotsilnist rozvytku franchayzynhovo systemy spivrobityntstva v Ukrainsi [The expediency of developing a franchise system of cooperation in Ukraine], Regional economy. no 3, (2001). pp.251-255.
6. Morozov V. Using a franchise model to manage value-based innovation projects. Bulletin of the national Technical University “KhPI”. (2020). № 1 (1328). pp. 56-62.
7. Sidun O.I. Osoblyvosti ta formy spivpratsi velykoho i maloho biznesu [Features of this form spivpratsi large and small business], Scientific Bulletin of Uzhhorod University, no 12, (2002). pp.100-103.
8. Leheida E. Zhyznennyyi tsykl franchayzynha [Franchise life cycle], Business Inform, no 5, pp.28-33.
9. Tsirat A. Franchayzing i franchayzingovyiy dogovor. [Franchising and franchising agree-mment]. Kyiv. (2002) 240 pp.
10. Hayes J. Questions To Ask Before You Invest In A Franchise. Jenkintown. (2013). 123 p.
11. Bisio R. The Educated Franchisee: Find the Right Franchise for You.USA. (2017). 243 p.
12. Publykatsiia dokumentiv Derzhavnoi Sluzhby Statystyky Ukrainsi [Publication of documents of the State Statistics Service of Ukraine] URL:[https://ukrstat.org/uk/operativ/operativ2007/tyr/tyr\\_u/potoki2006\\_u.htm](https://ukrstat.org/uk/operativ/operativ2007/tyr/tyr_u/potoki2006_u.htm) (date of application: 4.11.2021).

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## **DEVELOPMENT AND ANALYSIS OF AN EXPERT SYSTEM IN THE FIELD OF RETAIL TRADE OF MOTOR VEHICLES**

**Abstract.** This work describes the development of an expert system for the estimation of the cost of used cars. Data for used cars from Eastern Europe is analyzed. The practical value of the work is to help ordinary sellers and buyers of used cars to have an idea of how much their car costs on the market, taking into account its characteristics, or what cars are on the market, taking into account the budget. The developed expert system provides the predicted price value for the corresponding parameters.

**Keywords:** expert system, retail, motor vehicles, knowledge base, regression model, data normalization, linear regression, random forest, decision tree.

Motor vehicle retailing history began after the start of production of the first cars. Almost every family has sold their car at least once in their life. According to Edmunds.com, an online car review website, about 40 million used cars are sold annually in the United States [1]. According to Ukrainian websites, 80% of all new car registrations in Ukraine were used cars [2]. And in December 2018, the market of used cars in Ukraine was three times higher than sales of new [3].

The field is constantly evolving, so it is clear that it needs the development of technologies for estimating costs of cars. Currently, there are several ways in which experts form the price of a car. This is usually a percentage of the initial cost of the car given the elapsed time since release and the condition of the automobile. However, for the average citizens who want to sell their car, this assessment can be a problem, because they are not experts and can not correctly estimate the cost of the vehicle.

It is also important not to disregard the possible dishonesty of appraisal experts or dealers who make a markup. There is a need for an expert system that will provide the calculated price of a used car, analyzing its characteristics (mileage, engine capacity, body type, etc.).

Similar systems and algorithms already exist, but they are designed in most cases for the American market and have almost nothing to do with Ukrainian realities. Therefore, the expert system should be based on data from Eastern Europe (CIS).

The created expert system will promote the development of the Ukrainian automobile retail market, will help to sell second-hand cars effectively, providing the recommended price, considering only parameters of the vehicle.

The purpose of the work is to analyze and develop an expert system for pricing of vehicles in the field of retail trade using machine learning methods.

Retail is the process of selling consumer goods or services to customers through multiple distribution channels for a profit. Pricing in the secondary car market is a topic that interests both sellers and buyers of vehicles. The cost of used cars goes down in direct proportion to their lifespan. However, this is not the only factor that has an objective impact on the price of the vehicle being sold.

To predict the value of a car using an expert system, it is necessary to pre-determine the indicators related to price prediction. Literature sources report that it is necessary to consider the following attributes [4]:

- manufacturer/class - each car brand occupies its segment in the car market: an executive-class car will cost more than an economy class car;
- type of transmission (gear box) - a car with an automatic transmission costs more than a car with a manual transmission;
- color - cars with popular colors (black, silver, white) cost more than cars of other colors;
- mileage - the odometer measure as nothing else affects the price of the vehicle. The higher the odometer, the lower the price of the car;
- year of manufacture/age - the older the car, the less it costs;
- engine/fuel type - diesel cars are more expensive than gasoline ones;
- engine capacity - the larger the volume the higher the price;
- type of drive - all-wheel drive always increases the price of the car, in contrast to the front one;
- body type - on average, a station wagon and sedan cost less than a convertible and a coupe.

The future expert system will be created based on this data and on methods and models for solving regression problems: linear regression, Random Forest, decision tree regression, LASSO regression and Ridge regression. To analyze and build models, a dataset containing information about used cars will be used in the work. The dataset consists of instances of automobiles: their parameters and the prices at which they were sold. There are both categorical and quantitative attributes in the dataset.

Preliminary casual overview and correlation analysis were used to analyze the attributes.

From a superficial analysis (with uncleaned data), it became clear that there is a correlation between mileage and price and the year of car production and the price.

Some data was cleared from inadequate or unnecessary values: certain attributes that did not have a description or were related to the site from which the data was taken were removed; cars with a year of production of at least 2000 were selected; cars that had the emergency state attribute were removed (i.e. the car was damaged after the accident).

Manufacturer and model name metrics have a very large number of unique values, which can complicate analysis and modeling. Therefore, it was decided to remove these indicators and form a common one that will correlate with the price - the

class of the car. So we can conditionally divide the manufacturers into three classes (the average price is more than 16,000, the average price is between 10,000 and 16,000 and the average price is less than 10,000) (Figure 1).



Figure 1 - Average price for each manufacturer

A correlation analysis was performed to further assess the impact of indicators on pricing. Using the resulting correlation map (Figure 2), you can see that age has the greatest correlation with the price of the car. The price also correlates with the value of the odometer, engine capacity, machine class. However, the correlation coefficients between body color, fuel type, engine type, and price are relatively small, i.e. there is no noticeable correlation, so these indicators can be removed from the dataset.

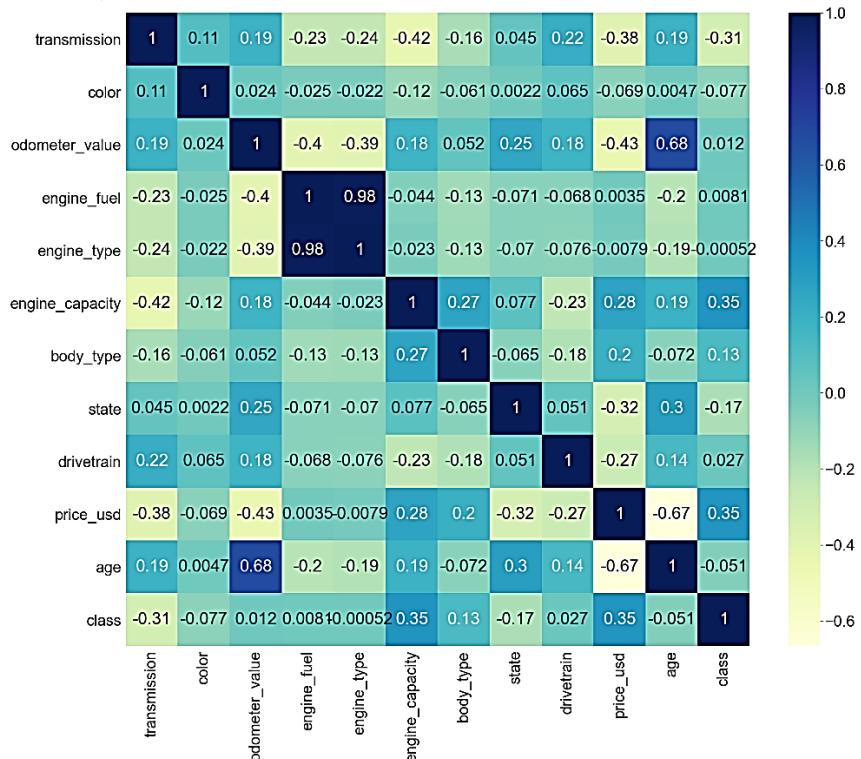


Figure 2 - Heats map of attributes correlation

After obtaining the necessary data, several algorithms were selected that were most suitable for achieving the goal of the work. Five regression algorithms were

selected that previously proved to be the best in the solution of a similar problem. These are the following algorithms: Linear Regression, Random Forest, Decision Trees, LASSO Regression, and Ridge Regression.

After construction, analysis, and training of the obtained models, the following results were obtained (Table 1).

Table 1  
Models prediction results

Model	Coefficient of determination ( $R^2$ )	MSE
Linear Regression	0.7165	0.0053
Random Forest	0.8700	0.0024
Decision Tree	0.7761	0.0042
LASSO Regression	0.7170	0.0053
Ridge Regression	0.7165	0.0053

The best result was shown by the model based on Random Forest, which is recommended for use in this expert system.

**Conclusions.** In this work, an expert system was developed for use in the automation of price formation in the field of retail trade of motor vehicles. The developed ES makes it possible to give recommendations to the users on the pricing of their cars, depending on the characteristics of the cars.

During the development of the ES, knowledge extraction was carried out by analyzing the characteristics of vehicles with regression algorithms.

Based on the results of the analysis of the literature and the correlation analysis of the dataset, the main characteristics that affect the price of the car were derived: mileage, age, type of transmission, and class (manufacturer) of the car.

Of all the considered models, the Random Forest machine learning algorithm showed the best results - the coefficient of linear determination is 87%. Unfortunately, none of the models showed 90% + accuracy, so the question of improving existing models, adding new data, and using neural networks remains open.

#### References:

1. Edmunds. USED VEHICLE OUTLOOK 2019 / Edmunds.
2. Car sales in Ukraine in 2020, 2020. URL: <https://proautomoto.com/category/198-avtoprodazhi-v-ukraine-v-2020>.
3. Automotive market in Ukraine 2018 / 2019. URL: <https://inventure.com.ua/analytics/investments/avtomobilnyj-rynok-ukrainy-2018-2019>.
4. What affects the cost of the car. URL: <https://avtocod.ru/chto-vliyaet-na-stoimost-avtomobilya>.

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## PACKAGE MANAGERS SECURITY MANAGEMENT

**Abstract:** Software today has become an assembly of components from a wide range of sources. Individual packages may be developed in-house, acquired from third parties, or downloaded from free and public sources. The security risks of these sources are straightforward to understand in isolation. But, when used in concert, new interactions arise that can compromise even a conscientious organization. Many organizations use public package feeds — such as Maven Central, npm, NuGet Gallery, and the Python Package Index (PyPI) — to take advantage of the open ecosystems they offer.

**Keywords:** Open-source, package managers, typosquatting, dependency confusion.

Over the last decade, there has been a dramatic increase in the scope, quality, and availability of free, open-source software. Even closed-source applications commonly depend on freely shared libraries, tools, and operating systems. A critical factor in this has been the development of ecosystems around package indexes that allow anyone to publish, such as Maven Central, npm, NuGet Gallery, and Python Package Index.

A public, open-package index allows anyone to share their code without proving their identity. This ease of publishing has resulted in large, active ecosystems of packages. These ecosystems can include various elements, from generic building blocks to niche, domain-specific algorithms, along with powerful tools for discovering, acquiring, and composing these packages.

Organizations (or “clients”) use private feeds as package index mirrors or to distribute internal packages to protect against upstream compromises, such as package hijacking and typo-squatting. Package management tools typically allow specifying multiple sources from which to download components, making it easy to consume from public and private indexes. This hybrid configuration can enable new ways for attackers to enter your systems through otherwise secure infrastructure due to how package management tools resolve names across multiple sources.

Typosquatting, also called URL hijacking, a sting site, or a fake URL, is a form of cybersquatting, and possibly brandjacking which relies on mistakes such as typos made by Internet users when inputting a website address into a web browser. Should a user accidentally enter an incorrect website address, they may be led to any URL (including an alternative website owned by a cybersquatter) [1]. The misguided traffic is then often monetized either with advertisements or malicious attacks such as drive-by downloads or exploit kits.

Whether and how the concept behind DNS typosquatting can be transferred to other use cases? By using the programming language Python for several years, I learned that the third-party package manager pip (a command-line application) is used to install software libraries from Python’s community repository named PyPi. The natural question is: how many users do commit typos when issuing an installation command in the terminal by using pip [2]?

Because everybody can upload any package on PyPi, it is possible to create packages that are typo versions of popular packages that are prone to be mistyped. And if somebody unintentionally installs such a package, the next question comes intuitively: Is it possible to run arbitrary code and take over the computer during the installation process of a package?

We can create a fake package that has a similar name as a famous package on PyPi, Npmjs.com, or rubygems.org. For example, we could upload a package named reqeusts instead of the famous requests module. We have investigated that it is possible to create such typo package names in three different ways [3]:

- Creative typo names like coffee-script instead of coffee-script. Often only humans can create creative typo names because its creation process requires an intuitive understanding of what grammatical mistake is easy to make with the origin name.
- Stdlib typos or core package names like urllib2. Stdlib typos are package names that do exist in the core of the language but haven't registered in the third-party package manager yet.
- Algorithmically determined typo names like req7est instead of request. Algorithmically typo candidates are suggestions from algorithms like the Levenshtein distance.

Shortly, defenses against typosquatting are [4]:

- Prevent Direct Code Execution on Installations This one is easy. Make sure that the software that unpacks and installs a third-party package (pip or npm) does not allow the execution of code that originates from the package itself. Only when the user explicitly loads the package, the library code should be executed.
- Generate a List of Potential Typo Candidates Generate Levenshtein distance candidates for the most downloaded N packages of the repository and alarm administrators on registration of such a candidate.
- Analyze log files and prevent registration of often shadow installed packages Whenever a user makes a typo by installing a package and the package is not registered yet, a logfile entry on the repository server is created (because the install HTTP requests target a non-existent resource). Parse these failed installations and prevent all such names that are shadow installed more than a reasonable threshold per month.

Early February 2021, the author came across an article [5] that spoke about a novel supply chain attack based on dependency package naming conventions. The attack consisted of uploading malware to open-source repositories such as PyPI, NPM, and RubyGems, and naming them such that they would be downloaded and used by the target company's application.

Dependency confusion is a novel attack, and we need to define what is a dependency, how dependency confusion works, and how we can protect our codebase from this attack [6].

Dependencies are code modules packaged for easy consumption in the application code that you write. It is a code reusability mechanism for commonly public or non-public solved problems and is directly imported via installation into your applications [6].

One common hybrid configuration that clients use is storing internal packages on a private feed but allowing the retrieval of dependencies from a public feed. This ensures that the latest package releases are automatically adopted when referenced from a package that does not need to be updated. Internal developers publish their packages to this private feed, and consumers check both private and public feeds for the best available versions of the required packages. This configuration presents a supply chain risk: the dependency confusion attack [7].

A dependency confusion attack happens when an attacker discovers that a client is using a private package that is not present on the public feed. After the attacker uploads a higher version of the private package to the feed, the client downloads it automatically because it has the same file name. Services that merge package feeds also allow this substitution if packages from public sources may override those from private sources [7].

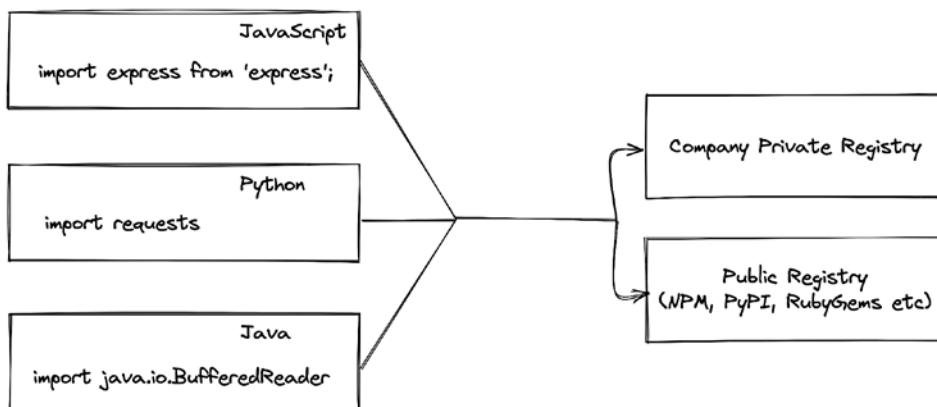


Figure 1 – Example of a dependency request path

There are a lot of possible mitigation strategies – from caching and reviewing every requested package in the internal network to whitelisting approved public packages for software development. The author considers mitigation strategies proposed by Twilio and Microsoft [6, 7]:

- Naming conventions for all internal packages.
- Reference one private feed, not multiple.
- Protect packages using controlled scopes.
- block proxying of certain packages.
- Internal package manager as a single source.
- Utilize client-side verification features.
- Restrict deployed hosts from accessing the registry.
- Controls for laptop access.

#### References:

1. Microsoft Research. "Example Screenshots of Strider URL Tracer With Typo-Patrol". Archived from the original on 21 December 2008. URL: <https://web.archive.org/web/20081221214435/http://research.microsoft.com/en-us/um/redmond/>.
2. Nikolai Philipp Tschacher. Typosquatting in Programming Language Package Managers. Bachelor, University of Hamburg, Hamburg, March 2016.
3. Joseph Hejderup. In Dependencies We Trust: How vulnerable are dependencies in software modules? Master's thesis, Delft University of Technology, May 2015.
4. Yi-Min Wang, Doug Beck, Jeffrey Wang, Chad Verbowksi, and Brad Daniels. Strider typo-patrol: Discovery and analysis of systematic typo-squatting. In Proceedings of the 2nd Conference on Steps to Reducing Unwanted Traffic on the Internet - Volume 2, SRUTI'06, page 5, USA, 2006. USENIX Association.
5. Alex Birsan. Dependency Confusion: How I Hacked Into Apple, Microsoft, and Dozens of Other Companies. URL: <https://medium.com/@alex.birsan/dependency-confusion-4a5d60fec610>.
6. Twilio. Dependencies, Confusions, and Solutions: What Did Twilio Do to Solve Dependency Confusion. URL: <https://www.twilio.com/blog/avoiding-dependency-confusion-attacks>.
7. Microsoft Azure. 3 Ways to Mitigate Risk When Using Private Package Feeds. URL: <https://azure.microsoft.com/en-us/resources/3-ways-to-mitigate-risk-using-private-package-feeds>.

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## **A MODEL FOR DETERMINING THE PROFICIENCY OF THE WORKERS OF EDUCATORS OF HIGHER EDUCATION INSTITUTIONS**

Four-step model of proficiency progress

The cycle of proficiency progress (Figure 1) begins with the process of orientation, in which the student determines which capability he wants to develop. Once this decision has been made, the student has a choice. One very fast way typical of non-formal learning and leisure-related proficiencies is to move directly to proficiency-based proficiency progress activities and little knowledge of their current level of language proficiency. Another way, more related to formal education and professional progress, is to start collecting information about the current level of student proficiency. Then the student can choose again: either he has his level of proficiency officially distinguished by others, or he can move directly to the activity of proficiency progress. Again, the latter way is a more informal learning way [1].

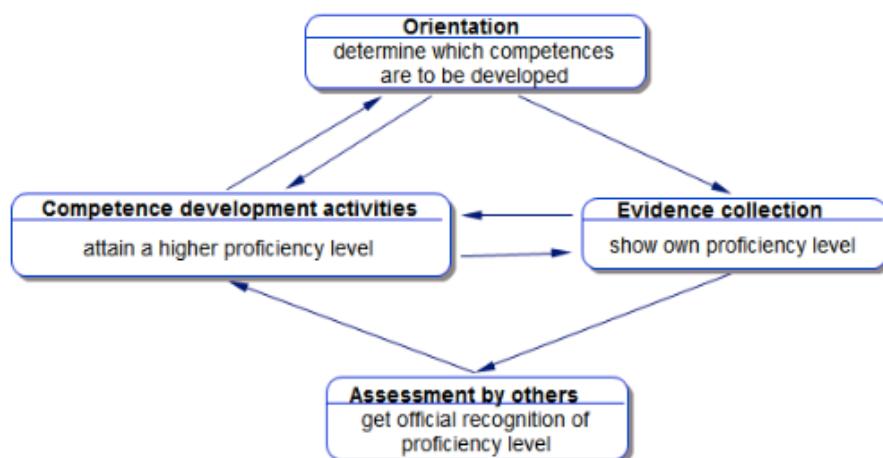


Figure 1 - Cycles of student proficiency progress

It is very significant to realize that the formal learning way is not yet completely formal. In fact, the assessments of others are the point where the formal learning path begins, where prior learning, which can be either informal or formal, turns into formal recognition. When a cycle occurs for the first time, the moment of evaluation is often referred to by others as "initial estimates".

This cycle of proficiency progress is largely based on studies by Duvekot, R. C., Schuur, K., Paulusse, J. [3, 4]. However, focusing on the individual student, aspects such as the enterprise of learning and awareness of enterprises remain out of consideration.

### **Presentation of the main research results**

Human resource management depends on policies and operations and systems that affect workers behavior, attitudes and execution. Human resource management is a process that includes 4 tasks: attracting, progress, motivating and retaining human

resources. Therefore, the tasks of personnel management are to achieve the desired results of joint efforts of workers:

- 1) Recruitment of workers with a level of salary that meets the needs of the enterprise;
- 2) Education and progress of talents and skills of workers;
- 3) Support of personnel capability and creation of conditions for favorable relations between them;
- 4) Providing conditions to meet the material and spiritual needs of workers, while maintaining a balance between individual aims of workers and the aims of the enterprise.

The selection strategy is the stage of accepting or rejecting the request. The selected employee must be not only the utmost qualified, but also the utmost harmoniously suited to the team and the tasks of the enterprise (5).

The applicant declares his readiness to participate in the work, sending the necessary documents.

Thus, the first stage of human resource management concerns the involvement of workers, and the second stage - the acquisition of skills, renewal and promotion of workers through training. Thus, for enterprises, human resource progress through training is an integral process that promotes the progress of abilities and talents, increases professional knowledge of workers, forms a positive attitude to corporate aims and ultimately influences workers behavior and, consequently, increases productivity. Human resource progress plays a very significant role in the progress of the enterprise (6).

Also, William James (1995) from Harvard University in a study concluded that employees of enterprises use from 20 to 30 percent of their learning opportunities. His research showed that with specialized incentives, workers show 80 to 90 percent of their training opportunities. Therefore, human resource management plays an significant role at various levels, including: Introduction, acquisition of skills, renewal and promotion of effective teaching skills [7].

An significant role is played by the criteria for evaluating workers for advanced training.

Thus, the basic criteria for selection at Yancheng Polytechnic Institute (PRC, Jiangsu Province) are 5 criteria: general cultural, general professional, communicative, individual, self-progress and self-education (Fig. 2).

To determine the level of educators, the method of expert evaluation of each of the criteria on a scale from 0 to 10 points. The minimum selection limit is 5 points for each of the criteria [8].

However, according to the author, this methodology can be upgraded due to three criterias.

First, the current 5 criteria do not sufficiently reflect the level of the educator. Therefore, it is advisable to increase these criteria.

Secondly, the methodology of expert assessment should be expanded to include in the circle of experts different groups of people who are in contact with the educator (students, colleagues, administration). For this purpose, in addition, the use of a

universal computer program for calculations of quantitative assessment of teaching quality is suitable [9].

Third, conduct mandatory educator testing. The emphasis should be not only on professional skills, but also on the so-called "soft skills" - non-professional skills that are necessary for success teamwork.

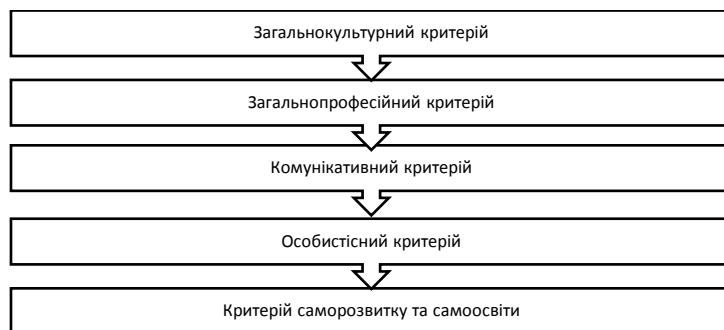


Figure 2 – Criteria for selection of Yancheng Polytechnic Institute to increase the professional proficiency of educators

To upgrade the definition of the proficiency of the workers of educators of higher education institutions, the following model has been developed, which includes three levels of assessment. Soft skills criteria have been added to the required criteria. Testing is recommended for both professional and psychological parameters. Expert assessment was expanded, two additional groups were involved: a group of colleagues, a group of students.



Figure 3 – A model for determining the proficiency of the workers of educators of higher education institutions is proposed

#### Conclusion

A model for determining the proficiency of the workers of educators of higher education institutions has been developed, which includes three levels of assessment.

Soft skills criteria have been added to the required criteria. Testing is recommended for both professional and psychological parameters. Expert assessment was expanded, two additional groups were involved: a group of colleagues, a group of students.

It is expected that this model will allow more professional and effective assessment of the proficiency of teaching workers. Subsequent research will focus on testing this model.

**References:**

1. Judith Schoonenboom\*, Colin Tattersall, Yongwu Miao, Krassen Stefanov, Adelina Aleksieva-Petrova, four-stage model for lifelong competence development // Proceedings of the TENCompetence Open Workshop in Manchester, UK, 11th and 12th January 2007 –, 18631
2. A. Biloshchitskyi, S. Biloshchitska, A. Kuchansky, O. Bielova and Y. Andrushko, "Infocommunication system of scientific activity management on the basis of project-vector methodology," 2018 14th International Conference on Advanced Trends in Radioelectronics, Telecommunications and Computer Engineering (TCSET), Slavsk, 2018, pp. 200-203, doi: 10.1109/TCSET.2018.8336186.
3. Duvekot, R. C., Schuur, K., & Paulusse, J. (Ed.). (2005). The unfinished story of VPL. Validation and valuation of prior learning in Europe's learning cultures. The Netherlands, Utrecht: Foundation EC-VPL & Kenniscentrum EVC.
4. Golovachyova, V., Tomilova, N., & Abildaeva, G. (2020). The expert system of control and knowledge assessment. Scientific Journal of Astana IT University, 1, 21-29. <https://doi.org/10.37943/AITU.2020.1.63601>
5. PMI (2002) Project Manager Competency Development (PMCD) Framework – Second Edition(2002) Newtown Square, PA: Project Management Institute
6. PMI (2002) Project Manager Competency Development (PMCD) Framework – Second Edition(2002) Newtown Square, PA: Project Management Institute
7. Mark A. Huselid. The Impactof Human Resource Management Practices on Turnover, Produce Productivity, and Corporate Financial Performance, Journal. 1995;38(3):635–638.
8. A. Biloshchitskyi, A. Kuchansky, Yu. Andrushko, and O. Bielova, "Learning space conceptual model for computing games developers," 2018 IEEE 13th International Scientific and Technical Conference on Computer Sciences and Information Technologies (CSIT 2018), pp. 97-102, 2018. doi: 10.1109/STC-CSIT.2018.8526719
9. Abili Kh. Tehran: Publication of the International Institute; 2005. Assessment of plans and programs for development. [Google Scholar]

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## **DEVELOPMENT OF METHODS FOR SOLVING THE PARTNER SELECTION PROBLEM**

**Annotation.** In the conditions of intensive development of scientific communities' mobility to ensure openness of innovations, it is essential to rationalize the choice of partners rational. The article considers a conceptual model of research on the problem of choosing partners for the implementation of research or educational projects. The article defines the general requirements for the development of information technology to select potential partners for research and educational projects.

**Keywords.** Partner selection problem, scientific project, multi-objective optimization

To effectively organize the preparatory stage of finding a solution to the problem of finding partners for a research project, you can perform several steps:

1. Determine to which direction or directions the activity of potential partners (object or subject of research activity) can be attributed.

2. Assess the contribution of partners in the development of scientific areas. That is, to assess the importance of partners in communities united by scientific directions.

3. Select those potential partners that correspond to the project, project work packages, and individual work package tasks.

Thus, finding partners for cooperation within research projects is related to the task of identifying scientific research areas. The modern development of science and innovation testifies to the growing degree of interdisciplinarity. The paper [1] proposes the following ways to identify areas of research: calculation of the index of integration or disciplinary diversity; construction of a similarity matrix for each thematic category and grouping of elements of the thematic group; generating maps to visualize communication within directions.

The next step in the preparatory stage of the task of finding partners is to assess the contribution of partners in the development of the relevant scientific field. It is first necessary to identify the links between all scientific publications through citations between these publications. The identified links between scientific publications open up opportunities for clustering these publications by the scientific field. Each research field will include a certain number of authors of publications that belong to a specific field or cluster. Thus, it is possible to put following a particular author a certain amount of areas of research, ie, to identify research areas of the authors. The scientific field's potential will be determined by evaluating the research activities of scientists who belong to this field. In essence, clusters or areas of research can be seen as dynamic objects with a history of development and predictable potential.

In the third step, you need to select those partners who meet the entry conditions. Articles [2] describe some methods for selecting partners. The key factors influencing the creation of standard forms of scientific cooperation are described in [3]. It determined that the main factors are the level of reputation of agents and the features of

cooperation mechanisms. Mathematical methods for selecting partners for cooperation are described in [4]. In [5], the method of the analytical hierarchy using for this problem. In [6], it proposed to use a modification of the genetic algorithm for this task. Theoretical aspects of the formation of factors for the selection of partners for cooperation in innovative projects are given in [7]. The process of selecting partners in joint international enterprises is described in [8]. Some aspects of this process can be used to choose partners for research and educational projects. If the number of potential partners significantly exceeds the possibilities of their involvement in the project, you can use the specific selection methods proposed in this work.

Consider the conceptual model of partner selection, the scheme of which is shown in Figure 1.

The main components of the conceptual model are:

1. Defining criteria for selecting potential partners.
2. Applying the multi-objective optimization.
3. Applying Delphi method.
4. Building the preferences of partners or project executors.
5. Deciding on assigning partners project tasks that meet the relevant work package.

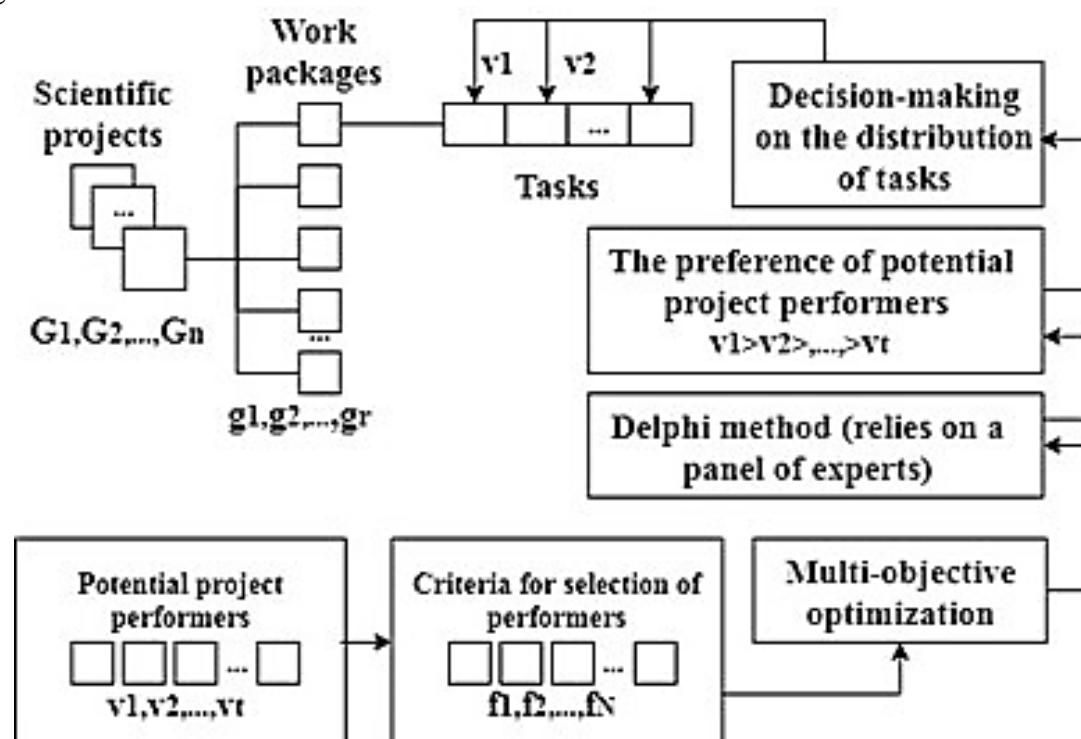


Figure 8 – The conceptual scheme for solving the problem of finding partners for research or educational project.

The main stages of deciding on the choice of partners according to the presented concept are as follows:

5. Formation of a preliminary list of potential partners.
6. Defining criteria for selecting partners.
7. Application of the method of multi-objective optimization to choose a set of optimal partners.
8. Application of the expert method for assessment of the received set of partners on conformity to requirements.

9. Forming a matrix of partner preferences. Determining the ranked list of potential partners.

10. Final selection of partners to perform specific tasks of the relevant work package of the research project.

Let a finite set of potential executors of these projects be given

$$V = \{v_1, v_2, \dots, v_t\}, \quad (1)$$

$t$  is the number of potential partners. Partners can be scientists, project managers, research institutions, higher education institutions, etc.

The decision on whether to select partners to implement the relevant work package is made by the project management team or the decision-maker. You can use the method of aggregation of expert assessments to determine the optimal composition of the executors of work packages of each of the projects.

Let a set of experts be given

$$E = \{E_1, E_2, \dots, E_s\}, \quad (2)$$

Each of the experts makes the preferences of potential performers, taking into account the vector of criteria. An incomplete benefit profile is allowed. Let  $\xi_{c,b}^{ij}$ ,  $j = \overline{1, r_i}$ ,  $i = \overline{1, n}$  is the average frequency of occurrence of each of the benefits between potential performers  $v_c$  and  $v_b$ ,  $v_c \in V$ ,  $v_b \in V$ ,  $c \neq b$ . Then we obtain a matrix of advantages of the form [13]:

$$\psi^{ij} = \begin{pmatrix} \xi_{1,1}^{ij} & \xi_{1,2}^{ij} & \dots & \xi_{1,t}^{ij} \\ \xi_{2,1}^{ij} & \xi_{2,2}^{ij} & \dots & \xi_{2,t}^{ij} \\ \vdots & \vdots & \ddots & \vdots \\ \xi_{t,1}^{ij} & \xi_{t,2}^{ij} & \dots & \xi_{t,t}^{ij} \end{pmatrix}, \quad (3)$$

Using methods of forming a collective solution based on a matrix of pairwise comparisons, it is possible for each package  $g_j^i$  of project  $G_i$  get an orderly list of potential performers:

$$v_{k_1}^{ij} > v_{k_2}^{ij} > \dots > v_{k_t}^{ij}, k_1 < k_2 < \dots < k_t, k_q \in \{1, 2, \dots, t\}, v_{k_q}^{ij} \in V^{ij}, q = \overline{1, t}. \quad (4)$$

Given this list, the project manager selects specific contractors and forms a working group.

#### References:

1. A. Porter, I. Rafols, Is science becoming more interdisciplinary? Measuring and mapping six research fields over time, *Scientometrics*, 81(3), 2009, pp. 719-745.
2. H. Xu, Review of methods of evaluation of scientific and research activity for the choice of selection of scientific partners, *Management of development of complex systems*, 38, 2019, pp. 156-160. doi: 10.6084/m9.figshare.9788654
3. C. S. Wagner, L. Leydesdorff, Network structure, self-organization, and the growth of international collaboration in science, *Research Policy*, 34(10), 2005, pp. 1608-1618.
4. S. Zhang, D. Poulin, Partnership management within the virtual enterprise in a network, *International Conference on Engineering Management and Control*, 1996, pp. 645-650.
5. X. N. Chu, S. K. Tso, W. J. Zhang, Q. Li, Partners selection for virtual Enterprises, in: *Proceedings of the 3th World Congress on Intelligent Control and Automation*, 2000, pp. 164-168.
6. W. D. Feng, J. Chen and C. J. Zhao, Partners selection process and optimization model for virtual corporations based on genetic algorithms, *Journal of Tsinghua University Science and Technology*, 40, 2000, pp. 120-124.
7. M. Garcez, R. Sbragia, I. Kruglianskas, Factors for selection partners in innovation projects – qualitative evidences from non-equity bilateral alliances in Brazilian petrochemical leader, *Review of Administration and Innovation*, 11, 241, 2014. doi: 10.5773/rai.v11i2.1292.
8. A. K. Al-Khalifa, S. E. Peterson, The partner selection process in international joint ventures, *European Journal of Marketing*, 33 (11/12), 1999, pp. 1064-1081.

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## **POSSIBILITIES AND RELEVANCE OF TELEMEDICINE IMPLEMENTATION IN GOVERNMENTAL ELECTRONIC MEDICAL SYSTEMS**

**Abstract.** This study was conducted due to the growing relevance of telemedicine services in the context of the COVID-19 pandemic. It outlines the prospects for the implementation of the telemedicine system in the state electronic health care systems, the main stakeholders for the implementation of this project and some successful examples of the launch of telemedicine platforms by foreign governments. In addition, the analysis identifies the main problems that are obstacles and risks in launching such systems.

**Keywords:** telemedicine, COVID-19, government, electronic systems.

As of today, world's health care systems are still affected by the COVID-19 coronavirus pandemic. Ukraine's medical system is maximally mobilized to combat COVID-19, but the risks of infection for medical professionals and hospital patients remain disproportionately high. [1]

Such statistics are due to the contact of doctors with patients who have severe form of the disease, but also with those who have no symptoms or mild form of the disease but have to visit doctors to get the diagnosis. In addition, the risk of contact with patients with COVID-19 often forces people with chronic diseases to avoid visiting hospitals and clinics, leaving without medical care people, who often need it most.

However, these days it's possible to use information technology in electronic systems to reduce such risks. The analysis presented in this paper shows that the implementation of a telemedicine in electronic medical systems can provide major benefits in maintaining the safety of health professionals and ordinary citizens.

This work outlines the prospects for the introduction of telemedicine services in public health systems and the expected obstacles to the implementation of such innovations, as well as demonstrates successful examples of such services abroad, which we hope will begin discussing such a possibility in Ukraine.

Telemedicine is especially relevant in the context of the COVID-19 pandemic. By providing the opportunity for communication between the patient and the doctor it helps to protect medical professionals and patients from the spread of viral diseases. And for the patients themselves, it is an opportunity to get a diagnosis and treatment

faster, which will help prevent the spread of the virus by this person, allow treatment to begin immediately and allow the patient's condition to be monitored, so that in case of unexpected complications there is a possibility to respond quickly.

Telemedicine services are crucial for people at risk of complications from COVID-19 infection, people that have chronic diseases, and for people with limited mobility. For these citizens, personal visits to the hospital or clinic may be difficult due to the risk of infection, or a lockdown that restricts movement for citizens, and the telemedicine system may provide regular consultations for these groups without the need to visit medical facilities.

Undoubtedly, the unprecedented workload of the medical system has a strong impact on the ability of doctors to implement and apply the latest technologies. Lack of time, which until ten years ago was one of the least significant obstacles to the introduction of telemedicine [2], is now becoming a major problem due to the volume of work related to COVID-19.

Insufficient computer skills, which are often cited by health professionals as a reason to avoid using a telemedicine system, if available, can also be a significant obstacle [2]. However lately the computer awareness is increasing, and the motivation of physicians to use remote video communication technologies with patients and colleagues is growing.

Due to their centralization and prevalence, provision of such a service by government agencies can help to circumvent several problems, including issues of legal regulation, sources of funding and the unpopularity of the service.

Of course, there are shortcomings in the idea, such as low rates of innovation, low probability of implementation of experimental projects and distrust in the protection of personal information during operation. However, there are already successful examples of the implementation of telemedicine by governments.

For example, the Dubai Health Department launched a service called "Doctor for every citizen." With help of this service all residents can access free consultation through audio and video calls [9]. There is an example of the Government of India, which launched the application "Dial-A-Doctor". Patients now can communicate digitally with doctors [10]. Also, Lithuania currently has several national projects that seek to integrate information and communication technologies into the country's medical system to provide telecommunications services to the country's citizens [11].

In my opinion, the project approach will be the most successful for the implementation of such plan. It is suitable for both small and large-scale national projects, and thanks to its methodology makes it possible to achieve the goals in a timely manner and within the defined budget.

The main stakeholders of such a project and their impact on the project can be:

<b>Nº</b>	<b>Stakeholders</b>	<b>Stakeholder's impact on the project</b>
1	Government agencies (Ministry of Health, National Health Service of	Ensures consistency of project results with strategic goals. Defines requirements and

	Ukraine, State Administrations)	restrictions for the project. Provides funding.
2	Private business (developer company)	Ensures the achievement of project results, defines project objectives, milestones, provides hardware, performs development, system implementation and staff training.
3	Hospital (medical staff)	Form an initial request for the system and work with the contractor to implement the system.
4	Users (patients)	The degree of satisfaction of their needs will affect the degree of use of the developed system and will determine the overall success of the project..
5	The general public	Form a positive or negative opinion about the innovative activity of the medical system.
6	Media	Cover the project from the positive or negative side.

The project's team can be divided in five parts: product development division, advisory division, implementation division, support division and leadership division.

Product development division is responsible for UX/UI design, coding, test and quality assurance, as well as completion of administrative process.

Advisory division that consists of Ministry of health expert, National Health Service of Ukraine expert and an appointed team from the medical institution is identifying a need which the service must satisfy to be approved, defines success, outlines risks and advice to avoid them.

Implementation division is responsible for carrying out the enforcing of the system in the institution and organizing training for medical professionals regarding the system.

Support division aids after the implementation of the telemedicine system.

Leadership division provides planning, budgetary approval, decision-making, monitoring and maintains the workplace culture.

Team roles required for the project are the following: Project manager, Business analyst, Ministry of health expert, National Health Service of Ukraine expert, UX designer, UI designer, Front-end developers, Back-end developers, Quality assurance engineer, Product owner.

Such team composition would allow for the swift and timely completion of the workflow steps, while also maintaining the structure agile enough to react to possible goal changes without delay.

**Conclusions.** At present, telemedicine services are in high demand among patients, especially for those with chronic diseases, disabilities, or suspected

COVID-19. The telemedicine system is also useful for doctors - to prevent viral infections and to consult with colleagues.

The introduction of telemedicine services based on state electronic systems is particularly promising, but it faces such threats and risks as: workload and insufficient computer skills by doctors, slow implementation of innovations by the state and distrust by citizens. However, in the international arena there are already examples of successful implementation of telemedicine by the state, which indicates the possibility of successful implementation of such a system in Ukraine.

### **References:**

1. "Coronavirus: why is it so dangerous for medical professionals." BBC NEWS.Ukraine 01.04.2020. URL: <https://www.bbc.com/ukrainian/features-52118922>
2. K. Rymarenko, D.Dobryansky, Telemedicine implementation in Ukrainian Health care institutions: experience of Ukraine-Swiss Mother and Child Health Programme, Clinical information technologies and telemedicine 2010, issue 7, p.77-82.
3. Ohannessian R, Duong TA, Odone A, Global Telemedicine Implementation and Integration Within Health Systems to Fight the COVID-19 Pandemic: A Call to Action, JMIR Public Health Surveill 2020;6(2):e18810, doi: 10.2196/18810
4. Brook Calton, MD, MHS, Nauzley Abedini, MD, MSc, and Michael Fratkin, MD, Telemedicine in the Time of Coronavirus, e12 Journal of Pain and Symptom Management, vol. 60 No. 1.06.2020.
5. Chernyavskaya L.M., Kubatko V.V. Smiyanov V.A., Development of telemedicine in Ukraine, 2021, URL: [https://essuir.sumdu.edu.ua/bitstream-download/123456789/82880/1/Chernyavskaya\\_Masters%20thesis.pdf](https://essuir.sumdu.edu.ua/bitstream-download/123456789/82880/1/Chernyavskaya_Masters%20thesis.pdf)
6. Bilovoz A.M., Beregovaya A.A., Tkachenko S.G, Telemedicine – as a current breakthrough in the training of future doctors, 8.04.2021, Current problems of higher medical education and science, p. 28.
7. Dubchak L.O. Telemedicine: The current state and perspectives of development, Information processing systems 2017, issue 1 (147), ISSN 1681-7710.
8. Korluk S.S., Problem aspects of telemedicine implementation in Ukraine, International scientific and practical conference, 26-27.02.2021, p.162.
9. Telecommunications and digital government regulatory authority, Virtual Doctor for COVID-19, 24.10.2021, URL: <https://u.ae/en/information-and-services/health-and-fitness/telemedicine>.
10. Financial Express, Dial-A-Doctor: eSanjeevani portal for telemedicine a welcome move by govt, 27.04.2020, URL: <https://www.financialexpress.com/opinion/dial-a-doctor-esanjeevani-portal-for-telemedicine-a-welcome-move-by-govt/1940225/>.
11. World Health Organization, Lithuania: Transforming primary health care during the pandemic, URL: [https://www.euro.who.int/\\_\\_data/assets/pdf\\_file/0008/506870/primary-health-care-Lithuania-eng.pdf](https://www.euro.who.int/__data/assets/pdf_file/0008/506870/primary-health-care-Lithuania-eng.pdf)

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## HR IN INTERNATIONAL EDUCATIONAL SERVICE SYSTEM

It is beyond doubt, that the importance of human resource management (HRM) in enterprises is very high. The need to harmonize HRM and business strategies is widely known [1]. Effective HRM is vital to meet ever-changing market demands [2].

Technology and HRM have a wide range of influences on each other, and HR experts must be able to implement technologies that reengineer the personnel management function, be prepared to support enterprise and operational changes due to technology development, and be able to maintain proper management climate for innovative and knowledge-intensive enterprises [3]. High-tech advances are advancing primarily due to the high demands of human resources experts to rise speed, efficiency and reduce costs [4].

Studies by Snell, Stuiber and Lepak [5] have shown that through the use of IT, human resource management systems can solve problems more critically, flexibly, cost-effectively and more customer-oriented. Many experts predict that the PC will become a central device for all experts in the field of HR [6]. Virtualization of human resources management is caused by the factor of increasing complexity of IT and increasing external structural parameters [7]. IT enables enterprises to carry out relevant human resource management operations. And a wide range of proposals in the market of human resource management technologies allows you to use the latest systems with minimal investment [8].

### Presentation of the main research results

The development of the Chinese international service system for students is ongoing, but according to the author is not fast enough. For example, the program is presented, which is currently enrolling foreign students in one of the universities of Shandong Province (Fig. 1-3).



Figure 1 – Screenshot of the main menu of the international service system for students



Figure 2 – Screenshot of the menu of choosing specialties of the international service system for students



Figure 3 – Screenshot of a student's personal questionnaire in the international service system for students

Although this system is aimed at facilitating the enrollment and further education of students, but its functionality is limited. There is a single integration of higher education institutions of this system with internal human resource management services, but it has not yet reached global development.

To globalize the learning process of foreign students, it is advisable to use an consolidated learning platform. A number of training courses have been developed for this platform. The Master of Business Administration course was adopted to conduct a joint Ukrainian-Chinese training program (Figure 4).

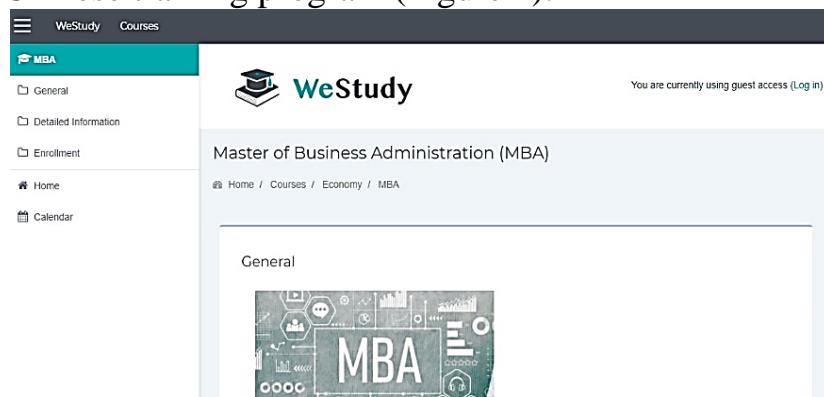


Figure 4 – Screenshot of the main page of the consolidated learning platform

According to the author, the harmonization of the Chinese international service system for students and an consolidated learning platform will rise the level of human resource management for educational institutions.

## Conclusion

To globalize the learning process of foreign students, it is advisable to use an consolidated learning platform. A number of training courses have been developed for this platform. The Master of Business Administration course was adopted to conduct a joint Ukrainian-Chinese training program.

Harmonization of the Chinese international student service system and consolidated learning platform will rise the level of human resource management for educational institutions.

## References

1. Agarwal, R. and Ferratt, T.W. (1999). Crafting an HR strategy to meet the need for IT workers. *Communications of the ACM*, 44(7), 58-64; Lengnick-Hall, M.L. and S. Moritz (2003). The Impact of E-HR on the Human Resource Management Function. *Journal of Labor Research*, 24(3), 365-379.
2. Hustad, E. and Munkvold, B.E.(2005). IT-supported competence management: A case study at Ericsson. *Information Systems Management*, Spring, 78-88.
3. Hempel, P.S. (2004). Preparing the HR profession for technology and information work. *Human Resource Management*, Issue2-3, 163-177.
4. A. Kuchansky, Yu. Andrushko, A. Biloshchytskyi, O. Danchenko, O. Ilarionov, I. Vatskel, and T. Honcharenko, "The method for evaluation of educational environment subjects' performance based on the calculation of volumes of M-simplexes," *Eastern-European Journal of Enterprise Technologies*, 2(4(92)), pp. 15-25, 2018. doi: 10.15587/1729-4061.2018.126287
5. Buckley, P; Minette, K.; Joy, D; and Michaels, J. (2004) The use of an automated employment recruiting and screening system for temporary professional employees: A case study. *Human Resource Management*, Issue 2-3, 233-241.
6. Snell, S. A., Stueber, D. and Lepak, D. P. (2002). Virtual HR Departments: Getting out of the middle. In R. L. Heneman and D. B. Greenberger (Eds.), *Human resource management in virtual organizations*, pp 81-101, CT: Information Age Publishing.
7. A. Biloshchytskyi, A. Kuchansky, Y. Andrushko, S. Biloshchytska and O. Danchenko, "Development of Infocommunication System for Scientific Activity Administration of Educational Environment's Subjects," 2018 International Scientific-Practical Conference Problems of Infocommunications. Science and Technology (PIC S&T), Kharkiv, Ukraine, 2018, pp. 369-372, doi: 10.1109/INFOCOMMST.2018.8632036.
8. Kovach, K.A. & Cathcart, C.E. (1999). Human Resource Information System (HRIS): Providing business with rapid data access, information exchange, and strategic advantage. *Public Personnel Management*, 28(2), 275-282.

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## **AGILE METHODOLOGY FOR JOINT EDUCATIONAL PROGRAMS IMPLEMENTATION**

In 2012, a study was conducted to evaluate the use of the Agile approach to curricula [1]. A pilot educational program for project management students has been developed and implemented. The first pilot project was a one-month, divided into four "sprints" per week. Each sprint had its own set of goals. Agile "persons" based on the nature of students, parents, teachers and others have been developed to know exactly how to provide value that meets their needs.

The concept of using Agile as an approach to teaching and learning is not new [2-7]. However, while related articles appear periodically in publications such as the Journal of Information Systems Education (JISE) and other educational publications in the field of information systems, there are very few sources where such materials have been systematized and conveniently presented in a separate manual [8].

One study [9] observed 74 students from 4 groups studying the discipline of "information systems" (introduction to computer engineering, programming, analytics and data mining), from freshmen to senior groups, and those studying IP by specialty, and those who have a general course. The obtained results testify to interesting conclusions concerning the differences between the sexes during individual and pair work; the quality of the decision based on age, motivation, individual or pair work, and perception of the concept of work performed; and the influence of experimental parameters between the first year (introduction to computer science) and the senior course (data mining). The authors suggest that pairwise programming may not necessarily be "a key factor influencing changes in attitudes" or "consistently associated with improved solution quality." In addition, the type of "subject is less important for improving the quality of the solution compared to the possibility of involvement in pair programming" and "the perception of the course differs at different levels of academic training." The study supports the idea that pair programming can be implemented in courses outside of software development and provides a new perspective on gender differences, and other activities practiced in a flexible methodology can improve the quality of material perception.

Scrum is used to facilitate self-regulated learning in the introductory programming course within the Doubtfire Learning Management System (LMS) [9]. The author presents an interesting, unconventional approach as opposed to the traditional approach to programming.

### **Presentation of the main research results**

KanbanFlow is an online tool for both individual and collaborative work on "cost-effective development" projects with the Kanban methodology [10]. The service allows you to add several kanban boards to make plans and track work on various projects.

The service is suitable for both personal productivity and project and team management.

As soon as any member of the team makes changes to the board, these changes are displayed on all screens of the team. So, if you add, delete or move the task to yourself, the same action will be repeated in the rest of the team.

If desired, you can track the time spent on the task with a timer. The timer supports the popular Pomodoro method for time management.

Figures 1 - 3 show the task board and subtasks of the specialized bachelor training program "3 + 1" in KanbanFlow.

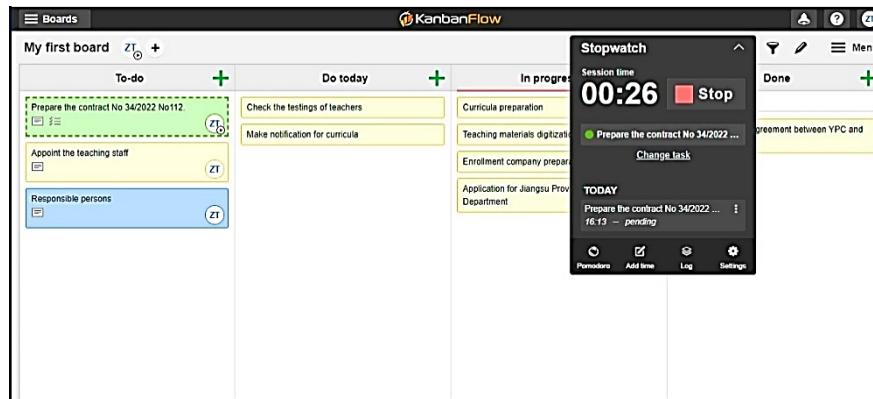


Figure 1 – Task board of the specialized program of preparation of bachelors "3 + 1" in KanbanFlow

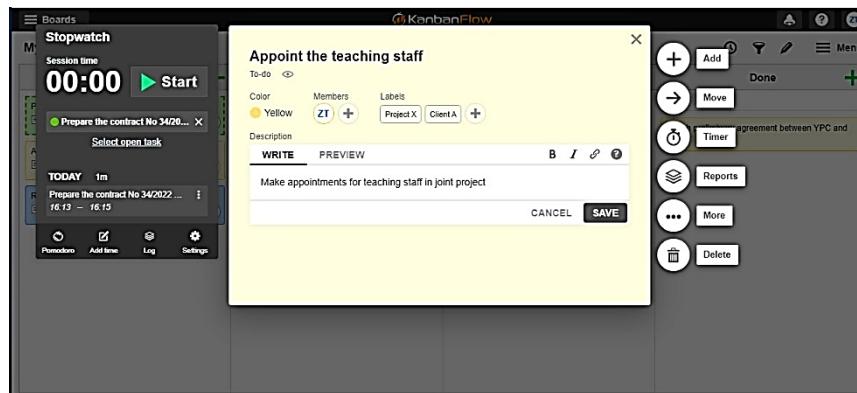


Figure 2 – Task menu for the specialized bachelor training program "3 + 1" in KanbanFlow

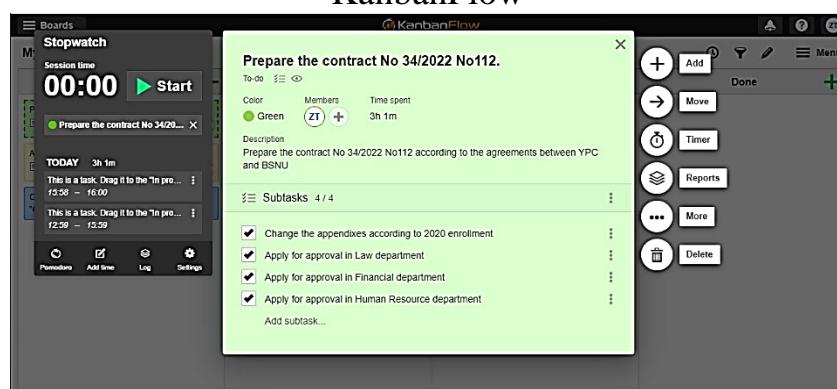


Figure 3 – The menu of assignments of subtasks in KanbanFlow

The use of modern software accelerates the management of a complex project of a specialized program for bachelors "3 + 1". Agile's approach of dividing tasks into

sprints, building a Kanban board and attracting a student as a "customer" has proved very successful. The KanbanFlow online tool has never been used before for this task. Its use has reduced the time spent on project management and improved the interaction of the international team, which consists of Ukrainian and Chinese specialists.

The preparation of training materials is divided into sprints, with further improvements throughout the implementation of the program. The main "customer" in this program is a student, and the ultimate goal of each project under the program - the competence of the student in the labor market after graduation. Therefore, this program can be considered complex, and one that is constantly evolving, as the needs of the Chinese labor market are constantly changing and evolving.

### Conclusion

When planning the learning process can increasingly be done using the principles of Agile methodology. Higher education institutions that implement a joint international training program are no exception. This is how a joint educational project between the Petro Mohyla Black Sea National University and the Yanchen Polytechnic Institute called "3 + 1" is being prepared.

This program is planned using Agile approaches, namely using the Kanban methodology. This uses KanbanFlow software.

The KanbanFlow online tool has never been used before for this task. Its use has reduced the time spent on project management and improved the interaction of the international team, which consists of Ukrainian and Chinese specialists.

### References:

1. Mohamed Hassan Agile for Developing Education Programs Edited by: Cindy Coan <https://www.projectmanagement.com/blog-post/27977/Agile-for-Developing-Education-Programs>
2. Andersson, R. & Bendix, L. (2005). eXtreme Teaching. Proceedings of 3:e Pedagogiska Inspirationskonferensen, LTH, Lund Institute of Technology.
3. Andersson, R. & Bendix, L. (2006). Towards a Set of eXtreme Teaching Practices. In Salakoski, T., T. Mantyla, & M. Lasko (eds.) Proceedings of Koli Calling 2005. 5th Koli Calling Conference on Computer Science Education, November 17- 20, 2005, Koli, Finland. TUCS General Publication 41, January 2006, 33-40.
4. Chun, A. H. W. (2004). The Agile Teaching/Learning Methodology and its E-Learning Platform. Lecture Notes in Computer Science, 3143, Springer-Verlag Heidelberg, 11- 18.
5. Lang, G. (2017). Agile Learning: Sprinting through the Semester. Information Systems Education Journal, 15(3), 14-21.
6. A. Biloshchitskyi, A. Kuchansky, Yu. Andrushko, and O. Bielova, "Learning space conceptual model for computing games developers," 2018 IEEE 13th International Scientific and Technical Conference on Computer Sciences and Information Technologies (CSIT 2018), pp. 97-102, 2018. doi: 10.1109/STC-CSIT.2018.8526719
7. Razmov, V. & Anderson, R. (2006). Experiences with Agile Teaching in Project-Based Courses. Proceedings of the ASEE Annual Conference and Exposition.
8. A. Kuchansky, Yu. Andrushko, A. Biloshchitskyi, O. Danchenko, O. Ilarionov, I. Vatskel, and T. Honcharenko, "The method for evaluation of educational environment subjects' performance based on the calculation of volumes of M-simplexes," Eastern-European Journal of Enterprise Technologies, 2(4(92)), pp. 15-25, 2018. doi: 10.15587/1729-4061.2018.126287
9. Vuokko, R. & Berg, P. (2007). Experimenting with eXtreme Teaching Method – Assessing Students' and Teachers' Experiences. Issues in Informing Science and Information Technology, 4, 523-534.
10. Schmitz, K. (2018). A Three Cohort Study of Role-Play Instruction for Agile Project Management. Journal of Information Systems Education, 29(2), 93-104.

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# emerline

LeverX is an official partner of the German company SAP and is engaged in the development and implementation of software that helps automate business processes.

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Client geography – USA and Western Europe.

180+ implemented projects.

LeverX Group has offices in eight countries – Belarus, the United States, Austria, Latvia, Uzbekistan, Lithuania, Poland, and Ukraine. Headquartered in Silicon Valley.

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