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FOREWORD

Conference on Information Technology for Practice 2018

Ladies and gentlemen, welcome to the traditional IT4Practice 2018, a conference with international attendance. This year, we hold the 21th vintage of this conference.

It is organized under the auspices of CIT (VŠB-TUO Information Technology Center), EUNIS-CZ (Association of European University Information Systems Czech Republic), IT Cluster z.s., ČSSI (Czech Society for System Integration - Moravian-Silesian Section) and Regional Authority - Moravian-Silesian Regional Authority. This conference is also very well being evaluated by the European Union. Organizers strive to register this conference in recognized databases.

In agreement with the name of the conference, participants come from academic staff, managers and ICI staff, IS designers at companies and institutions, ICT providers, and students. The topics of this year's conference are:

- Information Management;
- ICT Innovation;
- Information security;
- Information Society and Education.

The Aim of organizers is to create a platform for the exchange of knowledge and skills in the field of ICT innovations and the use of new our knowledge's in practice. Today it is not easy to get practitioners willing to share their experiences.

We wish you to create new professional contacts and tighten the existing ones which are useful for solving specific problems in your companies and institutions.

On behalf of the organizers

Milena Tvrdíková October 2018

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INFORMATION MANAGEMENT

Expanding the Capabilities of Medical Information Systems to Automate the Document Flow of Health Care Institutions

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Abstract. In Russia, modern information technologies are rapidly being introduced into all spheres of human life, including the health care system. Health informatization is carried out in order to improve the efficiency of medical care and ensure the socio-economic development of the country. The article deals with the principles of medical information systems (MIS) application for document flow automation in medical organizations. It is shown that the introduction of electronic document management between medical and preventive institutions of medical and social expertise and on the basis of medical information systems can improve business processes, increase patient satisfaction, the availability of services to persons with disabilities. It is proposed to improve the MIS with the use of specialized software for the organization of medical examinations.

Keywords: medical information systems, automated workplace of a doctor, healthcare informatization, electronic document flow

JEL Classification: I15, C80

1   Introduction

Modern medical organizations produce and accumulate huge amounts of data. The quality of medical care and the standard of living in the country as a whole and each of its territorial subjects, in particular, directly depends on how effectively this information will be used by doctors, managers, governing bodies, all parts of the medical sphere.

Ensuring timely access to information becomes critical when it comes to people's lives. Possession of the necessary information, actual or historical, is often the only thing that is not enough for the doctor to provide the patient with the necessary medical care in a timely and qualified manner. Routine document

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management, lost copies of documents, geographically dispersed information about the same patient, lack of qualified search methods – all this takes time and energy from medical professionals and significantly reduces the efficiency of their activities.

The introduction of electronic document management saves any therapeutic and prophylactic institution (TPI) from a significant amount of paper work. When it is used, it becomes much easier to store and find the necessary information for the doctor, and the manager – to track how the employees of the health facilities perform their assigned work tasks. With electronic medical documents becomes easier process and care about the safety of personal data of patients of health care facilities.

Now all hospitals are United by the Federal network. Therefore, electronic queue of patients is organized through one of several services through a single portal of public services, through a regional service or simply in a clinic through an infomat or a registry window. One of the important advantages that Informatization of medicine gives to patients is that all decisions and actions of the doctor will be documented. In addition, regardless of the location of the patient, the doctor of any public health facility will be able to get full information about the health of the patient, referring to his electronic card, which collects data of examinations by specialists and their purpose, the results of tests and studies, registration data for an appointment with the doctor.

Health informatization is one of the most important components of the general informatization of society. The main goal of health informatization is progress both in the development of the service itself and in monitoring the health status of patients. Within the framework of these areas, very successful work is being carried out on the urgent problems and sick places of modern health care.

2   Methodology

This study analyzes the state of health Informatization in Russia. The statistical data of the Federal state statistics service were used as a basis for the study.

Medical information and analytical centers, automated information systems of compulsory medical insurance funds and insurance medical organizations have been established in the constituent entities of the Russian Federation. At the same time, the developed information systems, as a rule, are narrowly focused on providing private functions and tasks. The lack of a common approach to their development in the process of operation has led to serious problems. As a result, existing information systems are a complex of disparate automated workplaces, rather than a single information environment.

The level of health system equipment with modern information and communication technologies is extremely heterogeneous, and is mainly limited to the use of several computers as stand-alone automated workplaces. Another problem in the field of health system Informatization is the lack of unification of used software and hardware platforms.

Some companies, mostly operating and financed from the mandatory health insurance system, implementing the system, allows to keep records of patients, conduct analysis activities and preparation of regular reports. In General, health care institutions do not form a single information space, so the electronic exchange of data between them is difficult.

The only type of software installed almost everywhere in health care institutions is the developed programs of accounting of registers of the rendered services of system of compulsory medical insurance, and also components of information systems of providing with preferential medicines. To date, there is no unified approach to the organization of development, implementation and use of information and communication technologies in medical institutions and organizations. As a result, the ability to integrate existing software solutions is very limited.

Thus, the existing level of Informatization of the health care system does not allow to quickly solve the issues of planning and management of the industry to achieve the existing targets.

The purpose of Informatization of the health care system is to increase the availability and quality of medical care to the population based on the automation. The process of information interaction between institutions and organizations of the health care system, health management bodies

of the Russian Federation, as well as Federal Executive authorities, ensuring the implementation of the state policy in the field of health care.

3   Medical information systems

Medical information systems (MIS) are a type of information systems. Medical information system is a set of information organizational, software and hardware designed to automate medical processes and (or) organizations. The modern classification of medical information systems is based on the structure of health care as an industry by levels: basic (clinical); institutional (polyclinics, hospitals, dispensaries and other medical organizations of various subordination, up to Federal); management (municipal, city, district, subjective); Federal government.

Within each level of MIS are classified according to functional principle, i.e., goals and objectives. All MIS are consistently divided into a number of automated systems:

- medical and technological systems;
- automated workplace;
- information technology systems;
- information systems of medical organizations of all types and levels;
- information and analytical systems;
- Unified state health information system (USHIS)

Information exchange is a key component in any system. In the field of health, information has been circulating between organizations, doctors, scientists and other professionals, and in recent years between medical information systems, both at the same level and at different levels. Due to the long-term lack of coordination of actions of the information community at the state level, the current level of health Informatization in the Russian Federation is extremely heterogeneous.

According to the research conducted by «Comprehensive medical information system», today 260 different software products are used in the Informatization of public health in Russia. The undisputed leader among the Russian regional IIAs is the unified information and analytical system of Moscow-this system accounts for 37% of the total volume of public procurement for information (Gusev, 2016).
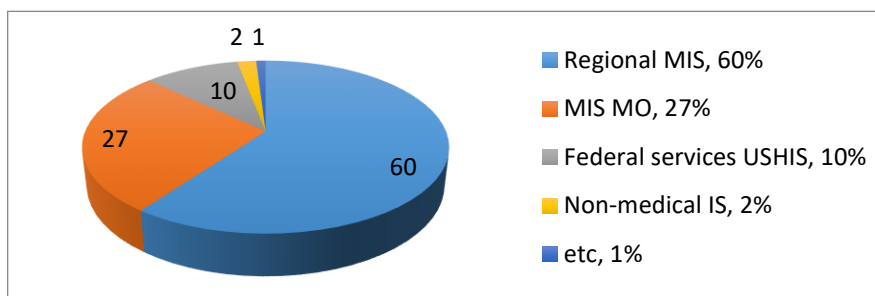
Figure 1   Public procurement in the field of health by type of SOFTWARE, 2013-2018

Among the medical information systems designed to automate individual health facilities, 89% of the costs were incurred by various medical information systems of medical organizations (MIS MO), the number of which during the observation period amounted to 160 systems. The second place is occupied by laboratory information systems (6%), the third (3%) – software products for the automation of pharmacy activities.

Specialized solutions, such as laboratory or radiological information systems, emergency or drug solutions, do not have a significant market share, and each of these solutions accounts for less than 1% (Rudycheva, 2017).

Table 1   Basic medical information systems of a medical organization,. Source: Gusev, 2016

№	Medical information system	Number of regions that purchased this solution and its services	Amount of contracts, mln RUB	% of total amount*
1	qMS (SP. Arm, Saint-Petersburg)	9	659,3	15,96%
2	Medialog (Moscow)	20	468,7	11,34%
3	Integrated MIS (KMIS, Petrozavodsk)	19	271,5	6,57%
4	Trustmed (Softrast, Belgorod)	7	192,4	4,66%
5	Maginfocenter (Surgut)	2	143,8	3,50%

* in this case, % is taken from the amount of all state contracts on institutional systems

The existing medical information systems partially overlap each other in terms of functions, support different data formats and are not designed to work in a single information space, so they cannot be integrated into one system without significant changes. The lack of a unified legal, organizational and methodological framework for the operation and use of information

systems, does not allow to obtain complete, accurate and up-to-date information about the state of all health sectors.

Medical information systems should also help to solve one of the most important tasks of the development of information technologies in the provision of services to persons with disabilities – the organization of electronic interaction between health care organizations and medical and social examination institutions (Ministry of Labor of Russia, 2018).

4 Automation of medical examination

Registry staff, administrators and doctors have to process a very large amount of information during medical examinations or professional examinations for organizations. Due to the need to work with the registration of both primary and subsequent documentation, the time spent in the medical organization increases and it will not be possible to pass all the doctors and examinations in one visit to the hospital.

Within the framework of the project "Lean polyclinic" Ryazan state medical University together with the company "KIVC Ryazanstoroy" on the basis of 1C platform was written a program that optimizes the logistics flow of patients in a medical institution (Ministry of health of the Russian Federation, 2017). With its help, you can create a route list of visits to doctors during a medical examination with a minimum waiting time, which significantly reduces the presence of the patient in the hospital and as a consequence reduces queues, reduces the economic costs of the organization. To start working in the program you need to fill in directories. Directory "SPECIALISTS" is designed to maintain a database of specializations of doctors of medical institutions. Directory "EMPLOYEE" is designed to maintain a database of employees of the medical organization in accordance with their specialties. Templates for preventive examinations for each age group are created, in which doctors and their time of admission are entered. Directories "PATIENTS" and "INSURANCE COMPANIES" are used to maintain a database of patients and their details, if the medical institution in the course of the need to store patient data. For each section of the program created help to facilitate the use of all functionality. After filling in the directories, you must fill in the section "work SCHEDULES",

which contains the schedule of doctors in accordance with the types of examinations. On the basis of the schedule of doctors, a single ticket for the day is created in the section SINGLE TICKET for visiting several doctors. When you create a single ticket, select the type of examination, date of visit, change of doctor and press the button to FORM A single TICKET according to the SCHEDULE. A list of doctor's visit coupons for the day is created.

Figure 2   Formation of a single ticket for medical examination, Source: own.

5   Conclusion

The analysis of the spread of medical information systems showed heterogeneity of health Informatization in Russia. The existing medical information systems partially overlap each other in terms of the functions implemented, support different data formats and are not designed to work in a single information space, so they cannot be integrated into one system without significant changes. The proposed approach to the introduction of information technologies in the medical organizations, as well as electronic interdepartmental document between health organizations and institutions of medical expertise allows to achieve the goal of improving the availability and quality of medical care, including those with disabilities.

Within the framework of the "Lean polyclinic" project, specialized software has been developed to optimize the processes of management of logistic flows of patients in the polyclinic during medical examinations. It is proposed to improve the MIS using specialized software for the organization of medical examinations.

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A Management of Keys of Data Sheet in Data Warehouse

Olexander Beley[1], Volodymyr Chaplyha[2]

Abstract. Consider the peculiarities of corporate data protection in a modern information and communication economy and digital society. Displaying features protect data on disks, and shows features of formation of key protection for data warehousing. The comparison of the formation of keys in a data warehouse SQL Server and virtual machines on Microsoft Azure.

Keywords: data warehouse, data protection, communication economy, key protection, virtual machines

JEL Classification: C63, D12

1 Introduction

Modern corporations face intensive growth in the amount of data that is needed for their daily activities. For rapid response to changes in the market situation, the behavior of competitors and customers need to have financial, marketing, technical, statistical and other information used various types of storage, storage network, hard disk drives and tape drives.

The high level of corporate data centralization makes them more vulnerable and, to some extent, simplifies the task of the attacker to obtain unauthorized access to these data. The situation is complicated by the fact that modern data storage technologies practically do not provide built-in means of access differentiation and protection of information. Therefore, often, if not always, confidential information, which represents a value for a corporation and the source of which is threatened with serious troubles - a loss for business reputation, litigation or loss of competitive advantages, is virtually in no way protected against a number of threats (Christy, 2017)

Data warehouse security cannot be secured with network security features such as firewalls, IDS / IPS, and virtual private network (VPN). First of all, these parameters do not limit the possibility of legal users of the corporate network, and secondly, the presence of at least one gaps

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in protection will allow the attacker to access the stored data (Tvrdikova, 2016).

It does not work in the case of physical unauthorized access and authentication means (multifactorial, biometric or smart cards), because authentication will not be saved if an attacker receives physical access to the data store. Approximately 50-80% of attacks aimed at obtaining sensitive information begin with the corporate network.

In most cases, the only way to effectively protect against unauthorized access is to encrypt data. If the information is encrypted, even the entry of the media into the hands of the attacker will not lead to information leakage in the absence of encryption key in it (Pitner and Ministr, 2015).

The most realistic option for implementing a software security system for information in its centralized storage is the "transparent" encryption of data stored on hard drives. This means that all data when they are written to a disk are automatically encrypted, and when reading, they are decrypted. Encryption is performed by the software driver, the key is in the RAM (Ian Foster, 2008).

Such a system is installed on the server to which directly attached media is protected. These can be conventional hard drives (IDE or SCSI), RAID arrays, Fiber Channel data stores and more (Ministr J., 2014).

Usually the kernel of the system consists of two drivers (Figure 1). One is an input/output filter of the corresponding subsystem, and the second, the crypto, implements one or more encryption algorithms and can be both a complete driver and a dynamic library of a zero ring.

Such architecture, firstly, makes it possible to use one common cryptogram for various applications, and secondly, it provides greater flexibility in the difficult task of overcoming legislative restrictions in the field of regulating the turnover of cryptographic means. Individual modules implement a user interface with the kernel of the system, with the possibility of remote administration of the system from any workstation network or the Internet (Wienman, 2011).
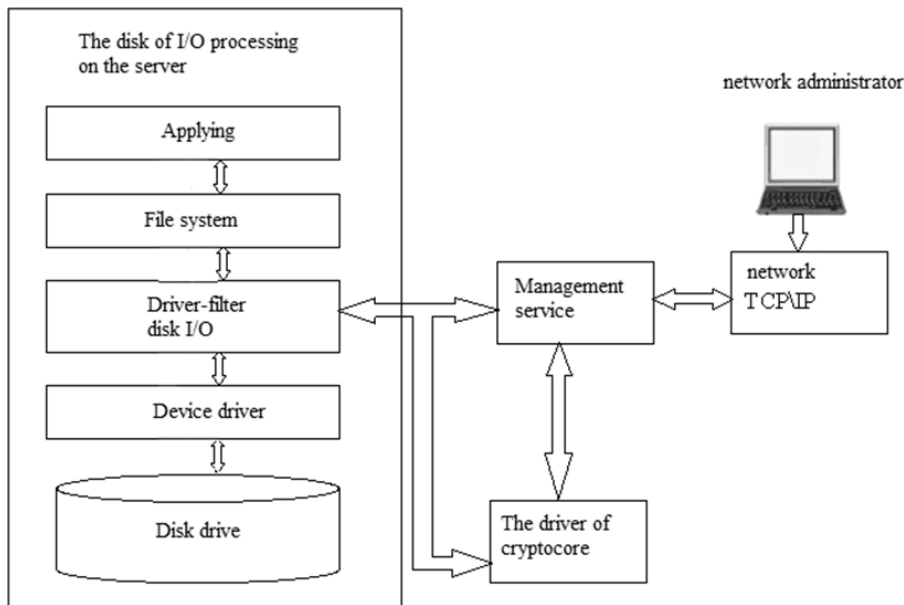
Figure 1 Architecture of the system of protection of information on disks,
Source: Aiken, 2011

Such architecture, firstly, makes it possible to use one common cryptogram for various applications, and secondly, it provides greater flexibility in the difficult task of overcoming legislative restrictions in the field of regulating the turnover of cryptographic means. Individual modules implement a user interface with the kernel of the system, with the possibility of remote administration of the system from any workstation network or the Internet (Wienman, 2011).

After installing the system and generating encryption keys, it is necessary to encrypt the drives on which the confidential information is stored. This operation is performed once, immediately after installation of the system and generation of encryption keys. Depending on the encrypted partition, initial encryption can take a lot of time; In addition, some systems monopolize access to the encrypted partition, preventing other processes from accessing it.

Storage of data has become more diverse than ever before, and the source of the threat is not always obvious. Currently, organizations are just as vulnerable to internal threats as for outside attacks. Both accidental and deliberate disclosure of important data causes serious damage. It must be recognized that perimeter protection does not take into account

the existence of internal threats, and once an attacker overcame it, the data will be available from the outside.

Often, as a data warehouse, corporations use SQL Server. In SQL Server- and provides its own method of software key encryption and management system. To do this, SQL Server has its own encryption model, which includes the management of embedded encryption keys based on the ANSI X9.17 standard (Financial Institution Key Management standard). This standard defines several levels of encryption keys used to encrypt other keys, and those, in turn, are used to encrypt the data itself (Beley O., 2017).

SQL Server provides several types of encryption to protect sensitive data, including transparent data encryption (TDE), column-level encryption (CLE), and back-end encryption. In all these cases, within this traditional hierarchy of keys, the data is encrypted using the symmetric encryption key (DEK). The symmetric encryption key is then encrypted by the hierarchy of keys stored in SQL Server. An alternative to this model is the Extended Key Management Provider model. The Extended Key Management Provider architecture allows the SQL Server to protect the data encryption keys using an asymmetric key stored outside of SQL Server by an external provider of encryption services. This model adds an extra level of security and separates key management and data management.

In Fig. 2 we compare the traditional key management service with the Azure key store.
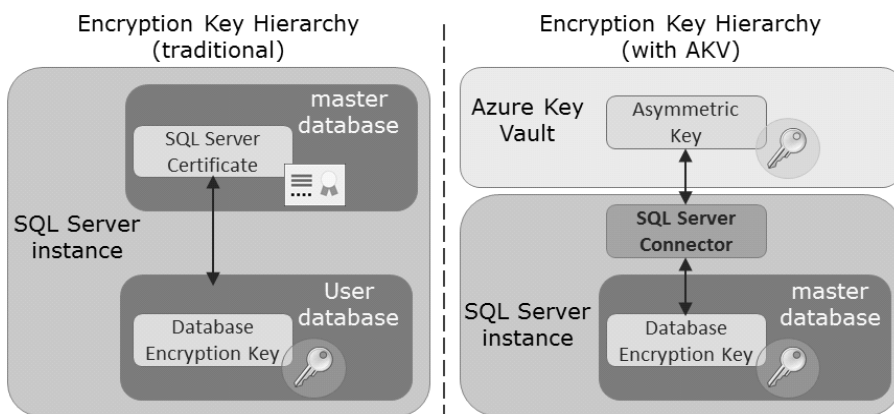
Figure 2 Traditional Key Management Service and Azure Key Store, Source: own.

SQL Server connector acts as a bridge between SQL Server and Azure key holders, so SQL Server can use scalability, high performance, and high availability of the Azure key store. The following figure shows how the key hierarchy works in the architecture of the extended key management provider with the Azure key store and SQL Server connector.

In Figure 3 we present the flow of the extended key management process using the Azure key store.
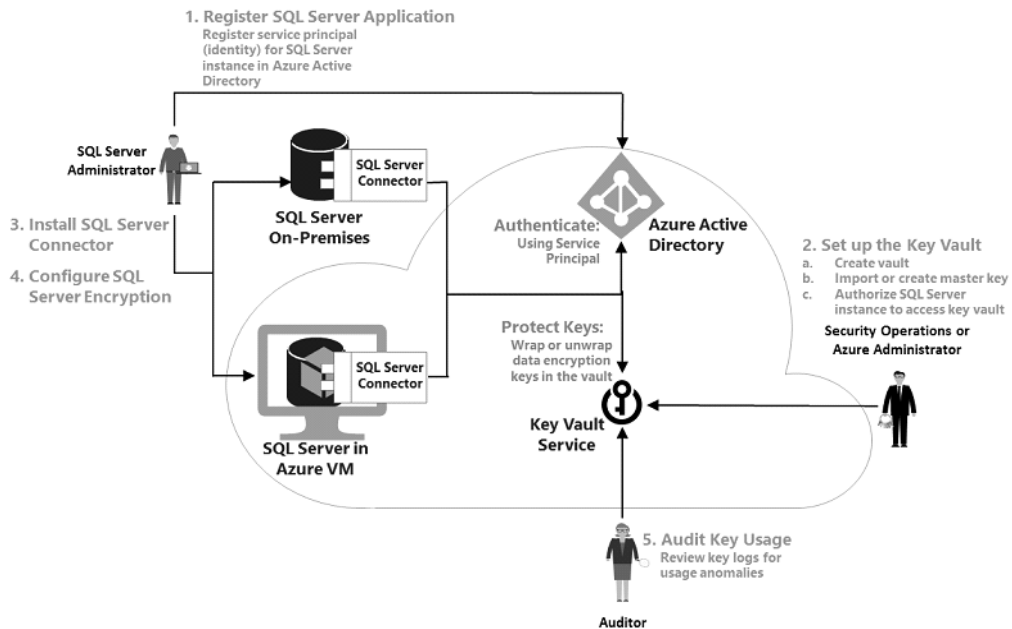
Figure 3   Traditional Key Management Service and Azure Key Store, Source: own.

The keystore can be used with SQL Server settings on Microsoft Azure virtual machines and local servers. The key store service also provides the ability to use rigorously monitored and monitored hardware security modules (HSMs) to provide a higher level of protection for asymmetric encryption keys (Karpinski M., 2017).

2 Features of data encryption and access keys in Microsoft Azure

Microsoft Azure includes tools for data protection in accordance with security and compliance standards in the organization. This article focuses on the following issues:

- protection of inactive data in Microsoft Azure;
- description of various components providing data protection;
- analysis of the advantages and disadvantages of the main approaches to management protection.

For security reasons, encryption of inactive data is carried out. Organizations using Azure can use inaccessible data encryption without the cost of implementation and management, and without the risk associated with a custom key management solution. Organizations can provide Azure full control over inaccessible data encryption. In addition, they have various options for precise control of encryption or encryption keys.

Inactive data encryption is the encoding of data when stored. Inactive data encryption schemes in Azure use symmetric encryption to quickly encrypt and decrypt large volumes of data based on a simple conceptual model:

- symmetric encryption key used to encrypt data when they are stored in the repository;
- the same key is used to decrypt data when preparing for memory use;
- data can be partitioned, and different keys can be used for each section;
- the keys must be kept in a safe place with access control policies that restrict access to certain certificates and record information about the use of keys. Data encryption keys are often encrypted using asymmetric encryption to further restrict access.

In practice, the basic scenarios of management and regulation, as well as guarantees of scaling and accessibility require additional designs. Below are the basic concepts and components of inaccessible data encryption in Microsoft Azure. Encryption while storing provides data protection, which is stored (inactive data). Attacks which are directed at such data includes attempts to obtain physical access to equipment, on which data is stored, with the subsequent compromise of these data.

With such an attack during service, improper management of the hard disk of the server may occur, which allows the attacker to pull it out. Later, an attacker can put a hard drive in a computer under his control to try to access data.

Inaccessible data encryption is intended to prevent malicious users from accessing unencrypted data by encrypting data on a disk. If an attacker receives a hard disk with encrypted data without access to encryption keys, the probability of compromising data is very small. In this case, the attacker's attacks will be directed to encrypted data. Attacking these attacks requires much more effort and resource consumption than accessing unencrypted data on hard disks. For this reason, we strongly recommend using inactive data encryption, which is of paramount importance for many organizations.

Inaccessible data encryption also requires an organization that needs data management and compliance. Industry and government regulations, such as HIPAA, PCI, and FedRAMP, describe security measures based on encryption and data protection requirements. Storage encryption is a mandatory requirement for compliance with some of these standards.

In addition to regulatory requirements and compliance requirements, the encryption of inactive data should be considered as an opportunity for extended protection for the platform. Although Microsoft provides a standards-based platform for services, applications and data, comprehensive capabilities, physical security, data access control and audit, it is important to provide additional "overlapping" security measures in the event of a major failure. Encrypting inactive data provides such an additional protection mechanism.

Microsoft seeks to provide the ability to encrypt inactive data in cloud services, and provide users with an appropriate way to manage encryption keys and access to logs from which you can learn about the use of these keys. In addition, Microsoft is actively working to ensure that all user data can be applied to this default encryption.

To encrypt data stored on a disk, using a secret key encryption requires secure key creation, repository, and access control and encryption keys. Although some moments may differ, the implementation of encrypting inactive data can be described using the concepts illustrated in the appropriate schema.

The storage location of encryption keys and access control to these keys is of fundamental importance to the encryption model of inactive data. Keys must be securely protected. At the same time, certain services must be accessible to them, and they must be accessible to specific users. For Azure

services, the recommended key store solution is the Azure Key Vault, which provides general management capabilities in the services.

Figure 4   Components encryption inactive data in Azure, Source: own.

Keys and keys are stored and stored in keys and can be accessed by users or services. Azure Key Vault supports the creation of user keys or the import of custom keys for use in scripts of user-managed encryption keys. Azure Active Directory accounts can be granted permission to use, manage, or access keys stored in Azure Key Vault to encrypt inactive data and decrypt.

When implementing encryption of inactive data, several keys are used for shaving. Asymmetric encryption can be used to provide the credentials and authentication necessary for key management and access to them. Symmetric encryption is more efficient for mass encryption and decryption, which ensures more reliable encryption and better performance. Restricting the use of the encryption key reduces the risk of its compromise, as well as the cost of re-encrypting if necessary to replace the key. The Azure encryption model uses a key hierarchy, which consists of the following key types:

Data Encryption Key (DEK) - Symmetric AES256 key for encrypting a partition or data block. One resource can include many sections and many data encryption keys. Encrypting each data block with another key creates additional complexity for executing attacks on encrypted data. Access to the DEK is required by the resource provider or instance of the application that encrypts or decrypts a particular block. When DEK is replaced with a new key, re-encrypting this key requires only data in its associated block.

Key Encryption Key (KEK) is an asymmetric encryption key used to encrypt encryption keys. Using the key encryption key allows you to directly

encrypt and control the data encryption keys. The entity that has access to the KEK may be different from the entity required by DEK. Essence acts as a broker when accessing DEK to restrict access to each DEK for a particular section. Since KEK is required to decrypt the DEK keys, it can actually be considered a single point by which you can delete the DEK keys (by directly removing the KEK).

Data encryption keys, encrypted using key encryption keys, are stored separately, and only the entity that has access to key encryption keys can receive any encryption key encrypted with the KEK key. Multiple key storage models are supported. We will review each model in more detail in the section below.

There are three scenarios for server-side encryption:

Scenario 1. Server-side encryption using a managed key service:

- Azure resource providers perform encryption and decryption operations;
- keys run by Microsoft;
- all the possibilities of the cloud.

Scenario 2. Server-side encryption using user-managed keys in Azure Key Vault:

- Azure resource providers perform encryption and decryption operations;
- the user manages the keys through Azure Key Vault;
- all the possibilities of the cloud.

Scenario 3. Server side-by-side encryption using user-managed keys on user-managed hardware:

- Azure resource providers perform encryption and decryption operations;
- the user administers the keys on the managed equipment;
- all the possibilities of the cloud.
- For encryption on the client side, consider the following:
- decrypted data is not available to Azure services;
- key management and storage are available in a local environment or other secure storage. Keys are not available for Azure services;
- the capabilities of the cloud are limited.

At Azure, supported encryption models are divided into two groups. As already mentioned, it is client-side encryption and server-side encryption. Note that regardless of the Azure data encryption model used, Azure always recommends using a secure transport channel such as TLS or HTTPS. Thus, transport layer encryption should be determined by the transport protocol and should not be a key factor in determining your encryption model for inactive data.

The client encryption model is executed by the service or called by an application outside the resource provider or Azure. This encryption can be done using the Azure service application or the application that runs in the user data center. In any case, when using this encryption model, the Azure resource provider accepts the encrypted large binary data object without the ability to decrypt this data in any way, or without access to encryption keys. In this model, the keys are controlled by the calling application or service. This process is opaque for Azure.

Server-side encryption models are Azure encryption. In this model, the resource provider performs encryption and decoding operations. In particular, the Azure storage service can retrieve data using plain text operations, and then perform internal encryption and decryption. The resource provider may use the encryption keys, managed by Microsoft or by the user, depending on the configuration.
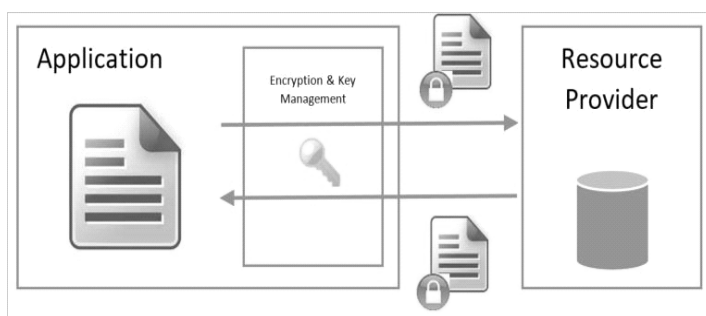
Figure 5   Customer encryption model, Source: own.

Each of the inaccessible server side-to-server data models means excellent key management features, including where and how encryption keys are created and stored, as well as access models and key change procedures.
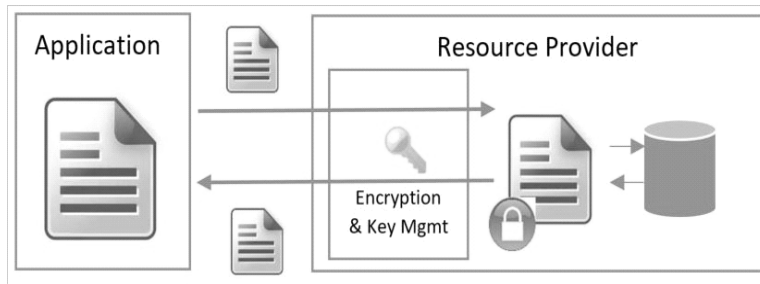
Figure 6   The model of encryption by the server, Source: own.

For many users, the essential requirement is the guarantee of encrypting inactive data. Server-side encryption with a key-driven service allows the user to implement this model, allowing users to tag specific resources (storage, SQL Server database, etc.). The all aspects of key management to encrypt and transfer, such as issuance, modification and backup copy of keys. Most Azure services, which generally support inaccessible data encryption, support this Azure encryption key management task transfer model. The Azure resource provider creates the keys and places them in a safe repository, extracting them as needed. This means that the service has full access to the keys and fully controls the lifetime of the credentials.

Thus, server-side encryption with a key-driven service quickly encrypts low-cost, inactive data to the user. Open the target subscription and resource provider on the Azure portal and select the check box that indicates that the data needs to be encrypted. In some server resources, server-side encryption resources are enabled by default using the key-driven service.

Server-side encryption using Microsoft-controlled keys means that the service has full access to and management of keys. While some users want to control the keys, because they believe they will take more security, when evaluating such a model, it is necessary to consider the costs and risks associated with the use of the user's keystroke. In many cases, an organization may decide that a lack of resources or risks associated with a local solution exceeds the risks of cloud management of inaccessible data encryption keys. However, this model may not be suitable for organizations that have requirements for managing the production and life cycle of encryption keys or have a separate encryption key management service (separate key management from the general management model for the service).

In the server-side encryption model using user-operated keys, the Azure Key Vault service accesses keys for encryption and decryption, if necessary. Inaccessible data encryption keys become accessible to the service through an access control policy. This policy gives the service access based on the certificate to receive the key. The Azure service running on behalf of the linked subscription can be configured using a certificate from this subscription.
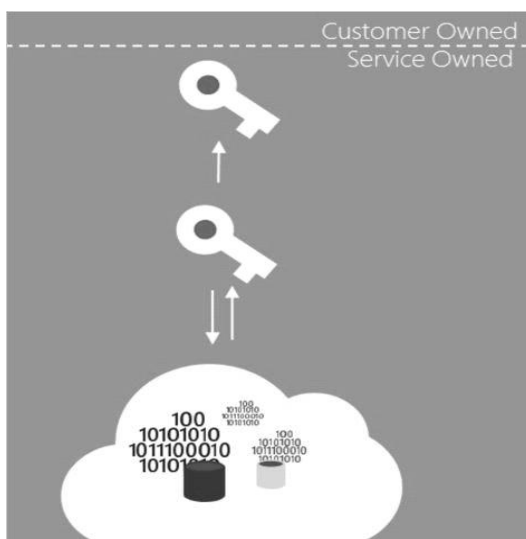
Figure 7   The model of management of server encryption keys through, Source: own.

The service can perform Azure Active Directory authentication and receive a token of authentication by identifying itself as service acting on behalf of the subscription. Then, this token can be provided to the key store for the key that access has been received.

For operations using encryption keys, the service can be granted access to any of the following operations: decryption, encryption, packaging, unpacking, checking, signing, receiving, transferring, updating, creating, importing, deleting, backing up and restoring.

In order to obtain a key for encryption or decryption of inactive data, the service certificate run by an instance of the Resource Manager must have an unpacking key (to receive a decryption key) and a packaging key (to insert a key in the repository when a new key is created).

3 Management of encryption keys in cloud storage

Some Azure services allow you to use the management model with your own keystroke. This control mode is useful in scripts that need to encrypt inactive data and manage keys in their own repository outside of Microsoft's control. In this model, the service needs to get the key from an external site. What ultimately affects performance and availability guarantees, and the configuration becomes more complicated. In addition, since the service has access to the encryption key during an encryption and decryption operation, the general security assurances of this model are similar to the model in which the keys are managed by users in Azure Key Vault. As a result, this model is not suitable for most organizations unless they have specific key management requirements. Because of these constraints, most Azure services do not support server-side encryption using a key-driven server on user-controlled equipment.

When using server-side encryption with a key-driven service in a device controlled by the user, the keys are stored in a system configured by the user. Azure services that support this model provide funds to create a secure connection to the user's repository.

Microsoft cloud services are used in all three cloud models: IaaS, PaaS, SaaS. Here are examples of their placement in each model.

- Software services ("software as a server" (SaaS)) have an application provided by a cloud service, such as Office 365;
- Platform services through which users use the cloud in their applications, including access to service bus functions, storage, and analytics;
- Infrastructure services (infrastructure as a service (IaaS)), in which the user deploys operating systems and applications located in the cloud and can use other cloud services.

For software users as a service (SaaS), inaccessible data encryption is usually included or available in each service. Office 365 has implemented several validation or inaccessible encryption mechanisms. For information about Office 365, see the encryption technology in Office 365.

Platform users as services (PaaS) are typically located in the program environment, and all Azure resource providers are used to store user data. To view the available options for encrypting inactive data, see the table below for the used repositories and application platforms. If encryption is supported, the table contains a reference to instructions for enabling inaccurate data encryption for each resource provider.

Users using infrastructure as a service (IaaS) can use a number of services and applications. IaaS services can enable inaccessible data encryption on their Azure virtual machines and virtual hard disks by encrypting Azure disks.

Similar to the PaaS solution, the IaaS solution can use other Azure services that store data in an encrypted form. In these cases, you can enable inaccessible data encryption support for each Azure service you use. The table below lists the main repositories, services and application platforms, as well as supported inaccessible data encryption models. If encryption is supported, they are referred to the instructions for enabling inaccurate data encryption.

A complete solution for encrypting inactive data assumes that data is never stored in unencrypted form. When used when the server loads data into memory, data can be stored locally in different ways, including a Windows bootable file, an emergency dump, and logging that can execute privileges. In order to ensure that these data are encrypted during storage, IaaS applications may Use the Azure drive encryption on the Azure IaaS (Windows or Linux) virtual machine and the virtual disk.

It is recommended that IaaS applications use Azure disk encryption and inaccessible data encryption options provided by any Azure service. In some cases, for example, with non-standard encryption requirements or using a non-Azure repository, the IaaS application developer may need to implement encryption of inactive data on its own. IaaS solution developers can provide better integration with Azure management and meet user expectations by using certain Azure components. In particular, developers should use the Azure Key Vault service to secure keys safely, and provide their users with an agreed set of key management options for most Azure platform services. In addition, user-centric solutions must use the Azure-managed services credentials to provide service accounts access to encryption keys. Developer Info for Azure Key Vault and managed services credentials in the respective SDKs.

Each Microsoft Azure service supports one or more inaccessible data encryption models. However, for some services, one or more encryption models may not be applicable. For services that support customer-driven key usage scenarios, they can support only a few types of keys that support the Azure Key Vault for key-key encryption keys. In addition, services can add support for these scripts and key types at different times. This section describes support for encrypting inactive data at the time of writing this article for Azure's major data storage services.

Any user who uses the infrastructure of the service (IaaS) Azure may include inaccessible data encryption on IaaS virtual machines and disks using Azure disk encryption.

All Azure storage services (BLOB storage, queue storage, spreadsheet and Azure file service) support server-side inaccessible encryption, and some services support client-side keys and client-side encryption.

- On the server side: all Azure storage services use server-side encryption by default using a managed key service that is transparent to the application. The Azure BLOB storage and the Azure file service also support the 2048-bit RSA-controlled RSA keys in Azure Key Vault.
- On the client side: large binary objects, tables, and Azure queues support client-side encryption. When using encryption on the client side, data is encrypted and transmitted in the form of an encrypted large binary object. The keys are executed by the user.

4 Conclusion

Protecting user data stored in Azure services is particularly important for Microsoft. All services located in Azure are committed to providing inaccessible data encryption options. Basic services, such as Azure, the SQL Azure database, and key analytics services, already provide inaccessible data encryption options. Some of these services support user-friendly keys and client-side encryption, as well as service-operated keys and encryption. Microsoft Azure services are constantly improving the availability of inaccessible data encryption, and new settings will appear in the previous and publicly available versions in the near future.

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Statistical and Soft Computing Modelling Methods Applied to Economic Data

Dušan Marček[1]

Abstract. We evaluate statistical and machine learning methods for predicting nominal wages in Slovak economics. In the first one based on statistical models such as B-J methodology and Holt-Winter´s model are applied. The second modeling approach is based on soft computing the SVM (Support Vector Machines). To illustrate the forecasting performance of these approaches the learning approaches are presented. Author test the suggested models on quarterly time series data examines the ability to forecast exchange rate values for the horizon of one day. We also show that an SVM approach can achieved better prediction result than classic statistical methods. All the models are compared and contrasted, to determine the best model for forecasting nominal Wages in Slovak economics. It is also found that the risk estimation process based on soft methods is simplified and less critical to the question whether the data is true crisp or white noise.

1 Introduction

Forecasting is a key element of management decision making. The ultimate effectiveness of any decision depends on the ability to predict the uncontrollable aspects of events following the decision. Over the past ten years statisticians and academics of computer science have developed new forecasting techniques based on probabilistic theory such as the use Kalman filter, threshold autoregressive models, the ARIMA/ARCH family models and models based on machine learning.

In economics there are many situations where quantities under investigation are functionally related or related in a more obscure manner. Very often it is difficult, or even impossible, to distinguish the independent variables. Traditionally, the formulation of multivariate models based on the statistical approach requires the following steps: (1) the choice

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of independent variables; (2) specification of a functional form of the model; (3) analysis of a data set appropriate to the theoretical and functional form of the model; (4) model estimation, statistical testing and evaluation of the model´s forecasting capabilities. Input selection and functional specification of the model are of crucial importance to the successful development of multivariate models. Any multivariate statistical (regression) model must first be based on a theoretical foundation for the multivariate relationship. We are of the opinion that humans find it easy to say what causes what, but hard to put exact the measure of relationships among variables.

Applying the prediction analysis, the forecasting ability linear statistical model (ARIMA and Holt-Winter´s model), will be compared and contrasted with a SVR model to determine the best model parameters for our data forecasting problem. We will provide out-of-sample evidence since it focuses directly on predictability as it is important to avoid in-sample overfitting for this type of non-linear models.

The aim of the paper is to explain achieved aspects of both statistical and soft approaches for quantifying forecast accuracy applied to quarterly daily time series and assess their prediction performance. The paper is organized as follows. In Section 2 we briefly describe methodology the basic ARIMA (AutoRegressive Integrated Moving Average) models and Holt-Winter´s model on an application, conduct some preliminary analysis of the time series and demonstrates the forecasting abilities of both statistical models. In Section 3 we introduce the SVM methodology. Section 4 presents results and puts an empirical comparison. Section 5 briefly concludes and proposes future work.

2   ARIMA and Holt-Winter´s Methodology

Time series models are generated under the assumption of no pattern change. To build a forecast model, a researcher usually collects a sample of observation from the available data. Data are then usually divided into two sets. The first one is the sample period for analysis, usually called as training data set, i.e. the period over which we will be building or estimating the forecasting model. The second one is the ex post forecasting period, so called as the validation data set. Within the ex post forecasting period only, the accuracy of the model can be calculated.

The method of building an appropriate time series forecast model is an iterative procedure which consist of the implementation of several steps as shown in *Figure 1* (Box, Jenkins, 1976), (Montgomery, Johnston, Gardiner, 1990).
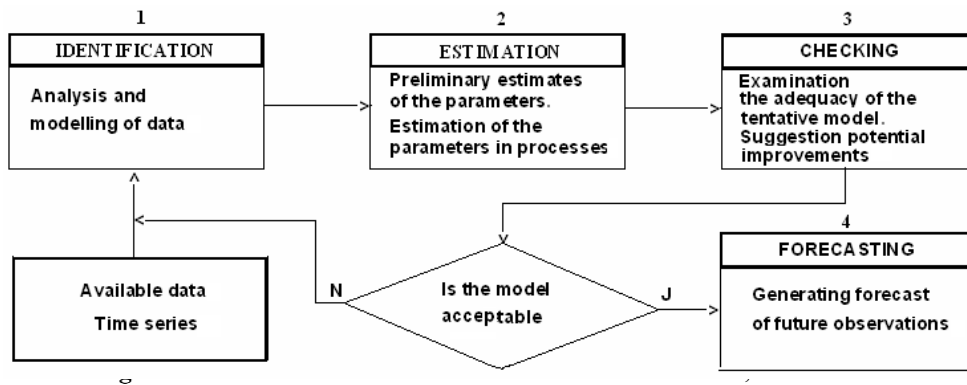
Figure 1   Flow chart of building an appropriate time series model. Source: Own pressing.

The main four steps in Figure 1 are: identification, estimation, diagnostic checking, and forecasting. In the identification step a tentative model is identified by studying the behaviour of the autocorrelation function (ACF) and partial autocorrelation (PACF) functions. In the estimation step, the estimates for the parameters of the tentative model are computed. In the next step diagnostic checks are performed. The Langrange multiplier test is used for testing for heteroscedasticity (Breutsch, Pagan, 1980). The adequacy of the model to the data is checked by testing the significance and relationship of the parameters. To detect non-liner hidden patterns in stochastic financial time series of generally high frequency the fitted residuals are subjected to the BDS test (Brock, et al., 1996). If any of the tests or residuals are un-acceptable, the model must be refit and previous steps repeated. Once the appropriate model has been found, it can be interpreted and future forecast can be found.

We illustrate the statistical ARIMA methodology on the developing a forecast model for quarterly wages time series. The aim is to perform an one quarterly ahead forecasts of the wages values (see Figure 2). The sample period for analysis from January 2, 2001 to June 30, 2005 was defined, i.e. the period over which the forecasting model can be developed and the ex post forecast period from July 1, 2005 to December 31, 2005 denoted as validation or ex-post data set.).
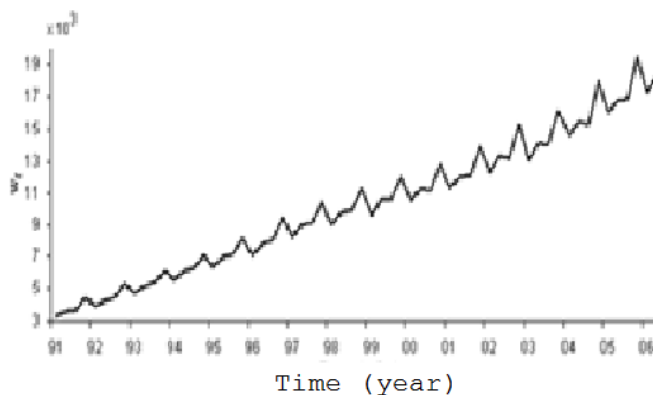
Figure 2   Time plot of the wages time series. Source: Own processing

Time series does not have a constant mean value, it shows a trend. The variance is not constant and increases over time. We will try to transform the time series into a stationary series. We will do this by the following two steps. Firstly, we remove the non-constant variance. To stabilize the variance, a nonlinear transformation such as a logarithmic is often performed. In this time series, we use a natural logarithmic transformation. After performing logarithmic transformation the variance is now stabilized. However, the quadratic trend is still presented and there is abvious seasonality of period 4. Next we will difference the data 2 times with period 1 and 1 times with the seasonal period 4. The plot of the differenced data are depicted in Figure 3. We see that the periodic behavior has been eliminated.
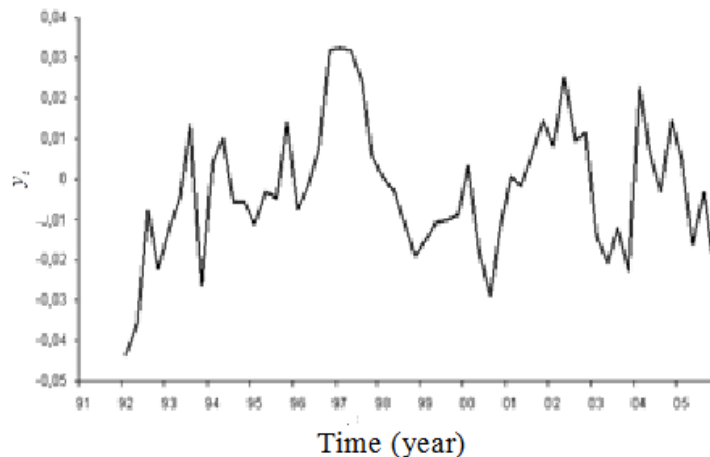
Figure 3   Time plot of the transformed (stationary) time series of wages.
Source: Own processing.

To study the estimation problem, we looked to determine the maximum lag for which the PACF coefficient was statistically significant and the lag

given the minimum AIC. According to these criterions the following model was specified

$$\hat{y}_t = -0.001656 - 0.4567\,y_{t-1} + 0.9052\varepsilon_{t-1} + 0.588\varepsilon_{t-2} + 0.365\varepsilon_{t-3} \quad (1)$$

which is the ARIMA(1.2,3) process. The approximate and predictive accuracy of the model (1) is documented in *Table 1* and visually shown in *Figure 4* on the left.

Table 1 The summary approximation and predictive characteristics of the ARIMA and Holt-Winter´s model. Source: own

Model	model/Fig.no.	p	q	MSE_A	MSE_E (3)	MSE_E (4)
ARIMA	Time series/4 l.	1	3	25289	104830	111880
Holt-Winter´s	Time series/4 r.			34959	11216	18899

MSEA reports the precision for training data the set A (1991-2005). MSEE expresses the ex-ante predictions (MSEE (3) or MSEE (4) for 3 or 4 quarters of 2006).

We also developed the exponential time series model according to Holt-Winter´s methodology with additive seasonal component. This model was developed using the methodology available on the free online resource [1]. Next, we provide only results from the Holt-Winter´s model with an additive seasonal component because it provided better approximation and predictive accuracy rates than the model with the multiplier seasonal component listed in Table 1. The development of its values over time is shown in *Figure 4* on the right.
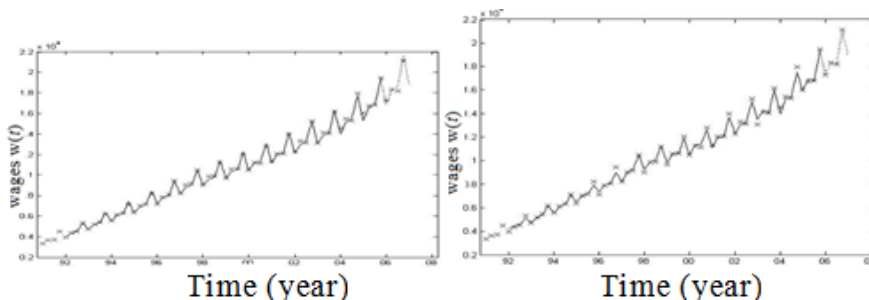
Figure 4 Arima model. Source: Own processing.

On the left, a chart of wage developments and their forecasts based on the ARIMA model (1). The full line represents estimates of the ARIMA(1,2.3). time series for the year 2006. The dashed line represents an estimate of ex ante forecasts for year 2007 according to model

ARIMA(1,2,3). The crosses represent actual values of the wages time series. On the right, a wage chart and their forecasts based on the Holt-Winter´s model. The full line represents estimates of the wages time series for year 2006 with the additional Holt-Winter´s model. The dashed line represents an estimate of ex ante forecasts by the additive Holt-Winters model 2007. The crosses represent actual values of the wages time series.

3   SV Regression Model

SVR (Support Vector Regression) is an extension of the support vector machine (SVM) algorithm for numeric prediction. Its decision boundary can be expressed with a few support vectors. When used with kernel functions it can create complex nonlinear decision boundaries while reducing the computational complexity.

The initial hypothesis for choosing the shape of the SV regression model is the hypothesis that wages show inertia, which can be expressed in a simple causal model in the following form $w_t = \phi w_{t-4} + \varepsilon_t$, or as the simple time series model $w_t = b_0 + b_1 t + \varepsilon_t, t = 1, 2, ..., 60$, where ε_t is the white noise random component. By taking this hypothesis into account in the SV Regression Model, its initial shape may take the following form

$$\begin{cases} f(\mathbf{x}, \mathbf{w}, b) = K(\mathbf{x}_i, \mathbf{x}_j)\mathbf{w} + b \qquad \text{or} \\ f(\mathbf{x}, \alpha, b) = \sum_{i=1}^{n} (\alpha_i - \alpha_i^*) K(\mathbf{x}_i, \mathbf{x}_j) + b. \end{cases} \qquad (2)$$

where $K(\mathbf{x}_i, \mathbf{x}_j)$ are relevant kernel function, $\mathbf{x}_i, \mathbf{x}_j = (W_{t-1}, W_{t-2}, \ ...)$, b is a real constant (bias), $K(./.)$ is the kernel function. The real constants are obtained from the solution of the following quadratic programming (QP) problem

$$\max_{\alpha, \alpha_i^*} \quad -\frac{1}{2} \sum_{i,j=1}^{n} (\alpha_i - \alpha_i^*)(\alpha_j - \alpha_j^*)\psi(\mathbf{x}_i^T \mathbf{x}_j) - \varepsilon \sum_{i=1}^{n} (\alpha_i + \alpha_i^*) + \sum_{i=1}^{n} y_i (\alpha_i - \alpha_i^*) \quad (3)$$

subject to constrains

$$\begin{cases} \dfrac{\partial L_p}{\partial w} = 0 & \rightarrow \mathbf{w} = \sum_{i=1}^{n} (\alpha_i^* - \alpha_i)\psi(\mathbf{x}_i), \\[2mm] \dfrac{\partial L_p}{\partial b} = 0 & \rightarrow \sum_{i=1}^{n} (\alpha_i^* - \alpha_i) = 0, \\[2mm] \dfrac{\partial L_p}{\partial \xi_i} = 0, \dfrac{\partial L_p}{\partial \beta_i} = 0 & \rightarrow 0 \le \alpha_i \le C, \;\; i = 1,...,n, \\[2mm] \dfrac{\partial L_p}{\partial \xi_i^*} = 0, \dfrac{\partial L_p}{\partial \beta_i^*} = 0 & \rightarrow 0 \le \alpha_i^* \le C, \;\; i = 1,...,n \end{cases} \tag{4}$$

where L_p is the Lagrangian with Lagrange multipliers given by $\alpha_i, \alpha_i^* \ge 0$; $\beta_i, \beta_i^* \ge 0$; ξ_i, ξ_i^* (for details see (Suikens, 2000)).

where L_p is the Lagrangian with Lagrange multipliers given by $\alpha_i, \alpha_i^* \ge 0$; $\beta_i, \beta_i^* \ge 0$; ξ_i, ξ_i^* (for details see (Suikens, 2000)).

In the SV regression, to estimate its parameters the user must further choose some attributes that affect their estimates. These are the following attributes: measure of error approximation (Loss Function ε), the regularization and weights vector norm, kernel function K and its degree (for further details see (Vapnik, 1998)).

In *Table 2* some attributes of SV regression and the corresponding approximation rates (*MSE*) are calculated. In *Figure 5* the approximate functions of the quarterly nominal wages of the Slovak Republic by using different types of kernel functions are graphically depicted.

Table 2 Results of SV regression for three different choices of kernel functions and for data training dataset from 1991Q1 to 2005Q4. Source: own

model/fig.	kernel function	σ	degree -d	loss function	*MSE*
Causal (a)	RBF	1150		quadratic	15590
Causal (b)	RBF	600		quadratic	10251
Causal (c)	ERBF	600		quadratic	3315,7
Causal (d)	RBF	1		quadratic	0,421

In the last column, the data approximation rates are calculated for the SV regression model (2). The statistical accuracy measures of SVR models in Table 2 were obtained by loss function with tube ε = 0.2 and by the value

of the optional constant of C = 105. The partially modified software proposed by Gunn (1997) was used. For the comparison of the models in Table 3, The statistical accuracy measures of the SV regression models are presented together with the ARMA and Holt-Winters model.

Table 3. Comparing the accuracy of ARIMA, Holt-Winter´s and SVR models, Source: own

model	model/fig.	p	q	MSE_A	MSE_E (3)	MSE_E (4)
ARIMA	time series/1 l.	1	3	25289	104830	111880
Holt-Winter´s	time series/			34959	11216	18899

model/fig.	J. func.	St.d.	σ	loss func.	MSE_A	MSE_E (3)
causal (SVR)	RBF		1150	quadratic	15590	62894

As can be seen from the experiments performed, SV regression is an effective tool for modelling the economic process. It achieves an extremely accurate approximation, the solution is global and unique.
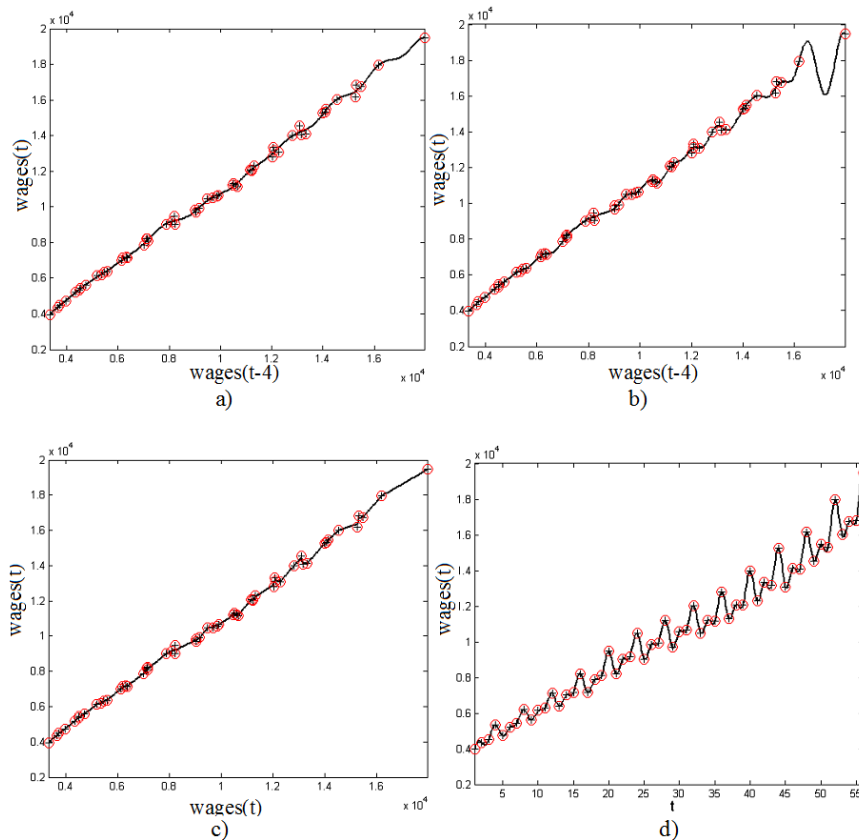
Figure 5   Results of the SV regression for various kernel functions, loss functions and standard deviations σ according to *Table 2*. Source: Own processing.

4   Conclusion

In this paper, we have examined three approaches to study non-linear models on the time series of wages in the Slovak Republic. For the sake of calculating the measure of the goodness of fit of the regression model to the data we evaluated eight models. First model was based on an ARIMA model, the second one on Holt-Winter´s approach causal multiple regression, the next two models were simple causal and time series models and the last four models were SVR models. The Holt-Winter´s and SVR models give best predictions outside the estimation period and clearly dominates the other models. It should be pointed out that we are ranking all the models within category of the forecast summary statistics.

Acknowledgement

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Specifics of Contractual Documentation of Agile Software Development

Martin Števko[1], Jan Ministr[2]

Abstract. Software development using agile methods is an alternative to development of a software through "classic" waterfall development. The contractual documentation should respect the method of software development applied in particular project. The contract for work based on the "classic" development methods are not usually suitable for software development projects based on agile development of a software. The paper is focused on the particularities of the contractual arrangements in agreements on software development based on agile methods.

Keywords: Law, Contractual documentation, Software development, Agile methods, Scrum

JEL Classification: D81, K12, L86

1. Introducton

Majority of the software development projects are realized through waterfall software development model where the phases of development of software are separated and sequenced. The waterfall software development process including the particular phases is described in Figure 1 below.

Figure 1 The Waterfall model, Source: Shore J., Warden S., 2007.

The advantages of projects based on the waterfall model are clear and structured "way" to development of the software which enables to set up the exact milestone for tracking of the progress of software development. Also, the initial and comprehensive analysis of the requirements on the "newly" developed software could reduce the costs necessary for another phases of software development project (Bird & Bird,2015).

Nowadays the software development projects have to face to the frequent changes of requirements, unclear user and customer requirements

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or underestimating of analysis phase. These circumstances have often a negative impact on terms and meeting of deadlines as well as on compliance of real cost with initial budget and for these reasons the software development projects are often affected by delays of the terms as well as budget exceeding.

2. Contract is the story – Can be „Waterfall and Agile development" same stories?

The issues of "classic" software development project as well as changes of client`s requirement on these projects led to creation of another approaches to realization of these projects. The agile software development methods have provided the alternative approach to software development processes and they allow to reduce the above mentioned negatives whose occur during the software development projects based on the waterfall model. Furthermore the agile methods are react to the customer needs for quickly delivering of the basic (core) part of the new software which is further customized during the „real" operating of the developed software. The agile development methods are based on the iterations – short development cycles where design, coding and testing tasks are committed paralely as it is described in Figure 2. The length of particular iterations is 2 – 4 weeks. At the end of each iteration, the functional software (or new functionality) is delivered to the customer.
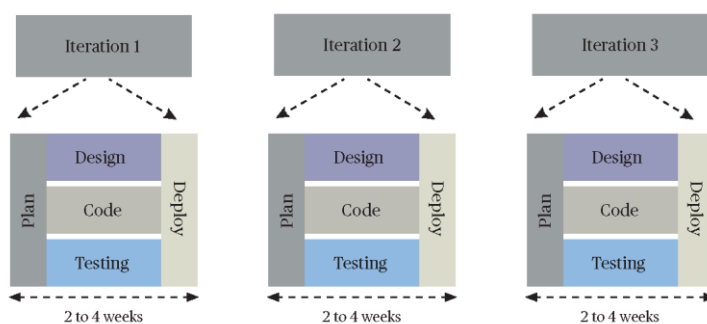
Figure 2 The Agile model, Source: Shore J., Warden S., 2007.

It is necessary to point out that also the software development based on the agile methods has not only positives and it is very suitable to consider which software development strategy respectively development model shall be applied for particular project (Jansa, Otevřel, and Števko, 2018).

From our perspective the legal contracts are containing the stories and potential scenarios about the processes and situations whose may occur in the reality. It is apparent that the process and progress of software development projects based on the "traditional" waterfall model is different that the course of these projects where the agile development methods are implemented and practiced. From these reason the contracts on software development based on the agile methods need "different" description of stories and scenarios than the "traditional" software development contracts despite in all cases the very important contractual type is contract for work (Myslín, 2017).

There are many agile software development methods, for example Scrum, Extreme Programming, Crystal Clear, Dynamic Systems Development Method, etc. In continuation of this article, we focus on the Scrum method but the majority of following information are relevant for the other agile software development methods. The Scrum development process is described in Figure 3.
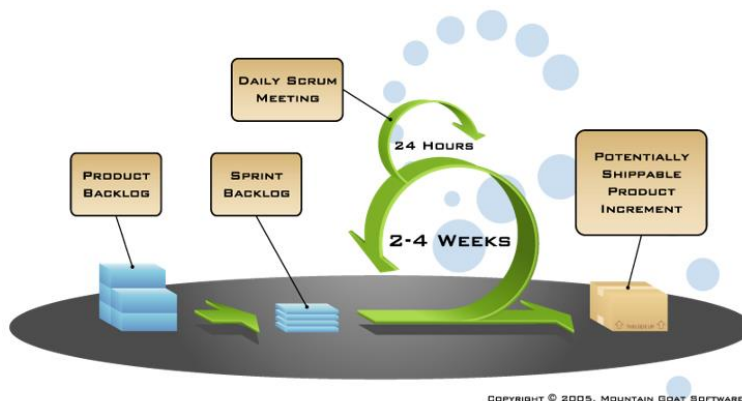
Figure 3   Scrum process, Source: Mountain Goat Software, LLC

The Scrum method could be briefly described in following point:

- Product Backlog – a prioritized list of individual tasks for development throughout the project.
- Sprint – name of the particular iterations. Spring backlog contains the list of tasks whose should be processed during particular sprint.
- The output of each sprints is a functioning part of the software that can be used by the users / customer.

3. Subject and form of the software development contracts based on the Agile methods

In principle, the contracts on the projects where the agile methods are applied as well as contract on the "waterfall project" are based on the delineated contractual type – contract for work. However quite big difference is that case of Agile methods the nature of the "main" contract is the Framework contract and for each iteration there is a partial contract for work which is governed by rules defined in the framework contract.

3.1. Subject of the contracts

The subject of Framework contract could not be the obligation of contractor for development of defined software in respect with the requirement defined by the client of users identified during the analytical phase of the project, because not all requirements are uncovered when the development project is started. Despite that in the beginning of the development project based on the Agile method the purpose of the developed software and KPI could be known, the detailed users and customer requirement are uncovering during the particular Sprints. The main obligation of the contractor has to be defined differently than in contract for development based on the waterfall model. In Agile "project" the major obligation for the contractor could be defined in following way: To perform the activities step-by-step to develop and implement the software and its parts through sprints or project cycles. It is obvious that the obligation of the contractor is in performing the activity and not in delivering of specified result. The main obligation of the customer could be defined as To hand over correctly done parts of software and to pay for each agreed sprints hourly or otherwise agreed remuneration. Also in customer obligation is resonated the special nature of agile development contracts – the remuneration is paid for performed activities, not for whole developed software (Mountain Goat Software, 2016).

It is very important for contracts on the projects where agile methods are applied that the Framework contract is very accurate and really describe the particular processes of Scrum and rules for accepting of the outputs of the Sprints (in details described below). Also the purpose and aim of the contract are very important because description of aim of the developed software including KPIs defines the "main direction" of the development.

From the legal point of view the particular Sprints are realized based on the partial (sub) contracts as was mentioned above. The partial contract shall define the tasks in the particular Sprint, scope of hours of man-days for performing the tasks in the Sprint. The Framework contract defines the terms and rules of handover but they could be modified in partial contract for the Sprint.

3.2. Form of the contracts

It is necessary to point out the Framework contract is usually created for "long" time, multiply reviewed by both contracting parties and concluded in formal way. On the contrary the rules for concluding the partial contract (for the Sprints) have to be "very easy" and they have to enable to concluding the sub-contracts by E-mail, recording in meeting minutes or in another very simple form.

4. Communication and cooperation rules of the contracting parties

The communication of the contracting parties is very important during the agile software development projects. Because the development is very dynamic and the requirements on software in particular Sprints and outputs of the Sprints are "discussed" with the customer and users in each Sprint and based on the evaluation of outputs of previous Sprint are prepared the tasks for currently performed Sprint.

The Agile methods contain the specific communication rules including the definition of the meetings whose shall be performed during the whole project as well as meetings whose shall be performed during each Sprint, e.g. Sprint planning meeting, Daily meeting, etc.

During the development project many decisions are done. A number of these decisions can not be planned in advance and are based on the current state of the development project. Such decisions can be essential for running the whole project or at least for realizing particular Sprints. From these reasons it is necessary to define roles of particular project member and their identification in Framework contract, because as it was mentioned above, some of these decisions can be very serious or may have interesting impact to project costs.

The Framework contract should contain identification of authorized persons as well as the description of regular meetings, its participants and specification of time when particular meetings shall be arranged.

5. Software support of the agile development projects

There are the "project oriented" software focused on managing of tasks in project (product) backlog and sprint backlog. These software could be very helpful during the project realization because information about the project are very often updated based on the results of particular tasks and Sprints. Also the software tools enables to store all information concerning the project in centralized point and every participant of the project could have the easy "access" to information corresponding to its position.

5.1. Project management software tools

The rules of usage of such software tools should be defined in the Framework contract to ensure that all members of the project team have access to relevant information as well as to prevent their misuse or loss.

From the legal point of view is also important that the subject of Sprints as well as changes of the whole project are "stored" in this information and this information represent the proves about the agreement of contracting parties about the subject of the particular Sprints and changes of whole project or its parts.

5.2. Storage and management of versions of developed software

A separate topic is software for management of version of developed software – during the performing of the project there are many versions of the developed software and its parts and it is very suitable to store them in an organized form with information about changes made in the particular versions.

6. Hand-over of Sprint outputs

As it was described above, the whole project is divided to the Sprints and outputs of each Sprint should represent the functioning developed software or its parts. The outputs of the project are not the handed-over when the project is finishing but they are handed-over after finish of each Sprint. From this

reason it is necessary to set up different rules than in case of "traditional" development project where the outputs are handed-over in one time when the developed software is completed as whole (or the separate modules of software are done).

For the hand-over of outputs of particular Sprint it is not enough to test only these outputs (for example through UAT tests). It is very suitable to test the compatibility and consistency of these outputs with whole developed software and whole developed system itself. Furthermore it is necessary to keep the coding rules in all Sprints and during the hand-over outputs procedure is suitable to test whether the coding standards have been met as well as reviewed all source codes (Rubin, 2012).

7. Costs of agile development project and its payments

Generally the advantage for the customer is to pay whole agreed price after finishing of the project when whole software could be tested and reviewed. The software development project based on agile methods do not allow reimbursement of the costs after the whole software is finished respectively it would be very unusual to pay the price of software developed through agile method after this development is finished (Jansa, 2017).

During the realization of agile development projects, the agreed amount is paid after the completion of each sprint. This amount could be calculated based on the hours or man-days spent by performing the Sprint or it could fix amount. It is usual that the agreed amount is paid after the completion of each Sprint. Obligation of customer to pay the agreed amount for particular Sprint may be linked to successful pass of tests described above.

On the other hand, the advantage of continuous payments is that the customer is not required to spent many financial funds at the end of the project. Furthermore if the project is aborted or finished before the software is completed, the customer usually does not have any obligation to pay any other amount because the project is "financed" continuously.

8. Conclusion

The aim of this Article did not describe all specifics of the contractual documentation of software development based on agile methods. Description of all specifics would be too ambitious and would exceed the scope of this contribution many times and there are essential areas of contractual documentation that have remained in the background of this Article, in particularly copyright and licences and software defects.

The authors wanted to draw attention to the fact that contractual documentation used for software development by traditional methods is not generally suitable for cases when the agile methods of software development are applied. As it was noted in introduction of this Article the legal contract is description of "the story" and potential scenarios and the authors are persuaded that from this Article is obvious that "the story" of agile software development methods is quite different than the traditional story based particularly on waterfall model.

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Changes in Requirements for the Structure and Quality of Enterprise Information

Milena Tvrdikova[1]

Abstract. The use of modern ICT, automation and robotics as part of the solution of many processes produces huge volumes of structured and unstructured data on a daily basis, both in the corporate environment and beyond. The lifestyle of the society is changing, too. There are significantly increasing demands on the security of information systems and populations around the world. The aim of the paper is to analyze the current situation in the ERP market, choose appropriate criteria for selecting ERP vendors. When transforming ICT into the services sector for interested user companies and develop a draft procedure to achieve an effective solution in the context of societal changes, increasing volume of data, methods of processing such data and the quality of the available analytical tools.

Keywords: Flexible IT, lifestyles, ERP, automation, robotics, innovation, Big Date, Data science platform

JEL Classification: O31, O32, O33

1 Introduction

The consequences of the development of information systems have led to a number of changes in both production and non-production technologies, which have begun to be offered as innovative or new products and, in particular, as services. Business practices have changed as well as employees' approach to ICT, which has affected a variety of business processes, models, and enterprise architectures. Business has become an essential part of the solution and part of the IS applications of companies and institutions. The purpose is to increase financial potential through more efficient use of ICT. Companies require solutions matching their financial possibilities, respecting the use of modern ICT capabilities and their efficient operation. This means reducing costs through integrated and optimized business processes and expanding revenue from the sale of new or innovated products and services. The view of the life cycle of an ERP enterprise information system is also changing. The interest of IS users in its quality does

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not end strictly when it is commissioned but it continues with its efficient operation and further development. This is based on the knowledge of managers and other employees about the contemporary information technologies.

Business IS trends stimulate supplier IT companies as well as qualified users to create new business models. They emphasize the potential use of the latest ICT in delivering their products and their operations. Current information systems also offer support for e-business and business with the support of mobile devices and technologies. Trends include automation of processes, robotics and changing approach to the use of information technology.

2 Knowledge constituting the theoretical basis for changes in the use of information technology

Knowledge can be break down according to the following criteria.

Virtuality & virtual reality

Virtuality has become an important term. Virtuality, one of the symbols of our time, includes virtual substitutions of real objects, virtual social events, and virtual implementation of research projects. It is related to business processes, money, the use of virtual robots and simulation by these robots of human behaviour.

Virtualization greatly reduces the economic barrier of technological development. The very aim of virtualization is to develop a systematic and general approach to a virtualized network. Virtual networks are ideal for enabling the coexistence of different network architectures. By disconnecting infrastructure from the services and by offering individual parts of virtualized network infrastructure, it can provide the opportunity to deploy new architectures, protocols and services.

The concept of virtual reality can best be explained as a frame of thinking, when our thinking finds himself in "non-real world" which seems real to us.

Automation

Automation changes the lives of individuals and the society as a whole. According to Zlatuška (Zlatuška, 2000), the use of ICT in the automation of production and administrative activities has become one of the dominant factors contributing to increased productivity of human activity and accompanying social changes during the twentieth century. ICT has become a universal technological innovation.

Automation of company processes enables the integration of process environments. The need for a closed and balanced business process of integration and integration capabilities at the IT level has led to the convergence of enterprise modelling processes and enterprise application software. (Melchert, 2004). The main reason to begin modelling business processes is company documentation. Typically, this happens in the context of business processes of re-engineering and improvement of projects. In this regard, the enterprise model can be used as a template for workflow design and the coordination of activities, resources and data with respect to the appropriate business model. Process specification must be transferable from business models. This can be provided by standardization formats for business processes, such as Business Process Modelling Language (BPML), which can greatly facilitate this exchange of information.

Robotics

Robotics largely affects business processes; we are currently witnessing an intensive onset of use robotes not only in manufacturing plants, but also in services and especially in the processing of digital Big Data. This area opens up a broad opportunity for the use of robots, which are often the source of Big Data. At present, special attention is paid to the development of robotics for services and non-industrial activities. Mobile robots are often used as service robots. This is mainly caused by the unattractive nature of certain human activities in different professions. (Hajduk 2003) Robotics is undergoing an incredibly rapid development.

Flexibility

Flexibility improves ICT efficiency. Today's ERP systems are flexible IT, adapting the system to the requirements of today's users bringing IT knowledge from personal life. ERP solutions that run on a standardized

architecture can support multiple databases, operating systems and hardware platforms. This architecture is cost-effective for IT organizations and enables efficient use of information technology. ERP solutions that use modern web architectures and web services and support wireless and mobile wireless devices give organizations the opportunity to further increase efficiency by extending their internal systems to remote mobile users, partners, and vendors. Users simply log into the system using smart self-service applications.

3 ERP – enterprise resource planning, integrated information systems of companies and institutions

The main goal of creating ERP systems is to integrate business functions. Traditional features of ERP systems include automation and integration of business processes, sharing of data, processes and their standardization in the enterprise, together with the ability to process historical data. (Sodomka 2011).

Modularity is one of the typical features of ERP. This is particularly desirable in terms of choosing individual modules that make up a comprehensive solution according to the needs of a company or institution. They provide for functionality and flexibility in different areas of business due to different information needs. These modules, as elementary ERP components, are divided into three basic categories, Application modules, application management modules, and system modules. Tvrdíková (2011). However, ERPs may also include other modules, primarily implementation modules (Methodology, Process Features, Development Tools and Customization Tools).

3.1 Types of ERP systems

The complex ERP systems offer a standardized set of application modules and, according to customer needs, create a unique system that covers the specifics of the business or business activities of customer.

Problem-oriented ERP systems are differed from complex ERPs. They are on focusing on detailed functionality and the ability of the vendor to provide a high-quality implementation team in a given application area.

ERP systems for medium and small businesses and organizations offer standard ERP solutions at an affordable price with a limited number of application modules and their functionality, but the number of features and modules currently offered is continuously growing.

At present, some companies and institutions are willing to invest up to CZK millions in information systems. However, they expect an adequate implementation project for this money, which will take account the specific aspects of the value-creation processes, possibly also consultancy services, which will help to improve and standardize them.

3.2 Means of increasing the efficiency of an enterprise information system

The activities for improve efficiency are especially standardization and automatization of business processes, flexibility to support solutions and fully integrated set of business management solutions and using modern web architectures and web services in solution.

Standardization and automation of business processes not only locally but also globally and in remote areas of the customer's business, which will greatly speed up business operations. New solutions standardize and, by automation, speeds up processes. That is why most suppliers, which offer this solution are ranked among the "best in class".implementation (according to Aberdeen).

Suppliers ERP solutions offer flexibility to support unique solutions. When larger customization is required, software development files are usually available from system integrators. The offer a fully integrated set of business management solutions, solutions that are shared over a network. This provides overview and collaboration among departments, but also between the suppliers and their customers, partners, suppliers and remote users. Flexible ERP solutions that use modern web architectures and web services, they support wireless and mobile wireless devices this give organizations the opportunity to further increase efficiency by extending their internal systems to remote mobile users, partners, and vendors. Users simply log into the system using smart self-service applications.

Integrated 3rd generation ERPs have changed the goals of ERP systems from designing technologies in domains to business-focused domains and from

designing systems to programming business configurations, process mapping, and re-engineering. They also allow them to use Business Intelligence applications for analyses to support decision-making and planning.

4 The impacts of changes in the evaluation of the quality of integrated ERP systems

Second-generation ERPs include the features and technologies of other types of applications. Second-generation ERPs include the features and technologies of other types of applications. Most often these are , management of costs associated with sourcing of products and services, Supply Chain Management, logistics chain management and Product Lifecycle Management, also offering the possibility of involving external entities in innovative activities (suppliers, customers, business partners), this systems Very Important is for these systems are openness to other applications and external data sources.

Theoretical basis for changes in information technology has were described at chapter 2. They are virtualization, automation, robotics and the need of flexibility.

The consequences of these changes are:

Globalization – the need continuously keep track of changes in external conditions due to competitiveness. Requirements for consistently stable performance at high system adaptability. The distance plays an ever-smaller role "Being digital" (Nicholas Negroponte). World of atoms is changing into the world of bits" (today already now of tera-bits), it evokes the need for increasing competitiveness of entrepreneurs and persons.

A change in the previously established way of thinking in innovations of management and financing of corporate IS automatically require the mobility and personalization of application devices, the frequency of requests for exchange or modification of a part of corporate IS is growing.

IT and ICT transformation into the service sector – significantly changes the business environment. Modern automation and robotics – produce huge volumes of data (Big Data) daily. This situarion of raises the need to process these data professionally; the situation strongly supports the development of a special science field called Data Science Platforms & Machine Learning platforms.

To support the development of an appropriate information strategy is important. The choice of supplier is affected primarily by the specific requirements depending on the type of activity of the user.

5 The four phases of digital business transformation into a new information strategy

Many manufacturing companies have long been pursuing digitization activities. The effects of digitization are always the same - increased production, minimizing errors and reducing production costs. It requires the introduction of new manufacturing processes such as digital production and quality control, predictive maintenance, robot use in production processes, etc. There is a need for the transmission of large amounts of data. This data must always be kept securely in the right place, in the required format, and without errors. Only in this way can the digital transformation be successful. (David Šolc AIMTEC a.s.)

The first phase is the collection of data across logistics and production – creating a complete digital image of the company. Data is collected directly from machines and equipment, using sensors, IoT or mobile devices.

In the second phase, the data sources logically interconnect and integrate with the systems. The goal is the horizontal integration of all processes in the company, from receipt of material to the dispatch of the finished product.

The third phase is the vertical integration of collected data, their analysis, reporting and process visualization. Data analysis results help to eliminate inefficiencies in processes and optimize them.

The fourth phase is final. Devices and systems perform own process optimization based on collected big data. Machines learn, autonomously decide and adjust. Processes are managed digitally within the company.

5.1 Enterprise Architecture to Integrate Strategic Business Planning

Use can be made of the Enterprise Architecture to Integrate Strategic, Business, and Technology Planning according to (Scott Bernard), which involves the architecture of enterprises, strategic planning, business agility, technology planning, integration and administration.
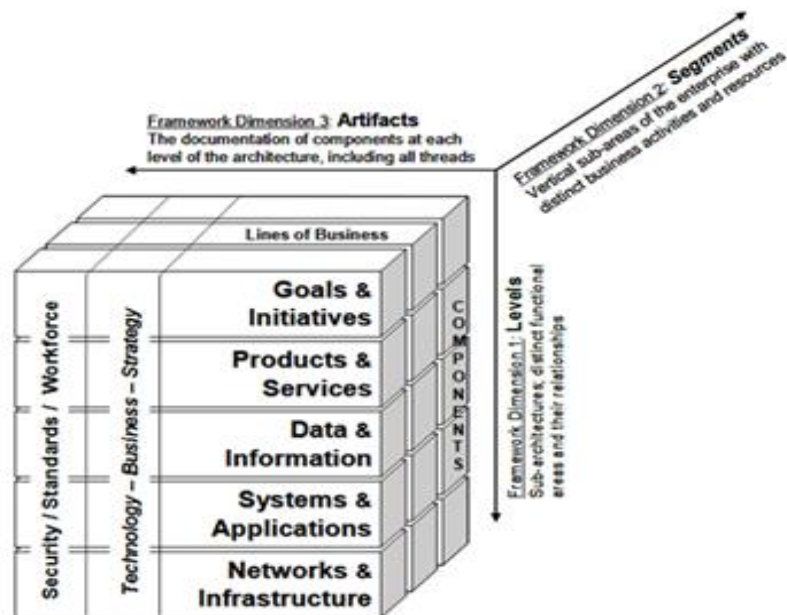
Figure 1   The EA3 "Cube" Framework, Source: Rozehnal, Novák (2016)

The framework consists of methodology, data repository, best practices, artefacts, knowledge, network organization model, and Living Enterprise. Component documentation at each level includes all sub-processes. Integration of machines, systems, databases and applications penetrates all phases of digitization. Data from different sources is combined, transformed and evaluated. The increase in the number and variability of integrations will reach such an extent that it is necessary to choose the right integration strategy, to integrate in the solution a logic that reflects the complexity of business processes. The goal is to provide managers with relevant analytical tools to support their decision-making.

5.2   Data Science and Machine Learning

By the end of November 2017, Gartner has published its Magic Quadrant for ERP solutions, specially focused on the needs and specifics of medium-sized businesses. In this diagram, Microsoft Dynamics AX is in a prominent position, approaching the area of visionaries. The solution is suitable for businesses that use their ERP systems to support multiple business entities

in different countries or geographic areas. They can also run several business units with different offers. Without increasing time demands, they maintain cross-entity processes and level of coordination. The solution has also triggered the interest of many large companies with thousands of users. These customers have been supported by extending the solutions to include industry-specific versions.

For example, To-Increase for manufacturing and construction. According to Gartner, customers evaluate quality, usability, flexibility and scalability of Microsoft Dynamics AX. For many large customers looking to increase their business and processes with a view to further growth and competitiveness, interest in the To-Increase system is growing.

The Dynamics AX is experiencing growing acceptance by large businesses. The Gartner Magic Quadrant for Midmarket in 2017 is designed for product-oriented company with 100 to 999 employees and an annual turnover of USD 50 million to 1 billion.

6   Big data and Data Science Platform

With the global digitization and growth of volume and complexity of the data structure, the next stage of ERP systems development, Big Data processing and Data Science platform is coming. Attention is paid to: processing a much larger amount of data, using new analytical approaches (such as deep neuronal nets and natural language processing). The importance it does not lose data mining. These solutions place significantly greater demands on the computing infrastructure and specialized skills of the vendor.

"Magic Quadrant for Data Science Platforms" focuses on the possibilities of expert data processing in newly created IS solutions. It evaluates 16 vendors that can be the best choice when dealing with new designs. The choice depends on the requirements and expectations of a company. The analysis was performed by Linden et al (2016).

In order for vendors to be included in the "Magic Quadrant for Data Science Platforms", they must also meet revenue requirements and identify reference customers that constitute a major cross-sectoral and cross-geographic traction. Only then do they qualify as suitable companies.

Analyze Gartner 2017 Magic Quadrant for Data Science Platforms by Gregory Piatetsky-KDnuggets:

Like Gartner 2017 MQ for Data Science platforms: profit-making and loss-making, we compared the last magic quadrant in 2018 with its previous version. Below we examine changes, profits and losses. While open source platforms such as Python and R play an important role in the data science market, Gartner's research methodology does not include them, so this report only evaluates only commercial vendors. Below are the results of the analysis, the comparison with the previous version, the shifts in the sectors affected by the changes, the towing companies and the losers.

Gartner constantly changes the names of this report (and implicitly the market segment). These changes reflect the rapid changes in the field in terms of both content and abilities and the development of labelling that reflects an increase in Artificial Intelligence (AI) and Machine Learning applications. (Gregory Piatetsky, KDnuggets 2018).

Gartner defines data science and the platform for machine learning as: "A cohesive software application that offers a mixture of basic building blocks essential for creating many kinds of data science solutions and for incorporating those solutions into business processes, surrounding infrastructure and products."

The 2018 report evaluated 16 analytical and scientific companies on multiple criteria and placed them in four quadrants, based on the completeness of the vision and the ability to execute.

Characteristics of these companies:

The platform Alteryx enables data scientists to create models in one workflow. SAS provides a range of software products for analysis and data science. RapidMiner platform includes the RapidMiner Studio development tool RapidMiner Server and RapidMiner Radoop.

H2O.ai offers an open-source platform for machine learning, including H2O Flow, its main component; H2O steam; H2O sparkling water for integration and H2O Deep Water, which provides deep learning skills. H2O.ai moves from Visionary in the previous magical quadrant to Leader.

TIBCO Software (new) entered this market by acquiring Quest Software's well-known platform Statistica.

IBM provides many analytical solutions. For this MQ, Gartner evaluated SPSS Modeler and SPSS Statistics, IBM plans to deliver a new interface for its SPSS products in 2018 that fully integrates SPSS Modeler into DSX.

Microsoft provides more products for scientific and machine learning. For work, In-Cloud includes Azure Machine Learning, Azure Data Factory, Azure Stream Analytics, Azure HDInsight, Azure Data Lake and Power BI.

Domino (Domino Data Lab) Data Science platform of this company is a comprehensive solution for scientific teams of scientific data processing.

Dataiku offers Data Science Studio (DSS) with a focus on interdisciplinary collaboration and ease of use.

Databricks (new) offers the Unified Analytics platform of the Apache Spark cloud platform. It also provides proprietary features for security, reliability, operation and performance.

SAP has once again converted its platform from SAP Business Objects Predictive Analytics to a simple SAP Predictive Analytics tool.

Angoss acquired Data Watch, Angoss has loyal customers, it is still perceived as a desktop environment supplier.

Anaconda (new) offers Anaconda Enterprise 5.0, an open source development environment based on the concept of an interactive notebook. It also provides a distribution environment that provides access to a wide variety of open source development environments and open libraries.

Teradata offers Teradata Unified Data Architecture, a business analytical ecosystem that combines open and commercial technologies to provide analytical capabilities.

7 Criteria for the suitability of an ERP solution to improve the information strategy of businesses

The rapid expansion of information technologies (IT) accelerated our lifestyles. Globalization brings the emergence of new dynamic markets and increases competition among entrepreneurs. Entrepreneurs are forced to keep track of changes in external conditions to keep their businesses competitive.

The variability of the internal and external environments brings about numerous requirements for modification contractor of IT. The basis are in the requirements for a stable system performance at a high degree of adaptability. In line with the rapid development of information and communication technologies (ICT), entrepreneurs also automatically require the mobility and personalization of application devices.

These changes also change the current way of thinking in relation to innovating, operating, managing and financing of company information systems. Due to the large increase in the volume of data coming from companies from both internal and external sources, approaches and methods offered in the field of data processing also change.

IT vendors offer integrated automated enterprise systems (ERPs) and their operation in the form of services to replace on-premise solutions. The transformation of ICT into the services sector is reflected in the changes in the business environment and in the society as a whole.

7.1 Criteria for increasing the effectiveness of information strategy, economic

Extremely fast ICT development, advances in SW and HW components of information systems, changes in structure and volume of data, and societal climate have all created a need for a change in the approach to determining the information strategy of companies.

At present, both suppliers and users must respect economic criteria in the design and formulation of requirements. Digitalization has also affected the speed of trade transactions.

There is a reduction in costs. From an enterprise perspective, integrated ERP solutions enable organizations to reduce costs by automating workflows. They remove barriers to sharing information and employees can do their work in less time. Those who use automated and efficient ERP processes achieve an average yearly operating cost reduction.

ERP facilitates documentation of work steps and processes, so people to work on a consistent basis a have easy access to documented processes and quality is increasing. Management can quickly identify business issues and take immediate corrective action.

With better data and decision-making tools, companies can improve the quality of their decisions and improve operational results.

7.2 Focus on strategy to achieve results

If we want to get an idea of further developments in our business, but also of the competitive effects of external changes, we must not only create short-term plans but strive for a longer-term strategy (vision). Those who can do it will be more successful on the market.

In creating this vision play an importand role organizational factors, the positive relationship of managers with ICT and enough time of key people for the processes of ICT implementation from both non-production and production sections of the enterprise.

They are also significant external environment factors, pressures triggered by business partners and customers. Requirements of partners for system with the same technologies and safety and reliability factors.

8 Conclusion

The implementation of the new approaches to in improving the quality of enterprise systems is not only a matter of technology or information technology. In spite of digitization and automation, creativity and experimentation of person remain irreplaceable. Companies will always be confronted with a range of knowledge and skills of their managers. The future lies in the creative development of new solutions. New solutions it means new thinking.

We need to be able to consider the pros and cons of our own business model, as well as the business models of our customers, competitors and sales agents. SW and digitization can only deliver as much, as out the creativity and persons intelligence allows. That is the key to tomorrow's success. Digitization is a tool. They must be matche with the relevant personal know-how and experience of managers. The market's mission is to provide products in the broadest sense to meet the needs of society, and to provide.but also services and information not only in the context of business relations, but also other social, cultural and educational. Those have influence changes for research and development.

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IT INNOVATION

The Digital Transformation Pyramid on Intelligent Organizations

Piotr Adamczewski[1]

Abstract. Solutions of the Information and Communication Technology (ICT) are the foundation of modern economic organizations in a knowledge economy in the times of digital transformation. This is the case in particular in intelligent organizations, for which the advanced ICT infrastructure is the sine qua non condition for the effective knowledge management. This article is aimed at describing the role of modern ICT trends, which are described as SMAC, (Social, Mobility, Analytics, Cloud), and are becoming an essential ICT element supporting management processes. Such solutions enable to create new models of organization operations on the global markets using strategic resources, such as the knowledge supported with SMAC solutions as the digital transformation pyramid.

Keywords: Digital transformation, Intelligent organization, ICT, Knowledge management, SMAC

JEL Classification: A23

1 Introduction

The dynamics of market changes and the high level of turbulence in business environment make modern economic organizations face the challenge of continuous improvement in their operational methods and development. In practice, it implies the necessity to use modern ICT solutions in knowledge management, which enable to support business processes within the acquisition and reinforcement of business's competitive advantages.

Within the evolution of the information society towards the knowledge society, it boils down to the treatment of modern organizations as intelligent organizations. A intelligent organization is one whose business philosophy is based on knowledge management (Waltz, 2003). This term became popular in the 1990s owing to the growing ICT development, the dynamically changing economic environment, and the increasing market competitiveness. An intelligent organization is one that learns and has the capacity to create, acquire, organise, and share knowledge and use it in order to raise the efficiency of its operation and increase competitiveness on the global

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market. The idea of such an organization is based on the systemic approach to organization, i.e. its treatment as a complex organism founded on existing structures and executed processes, focusing on the role of knowledge. In that approach, which is called 'the fifth discipline' by P. Senge, owing to knowledge and suitable tools all elements of an organization and its personnel can collaborate in order to achieve set objectives (Senge, 2002). Thanks to that, the whole organization operates as an intelligent and successful organism in the competitive environment. This explains the mutual relationships between methods of fulfilling targets, their understanding, methods of solving problems as well as internal and external communication.

This article is aimed at presenting the latest condition of digitalization and development tendencies in supporting the intelligent organizations with SMAC solutions (Social, Mobility, Analytics, and Cloud), which is a sine qua non condition of enterprises from this sector to operate in a modern way and to take part in the process of digital transformation.

2 Intelligent organizations in the digital transformation

The most important characteristics of a intelligent organization include, among other (Grösser, 2012; Schwaninger, 2010):

- fast and flexible operation,
- the ability to monitor the environment,
- the capacity to diagnose early market signals and to react to changes in the environment, and
- the ability to implement new knowledge-based solutions and achieve economic benefits therefrom.

The growing volume of information used in a intelligent organization is accompanied by its increasing importance. Peter Drucker indicated already that traditional factors of production, such as growth, labour, and capital, are losing their importance in favour of a key resource, namely knowledge applied in the creative operation of an organization. It constitutes intangible resources that are related to human actions, whose use may be the basis for gaining a competitive advantage (Schwaninger, 2010). Knowledge has to be treated as information embedded in the context of an organization and a skill to use it effectively in the organizational activity. It means that knowledge resources

are data about its customers, products, processes, environment, etc. in a formalised form (documents, databases) and in non-codified forms (knowledge of staff).

In the practical dimension, the effective collaboration of such elements means the necessity to use advanced ICT solutions. Technical, technological, and organizational innovations, which have appeared in recent years, are all utilised (Adamczewski, 2017). They encompass almost all areas of a modern organization operation, starting from means of transport and equipment, through organization and material and raw material flow management, to the development of system structures that implement business processes, i.e. within logistics systems that are the essence of modern management based on ICT solutions.

The present effect of the ICT evolution in the form of the so-called third ICT platform, has been treated since 2013 as the foundation of the 4th industrial revolution, being the natural development stage of the 3rd revolution of 1969 (its symbol being electronics with its transistor and automated production). The main distinguishing element of new changes has become the redefinition of the present course of business processes that contributes to new operating models of economic organizations facing new challenges to maintain their position and expand on the market further. The industrial revolution of the 4th stage is breaking out due to (Adamczewski, 2016; Report IDC, 2016):

- the introduction of the all-present digitalization,
- decision processes based on virtual simulations and data processing in real time, and
- machine-machine and machine-man communication.

The digital transformation means a change of the present approach to a customer and a comprehensive process where an organization moves to new methods of operation using the state-of-the-art SMAC digital technology, including social media, mobility, big-data – analytics, and cloud computing. However, it has to be kept in mind that the role of digital technologies in that process is to enable the necessary changes and open an organization to new opportunities. Therefore, they should be a tool rather than the aim of transformation. The centre of the process has to be the customer and his needs, as the main driver for manufacturers and service providers. The digital transformation is no longer the method of gaining a competitive advantage – it

is becoming a factor that enables to stay on the market (Adamczewski, 2018), (McConnell, 2017).

Today, it is difficult to find an economic sector that would be isolated from what is happening in the area of ICT solutions. Within several years, Airbnb, a company with no hotels at all, and in fact operating based on an algorithm of room rental, has become one of the main players on the global hotel market. A similar role is being played by Uber on the taxi service market. Both organizations have made innovations of a digital disruption type, which have changed the previous business order, providing customers with new advantages. In most cases, technological innovations and solutions that change business models and operating conditions in individual enterprises and whole sectors come from outside. Therefore, the careful monitoring of what is happening in ICT is the requirement not only for ICT companies, banks or telecommunication firms, but primarily for all organizations that want to maintain their leading position on the market.

3 Trends in the digital transformation

Digital transformation is being spearheaded through a combination of software and hardware advancements. While the list of advancements is endless, the most promising technologies fall under one of the four umbrella terms described below briefly (Cisco, 2016), (Corcoran, 2016), (Perera, 2015), (www.solutions.pyramidci.com/digital-transformation-defi-nition-trends-every-thing).

I. The Data Science Trio

The Data Science trio refers to three advancements related to data science that are arguably causing the greatest disruptions across various industries at present. These three technologies are:

A.   Data Analytics and Big Data

Analytics refers to a set of qualitative and quantitative methodologies used to study and extract knowledge from raw data and use it to guide business decisions. Big Data refers to gargantuan data sets that contain important information and patterns hidden among large heaps of supplemental data. Both finite data analytics and big data analytics are applicable in virtually any scenario involving a database and sufficiently large amounts of data. Scores

of companies are currently hiring armies of Data Analysts to crunch through their datasets and help them improve/organize their practices and services.

B. *Machine Learning*

Machine Learning refers to the concept of giving computers the ability to learn on their own without human intervention. The primary usage of machine learning is to teach computers to recognize patterns on their own in cases where human analysis is too slow, expensive, or even impossible. Machine learning has thus seen itself being employed in recommendation engines, market analyses, spam filters, network security solutions, and more. Any organization that has data-based assignments which are large & repetitive (or) involve some form of identification tasks (or) a combination of both the above, should consider exploring machine learning solutions.

C. *Artificial Intelligence*

Artificial Intelligence (AI) refers to a computer possessing the ability to perform a task or tasks in a manner that is just as effective or even more effective than a human being doing the same. While machine learning deals with a computer studying data and merely outputting what it has learned, Artificial Intelligence deals with a computer studying data and taking decisions/executing tasks based on certain pre-programmed instructions. AI is best implemented in any scenario requiring high speed and high precision decision making and task execution.

II. Internet of Things (IoT)

IoT refers to a network of interconnected physical devices and sensors that collect data and exchange it with one another using the internet as a communication platform. IoT networks allow for low cost embedded systems to be deployed into physical environments where they can continuously collect information, relay it, interpret it, and act on it accordingly. IoT helps in achieving a scenario where all variables of a physical environment can be mapped and each constituent device's functioning can be made to depend on said variables or outputs from other device(s). For this reason, IoT has found immense value in health-care, smart cities, and smart homes.

III. Remote Work Environments

High skilled employees are very often not available at the desired location of a firm or may sometimes prefer to work from home. In the digital

age, it makes no sense to compromise on talent by restricting hiring & work to a single physical location. Whether it is employees situated halfway across the world in a satellite office, or an employee situated half way across town in their own house, technological advancements such as video calls and internet-connected project management software allow us to send work to employees themselves when the reverse is not possible.

IV. Block Chain Technology

The finance industry is currently undergoing one of its largest transformations in history – thanks to blockchain. Blockchain refers to a distributed global database spanning across millions of computers all over the globe. It is not controlled by any central authority and uses state of the art cryptography to prevent unauthorized access to sensitive information such as transaction history. Blockchains have already been implemented to create cryptocurrencies (e.g. Bitcoin) which are unregulated digital currencies that offer alternatives to traditional currencies. Cryptocurrencies are used widely due to the unmatched security and freedom they offer in trading any amount of money, big or small, without having to face any bureaucratic trouble.

V. Other Promising Trends

Beyond the technologies discussed above, there are several other technologies promising digital disruption of legacy industries. Some of the most promising trends are:

A.   Virtual Reality and Augmented Reality

VR works by simulating entirely new environments digitally while AR works by imposing simulated elements onto real environments. Both VR and AR find already finding application in the fields of gaming, health-care, and warfare.

B.   Internet-Based Media & Advertising

Although internet-based media & advertising is already mainstream, most companies still prefer to spend more on print and TV platforms. As the world continues its tectonic shift to Internet-based consumption, firms such as Netflix and InMobi are already capitalizing lucratively on internet revenues for media and advertising content respectively.

Top 10 strategic technology trends include three groupings of complementary trends – Figure 1 (Gartner, 2017):

- the intelligent theme explores how AI is seeping into virtually every existing technology and creating entirely new technology categories. The exploitation of AI will be a major battleground for technology providers through 2022. Using AI for well-scoped and targeted purposes delivers more flexible, insightful and increasingly autonomous systems.

- the digital theme focuses on blending the digital and physical worlds to create a natural and immersive, digitally enhanced experience. As the amount of data that things produce increases exponentially, compute power shifts to the edge to process stream data and send summary data to central systems. Digital trends, along with opportunities enabled by AI, are driving the next generation of digital business and the creation of digital business ecosystems.

- the mesh theme refers to exploiting connections between an expanding set of people and businesses - as well as devices, content and services - to deliver digital business outcomes. The mesh demands new capabilities that reduce friction, provide in-depth security and respond to events across these connections.
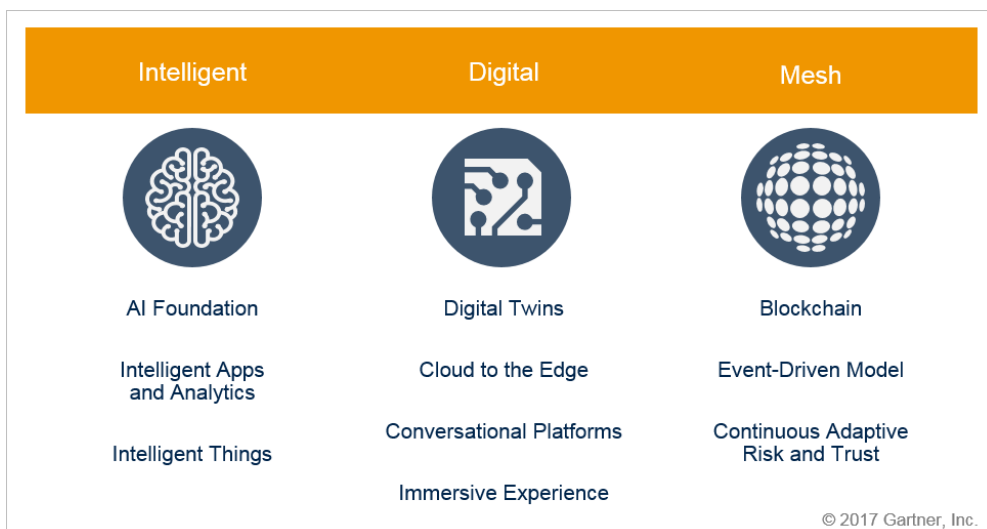
Figure 1 Top 10 Strategic Technology Trends for 2018, Source: Gartner, 2017.

4   The digital transformation pyramid

The concept behind digital transformation is how to use technology to remake a process so that it becomes more efficient or effective. It's not just about changing an existing service into a digital version but improving it. Some of the technologies used in digital transformation projects are IoT, blockchain, big data, cloud computing, AI, and machine learning. Digital transformation is more than just adding technology—part of the transformation includes changing how employees think. If the corporate culture doesn't support change, then it will be difficult for a company to instill new business processes and reach digital enlightenment. The shift to a digitally transformed business often means breaking down silos and relating differently to customers.

Such technologies determine changes in three areas of intelligent organizations that apply them through (Marz, 2015):

- developing relations with customers and counterparties owing to the deeper understanding of their needs, introducing numerous channels of communication, and enriching forms of self-service,
- improving operational processes within internal organizations and working environment as well as mechanisms of monitoring their efficiency, and
- modelling organizational operations within product manufacturing and services provided on the market.

There are three levels on which Digital Transformation needs to be approached within corporates - Figure 2 (www.linkedin.com/pulse/digital-transformation-pyramid-business-driven-approach-turchi):

- Business strategy,
- Corporate execution,
- Enabling technology.

An effective digital transformation program has to embrace at least two of the three levels – and, ideally, it must cover (in the long term) each of the three levels. For example, the definition of a new 'Digital' Business Model, without its execution through a new Go-to Market approach, is a pure theoretical exercise that will remain at board-level presentation and will not change the way a business performs.

The Digital Transformation pyramid
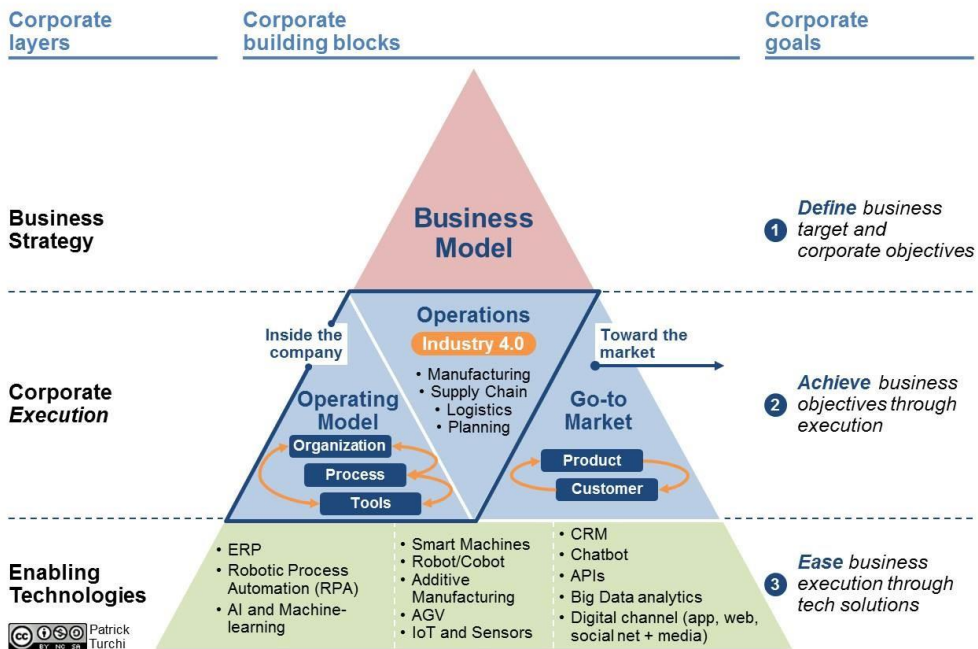
Figure 2 The Digital Transformation Pyramid, Source: www.linkedin.com, 2018.

On the other hand, the implementation of a new ICT system (such as an ERP or CRM) or the set-up of a standalone e-commerce is not a digital transformation initiative, if this is not part of an overall operating model transformation or of a new Go-to Market approach. It is important to acknowledge that each of the three level of the pyramid has a strong influence on (and actually defines) the other elements of the framework. A successful digital transformation program, in fact, requires a "system" approach to embrace a truly transformational initiative. Strategy, execution or technology alone cannot transform a company: only an integrated review of (at least) two of the elements enables corporate transformation.

There are five building blocks that define the framework - Figure 3 (www.linkedin.com/pulse/digital-transformation-pyramid-business-driven-approach-turchi):

- Business Strategy (Business Model),
- Operations,
- Operating model,
- Go-to market,
- Technology.

Each of the elements is relevant and the relationship among the elements must be taken into consideration in digital transformation initiatives. In fact, a new way of 'doing business' (both inside the company and in relation to the market) is the way a digital transformation program properly works. As a matter of fact, technologies impact the operating model and the operations of a company, as well as supporting the evolution of the Go-to market (for example through a new channel approach or through the review of the product portfolio or product features). Similarly, business model implementation requires the definition (and evolution) of specific operating models, operations activity and market approach.

Layer 1: Business Strategy (Business Model)
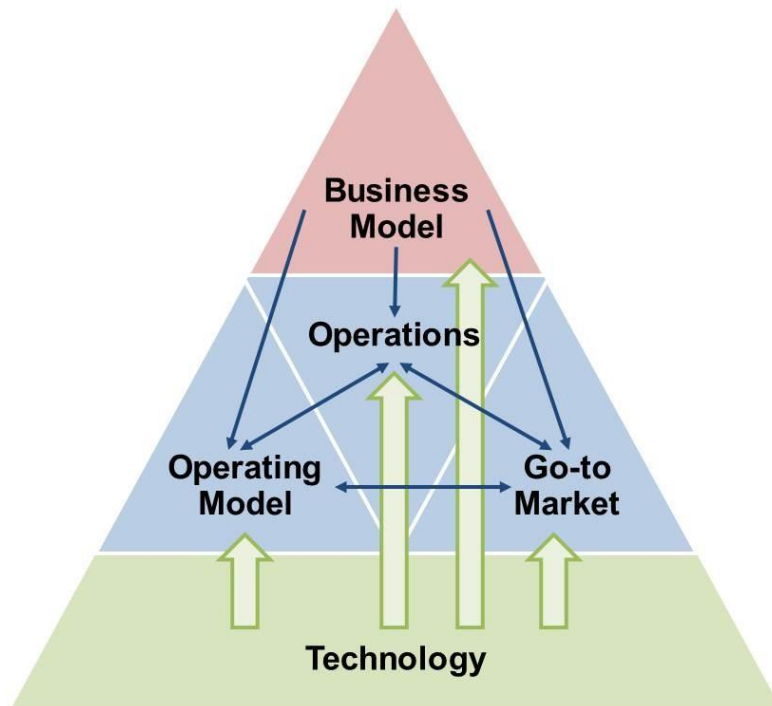
Figure 3 The Digital Transformation Pyramid, Source: www.linkedin.com, 2018.

When defining the business strategy in a digital (or digitally-enabled) environment, corporates have to evaluate opportunities and impacts (as well as potential threats) of technology-enabled business models (or digital business models), such as (but not limited to):

- Platform business and marketplace,

- Ownership model evolution (with the shift from ownership to access, through pay-per-use models),
- Value-added services through digital technology,
- Data-based products (and services).

Layer 2: Execution

It is not clear weather Sir Winston Churchill actually said "*However beautiful the strategy, you should occasionally look at the results*", but the point here is clear: execution is the key for corporate transformation, and Digital Transformation programs do not work differently. Execution works in fact in two directions: inside the company and outside the company (toward the market, or the markets the company is willing to serve).

There are three building blocks of execution:

- Corporate operating model,
- Operating model of operations,
- Go-to market approach.

Each of the blocks requires a specific deep-dive, since each of the 3 building blocks is actually made of further elements, and every one of them requires special attention when developing a digital transformation initiative. Nonetheless, it is important to keep in mind that, at this level, the strategy defined is realized through the very founding elements of a corporate:

- Product and customer: which defines the offer of the business (taking into consideration key elements, such as selling price, distribution channel, promotion and communication approach, digital-enabled product value proposition, etc.),
- Organization, procedure and tools, which - through the operative model - outline the structure of the corporate and the way it works,
- Operations, constitute the way the corporate realizes products (and services) that is willing to push into the market.

Those elements are, of course, the standard components of the strategy execution and are not only relevant in a digital transformation context. Nonetheless, it is important to highlight that in this context they require a specific approach through the evaluation of the digital and technological impact. For example, what is the "product" in a digitally-enabled context such as car-sharing platforms? Is it the service provided, the arrival at the final

destination, the access to the car, the time needed, etc? And consider that the very definition of "product" has then an impact on the definition of the price, the value provided, the core product offer, etc.

Layer 3: Technology

As mentioned at the beginning, technology is not the core of digital transformation, but is actually its enabler. Technology serves (and supports) the realization of the business target and objective through the 'execution' blocks. Technology is the enabler of the evolution of the operating model, of operations (with Industry 4.0 approach) and the realization of the Go-to market approach. On the other hand, technology is the driver of changes on each level of the pyramid, and being able to identify the impact of technology on each level of the pyramid is a key strategic corporate capability. It is important to identify business changes in the market driven by technology and to define strategic responses (or possibly anticipate with the correct strategic move).

5 Conclusions

The dynamic economic changes and the evolution of business relationships devaluate traditional sources of competitive advantages in the intelligent organizations, such as capital, infrastructure, access to outlets, and the quality of offered products and services. Modern enterprises that want to compete on the market effectively have to give priority to flexibility of their organization and its ability to implement innovative business models and reorganise logistics processes in digital transformation. Examples of numerous intelligent organizations show that the vision of a business managed in a modern way has come into the dynamic phase of realization, while the effective knowledge management with advanced ICT solutions is growing to the role of paradigm. There is no doubt that reserves still present in the intelligent organizations can be utilised, through supporting its operation with advanced ICT systems with the dominant role of SMAC solutions.

Nevertheless, it has to be remembered that the creation and development of such smart technologies has one basic aim for businesses, namely to accelerate the development pace and improve the quality of offered products and services, while reducing operating costs. Although it seems apparently simple, paradoxically innovation of intelligent organizations is burdened with

the concern about the unknown. The intelligent organizations are afraid of investing in solutions that are not popular yet. Nevertheless, the strategic vision of the management in such organizations will determine the directions and pace of popularising modern and effective solutions in knowledge management, which may contribute to the improvement of their competitiveness on the global market in digital age.

According to the above analysis, the conditions of effective knowledge management in intelligent organizations have to be treated in a complementary way, so that ICT aspects, although very important, do not dominate the preparatory work or the operation of solutions in this respect. Equally important are so-called 'soft' conditions, which concern the strategy of organization's development, its organizational culture, and qualifications and motivation of personnel. One thing seems certain already - the period of digital transformation poses new challenges for intelligent organizations in the area of knowledge management. If they rise to them, they can compete on global markets more effectively.

Acknowledgements

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Modeling and Simulating Cooperation in Organizations

Josef Daňa[1], Jaroslav Ráček[2]

Abstract. This paper presents a multi-variable agent-based model implemented in the NetLogo tool. Purpose of the model is to simulate the workplace environment, cooperation and competition of employees, their performance and levels of stress, and how these aspects can be influenced by management decision making. A brief overview about the components of the model is provided, as well as possible application and future directions of the research.

Keywords: modeling, simulation, organizational performance, cooperation

JEL Classification: C63, C71, D23, L20

1. Introduction

Quality of interaction between coworkers is an important factor that has both impact on the organizational performance as well as on the health and wellbeing of the employees. About 75 % of employees regularly experience psychic and somatic symptoms of stress and there is also a significant impact on the national economy (AIS, 2017). Existing research related to the association between stress and job performance brings about various findings – while it is commonly accepted that individuals perform best at medium level of stress (Teigen, 1994), other studies indicate that there might be positively or negatively linear relationship between stress and performance, or even no relationship at all. These findings are dependent on the context, task type and subject sample (Motowidlo, Packard, & Manning, 1986).

In the Laboratory for Search and Dialogue at Masaryk University, we have decided to extend the existing knowledge on this subject by developing a multi-variable agent-based model. This model allows us to simulate various aspects related to cooperation or competition between colleagues in a working environment. The model also includes parameters related to managerial decisions and how these may influence performance and health of employees. This model is fully adjustable to perform *in silico studies*,

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based on the parameter setups. Preliminary experiment shown that the model behaves correctly in predictable situations. The repository with a model is publicly accessible for anyone to experiment with the model (Daňa, Kopeček, Ošlejšek, & Plhák, 2018). The model is being continuously developed to include new components or to improve the existing ones.

2. The model

We have developed the model in NetLogo tool which is an environment for modeling and simulation of complex systems. NetLogo has library containing dozens of standard models and it also allows to create own agent-based models.

Our model represents an organization (e.g. a factory, company or research facility) where employees cooperate (to a certain degree) to achieve shared goal. While part of the work is done by an employee on their own, some percentage of the work is carried over to a colleague who, in exchange, returns same percentage of their work to the first employee. The employees are exchanging those parts of work that the other one can deliver more efficiently, therefore both benefit from such cooperation. However, individuals not always cooperate and may experience a temptation to defect the colleague to receive the benefit but refusing to pay back. This situation is modeled by the Prisoner's dilemma game.

2.1. Prisoner's dilemma

Prisoner's dilemma game (henceforth PDG) is a standard setting from game theory that deals with the cooperation vs. competition problem. It is now widely known that competition (i.e. defection of a colleague) is advantageous in short term while it doesn't have to bring the same results from the longer perspective. Axelrod & Hamilton (1981) organized tournaments and invited academics to propose a strategy that could beat other strategies when playing the repeated prisoner's dilemma game. Some of these commonly used strategies are included in our model, modifying behavior of the employees, as described in the Table 1 below:

Table 1 PDG strategies used in the model, Source: own.

Strategy	Label	Description
Defect	D	Always defects
Cooperate	C	Always cooperates
Tit for Tat	T	Repeats partner's last move.
Tit for two Tats	T2	Defects if defected in both last 2 rounds, otherwise cooperates.
Tit for Tat – Naïve Peacemaker	nT	Repeats partner's last move. There is a probability for cooperation if defected.
Pavlov	P	Initiates with cooperation. Then repeats last own action when won and switches action when lost last round.
Unforgiving	U	Once defected by a partner, always defects. Otherwise cooperates.

2.2. Description of the model

As described above, the employees interact in order to create added value. The quality of interaction, or more specifically their strategy related to the intention whether to cooperate or defect, is defined by the PDG. We have also included stress component into the model to simulate how the interaction impacts wellbeing of the employees. Every employee has its capacity to withstand stress. Once is this "stress container" exceeded, the employee becomes sick – it cannot work but it is still financially supported by the organization.

To simulate the existence of an organization, multiple parameters are included in the model and their values can be adjusted by a slider found on the interface of the model in the NetLogo environment. These sliders are highlighted with *italics* in the brief overview provided in following subsections.

2.2.1. Global parameters

- *initial-cooperation* defines the proportion of cooperative strategies (all except "Defect") vs. non-cooperative strategies ("Defect")
- *cooperation-part* refers to the percentage of the work scope that is exchanged between co-workers, e.g. 20 = 20 % of the total amount of work will be exchanged with a partner for given round.
- *initial-wage* is used to adjust the amount of money that every employee is given at the end of each simulation round.

- *patience* define the tolerance for repeated sickness of employees. After the value is exceeded, then given employees leaves the company and is replaced with a new one.

2.2.2. Employee related parameters

- *Productivity* represents employee's ability to create profit for the company. For sake of simplicity, we assume each employee having fixed productivity during their life. The productivity has normal distribution among the population, with mean value and standard deviation defined by *mean-value-producitity* and *std-deviation-productivity* sliders.
- *Resistance to stress* is modeled as a capacity of a virtual stress container. If the stress level is below the given threshold, the employee is healthy and working. When the stress level exceeds the limit, the employee becomes sick and unable to work.
- *upper and lower performance limits* define maximal and minimal performance of one employee. Given that management evaluation has (de)motivational effects, the performance of an employee will rise or fall. However, this cannot repeat ad infinitum. These limits ensure that employees cannot drop under 50% or exceed 200% performance.

2.2.3. Stress factors

There are several ways of how employees' stress is produced:

- Social interaction - stress caused by defection in PDG is adjusted by *stress-modification-on-PD* slider.
- Internal factors - stress caused by level of effort (slider *effort-stress-increase*) and stress caused by evaluation by management (slider *evaluation-stress-change*). On the other hand, the stress level can also be lowered by stress regeneration (*stress-regen* slider).

2.2.4. Management decision module

The management may decide whether to reward employees for their performance or cooperativity. Alternatively, some ratio between these two aspects can be chosen - this can be set up by the *sum-generated-vs-cooperation* slider.

It is also possible to adjust how good or bad is the management at evaluation of employees by two sliders: *boss-insight-cooperation* and *boss-insight-performance*. High values mean that management is good at evaluation of employees, i.e. the evaluation is precise. On the other hand, low values imply that management is poor at evaluation of employees, i.e. the evaluation is imprecise and close to random.

Another aspect related to management strategy making is a length of evaluation period. It is implicitly set as 30 – this means that the information about employees' behavior is collected for period of 30 days and serve as a basepoint for evaluation. However, any other value can be set by a *boss-reaction-time* slider.

Last parameter refers to the strength of impact that the management evaluation has on the employees' salary. This is adjusted by the *boss-reaction-intensity* slider. For example, 0.15 means that the management can only adjust 15% of the total salary. In other words, 85% of the salary is fixed.

2.3. Simulations and analytics

The parameters included in the model allows us to adjust experiments such that they simulate the selected features of an organization. In a similar manner, the NetLogo provides tools for analyzing and visualizing desired outputs of the simulations. Current state of the model monitors the overall gross performance of an organization, net profit, stress level of employees, number of employees on a sick leave with respect to their PDG strategy, average individual performance per strategy, average effort of employees, total amount of employees that left the organization during its lifespan, etc.

3. Possible experiments, applications and future work

The presented model is still under development; however, its present version is in working state and usable for simulation experiments. We have conducted a series of experiments aimed on exploring the impact of management strategies on stress and economic performance of employees, and the results are to be presented by the authors on world conference HICSS-52 in USA (Daňa, Kopeček, Ošlejšek, & Plhák, 2019).

Many other approaches and parameter setups can be taken. For instance, the overall organizational performance may be influenced by various

population compositions, part of the work to be exchanged, company size ("startups vs. corporations") and other factors related to *organizational culture*.

A specific conclusions or recommendation for a real-world company can be made once the parameters are set closely to the real values. A field study collecting the proper information which would allow to set the parameters close to reality is required for that, and it is a part of the next steps of the research.

Future extension of the model is intended to cover following ideas and concepts: implementing a social network interaction model, introduction of growth model to reflect the prosperity of a company, focusing on employment fluctuation and improving the concept so that repeated dismissal of employees will be penalize the company, and improving some of the existing concepts (e.g. employees' productivity) to make it more realistic.

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Models and information technologies to the organization of risk management system in banks of Ukraine

Vyacheslav Chaplyha[1], Volodymyr Chaplyha[2], Nataliya Abashina[3]

Abstract. The article discusses innovations, challenges and chances of organizing risk management in Ukrainian banks in accordance with the new requirements of the regulator. When creating a risk management system, it was proposed to use the "4-line defense" model. This allows you to increase the overall level of risk culture, ensures the maximization of profitability within an adequately evaluated bank's ability to accept risk. To fulfill the requirements of the NBU, the bank must create a reliable information system to automate the processes of each of the "lines of defense": For these purposes, it is advisable to use the best solutions in its class, for example, from the company SAS. They allow with a high-quality assessment of all types of risks and their impact on the efficiency of the bank.

Keywords: risk management, system organization, innovations, challenges and chances, model, information system, bank

JEL Classification: G210, L100, C450

1 Introduction

Improving the risk management system in the banking sector of Ukraine's economy and improving its efficiency are among the leading requirements and areas for the transformation of the financial sector in line with the integration of Ukraine with the countries of the European Union and within the framework of the agreement with the IMF on the Enlarged Financing Facility (EFF). Thus, in the Memorandum between Ukraine and the International Monetary Fund on Economic and Financial Policies of 03.02.2017 (Ministry of Finance of Ukraine, 2017). Ukraine has undertaken a number of commitments to fulfill its tasks to strengthen the financial system. In particular, it will continue to strengthen the supervision and regulation of banks; complete the definition of the key measures necessary to implement the Basic Basel Principles (BBP); take measures to ensure effective corporate

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governance in banks; to adopt a regulation on the minimum organizational and functional conditions for an effective risk management system in banks; will continue to implement a strategy for state-owned banks. In relation to the latter, the Verkhovna Rada of Ukraine adopted in the first reading the Law "On Amendments to Certain Legislative Acts of Ukraine on Improving the Functioning of the Financial Sector in Ukraine" (Verkhovna Rada of Ukraine, 2018).

In fulfilling its obligations and taking into account the ineffectiveness of the risk management systems operating in most banks, the need to increase the security of the banking system and based on (Verkhovna Rada of Ukraine, 2000) the Board of the National Bank of Ukraine in June 2018 approved the "Regulation on the organization of risk management system in banks of Ukraine and banking groups " (NBU, 2018a). The regulation defines the main objectives and principles of risk management in the bank and the banking group and establishes minimum requirements for the organization of a comprehensive, adequate and effective system of risk management at all levels of management. This provision takes into account the peculiarities of the banking sector of the Ukrainian economy and emphasizes the importance of applying new information and communication technologies and systems to support the transformation processes of risk management. Such a comprehensive policy of the National Bank promotes the improvement of the investment climate in Ukraine by increasing the security of the banking system and its efficiency.

2   Innovations, challenges and chances of organizing a risk management system in Ukrainian banks

According to the requirements of the National Bank of Ukraine (NBU), the main innovations of the organization of risk management system in banks and banking groups are the delineation of powers between the board and the supervisory board, the clear distribution of functions between divisions, the introduction of "three lines of protection" (in the terminology of Basel II): business structures and supporting divisions, risk management and compliance and internal audit.

At the same time: the responsibility to shareholders and clients of the council of the bank as a supreme management body increases; the "risk

officer" is introduced into the risk management structure and the post of chief compliance officer is in place (Ministr and Pitner, 2017). Thus, the bank strengthens its own control in the interests of shareholders and depositors, becomes more secure for them.

It should be noted that significant changes in the organization of the risk management system in banks and banking groups generate a number of challenges for the banking system of Ukraine. Among them:

- the transformation of banking supervision based on a risk-oriented approach;
- transformation of the management system with increasing responsibility Councils of Banks / Supervisory Boards;
- transformation of corporate culture using a holistic risk management culture system;
- reengineering of business processes in order to improve the efficiency of the bank;
- the introduction of new information and communication technologies and systems to support transformation processes;
- selection of the necessary specialists in compliance and risk management, as well as in the design and operation of new information and communication technologies and systems;
- increase in the cost of organizing a risk management system.

Note that the principle of "three lines of defense" now applies to all types of risks, and not just operational. At the same time, the transformed banking supervision together with the external audit can be considered as the "fourth line of defense" in the banking system (Fig. 1). A similar proposal was submitted (Arndorfer and Minto, 2015).

In this model, all employees are responsible for risk management and the management environment as part of their role in the relevant "defense line".

The first line of defense includes business units and divisions supporting the activities of the bank. The contribution of the first "line of defense" to the efficiency of the bank's operation consists in preventing (at the sites of responsibility areas) risk events, minimizing losses during their implementation, as well as time and expenses for leveling the consequences.
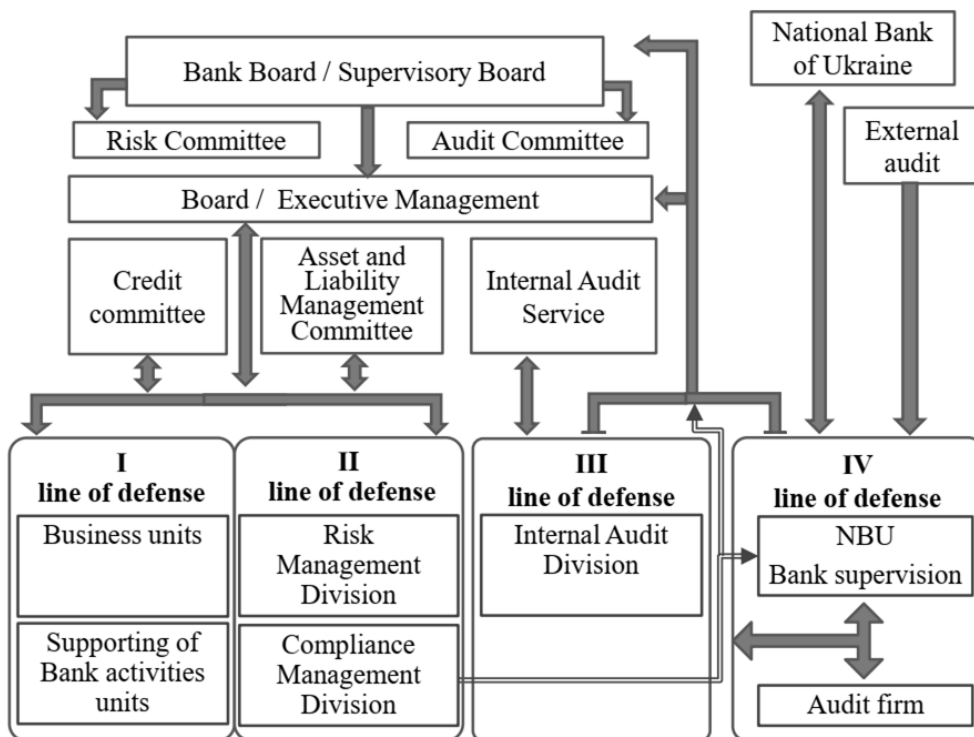
Figure 1 Model "4 lines of defense" in the banking system", Source: Own, development based on (NBU, 2018b) and (Arndorfer and Minto, 2015).

The second line of defense establishes policies and guidelines for the management of specific types of risk, provides the first line of defense (risk owners) with recommendations for effective risk management. The contribution of the second "line of defense" to improving the efficiency of the bank's operation, in our opinion, consists in: proactive risk management; optimal spatiotemporal allocation of the necessary expenses for it on objects; in an adequate assessment of the required capital reserve at risk; in optimal management of the necessary changes (when risk events occur) according to the criteria for minimizing total losses. A feature of this "line of defense" is the presence of a unit for monitoring compliance with the rules (compliance). The compliance officer has the right to veto decisions of bank management bodies, as well as the obligation to inform the NBU about confirmed facts of unacceptable behavior in the bank / violations in the bank's operations and conflicts of interests. Internal audit, as the third "defense lines", carries out checks and assesses the effectiveness of the functioning of the risk management system in the bank. The primary role of Internal Audit is to help

the Board and Executive Management to protect the assets, reputation and sustainability of the bank.

Banking supervision, as the fourth "line of defense" in the banking system: defines the main objectives and principles of risk management; establishes minimum requirements for the organization of an effective risk management system and the timing of their phased implementation by banks until 2020. This sets the general direction of risk management development in line with the transformation processes in the banking system of Ukraine.

Each bank chooses specific ways to fulfill the requirements of the NBU on the basis of its business specifics and the amount of assets, and bank supervision during inspections assesses the accuracy of the organization of the risk management system and its effectiveness. To accomplish its objectives, the bank must create a reliable risk management and reporting information system.

The National Bank defines the information system as a set of technical tools, methods and procedures that ensure registration, storage, processing, monitoring and timely generation of reliable information for reporting (informing), analyzing and making timely and adequate management decisions on risk management. Such a system provides aggregation of data on risks of a bank, rapid and reliable measurement of risks both at the level of an individual bank and at the level of a banking group, both in ordinary and in stressful situations. An integrated model can be used to identify crisis situations (Karpinski, 2015) and ICT support for emergency management (Rácek and Ministr, 2012).

3   Information Systems of the Management of risks and reporting

Information systems must meet certain requirements of the National Bank of Ukraine to automate the processes of risk management, compliance and internal audit of each of the "defense lines". To build such systems, you can use, for example, the SAS complex of solutions for financial institutions (SAS Institute Inc., 2016): SAS® High-Performance Risk - to support effective decision-making based on the perception of all corporate risks; SAS® Risk Management for Banking - for analyzing the main types of banking risks and calculating capital; SAS® Visual Analytics - for visual presentation of all data,

identifying relationships, trends and characteristics, publishing reports on the
Internet and working with reports on mobile devices. The basis of these
solutions is an integrated environment for automating the management of all
types of risks and internal audit. The system is based on unified DI (Data
Integration) and BI (Business Intelligence) platforms and provides banks with
a proven tool for building a unified centralized management system for all
types of risks across the organization that meets all the requirements of Basel
II and III. In Figure 2 shows the SAS System of Risk Management
and Compliance.

Figure 2   SAS System of Risk and Compliance Management, Source: SAS, 2016.

Figure 3 shows the visualization of results in the SAS$^{®}$ Risk
Management for Banking.

Figure 3 Portal in the SAS® Risk Management for Banking, Source: SAS, 2017.

4   Conclusion

Improving risk management is an important component of corporate governance in the banking system and the resolutions of the Board of the National Bank of Ukraine are aimed at improving its reliability and stability. The application of the "4 lines of defense" model raises the overall level of risk culture, ensures the maximization of profitability within the framework of an adequately assessed ability of the bank to accept risk.

To fulfill the requirements of the NBU, the bank must create a reliable information system to automate the processes of each of the "lines of defense": internal control, risk management, compliance and internal audit. For these purposes, it is advisable to use the best solutions in its class, for example, from the company SAS. They allow with a high-quality assessment of all types of risks and their impact on the efficiency of the bank.

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Innovative Technologies of Forecasting on the Example of the Budget of Ukraine in the Conditions of Transformation

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Abstract. The main economic indicators of the budget of Ukraine are considered, their structure and dynamics are analyzed. On the basis of the coefficient of coverage of expenditures by income, budgeting efficiency was calculated and imbalances were identified. The link between changes in the structure and dynamics of the budget of Ukraine and changes in the macroeconomic environment has been established. Since the Ukrainian economy is under the influence of globalization, integration and transformation processes, and its dynamics is nonlinear, variable in terms of behavior and structure, therefore forecasting by methods under unchanged conditions will not be correct. For the account of both external and internal sources of changes in the Ukrainian budget, the forecasting concept was proposed based on the integration of on the integration of linear regression, moving average, exponentially smoothed moving average, leading indicators and the Hurwitz criterion. The forecasts for 2018-2019 are made taking into account instability of the filling and distribution of the budget of Ukraine in the conditions of transformation changes.

Keywords: Budget of Ukraine, revenues, expenditures, forecasting, moving average, exponential smoothing, leading indicators, Hurwitz criterion

JEL Classification: C02, C53, G21

1   Formulation of the problem

The state budget of Ukraine, as a complex system integrated into the economy, fulfills the role of the main financial plan of the country and is agreed upon terms of accumulation and use of estimates of income and expenditures of financial resources. The state budget provides funding for measures of social and economic development of national importance, as well as interstate relations, and redistributes part of the financial resources between the administrative and territorial entities of Ukraine taking into account the ecological, economic, social conditions, the need to create equal conditions

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for financial provision of the regions. With the help of the budget, the most important proportions of the development of the economic system are reproduced, in particular, the structure of social production is formed, and an appropriate correlation between consumption and accumulation is provided (Euler, 2005). The budget creates an opportunity to regulate the efficiency and balance of development of the production and non-productive sphere, influence on the pace of development and structure of social production. The budget, as the main resource of centralized resources and the budget policy tool, is formed according to certain principles and in a certain order. The basis of budget formation is budget process, in which the planning of incomes and expenditures plays a significant role. Long-term planning options are limited, as the budget should reflect the cost estimate for a specific period of time. The effectiveness of budget planning depends on the quality of its implementation, that is, the formation of a financial plan sufficiently real enables the balance to be ensured between revenue and expenditure, to accumulate the necessary funds and to effectively finance the expenditures necessary for the successful execution of tasks entrusted to the state. One of the most effective planning tools is prediction, which caused the research problem.

1.1   Analysis of recent research

The budget and problems of managing it, according to both foreign and Ukrainian scholars (Euler, 2005), belong to the most acute. The question of effective planning and execution of the budget, optimization of the structure of the revenue and expenditure parts of it become of particular importance. A broad reflection of the issue of the budget process was found in the writings of O. Vasilik [Vasylyk and Pavliuk, 2010), V. Oparin (Euler, 2005), V. Fedosova (Fedosov et al, 2004), J. Shumpeter (Shumpeter, 1982), and others. However, the analysis of scientific literature shows that in the context of transformational changes, the question of assessing the dynamics of the budget, changes in its structure and the impact of the economic environment

remain relevant. Forecasting, which was not given proper attention, is especially important for budgeting.

1.2 The purpose of the study

The purpose of the study is to analyze the dynamics of the budget of Ukraine in the conditions of transformation changes, to develop analytical tools for forecasting it, based on the integration of linear regression methods, exponential smoothing, leading indicators and Hurwitz's criterion.

2 Main results of the study

2.1 Analysis of the dynamics of expenditure and revenue parts of the budget of Ukraine. Efficiency ratios of budgeting

One of the conditions for the correct definition of planned budget indicators is a deep retrospective and prospective analysis of its state and dynamics. We will analyze the behavior of the income and expenditure part of the State Budget of Ukraine per month during 2013 and 2017 (Table 1), (State Treasury of Ukraine).

Table 1 The dynamics of incomes and expenditures of the State Budget of Ukraine during 2013, 2017. Source: own.

№	Period, t	Revenues, million UAH	Expenditures, million UAH	Period, t	Revenues, million UAH	Expenditures, million UAH
1	31.01.2013	23 201	24 815	31.01.2017	59447	42892
2	28.02.2013	31 292	31 833	28.02.2017	52601	67685
3	31.03.2013	29 296	31 209	31.03.2017	62711	73982
4	30.04.2013	22 329	33 850	30.04.2017	85027	55687
5	31.05.2013	29 222	32 122	31.05.2017	65987	59792
6	30.06.2013	27 317	31 618	30.06.2017	69133	65989
7	31.07.2013	27 192	34 420	31.07.2017	52809	54461
8	31.08.2013	27 940	32 243	31.08.2017	79874	68589
9	30.09.2013	32 954	33 203	30.09.2017	58167	81991
10	31.10.2013	27 935	32 990	31.10.2017	61713	75172
11	30.11.2013	30 129	35 876	30.11.2017	77003	73685
12	31.12.2013	30 373	49 224	31.12.2017	68793	119317
13	31.01.2014	25 299	26 895	31.01.2018	55187	46881

The analysis of the tables gives us an opportunity to draw conclusions about the non-linearity of the behavior of the income and expenditure part of the State Budget of Ukraine during the years 2013 and 2017. The existing imbalance between the revenue and expenditure parts of the State Budget of Ukraine is explained by the opposite processes in 2013: a decline in production, which leads to a reduction in revenues and an increase in wages, which stimulates an increase in expenditures; in 2017: a slight increase in production and a significant increase in spending on reform and wages. Under such conditions, ensuring the balance of the budget, and at the same time the financial stability of Ukraine, becomes a difficult issue.

The system has the property of an emergence, which manifests itself in the presence of properties not characteristic of its constituents. For the system-wide feature of the budget we will adopt an income coverage ratio, the amount of which we expect, as the ratio of income to expenditures (Table 2).

Table 2 The dynamics of revenues, expenditures and budgeting efficiency during 2013 and 2017. Source: own.

№	Period, t	Revenues, million UAH	Expenditures, million UAH	Covering coeff.	Period, t	Revenues, million UAH	Expenditures, million UAH	Covering coeff.
1	31.01.2013	23 201	24 815	0,93	31.01.2017	59447	42892	1,39
2	28.02.2013	31 292	31 833	0,98	28.02.2017	52601	67685	0,78
3	31.03.2013	29 296	31 209	0,94	31.03.2017	62711	73982	0,85
4	30.04.2013	22 329	33 850	0,66	30.04.2017	85027	55687	1,53
5	31.05.2013	29 222	32 122	0,91	31.05.2017	65987	59792	1,10
6	30.06.2013	27 317	31 618	0,86	30.06.2017	69133	65989	1,05
7	31.07.2013	27 192	34 420	0,79	31.07.2017	52809	54461	0,97
8	31.08.2013	27 940	32 243	0,86	31.08.2017	79874	68589	1,16
9	30.09.2013	32 954	33 203	0,99	30.09.2017	58167	81991	0,71
10	31.10.2013	27 935	32 990	0,85	31.10.2017	61713	75172	0,82
11	30.11.2013	30 129	35 876	0,84	30.11.2017	77003	73685	1,05
12	31.12.2013	30 373	49 224	0,62	31.12.2017	68793	119317	0,58
13	31.01.2014	25 299	26 895	0,94	31.01.2018	55187	46881	1,18

The dynamics of the income expense ratio is non-linearly changing from 0.30 to 1.18 in 2013 and from 0.62 to 0.99 in 2017, indicating a low level of budgeting efficiency and a budget deficit in both periods under consideration.

2.2   Forecast of expenditure and revenue parts of the budget

Forecasting of economic indicators based on trend models, like most other methods of economic forecasting, is based on the idea of extrapolation. Under extrapolation is usually understood distribution of regularities and relationships operating in the investigated period, beyond its limits. In the process of constructing predictive models in their structure, sometimes elements of the future predicted state of an object or phenomenon are laid, but in general, these models reflect the patterns observed in the past and present, therefore reliable forecast is possible only with respect to such objects and phenomena which in largely determined by the past and present.

In order to predict the revenue and expenditure part of the State Budget of Ukraine in 2018 and 2019 with the help of growth curve models in MS Excel, it is first necessary to select the initial range of dynamics on the basis of which forecasting will be carried out. The result of the forecast will be a series of data that will increase linearly, but it will show a rather poor quality of the forecast because the dynamics of the State Budget revenues in different periods of the year is different from the average annual, this is due to a certain seasonality in budget filling, which is observed in each of the previous years among the ones we selected initial data.

To determine the seasonal factors, we need to divide the sum of all the full years of our initial data into the total amount of the whole sample and multiply it by 12th (Table 3).

The next step is to find the deviation and, accordingly, confidence intervals for our first forecast. The confidence interval is the range around each predicted value, which according to the forecast should reach 95% of future points (in the case of normal distribution).

After we calculate the deviation, we have it 6 360.12 million UAH, we will deduct it and add it to its predicted value and we will get an interval in which with our probability of 95% will be our forecast (Table 4).

Table 3   Values of seasonal factors for incomes and expenditures of the State
Budget of Ukraine for the period 2013 - 2017. Source: own.

Month	Seasonality factor for income	Seasonality factor for expenditures
January	65,28%	72,25%
February	89,18%	74,80%
March	115,11%	98,99%
April	95,05%	95,28%
May	96,71%	94,07%
June	90,15%	96,72%
July	83,95%	92,04%
August	109,85%	91,12%
September	101,51%	102,69%
October	101,12%	100,98%
November	124,73%	113,35%
December	127,37%	167,72%

Table 4   The results of the forecast of incomes of the State Budget of Ukraine
for 2018 - 20192013 - 2017. Source: own.

Forecast period	Revenues - Forecast million UAH	Revenues - Pessimistic Forecast million UAH	Revenues - Optimistic Forecast million UAH
February 2018	62 444,40	56 084,28	68 804,52
March 2018	81 473,11	75 112,99	87 833,23
April 2018	68 071,31	61 711,19	74 431,43
May 2018	70 046,81	63 686,69	76 406,93
June 2018	66 057,96	59 697,84	72 418,08
July 2018	62 191,43	55 831,31	68 551,55
August 2018	82 307,87	75 947,75	88 667,99
September 2018	76 906,87	70 546,75	83 266,99
October 2018	77 436,57	71 076,45	83 796,69
November 2018	96 564,41	90 204,29	102 924,53
December 2018	99 646,42	93 286,30	106 006,54
January 2019	51 614,13	45254,01	57 974,25
February 2019	71 265,67	64 905,55	77 625,79
September 2019	86 947,36	80 587,24	93 307,48
October 2019	87 438,89	81 078,77	93 799,01
November 2019	108 902,09	10 2541,97	115 262,21
December 2019	112 245,56	105 885,44	118 605,68

Now, summing up the results of our forecast for each of the months 2018 and 2019, we will get results for the revenue part of the budget in the corresponding years. Therefore, according to our first forecast, with the help of linear regression approximation, the income of the state budget in 2018 will amount to 888 304.60 million UAH. (confidence interval with a probability of 95% from UAH 811 983.16 million to UAH 964 626.04 million) and UAH 1,007,002.57 million. in 2019 (confidence interval from UAH 930 681.13 million to UAH 1,083,324.01 million).

In the same way as income forecasting, we take seasonal factors into account in our forecast and expect deviations in costs. For this forecast it is UAH 8,996 mln. After finding a deviation, we can establish confidence intervals (Table 5).

Table 5 The results of the forecast of expenditures of the State Budget of Ukraine for 2018 - 20192013 - 2017. Source: own.

Forecast period	Expenditures - Forecast million UAH	Expenditures - Pessimistic Forecast million UAH	Expenditures - Optimistic Forecast million UAH
February 2018	62 444,40	56 084,28	68 804,52
March 2018	81 473,11	75 112,99	87 833,23
April 2018	68 071,31	61 711,19	74 431,43
May 2018	70 046,81	63 686,69	76 406,93
June 2018	66 057,96	59 697,84	72 418,08
July 2018	62 191,43	55 831,31	68 551,55
August 2018	82 307,87	75 947,75	88 667,99
September 2018	76 906,87	70 546,75	83 266,99
October 2018	77 436,57	71 076,45	83 796,69
November 2018	96 564,41	90 204,29	102 924,53
December 2018	99 646,42	93 286,30	106 006,54
January 2019	51 614,13	45254,01	57 974,25
February 2019	71 265,67	64 905,55	77 625,79
September 2019	92 859,10	86 498,98	99 219,22
October 2019	77 472,79	71 112,67	83 832,91
November 2019	79 612,55	73 252,43	85 972,67
December 2019	74 975,54	68 615,42	81 335,66

Now, having summed up the results of our forecast for each of the months 2018 and 2019, we will receive the expected results for the expenditure part of the budget in the corresponding years. Therefore, according to the

forecast, with the help of linear regression approximation, the state budget expenditures in 2018 will amount to 915 415.66 million UAH. (in the confidence interval from UAH 807 463.66 million to UAH 1 023 267.67 million) and UAH 1 026 249.43 million. in 2019 (confidence interval from 918 297.42 million UAH to 1 134 201.44 million UAH).

According to our second forecast, built on the basis of a smooth series of dynamics by a simple moving average in 2018, the State Budget revenues will amount to UAH 890 240.68 million. (confidence interval - 835,898.16 million UAH $< \hat{y}_3 <$944 583,19 million UAH) and UAH 1,009,807.58 million. in 2019 (955 465,06 million UAH $< \hat{y}_3 <$0664,150.10 million UAH).

Expenditures in 2018 in turn will amount to 912 142.19 million UAH. (848,504.45 million UAH $< \hat{y}_3 <$975 779.94 million UAH) and 1 022 774.38 million UAH. in 2019 (959 136.64 million UAH$< \hat{y}_3 <$ 1,086,412.12 million UAH).

The third forecast is based on the exponential smoothing of a number of dynamics. According to him, in 2018, the State Budget revenues will amount to 847,938.39 million UAH. (confidence interval - 801,781.90 million UAH $<$ $\hat{y}_3 <$894,094.88 million UAH) and 961,614.10 million UAH. in 2019 (915 457.62 million UAH $< \hat{y}_3 <$1 007 770.59 million UAH).

Expenditures in 2018 in turn will amount to 875,635.46 million UAH. (at the confidence interval - 840,028.13 million UAH $< \hat{y}_3 <$911,242.79 million UAH) and 982,974.88 million UAH. in 2019 (947,367.55 million UAH$< \hat{y}_3$ $<$0185,882.1 million UAH).

2.3   Clarifying the forecast based on leading indicators

Using prediction models we predicts some confidence interval and the exact value of a row that divides this interval by 2. In most cases, the interval is quite large. Therefore, for a more accurate forecast, it is necessary to determine the trend to be able to select only one part of the confidence interval. To do this, you need to use other methods of forecasting. In particular, it is suggested to use the method of leading indicators (Kvasnij et al, 2010). Having analyzed the impact of various factors, we came to the conclusion that the most significant are GDP, average wages and consumer price index.

Table 6 presents the behavior of GDP, average monthly wage and consumer prices chain indices as key indicators of Ukraine's economic development during 2005-2017. On the basis of the analysis of their dynamics can be concluded that their nonlinearity and intolerance, as well as the existence of a close relationship between these indicators (State Statistics of Ukraine*).*

Table 6   Dynamics of GDP, average monthly wages, consumer price index and their chain growth rates during 2005-2017. Source: own.

№	Period, t	GDP, million UAH	Chain rate of GDP growth	Average monthly wages, UAH	Chain growth rate of the average monthly wage	Consumer price index
1	2005	441 452	1,28	806	1,37	1,10
2	2006	544 153	1,23	1041	1,29	1,12
3	2007	720 731	1,32	1351	1,30	1,17
4	2008	948 056	1,32	1806	1,34	1,22
5	2009	913 345	0,96	1906	1,06	1,12
6	2010	1 082 569	1,19	2239	1,17	1,09
7	2011	1 302 079	1,20	2633	1,18	1,04
8	2012	1 411 238	1,08	3 026	1,15	0,99
9	2013	1 454 931	1,03	3 265	1,08	1,01
10	2014	1 566 728	1,07	3 470	1,06	1,25
11	2015	1 979 458	1,26	4 207	1,21	1,43
12	2016	2 383 182	1,20	5 187	1,23	1,12
13	2017	2 982 920	1,26	6 993	1,35	1,14

Let's consider how the external environment, the economic system, affects the Consolidated Budget of Ukraine. In particular, the graph (Figure 1) shows that the dynamics of one of the main characteristics of the economic system of GDP is closely related to the dynamics of the revenue side of the Consolidated Budget of Ukraine.

Figure 1   Dynamics of the chain GDP growth rate and income of the Consolidated
Budget of Ukraine during 2005-2017, Source: own.

The dynamics of the chain growth rate of the average monthly wage almost coincides with the dynamics of the chain growth rate of the Consolidated Budget expenditures in Ukraine during 2005-2017, and the consumer price index also has a similar trend (Fig. 2).
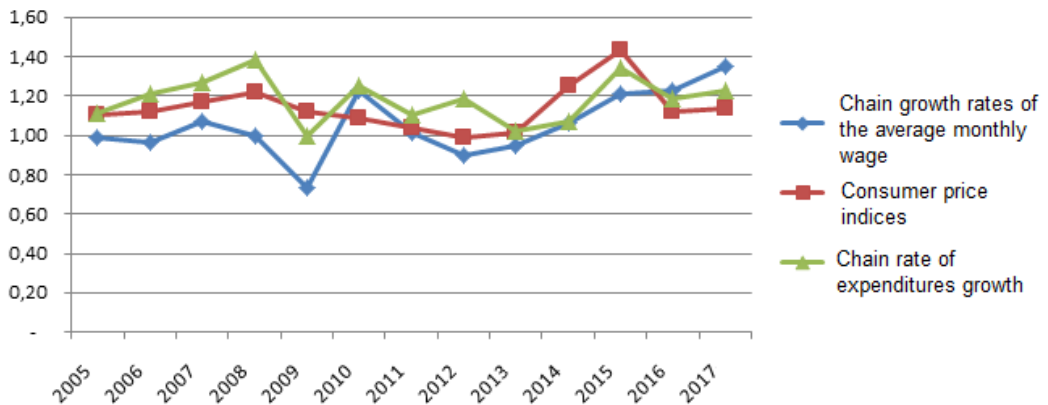
Figure 2   Dynamics of the chain growth rates of the average monthly wage, consumer
price indices and expenditures of the Consolidated Budget of Ukraine during
2005-2017, Source: own.

Taking into account the aforementioned, it can be assumed that the expenditures of the Ukrainian budget depend on the previous value of the average monthly wage, as well as on the consumer price index, and revenues - on GDP. Consequently, it can be argued with some probability that in the short term the tendency to increase expenditures and revenues of the budget of Ukraine will continue. Under these conditions, we can only take into account one part of the confidence intervals that were received. Thus, for the

revenue part of the budget, the forecast interval will be (888304,6; 964626,04), (847938,39; 894094,88) and (890240,68; 9444583,19) for 2018 and (1007002,57; 108324,01), (961614.1; 1007770.59), (1009807.58; 1064150.1) for 2019. For the expenditure part, the forecast interval will be (915415,66; 1023267,67), (875635,46; 911242,79), (912142,19; 975779,94) for 2018 and (1026249,43; 1134201,44), (982974,88; 1018582,21), (1022774,38; 1086412,12) for 2019. Thus, by combining several methods of forecasting, it was possible to obtain much more accurate predictive values in comparison with forecasts that were obtained by each method in particular (Hladkykh, 2012).

2.4 Improvement of the forecast based on the Hurwitz criterion

In order to improve our forecasting models, we must use the criterion of Hurwitz's pessimism-optimism. His meaning is that when choosing a solution, he recommends guiding some average result, which characterizes the state between extreme pessimism and unbridled optimism, that is, the criterion chooses an alternative with a maximum average result (there is an implicit assumption that each of the possible states of the environment can occur with equal probability). Formally, the Hurwitz criterion looks like this:

$$H = \max_{i}\left(k \min X_{ij} + (1-k)\max_{j} X_{ij} \right) \tag{1}$$

where k is the pessimism coefficient that falls between 0 and 1, depending on how the decision maker evaluates the situation. If he approaches her optimistically, then this value should be greater than 0.5. In a pessimistic evaluation, it should take the mentioned value less than 0.5. In our case, the coefficient is set depending on the situation that is observed in the economy.

So now we calculate with the help of the Hurwitz criterion for each of our forecasts more advanced values. Parameter k - we will give value at level 0.5.

In calculating the Hurwitz criterion, we first need to choose the most pessimistic and optimistic scenarios with our predicted ones. For the revenue

part of the State Budget of Ukraine for 2018, these amounts to UAH 847938.39 million. and 964626,04 million UAH. in accordance.

$$H^r_{2018} = 0{,}5*847938{,}39+(1-0{,}5)*964626{,}04 = 906282{,}215 \text{ million UAH}$$

For the expenditure part of the State Budget of Ukraine for 2018, the most pessimistic is the result - UAH 1023267.67 million, and the most optimistic is UAH -875635.46 million. Then, respectively

$$H^e_{2018} = 0{,}5*1023267{,}67+(1-0{,}5)*875635{,}46 = 949451{,}565 \text{ million UAH}$$

Using a similar algorithm, we will calculate the Hurwitz criteria for forecasts of the revenue and expenditure parts of the State Budget in 2019:

$$H^r_{2019} = 0{,}5*961614{,}1 + (1-0{,}5)* 108324{,}01 = 949451{,}565 \text{ million UAH}$$

$$H^e_{2019} = 0{,}5*1134201{,}44+(1-0{,}5)*982947{,}88 = 1058588{,}16 \text{ million UAH}$$

In late 2017 the Parliament of Ukraine adopted the draft law on state budget for 2018. In the draft budget for the following year, the following indicators were set: revenues of the State Budget at the level of 917879.4 million UAH. and expenditures of UAH 991700 mln.

Actually, the figures in the project are somewhat different from those projected by us, namely, lower incomes by 1.3%, expenditures lower by 4.5%.

Thus, it can be argued that our forecast of revenue and expenditure of the State Budget of Ukraine for 2018 is accurate and adequate as the error of real data did not exceed 5%.

3   Conclusion

Consequently, the Consolidated Budget of Ukraine, as a financial and economic system, is characterized by dynamism, which consists of changing the behavior and structure of the system with time, and this change is closely related to the change of the external environment. The dynamics of the budget of Ukraine are influenced both by internal structural changes and the external environment. In order to characterize the dynamics of the environment, they are selected as indicators: GDP, average wages, consumer price index, and their impact on the Consolidated Budget of Ukraine. The work estimates the expenditures and revenues of the budget for 2018-2019,

the forecast is updated with the help of leading indicators and the obtained data are improved with the help of the Hurwitz criterion.

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Development of a Virtual Instrument forQuality Control of Objects of Non-electric Nature

Ihor Midyk [1], Olga Lysa [2]

Abstract. Operational quality control of vegetables can be carried out using the imitative method of controlling their electrophysical parameters. The imitative method is based on measuring the electrical conductivity of control objects. Electrophysical parameters of vegetable juices are investigated. The electric and mathematical model of quality control of objects of non-electric nature is made, taking into account the results of experimental studies of the change of active and reactive conductivity components in the frequency range of the test signal. A virtual instrument was created to measure immittance. The experimental data obtained are processed using the LabView graphical platform, which works with USB 6009 self-contained measuring devices. For the generation of an alternating voltage, it is suggested to use the Loop cycle. The USB 6009 is managed through the DAQ task software.

Keywords: conductivity, immitance, admittance, virtual instrument, LabView graphics platform

JEL Classification: C53

1 Introduction

Vegetables are important food products that provide the consumer with useful minerals such as sodium, potassium, calcium, magnesium, iron. They are involved in the activities of enzyme systems, the creation of cells in the body. However, they can also have harmful elements, including toxins (lead, cadmium, arsenic, mercury, copper, zinc), the presence of which in vegetables exceeds the maximum permissible standards are dangerous to the health of the consumer. Therefore, operational methods of controlling concentrations in vegetables of useful and harmful elements are relevant.

The subject of the study is the development of a virtual instrument for measuring the physical parameters of liquids. The purpose of the research is to develop a method for the rapid determination of the concentration

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of useful minerals and harmful substances in vegetable juice by electrical parameters.

To achieve this goal, the following tasks were solved:

- to carry out systematic analysis of methods for quantitative determination of mineral substances in liquids;
- to develop the methodology and structure of the measuring instrument for the study of the influence of the concentration of mineral substances in vegetable juice on the components of its electrical conductivity;
- to work out the received experimental researches of changes of active G and reactive B in conducting components (admittance) and to give recommendations on operative quality control of vegetables in production conditions with insignificant material resources;
- to build a virtual instrument for measuring the physical parameters of liquids.

Laboratory Virtual Instrument Engineering Workbench (LabVIEW) is a system-design platform and development environment for a visual programming language from National Instruments.

The program is written using the graphics platform LabView contains two windows Front Panel and Block Diagram

You build the front panel using controls and indicators, which are the interactive input and output terminals of the VI, respectively. Controls are knobs, push buttons, dials, and other input mechanisms. Indicators are graphs, LEDs, and other output displays. Controls simulate instrument input mechanisms and supply data to the block diagram of the VI. Indicators simulate instrument output mechanisms and display data the block diagram acquires or generates.

After you build the front panel, you add code using graphical representations of functions to control the front panel objects. The block diagram contains this graphical source code, also known as G code or block diagram code. Front panel objects appear as terminals on the block diagram.

The following VI contains several primary block diagram objects-terminals, functions, and wires.

By Syrokhman I. V., Zavhorodnia V. M. (2009) - to evaluate the quality of food products, organoleptic and sensory analysis is often used. However, with their help it is impossible to determine all the necessary qualitative characteristics with high accuracy. Measuring quality control methods allow for more accurate quality control of materials – by Romodanova V. O. (2009). Depending on which processes are laid down in the basis of the measurement method or which properties are used, the measuring methods are classified into: physical, chemical, physico-chemical, microbiological, technological, biochemical, biological, commodity research. Methods for determining the concentration of Cu and other mineral elements are based on the obtaining of ash, which is obtained without accelerator and accelerator. However, measuring methods for controlling the quality of vegetables have a number of disadvantages, including: long process of preparation of samples for measurement, use for measuring expensive devices, highly skilled specialists.

According to the authors of the article, for the study of the quality of vegetables it is necessary to develop methods that would have a wide range of uses, high sensitivity, resolution, simple preparation of samples and affordable by the cost and ease of working with the device in the production environment, a significant rate of analysis. Such requirements, basically, correspond to conductometric methods of research. Conductometric method is based on measuring the electrical conductivity of control objects. At present, conductometry is used to quickly determine the concentration of solutions of salts, acids, bases, to control the composition of some industrial solutions. Conductometry involves direct methods of analysis and indirect using constant or alternating current (low and high frequency), as well as chrono-compactometry, low frequency and high-frequency titration. Determination of concentration is carried out by direct conductometry (according to the calibration graph, it allows directly determining the concentration of the electrolyte by measuring the electrical conductivity of the solution with known qualitative composition) or by conductivity titration (the method of analysis, based on determining the content of the substance by fracture of the titration curve). To determine the composition of the liquid, the frequency dependence of the dielectric losses of the substance is used, since it is a characteristic of the material. Conductometric analysis is based on a change in the concentration of a substance or the chemical composition of the medium

in a microelement space; it is not connected with the electrode potential, which is often close to the equilibrium value. Indicators characterizing non-electrical properties of the product are measured by converting the physical and chemical properties of substances and materials into an electrical signal using various primary converters (sensors). On the basis of the conductometric method in this work, experimental studies were carried out, the essence of which is to provide a sinusoidal signal to the solution under study and to analyze the response at the output.

2   Assessment of quality of vegetable products according to electric characteristics

Such scientists as Pokhodylo Ye. V., Stolyarchuk P. H. (2012) proposed way to study the quality control of vegetable juice by using the imitative method. To study the quality indicators, an experimental installation was created, the structure of which is shown in fig. 1.
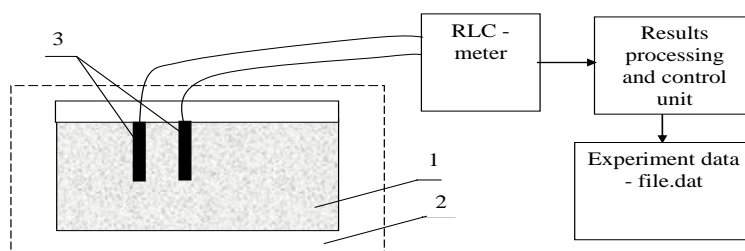
Figure 1   Structure of measuring means for imitative control of vegetable juice quality indicators: 1 - capacity filled with juice; 2 - Conductometric cell (capacitive transducer); 3 - graphite electrodes, Source: own.

The main units of the measuring instrument for immittance control of vegetable juice quality indicators are capacitive transducer, RLC-meter and a unit for processing results and control (computer). The main indicators to be studied are: the quantitative content of copper ions in carrot juice.

The principle of operation of a measuring instrument is as follows:

- in the laboratory conditions, model liquids - carrot juice of known characteristics;
- the model fluid was placed in a capacitive converter 2 with square graphite electrodes 3, which were completely immersed in a vessel 1 (the volume of the liquid did not affect the capacity of the converter);

- in response to the test signal on the RLC-meter, the characteristics of the studied model liquid (components of the juice's electrical conductivity) are obtained. Measure active G and reactive B components of conductivity (admittance);
- the data from the RLC-meter arrive at the result and control unit, they are processed by the computer and presented as experiment data in the form of a file with the extension dat;
- compare the results of the measurements and draw conclusions about the quantitative composition of the mineral substances in the model liquid.

The range of frequencies in which the conductivity measurements were carried out, as well as the amplitude of the test signal (1 mV) were asked by the researcher in the result and control unit. The content of copper ions in carrot juice was monitored. The range of controlled substances in the experiments consisted of 0.002 to 1.9 g / l juice. The change of active G and reactive in the conductivity (admittance) in the frequency range from 50 Hz to 100 kHz depending on the composition of substances by means of capacitive sensors was estimated.

Briefly we formulate the basic principles of the study of the change of active G and reactive in the constituent conductivity (admittance).

As an input test signal, we send a sinusoidal signal. In asynchronous mode, we receive an output signal. Then for the converter the output conductivity is given by the ratio:

$$G_{out} = \frac{1}{Z_{out}} = j\omega C_x + \frac{1}{R_x} \qquad (1)$$

where R_x – active component of resistance and C_x – capacity of capacitor electrolytic cell.

The frequency of the test signal directly affects the conductivity.

Capacitance of the capacitor of the conductivity of the conductivity electrolytic cell C_x is defined as:

$$C_x = \varepsilon_p \varepsilon_0 \frac{S}{l} \qquad (2)$$

where ε_p – dielectric permittivity of the solution; ε_0 – dielectric vacuum permeability; l – the distance between the graphite electrodes, S – area of covers (electrodes).

When measured, constant values are the area of the covers and the distance between the plates of the condenser.

The display of the device at the i-th frequency is as follows:

$$N_G = k_A \frac{1}{R} \tag{3}$$

$$N_B = k_A \omega C \tag{4}$$

where N_G – active component of conductivity; N_B – reactive component of conductivity; k_A – conversion factor of ADC (analog-to-digital converter).

The results of studies on the change of active G and reactive B in the conductivity (admittance) in the frequency range from 50 Hz to 100 kHz, depending on the concentration of $CuSO_4$ in the model liquid, are presented in Table. 1 and on fig. 2, 3

Table 1 Experimental studies of the change of the active G and the reactive B component of conductance (admittance) in the frequency range from 50 Hz to 100 kHz depending on the composition of the model liquids, Source: own.

| f, Hz	Active G component of conductivity (admittance)				Reactive B component of conductivity (admittance)			
	Carrot juice	Carrot juice + 0,5 g $CuSO_4$	Carrot juice + 0,8 g $CuSO_4$	Carrot juice + 1,9 g $CuSO_4$	Carrot juice	Carrot juice + 0,5 g $CuSO_4$	Carrot juice + 0,8 g $CuSO_4$	Carrot juice + 1,9 g $CuSO_4$
50	0.0164	0.0173	0.0182	0.0189	0.0054	0.0057	0.0058	0.0069
60	0.0171	0.0179	0.0188	0.0198	0.0050	0.0053	0.0054	0.0065
100	0.0184	0.0193	0.0202	0.0216	0.0039	0.0041	0.0041	0.0052
120	0.0188	0.0197	0.0206	0.0221	0.0035	0.0038	0.0037	0.0047
200	0.0195	0.0205	0.0214	0.0232	0.0026	0.0028	0.0027	0.0035
400	0.0202	0.0212	0.0220	0.0241	0.0017	0.0019	0.0017	0.0024
500	0.0204	0.0214	0.0223	0.0244	0.0015	0.0016	0.0015	0.0021
1000	0.0207	0.0218	0.0225	0.0249	0.0011	0.0011	0.0010	0.0015
2000	0.0210	0.0221	0.0228	0.0253	0.0007	0.0008	0.0007	0.0010
4000	0.0212	0.0224	0.0230	0.0256	0.0005	0.0006	0.0005	0.0007
5000	0.0213	0.0224	0.0230	0.0256	0.0005	0.0005	0.0004	0.0006
10000	0.0214	0.0226	0.0232	0.0258	0.0003	0.0003	0.0003	0.0005
20000	0.0215	0.0227	0.0232	0.0260	0.0002	0.0002	0.0002	0.0003
40000	0.0216	0.0227	0.0233	0.0261	0.0002	0.0002	0.0001	0.0002
50000	0.0216	0.0228	0.0233	0.0261	0.0001	0.0002	0.0001	0.0002
100000	0.0217	0.0228	0.0234	0.0262	0.0001	0.0001	0.0001	0.0001
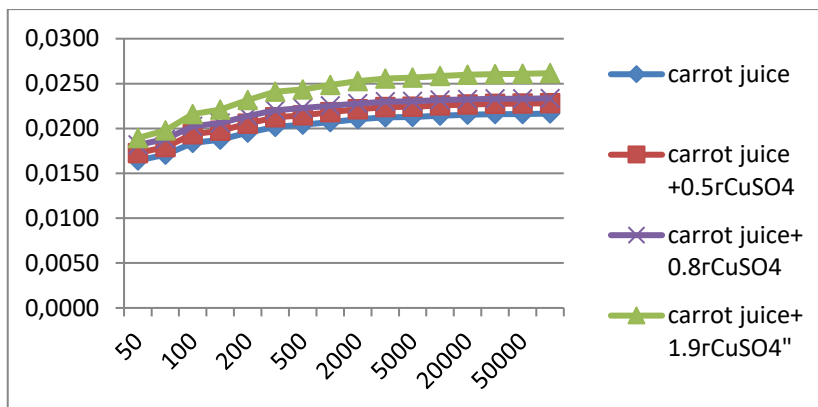
Figure 2 Schedule of the dependence of the active component G of conductivity
on the concentration of $CuSO_4$ in the model liquid, Source: own.
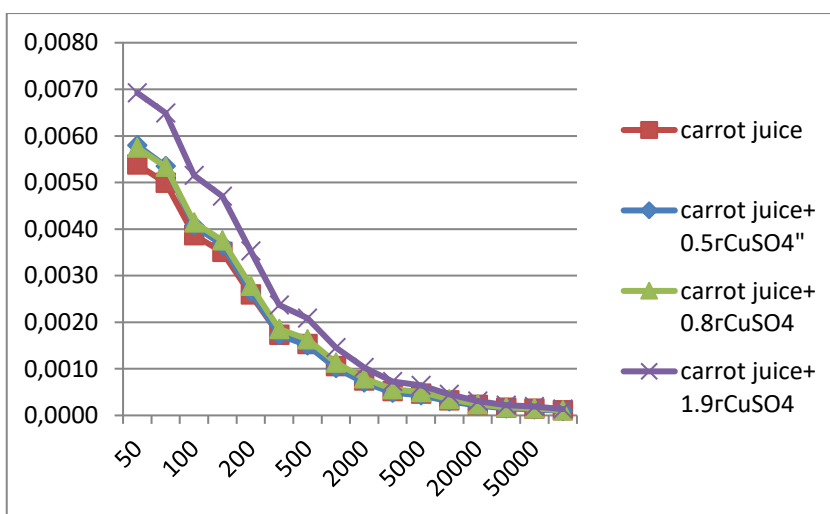
Figure 3 Schedule of the dependence of the reactive B component in conductivity
on the concentration of $CuSO_4$ in the model fluid, Source: own.

As a result of investigations of model liquids, the dependence of the active and reactive component of conductivity on the chemical nature and concentration of useful minerals and harmful substances was obtained. It has been established that the presence of $CuSO_4$ in carrot juice, which dissociate into ions in the solution, affects the dependence of both the active and reactive constituents of conductivity on the frequency of the electromagnetic field. As for the active component, there is a change in the amplitudes of the component, depending on the change in the concentration of $CuSO_4$ over the entire range of studied frequencies. The values of the reactive component

differ substantially in amplitude only at low frequencies, but this may be the result of the effects of external electromagnetic fields on the test substance. At high frequencies of the order of 5-100 kHz the value of the reactive component for juice with different concentrations of $CuSO_4$ in the amplitude practically does not differ. Consequently, the research of the reactive component of conductivity at these frequencies is non-informative.

3 Software development for immitance measurement using a USB 6009 block

As a result of the experiment described in the preceding paragraph, a series of consecutive data that reflects the physical parameters (complex voltages of the active and reactive components) is proportional to the immitance.

The simulated scheme for measuring the immitance of vegetable juice is presented in Fig. 4
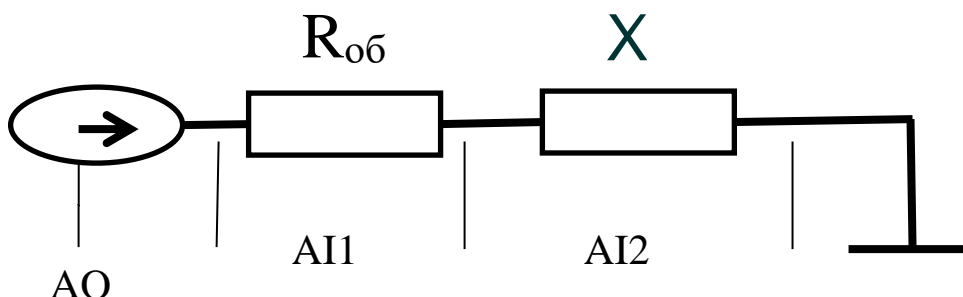
Figure 4 Diagram of measuring the immitance of juice of vegetable products, Source: own.

The scheme shows the following designations AO, AI.

AI (ANALOG INPUT), AO (ANALOG OUTPUT) – Inputs and outputs of the USB-6009 block, which is designed for reading and generating constant voltage. USB-6009 is a development by National Instruments company, which develops examples, updates their designs with the development of new software versions and to meet new user needs. The USB-6009 connects to the computer via the full-speed USB interface and has 8 analogue input channels (AI), 2 channels of generating analogue signals (AO), 12 digital input / output channels (DIO) and a 32-bit counter. Thus, AO - serves as the source of the test signal.

Since the nominal value of carrot immitance has a dimension of order of one thousandth part of Ohms, it is necessary to enter R_{lim} in the circuit to avoid overload.

The appearance of the R_{lim} is conditioned and adjusted, taking into account the approximate values of the measured immitance, as well as the technical characteristics of the USB 6009 block.

We recommend to use the LabView package to measure the immitance of the model fluid of vegetable products.

To measure and calculate the immitance of carrots, it is necessary to read the complex voltages U1 and U2. Voltages U1 and U2 are responsible for the analogue inputs of the USB 6009 block - AI1 AI2.

To calculate the immitance you need to take the following steps:

1) Generation of the test signal (sinusoid);
2) Reading of complex voltages;
3) Calculation of immitance.
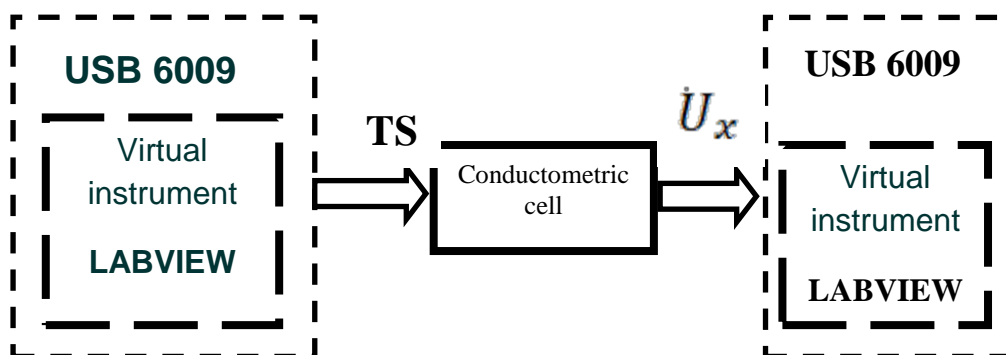
Figure 5 Block-scheme for measuring the immitance of juice of vegetable products, Source: own.

TS – test signal, $\dot{U}_x$ – complex voltages

According to specifications, the USB 6009 block generates a maximum voltage of 5V and a maximum current of 5mA.

The USB 6009 block is designed to generate DC voltage. According to the method of immitance measurement, the test signal is a sinusoid. Therefore, it is suggested to use the While Loop cycle to generate variable voltage. The USB 6009 block is managed through the DAQ task software.

All steps are executed in the LabView software package. The frequency of the test signal (sinusoidal) was given indirectly through the interval and the number of points. The signal frequency was calculated in the program approximatively.

The obtained experimental data are processed using the LabView graphical platform. In our case, the LabView system works with standalone USB 6009 devices. It has analogue inputs and outputs for generating and collecting measured data. The LabView Graphic Platform manages the USB 6009 block using the NI-DAQ (National Instruments - Data Acquisition) task. In the process of measuring is used software developed in the work.

Since the USB 6009 block does not generate a voltage variable, in the program was used separate DAQ elements and the Loop cycle with Stop Button.

The DAQ task for generating and collecting data is selected from the Functions palette in the Block Diagram window.

To start the DAQ task, you need to set the following Fig.6:

1) Receive or generate a signal
2) Type of physical measurements (voltage)
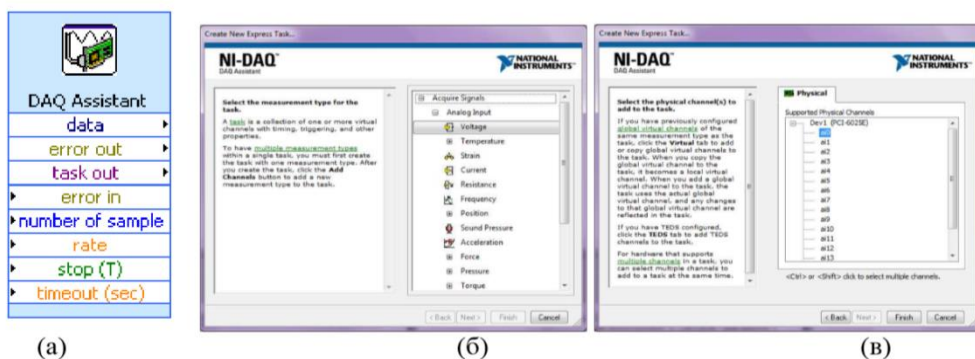3) Physical USB 6009 channels to be used.

(a) (б) (в)

Figure 6 Configuring the simulated device using DAQ Assistant:
   a) the DAQ Assistant icon;
   b) the DAQ-Assistant window, where is elected the reception or generation of the signal and the type of physical measurements (voltage) is chosen;
   c) a window listing the physical USB 6009 channels to be used,
   Source: own.

In the work for reading voltages according to the measurement scheme, shown in Fig. 4, the DAQ task setup window is presented (Fig. 7).
The window has the following options:

- Input range
- Data acquisition mode (N measurements or continuous mode)
- Frequency of measurements.
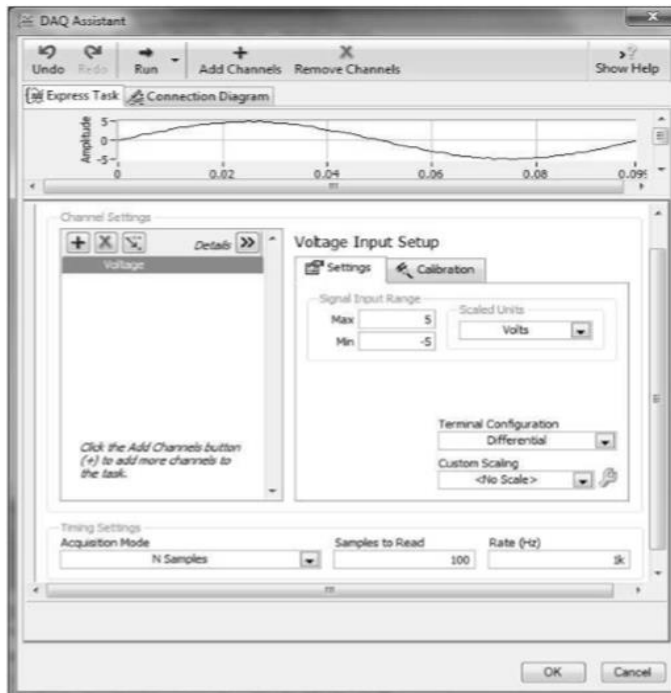
Figure 7   Setting properties of the measuring channel, Source: own.

Creating a test signal. This program demonstrates how to perform continuous analog output tasks on the USB- 6009 and also incorporates the theory of operation that is associated with software timed analog output. Continuous software timed analog output means that your analog channel will update only once for every iteration of the program's while loop. It is important to remember that these devices allow a maximum update rate of 150 samples per second on each channel; therefore the main program's while loop can iterate no faster than once every 6 ms. It is also important to remember that these devices allow an output voltage range of 0 to 5 Volts. This program outputs a sine wave with a DC offset and allows the user to select the number of points per cycle. It will be observed that increasing the points per cycle will increase the resolution of the output waveform, but also decreases its

frequency. The approximate period of the output waveform is equal to the points per cycle times the output rate.

Steps to Implement or Execute Code:

    1. Open the Test Signal VI

    2. Configure front panel controls

- Physical Channel
- Maximum Value
- Minimum Value
- Output Rate
- Points per Cycle

    3. Run the VI

4   Conclusion

On the basis of the conducted review of methods of quality control of vegetables, it was determined that the prospective method of quantitative analysis of mineral substances in vegetables is an electrical method for investigating liquids based on the principles of conductometric method.

Dependences of the active and reactive components of conductivity of vegetable juice with copper ion impurities on the frequency of the electromagnetic field in the frequency range of 50 Hz-100 kHz were established. The use of established dependencies improves the informative nature of electrical research, and thus increases the efficiency of the analysis of vegetable quality indices.

The structure of the measuring instrument for the imitative control of vegetable juice quality parameters is proposed. The described measuring instrument and the obtained dependencies make it possible to carry out an express method for controlling the concentration of harmful and useful minerals in vegetable juices by electrical parameters.

A virtual instrument for the imitative control of vegetable juice quality indicators has been created. Advantages of the device: practical and easy to use; has high accuracy of measurements; relatively cheap compared to other analogs; does not require long-term training of the studied samples; compact and non-obtrusive; provides software flexibility.

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Data Mining as Tool for Invoices Validation

Jan Sál[1]

Abstract. This paper shows, can company implement automated checks and data analysis methods into the Internal Control System of the company. The target is to make as automated process of control if the following document corresponds with the previous one. According to COSO framework, we recognize two groups of risks, which can be covered by this control mechanism. In the first step, we are speaking about pdf file to csv table conversion. After that, we developed comparison method for checking the corresponding team. Finally, we evaluate the results of the analysis and set targets for further development.

Keywords: GDPR, risk management, data mining, data protection, personal data protection

JEL Classification: G32, D81

1 Introduction

In this paper, we will have a look on the process of invoices validation, which our company receives from business partners. This validation is based only on checking of several fields, which are manually written by employee of the accounting department. It means that the system checks only fields, which people fills in. The first is the record about goods or services. Employee from the responsible business unit, who receives the goods or services, fills in the system information about delivery. The second is the employee of the accounting department, who receives an invoice.

Based on European regulation, have organizations to map, assess and prevent their risks. (Soomro and Fong-Woon, 2017). Risk Management System (RMS) are processes of mapping, assessing and preventing implemented company-wide. Risk Management System in our company consists of three layers – lines of defense. Management controls and Internal Control Measures are the key elements of the first line of defense. Each business department (atomic small part of the company) is responsible for building its own. Assurance units of the company together build the second line of defense. These are for example: Security, Quality, Compliance etc. the Third line of defense represents independent assurance for board of management and internal audit department plays key role (Brustbauer, J.

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2014). In our company are implemented processes which serves to manage these risks – they are called Risk Management System (RMS). Internal Control System (ICS) is key part of the RMS. In our company, Internal Control System works according to COSO framework. It provides to companies methodology based on years of experiences how to search, assess and prevent risks. Developer of this methodology is Committee of Sponsoring Organizations of the Tredway Commission in 1992, last major update was made in 2012 and many organizations implemented it into their ICS. (Moeler, 2017). COSO framework brings four groups of essentials risks areas. It divides them into groups depending on risks, which can endanger meeting the objectives. Each business unit (small part of the company) should work with each of these risks.

1) *Strategic risks* – relating to the entity's effective utilization of its resources to accomplish its goals and objectives, which are aligned with and supporting the entity's mission and vision. They focus on the long-term objectives of the particular business unit. All missions together make the mission of the company. If you do not deal with strategic risks well, you can survive now, but maybe you will not survive in the future.

2) *Operations risks* – relating to the effectiveness and efficiency of the entity's operations, including performance and profitability goals. These risks can endanger mid-term objectives

3) *Compliance risks* – relating to the entity's compliance with applicable laws and regulations. This group of risks can be invisible for a while but it is very dangerous.

4) *Reporting risks* – relating to the effectiveness of the entity's financial reporting process. The biggest risk from this group is that your financial reporting is not correct and you pay taxes in wrong amount.

According to COSO framework risk classification, we identified these three risks. (Janvrin et al., 2012)

- Compliance risk - Fraudulent, illegal, or unethical acts
- Compliance risk – Bribes and corruption
- Operational risk – Inefficient operations: lack of access to the goods and services per best purchasing price

2   Process of Invoices Validation

Nowadays, the process of validation of invoices works according to the systematic check of the several data elements from purchasing and accounting documents. Problem is that human fills all of these data elements into the system. There is no check of the documents based on the systematic check. As you can see, there are four steps where someone fills in the data.

1) During purchasing request (need specification) – filled in with particular **business unit**
2) Data from purchase order delivered by vendor – filled in by **purchasing department**
3) Data from invoice – filled in by an **accountant**
4) Data from delivery record – filled in by the responsible person of **business unit** – it do not have to be the same person as in the point 1 but in many cases it is the same person.
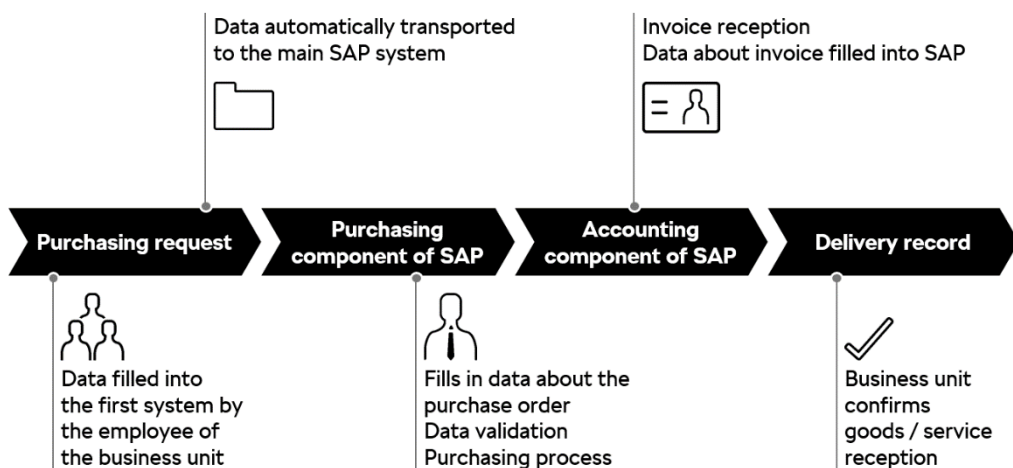
Figure 1   Document flow in the material management

   As you can see on the Figure 1 the process is not easy. It can start and end in the same person and the validation is difficult because there are only few fields, which are filled into the final system.

2.1   Process for invoices checking

The target is to have all the data from all these four documents on the one place. The best solution is to have one database with all data from particular

documents. All these documents have pre-defined structure with well-known key words, which give us possibility to identify the particular areas. Moreover, all these documents are scanned and stored as an attachment in the system. We will use this good thing, put them into the specific folder, from which we will make from scanned pdf document, document, which we can edit (it is possible to work with text instead of a picture).

After this preparation, we should prepare mockup for each kind of the document and prepare field comparison. Finally, we can evaluate the results and give feedback (reports in some period) to the business units, which monitors quality of work. On the other hand, we should have powerful tool to detect frauds or mistakes. Architecture of the solution, please find on the Figure 2.
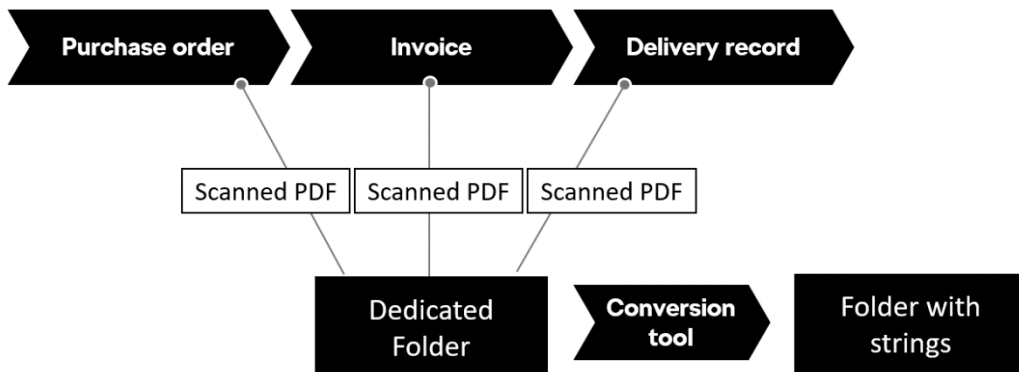
Figure 2   Pictures conversion tool architecture

As you can see, we are working with three groups of documents in general.

3   Data preparation – conversion tool

As we previously described, we are working in the SAP environment. We have developed automated temporary storage for all of these documents. Because of amount of data, we are not able to hold them all permanently two times - one copies are already stored as an attachment of particular detail structure of the record. Conversion has to be processed once a day and data on the file server on the internal network. It is not necessary to run analytical phase every day, because the csv files with bundles of marked strings are much smaller than the original pictures.

For data preparation and processing we used KNIME Analytics Platform. It is an open source tool for advanced data analytics including data mining, text mining, and predictive tools. KNIME is quite to similar to SPSS Modeler which is licensed by IBM. Its biggest advantage is that it has quite a big community which is ready to give you a hand. It has various options of prepared nodes and you can create your own workspace by combining them. (KNIME, 2017)

3.1 Conversion method

We used an R snippet to extract data from PDF file (R, 2018). We worked with the tabulizer package in R scripting language which is implemented directly as a snippet into KNIME Analytics Platform. At first, we loaded two necessary packages designed for R and distributed under open source license. They are tabulizer, dplyr. We used the same library and procedure as in the detection of risky financial transactions between our organization and embargoed partners but in this case, we worked with more tables for heather, body (which includes long texts) and footer with recapitulation. Moreover, we are processing many documents, so it was necessary to do the conversion in loop with some additional information. From the workflow we loaded some variables and used them in the conversion loop.

They are:

- Type of document (PO – Purchase Order, IN – Invoice, RR – Recipient Record
- Document number
- Date (yyyy – year, mm – month, dd – day)

R code:

```
library(tabulizer)
library(dplyr)
```

In the second step, we used function of the tabulizer called extract_tables() which gets one metrix of table for every PDF list.

R code:

```
location <- server/folder/PO_Number.pdf'
output <- extract_tables(location)
```

In the output, there are all PDF pages as a single matrix. In this phase, we have to combine all these n matrices into one matrix. We used a combination of functions do.call() which is a loopink function in other programming languages and rbind parameter which has an information about each matrix which should be combined.

R code:

```
final_table <- do.call(rbind)
```

Finally we exported the final table into a CSV file and will continue with cross-file set.

R code:

```
write.csv(final, file='PO/IN/RR_Number_yyyy_mm_dd.csv')
```

We use this method in loop for each document. It is good that there was a possibility to identify fields with important texts because we have standardized forms for each group of these documents.

(SÁL, J. 2017)

4 Data analysis

When the conversion is finished, we load all of these .csv files into the KNIME Analytics platform standard nodes to find out the right documents and make the comparison. We have identified key data elements for each check and set up specified kind of comparison. We converted all the date fields to a date format, all numbers to double and all texts to string.

Dates comparison

We converted all date fields to standardized format and deleted all blank characters using string manipulation nodes. Thanks to that, we were able to compare every date field.

Values comparison

The only difference between documents can be in value format. On the other side, they are from one subject so it should use the same format for the whole period. However, partner can change system etc. so we converted all prices and values into one formats.

Text comparison algorithms used

We are using three string comparison methods. Levenshtein's distance is a string metric for measuring the difference between two sequences. Informally, the Levenshtein's distance between two words is the minimum number of single-character edits required to change one word into the other. The Jaro–Winkler distance uses a prefix scale, which gives bigger ratings to strings that match from the beginning for a set prefix length. This is why it marks strings with the same first word as probably similar. N-gram model is a type of probabilistic language model for predicting the next item in such a sequence. In our models, we will use combination of these methods. (Sál, 2017)

5   Conclusion

Process of invoices validation is quite complicated and complex. It consists of the four independent steps and four independent documents. With this conversion and comparison tool, you are able to validate basic facts about documents.

Thanks to that, you can automatically control this process and eliminate the risk of human mistake.

It is important to say, that this is only the first step of bundle of tools, which can cover these risks as a complex solution. Pilot phase did not show exact results. Especially long text comparison method should be upgraded. The pilot project showed that only comparison is not enough. We have to implement methods of natural language processing pro precise the searching machine.

The second improvement can be in the systems connection. This searching machine can only check if the documents fits to each other. Connection between records in the SAP system and this kind of control can help us cover these risks more effective.

Acknowledgements

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INFORMATION SECURITY

The Models and Information Technologies of the Risk-Oriented Assessment of the Banks' Performance

Volodymyr Chaplyha [1], Nadiya Melnyk[2]

Abstract. The article is proposed the cluster model of the remote evaluation by stakeholders the financial performance of the bank considering risk. The model allows comprehensive appraisal and to do the more detailed analysis the communication of the accepted risk of the bank with the results of his financial activities and to identify specific ways of improving the efficiency of the bank at an acceptable level of risk. To determine and predict the probability of bank failures is proposed to carry out a cluster analysis in the neural network.

Keywords: cluster analysis, model, risk-based assessment, efficiency, bankruptcy, prognostication, neural network, banking activity

JEL Classification: G210, L100, C450

1   Introduction

Improvement of the risk management system in the banking sector of the Ukrainian economy and increase its efficiency are among the leading requirements and directions for the transformation of the financial sector on the way of Ukraine integration with the countries of the European Union and within the framework of an agreement with the IMF on the Enlarged Financing Facility (EFF).

An assessment of the efficiency of banks with considering risks is constantly at the center of attention of each group of stakeholders of the bank and defines it on the basis of their own interests and existing information opportunities for the implementation of such assessment. In this case, stakeholders generally use methods of classification and clusterization to analyze and evaluate the activities of banks that allow grouping and comparing banks with their own like.

Clustering is the task of splitting a set of objects into groups called clusters. Within each group should be "similar" objects, and objects of different

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groups should be as different as possible. With clear clustering, each object belongs to only one cluster. Fuzzy algorithms refer each object to different clusters with a certain probability. The advantage of a cluster approach is that it works even with a small amount of data, as well as failure to meet the other requirements of the classical methods of statistical analysis.

Interpretation of the term "cluster" in the economy, its description and the evolution of the cluster approach are sufficiently deeply embedded in the works of domestic and foreign researchers. The application of this method is fairly broad. For example, M.V. Reta (2010) proposed to use a multivariate statistical method, a cluster analysis, to test the proposed methodological approach to cost analysis at machine-building enterprises, and the method of hierarchical Ward agglomeration was used to classify enterprises. A.V. Voronin (2010) examines the methodological issues of using cluster analysis in the system of strategic management of the firm. Cluster analysis allowed identifying groups in a mutual o compatible and those that support local strategy. This requirement is essential to the efficiency of the overall strategy of the organization. J. Racek and J. Ministr (2014) used the cluster approach for automatic detection and identification of persons, objects and relationships in unstructured data. The data layer consists of data acquisition and data management modules.

The applying of cluster analysis in the area of banking services was almost not investigated. Such scientists as T.O. Podolskaya and A.A. Otdelkina (2012), T. Vasiliev (2013), R. Ferstl and D. Seres (2014), M. Kapullo (2015), O. Doroshenko (2016) state that in the analysis the banking system clustering has several advantages. In particular, it allows: to develop their own effective control mechanisms for each selected group; analyze changes in the bank's activities when it migrates from group to group. On a trend you can predict possible successes or problems not only one bank, but others in this group (Ministr and Pitner, 2017).

It should be noted that that systems of artificial intelligence have recently become more and more popular. Thus, V. Rashkovan and D. Pokidin (2016) identified six business models of banks using Kohonen self-organizing maps. They showed how these models were transformed during the crisis, and concluded that some of them were more prone to bankruptcy. The authors analyzed the risk profile of business models and identified risky and safe ones.

The method proved to be an effective tool for forecasting defaults, since according to the results of the test, based on historical data bankrupt banks were consistently located in the "risk" region of the map. Several potential areas for the use of this model are also outlined: the development of an early response system, the process of supervisory review and evaluation, and mergers and acquisitions in the banking sector.

2 Improving of the cluster approach to modeling the risk-based assessment of the effectiveness of the banks

In recent years, the cluster approach is increasingly being used in analyzing the functioning of the banking system in Ukraine. For stakeholders, risk-adjusted performance indicators (RAPM) are the most important indicators of banks' performance. The main problem that appears when attempting to calculate such indicators by external stakeholders is the difficulty in accessing data, which allows us to determine the share of economic capital for different types of activities of the bank and to calculate the expected level of losses. It is also impossible to use the results of risk-oriented clustering carried out by the National Bank because of their lack of open access.

In this situation, a methodological approach to banking clustering based on a three-dimensional model is proposed based on the ROE, ROA and ROI efficiency (ROE volatility), the values of which are compared with the corresponding median Me_{ROE}, Me_{SD} and Me_{ROA} their indicators for the number of investigated banks $\{B_i\}$.

As a result, we obtain a system with eight ratios of indicators that will correspond to eight clusters of banks:

$IF\{\overline{ROE}_{Bi} > Me_{ROE} \wedge \overline{ROA}_{Bi} > Me_{ROA} \wedge SD_{ROEi} \leq Me_S\}$ THEN $B_i \in$ Cluster 1;

$IF\{\overline{ROE}_{Bi} > Me_{ROE} \wedge \overline{ROA}_{Bi} > Me_{ROA} \wedge SD_{ROEi} > Me_S\}$ THEN $B_i \in$ Cluster 2;

$IF\{\overline{ROE}_{Bi} > Me_{ROE} \wedge \overline{ROA}_{Bi} < Me_{ROA} \wedge SD_{ROEi} \leq Me_S\}$ THEN B_i $\in$ Cluster 3;

$$IF\{\overline{ROE}_{Bi} > \text{Me}_{\text{ROE}} \wedge \overline{ROA}_{Bi} < \text{Me}_{ROA} \wedge SD_{\text{ROEi}} > \text{Me}_{\text{S}}\} \text{ THEN } B_i$$
$$\in \text{Cluster 4;}$$

$$IF\{\overline{ROE}_{Bi} < \text{Me}_{\text{ROE}} \wedge \overline{ROA}_{Bi} > \text{Me}_{ROA} \wedge SD_{\text{ROEi}} \leq \text{Me}_{\text{S}}\} \text{ THEN } B_i$$
$$\in \text{Cluster 5;}$$

$$IF\{\overline{ROE}_{Bi} < \text{Me}_{\text{ROE}} \wedge \overline{ROA}_{Bi} > \text{Me}_{ROA} \wedge SD_{\text{ROEi}} > \text{Me}_{\text{S}}\} \text{ THEN } B_i$$
$$\in \text{Cluster 6;}$$

$$IF\{\overline{ROE}_{Bi} < \text{Me}_{\text{ROE}} \wedge \overline{ROA}_{Bi} < \text{Me}_{ROA} \wedge SD_{\text{ROEi}} \leq \text{Me}_{\text{S}}\} \text{ THEN } B_i$$
$$\in \text{Cluster 7;}$$

$$IF\{\overline{ROE}_{Bi} < \text{Me}_{\text{ROE}} \wedge \overline{ROA}_{Bi} < \text{Me}_{ROA} \wedge SD_{\text{ROEi}} > \text{Me}_{\text{S}}\} \text{ THEN } B_i$$
$$\in \text{Cluster 8.}$$

Here $\overline{ROE}_{Bi}$ and $\overline{ROA}_{Bi}$ are average values of the ROE and ROA, SD_{ROEi} – standard deviation (ROE) for the bank B_i, calculated on the basis of monthly or quarterly data for the period T - one or several calendar (fiscal) years.

The proposed approach based on a three-dimensional model consists of the following procedures.

1. Setting a criterion for selecting elements of the set of investigated banks {Bi}, for example, by size of equity and assets, or according to one of the methods of the National Bank, the distribution of banks into groups or clusters.
2. Selection of elements of the set of investigated banks {Bi} according to the established criteria.
3. Calculation for each bank B_i of the parameters: $\overline{ROE}_{Bi}$, $\overline{ROA}_{Bi}$, SD_{ROEi}, Me_{ROE}, Me_{SD} та Me_{ROA} on the basis of monthly or quarterly reports which are available to stakeholders.
4. Distribution of banks in 8 clusters.
5. Analysis of dynamics of functioning of banks by taking into account the risk.
6. Formation of recommendations on the direction and mechanisms of change that should be implemented in banks belonging to a particular cluster.

This approach will allow stakeholders, including the National Bank, to differentiate banks in 8 clusters in detail by the level of efficiency and riskiness of their activities and, accordingly, more precisely formulating the

direction and mechanisms of change that should be implemented in the banks belonging to each of these 8 clusters (Fig. 1).
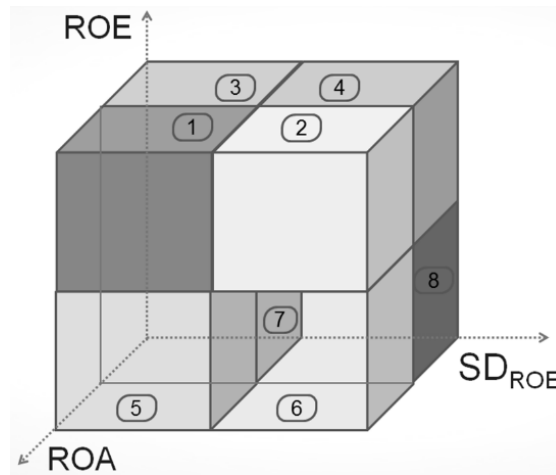

Figure 1 Distribution to clusters based on a three-dimensional model for assessing banks' risk-taking performance, Source: own.

Banks belonging to the first cluster can be considered the most efficient. They reach higher than average return on equity and return on equity, and the risk taken for such profitability is lower than the average for all investigated banks. Banks in the Eighth cluster have the worst performance and risk performance indicators and require special attention from both the regulator's banking supervisor and the owners and management.

The cluster analysis of Ukrainian banks on the basis of the proposed model showed that from 2009 to 2016 there was a tendency to reduce the number of banks in the first cluster with virtually unchanged banks in the first two clusters, indicating an increase in the riskiness of the banks surveyed (Fig. 2).

In 2014 – 2016 the number of banks in the first cluster increased, but also the number of banks with the worst indicators (8th cluster). As a result, the total number of banks in the first and second clusters with high efficiency has become smaller than the total number of seventh and eighth clusters of banks with low efficiency and high risk. The latter should carry out a comprehensive analysis of their risk management systems, identify the causes of high volatility of financial results and clearly formulate their policy in the field of risk.
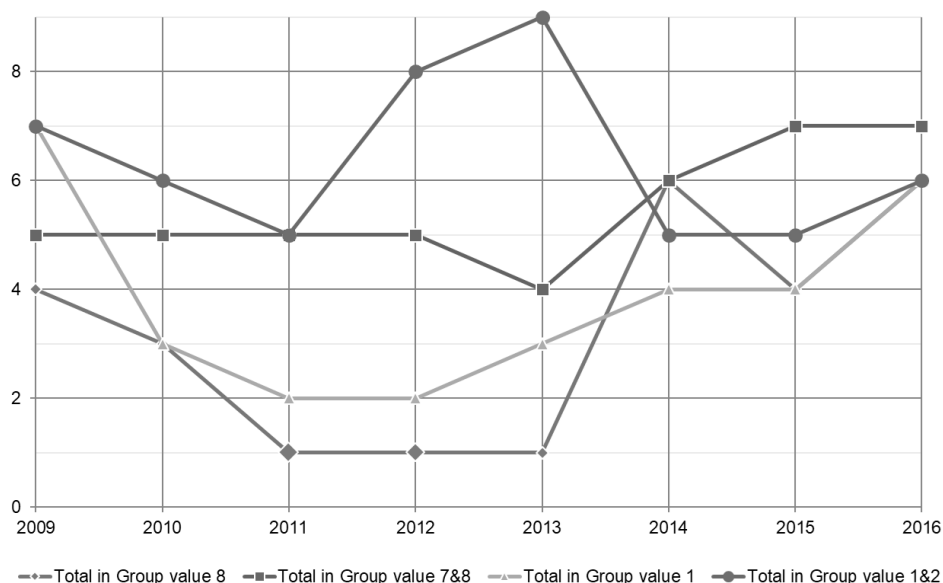
Figure 2 The number of banks surveyed, related to years to 1 cluster, total to 1 and 2
clusters, total to 7 and 8 clusters and to 8 clusters, respectively, Source: own.

The analysis can also be used to assess the effectiveness of bank
management and risk management systems in these banks.

3   Neural network in the tasks of cluster analysis of the activity of structural subdivisions of systemic banks of Ukraine

For the analysis of the financial results of the structural units of systemic banks
of Ukraine P.R. Tkachenko (2013) proposed to apply autosocial non-iterative
artificial neural networks based on the Geometric Transformations Machine.
These networks are characterized by high performance, precision
and the ability to solve complex, multidimensional tasks of an economic
nature.

GTM can be considered as a two-layer perceptron of autosocial type,
built on the method of "narrowed throat" (Fig. 3). The perceptron inputs all
the components of the existing sample vectors at the same time, the same
components are repeated as output signals of the training vectors
of the perceptron for training.

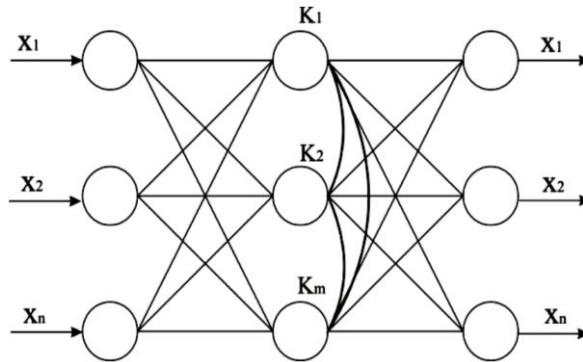**Figure 3** The GTM's autoassosiative neural-like structure, Source: (Tkachenko, 2018).

In the general case of "narrowed throat", when the number of neural elements of the hidden layer is less than the number of inputs (outputs), the transformation of the input vectors into identical outputs occurs with a certain error. Output signals of the neural elements reflect the signals of the main components. As a result of the application of optimization training procedures, the error of the transformation of input vectors in identical to them output is minimized, and the output signals of the neural elements of the hidden layer set the optimized representation of the input vectors in a new coordinate system of reduced dimension.

To solve the tasks of cluster analysis of the structural units of systemic banks of Ukraine, we propose to use software package of neural networks func*net Express on the basis of the GTM method, developed by "ITAMM". It provides an opportunity to allocate points or groups of points in the three-dimensional space of the main components. This selection is automatically transferred to the data table. This way you can visually select in 3D space grouped in a cluster of points and easily divide them into a plurality of data from points belonging to other clusters. On Fig. 4 can see that the user can choose on the axes which of the main components should be displayed data.

This technology allows us to estimate how much the subject vector corresponds, or does not correspond to the model we have built. Obviously, vectors whose error is much larger than for other vectors is due to some reasons from the general picture, and therefore should be considered and analyzed in more detail.
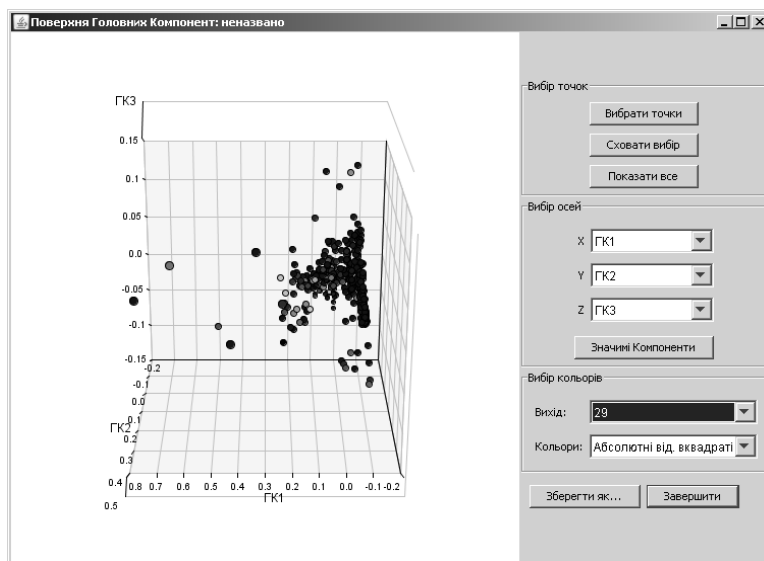
Figure 4   The Main components (3-D view), Source: own.

This allows us to find visually among the whole set of objects, in this case among the territorially separated divisions of the bank, whose results do not correspond to the overall picture throughout the static sample. The great error of reproduction of these objects can mean better results of work in the background of other departments, as well as unsatisfactory results. Moreover, it is possible to investigate and evaluate the errors in each of the parameters describing the object.

4   Conclusion

The proposed methodological approach which is based on a three-dimensional model for analyzing banks performance by taking into account the risk allows to comprehensively evaluate and sufficiently detailed the activity of banks by taking into account communication of accepted risk with the results of their financial activities. The analysis will be useful for stakeholders and, first of all, for shareholders, bank management, as well as for the National Bank of Ukraine.

Autosocial neural networks are more reliable when solving complex multidimensional problems, and also provide visual representation in three-dimensional space. The construction of three-dimensional feature maps in the space of the main components (clustering) is one of the tasks that is effectively implemented by using Geometric Convergences Machine.

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Cybersecurity Qualifications

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Abstract. Cybersecurity plays important role in the digital economy. We face a serious lack of workforce that may worsen. The acute, immediate, and growing workforce demand requires establishing new cybersecurity programs or courses of study. The institutions responsible for study programs need curricular guidance. In this paper, we describe existing frameworks and identify a need for national qualification framework for the Czech Republic.

Keywords: cybersecurity, qualifications, workforce, education

JEL Classification: C61

1 Introduction

The development of the first mainframe computers has prompted the need for security. With the growth of the domination of networking computers and systems, this need has deepened. The risk of cyberattacks has been added to the factors that have had a major impact on it. The number and impact of cyberattacks are becoming more and more serious. The digital economy should be enabled by a knowledgeable and skilled cybersecurity workforce (NICE, 2016). This vision should also be fulfilled thanks to the mission of the National Initiative for Cybersecurity Education (NICE). The NICE tries "to energize and promote a robust network and an ecosystem of cybersecurity education, training, and workforce development".

In order to educate people on cybersecurity, it is necessary to define this term. The Joint Task Force on Cybersecurity Education (JTF) (2017) defines cybersecurity as "computing-based discipline involving technology, people, information, and processes to enable assured operations. It involves the *creation, operation, analysis, and testing* of secure computer systems. It is an *interdisciplinary course of study, including aspects of law, policy, human factors, ethics, and risk management* in the context of adversaries." The work CSEC2017 by JTF advances cybersecurity as a new computing discipline, but it does not forget to emphasize its character of multidisciplinary.

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2 Need for a qualified workforce

Another important feature of cybersecurity is a serious lack of workforce that may worsen. The European Commission (EC) (2015) states that "demand for skilled workers with digital skills *increases by approximately 4% each year*. Unless decisive action is taken, the shortage of ICT professionals in the EU could worsen to *825,000 vacant posts* by 2020." The EC (2017) also claims that effective cybersecurity is based largely on the skills of the relevant staff. However, *350,000 cybersecurity experts* are missing in Europe in the private sector by 2022.

In this context, the question arises: How to cope with the described lack of professionals? It is necessary to identify where and what is missing. There are some areas where cybersecurity is essential. Examples are critical sectors and infrastructures, as well as key businesses. As is clear from the definition, cybersecurity is a term that involves several aspects. Therefore, we need a taxonomy and framework for cybersecurity. At the same time, it is important to recognize the urgent priorities. There should be found a way to help resolve the unwanted status quo.

3 Existing frameworks

European e-competence framework (e-CF) (2014) is a common European framework for ICT professionals in all industry sectors. The four dimensions reflect different levels of business and human resource planning requirements in addition to job proficiency guidelines:

1) 5 e-Competence areas: Plan, Build, Run, Enable and Manage;
2) 40 competences with a generic description;
3) 5 proficiency levels (e-1 to e-5), which are related to European Qualifications Framework (EQF) levels 3-8;
4) samples of knowledge and skills relate to 40 competences.

NICE Cybersecurity Workforce Framework (2017) is a national focused resource that categorizes and describes cybersecurity work in the US. It establishes a taxonomy and common lexicon for public, private, and academic sectors. It comprised of the components:

1) 7 categories– a high-level grouping of cybersecurity functions (Figure);
2) 33 specialty areas – distinct areas of cybersecurity work;

3) 52 work roles – the most detailed groupings of specific knowledge, skills, and abilities required to perform tasks in a work role.

Figure 1 Seven categories of NICE framework, Source: NICE Cybersecurity Workforce Framework, 2017.

The JTF has developed comprehensive curricular guidance in cybersecurity education. To define *Cybersecurity curricula (CSEC2017 JTF)* multiparty effort is required in the form of collaboration between major international computing societies (JTF, 2017):

- Association for Computing Machinery (ACM);
- IEEE Computer Society (IEEE CS);
- Association for Information Systems Special Interest Group on Security (AIS SIGSEC);
- International Federation for Information Processing Technical Committee on Information Security Education (IFIP WG 11.8).

Cybersecurity Curricula (2017) states in the introduction that "both government and non-government sources project nearly *1.8 million* cybersecurity-related positions going unfilled by 2022". The acute, immediate, and growing workforce demand requires establishing new cybersecurity programs or courses of study within existing programs. The institutions responsible for study programs need curricular guidance based on a comprehensive view of the cybersecurity field, the specific demands, and the relationship between the curriculum and cybersecurity workforce frameworks. Therefore, the Curriculum guidelines for post-secondary degree programs in cybersecurity was created.

The CSEC2017 JTF defines the audiences for this cybersecurity guidance:

- Faculty members in computing-based disciplines at academic institutions;
- Industry members who will assist with cybersecurity program development;
- Training and professional development providers;
- Faculty members in non-computing based disciplines;
- Academic administrators with oversight for program development;
- Workforce framework developers (government and non-government);
- Policymakers;
- Members of the K-12 educational community.

The CSEC2017 JTF thought model has three dimensions: 8 knowledge areas, 6 crosscutting concepts, and disciplinary lenses. We can see the model in Figure .
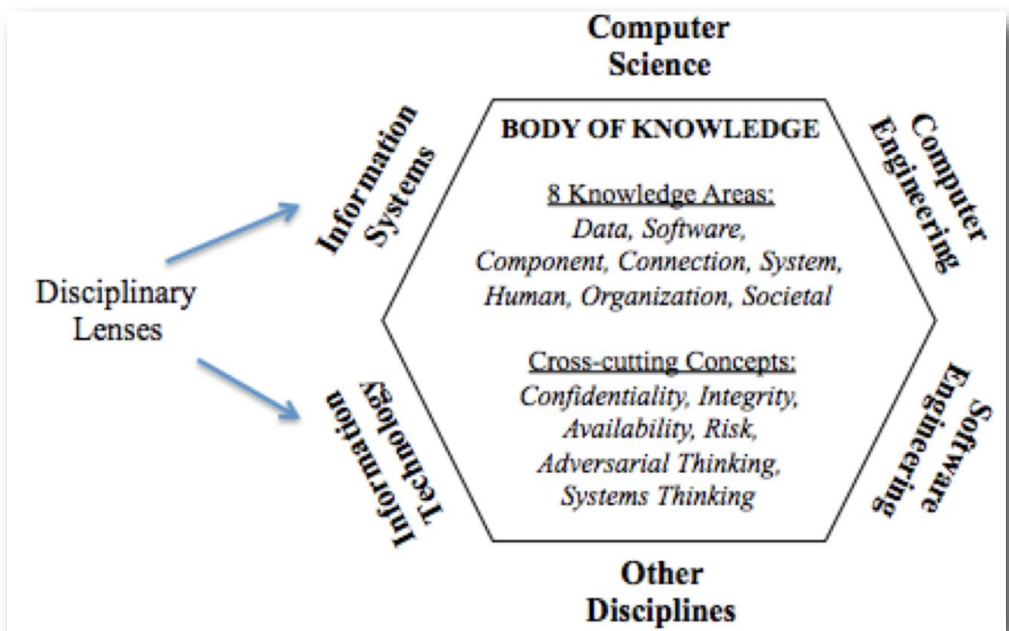

Figure 2 CSEC thought model. Source: CSEC2017 JTF, 2017, p. 20.

4 National qualification framework

As mentioned, cybersecurity frameworks appear in the world, but the general all-catch framework for the Czech Republic is missing. It is necessary to take into account the specifics of the Czech environment. Cybersecurity is intermixed within ICT professions. For this reason, the Masaryk University, Faculty of Informatics is engaged in the preparation of students for their career in the area of cybersecurity. One specialization of the new IT Management program is Information technology security (described in Pitner and Ministr, 2017). Although it should appear rather in secondary or upper-secondary education than a university, thanks to that we have a reference framework and starting point for National qualification framework in cybersecurity.

Several efforts have emerged in this area, but none with significant impact. To establish the national qualification framework collaboration of responsible bodies is required, such as NÚKIB - National Cybersecurity Agency, Ministries of Defense, Interior, Police, and Critical infrastructure operators. Moreover, strong academic coordination can help to incorporate the interdisciplinary nature of cybersecurity into the framework. Experts in the IT, law, sociology/politology areas should be involved. The framework should bound to new accreditation system (self-governed "institutional" or national one). We can also be inspired by the conclusions of the study (Cabaj et al., 2018) where 21 cybersecurity master programs of universities belonging to the top 700 universities (according to the 2017 ranking of QS World Ranking of Universities) were analyzed and reviewed.

5 Conclusion

As the number and impact of cyberattacks are becoming more and more serious, the importance of cyber security is growing. The problem is a significant lack of qualified workforce that may worsen. To meet workforce demand has been establishing new cybersecurity programs or courses of study. Frameworks, such as European e-competence framework (e-CF), NICE Cybersecurity Workforce Framework and Cybersecurity curricula (CSEC2017 JTF), help to create them. We identified and described a need for national qualification framework in cybersecurity for the Czech Republic. In the future, we will make efforts to create a framework.

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TEVOGS – Vehicle Onboard Guidance System

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Abstract. System TEVOGS is a solution increasing the safety of ground traffic or movement operations in predefined areas, such as airports, based on the collection of transport data from individual mobile units. The system uses a central processing of information about positions and their comprehensive transfer back. The visualization of this comprehensive information in graphic form offers a mobile unit driver an overview of not only his own movement, but also of the traffic in his surroundings.

Keywords: vehicle onboard guidance system, safe airport traffic

JEL Classification: L86

1 Purpose of the system

System TEVOGS is a solution designed to determine the position and supervise the mobile units with the primary objective to increase operational safety, movement control, improve efficiency of the mobile units' movement and support other applications. The system allows supervision over several tens, even hundreds of mobile units in an area covering up to tens of square kilometers.

System TEVOGS may be interconnected with other local information and safety systems. This option allows the inclusion into the system of those mobile objects that intend to enter the given area, and to ensure the priority of their movement in advance. The main advantage of the system is the capability to provide an overview of all the mobile units' movements in a given area not only to the movement supervisor, but the same information is available to each driver in each vehicle. By means of specific algorithm it is therefore possible to predict congestion or collisions situations.

2 Main features of the system

As was mentioned above, system TEVOGS is quite complex system with many features. It's able to acquire positional data in real time. Positional information is generated and processed in a way to ensure system's

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anticollision capabilities without any degradation. The recorded data about positions and times of the mobile units' movements allow subsequent analysis, assessment and optimization. Data logging and exploitation.

The system is resistant to signal reflections and receives signals also under conditions of loss of the Line-of-Sight (LOS) signal reception and clutter, i.e. in situations typical for reception at places with high obstacle density and with a large concentration of mobile units in a small area. System TEVOGS has an option to quickly define off-limits zones by the movement supervisor using the system. For instance, in case of an extraordinary event – emergency (like an accident, a fire,…) the movement supervisor marks the required zone and navigates the rescue team(s) towards the event location. For other mobile units the zone would remain off-limits (closed).

System TEVOGS is also flexible and widely usable, provides resistance against adverse impacts upon signal reception, solves non-standard situations by means of preprogrammed procedures. Each vehicle is equipped with comprehensive movement traffic information. The system is fully functional even under severe weather conditions, in low visibility during heavy snowfall, rain or dense mist.

The system is also ready for integration to other information and safety systems, customization of the software application accoring to the user's requirements and for future support of additional applications.

3   Basic components of the system

System TEVOGS consists of several cooperating components as can also be seen on **Chyba! Nenalezen zdroj odkazů.**:

- Mobile client unit TEVOGS CLIENT,
- Movement supervisor station TEVOGS SUPERVISOR,
- Monitoring station TEVOGS MONITOR,
- Signal TEVOGS SIGNAL,
- Wireless data network TEVOGS NET,
- Processing unit TEVOGS SERVER,
- Mobile client unit TEVOGS CLIENT.
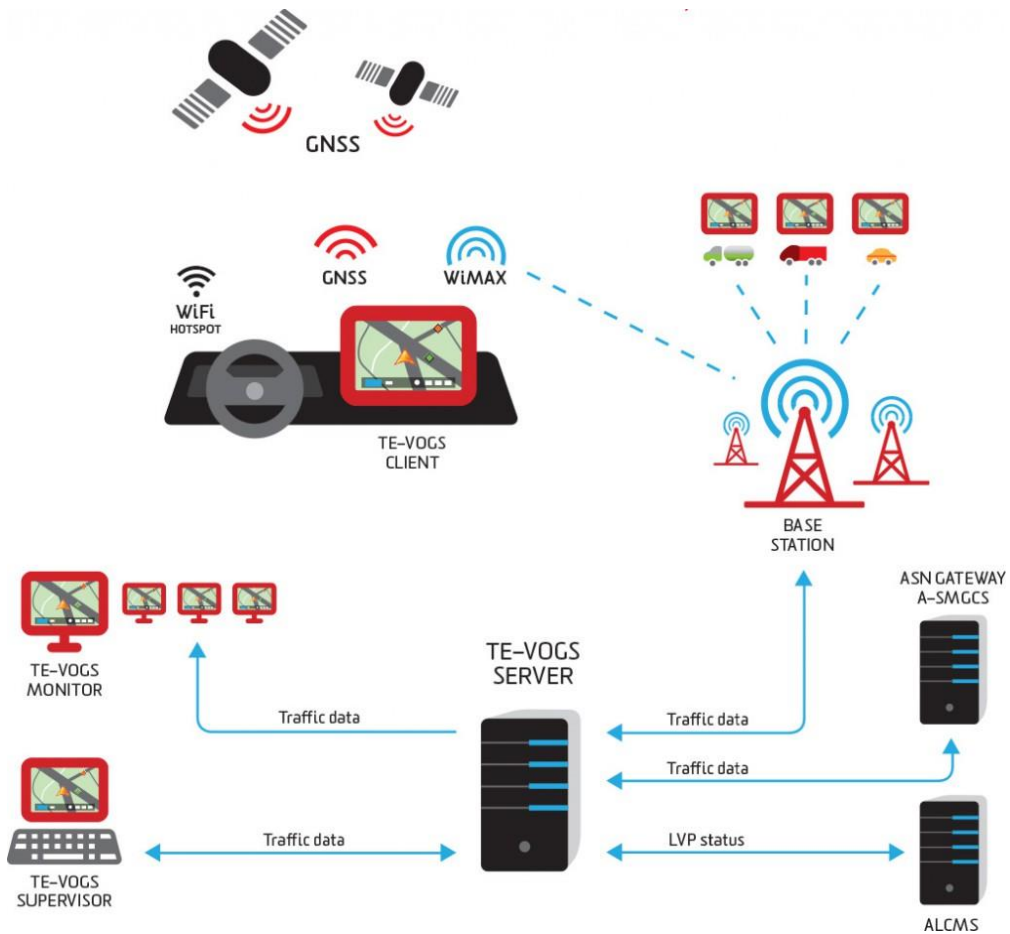
Figure 1 Basic components of system TEVOGS, Source: own

Navigation, information and communication unit of the TEVOGS system consists of a tablet with client software located in the docking station in the driver's cabin and of the roof extension with communication facilities for the wireless network and GNSS receiver.

3.1 Main features of TEVOGS Client

TEVOGS Client is a robust, reliable and widely usable component of the TEVOGS system allowing users to connect to the TEVOGS NET via wireless connection.

Basic functions of TEVOGS Client

Some of the basic functions of TEVOGS Client are display of its own position and position of other TEVOGS clients in real time, display

of positions of airplanes and mobile units from the A-SMGCS system, RWY (TXWY) Proximity Alerts (alert on entrance to the defined zone around the RWY (TXWY), Area Alerts (alert on entrance to the zones defined by the movement supervisor), information about the LVP condition alert, Function Crossing (support for safety of mobile units in places where the service communications cross the airplane taxiways on the service aprons), Points of Interest – option to enter the POIs' coordinates, to hand the coordinates over to the movement supervisor, messaging function and WiFi Hotspot – option to connect to the TEVOGS NET network even from outside of the vehicle.

Rugged tablet

Each vehicle is equipped with a mechanically durable tablet with a wide range of operational temperatures. This tablet may be used in the vehicle's docking station or separately outside the vehicle depending on the needs of the situation. Each tablet may be operated by touch screen with high brightness, clearly readable even in direct sunlight, adjustable day and night modes, automatic brightness adjustment, panning and zooming. Tablets have several optional accessories: 3G connection, 1D/2D Imager, barcode reader, HF RFID reader and other interfaces.

Operating modes

As stated above, TEVOGS Client supports two operating modes. It can be used either inside the vehicle (mobile use), meaning the tablet is inserted in the vehicle's docking station and TEVOGS Client is connected to the TEVOGS NET network.

Part of the TEVOGS CLIENT technology, which is permanently installed in the vehicle, operates as a WiFi HotSpot. Thus, the tablet may be operated as a part of the TEVOGS CLIENT at the distance of several tens of meters around the vehicle (portable use outside the vehicle); and owing to the local WiFi network it does not lose connectivity to the TEVOGS NET network.

3.2   Main features of TEVOGS Supervisor

TEVOGS Supervisor component delivers, as its name quite clearly states, supervision, control and monitoring of the whole system.

Basic functions of TEVOGS Supervisor

TEVOGS Supervisor allows users to access a monitoring display with airport map showing positions of all monitored vehicles and airplanes, to quickly define off-limits zones by the movement, to navigate e.g. the rescue and security team(s) towards the event location. The application allows multiple windows operation. It also includes set of tools for creation and working with Special Mode Zones, set of tools for working with Points of Interest and messaging function.

TEVOGS Supervisor also allows users to turn on or off some of optional functions according to their requirements. These are a car fleet administration, a set of tools for administration of audits and inspections and a set of tools for the data recording and exploiting, statistic functions.

3.3   Main features of TEVOGS Monitor

TEVOGS Monitor component has the same functions as the movement supervisor station, but with limited authorization to access information and to monitoring options based on specific user groups. It is basically a monitoring station with limited rights.

Basic functions of TEVOGS Monitor

As stated above, TEVOGS Monitor allows users to access a monitoring display with airport map showing positions of monitored vehicles and airplanes, same as TEVOGS Supervisor. This component is available as an application via web browser and allows multiple windows operations. It's designed for specific groups of special technology operators (rescue and security teams, fuel services, service teams,…) to improve awareness about up-to-date operating condition of the mobile technology.

4. Conclusions

System TEVOGS is currently deployed on a test run at selected airports in Czech Republic and Poland. A new version is being finished during fall 2018 that brings more powerful system software core, newly developed software functionalities for each user group and also new version of hardware with an emphasis on performance increase, higher stability and compactness. Current development focuses mainly on system security and resistance against various outages and external attacks.

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Comparison of Linear SVM Algorithm Implementations in Python for Solving an Author Identification Problem

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Abstract. Author identification within a set of text documents is a complex task. To solve it natural language processing and advanced data analysis algorithms are usually utilized. These algorithms are computationally demanding and therefore selection of a best-performing and resource-efficient implementation approach is a mandatory step.

In this paper, we focus specifically on the problem of speech author identification within textual records of speeches made at the National Council of Slovakia. We compare performance of different linear Support Vector Machine (SVM) classifier implementations in Python, with a goal of selecting the most efficient approach to solve the problem. The performance is measured for two implementations provided by Scikit-learn library and custom implementation utilizing the Theano library, executed on different hardware configurations. We analyze training time at different levels of problem difficulty, i.e. number of classes and training samples in the set.

The results show that there is a certain level of problem difficulty at which the Theano library implementation enables significantly faster training time than the Scikit-learn library implementations, especially when a GPU or multiple CPUs are utilized during the computation. Also, we discovered properties of each computational approach, and identified turning points in which the approaches outperform each other..

Keywords: Machine learning, natural language processing, classification, support vector machine

JEL Classification: C88

1   Introduction

Natural language in a text form is one of the most important media for transferring information and due to the popularity of social networks and the Internet in general, the speed of text data generation is increasing rapidly in recent years. For illustration, according to Internet Live Stats (2018) approximately 6000 Tweets are being posted every second. It is not possible for human brain to process such amount of data and computers are required

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to solve data processing tasks at this scale. This is the reason, why fields such as natural language processing, text data mining and machine learning, are gaining in importance.

Tasks such as analysis of social network comments are time consuming even on latest hardware and performance of different algorithms and their implementations varies with problem size. In this work, we compare different implementations of the same mathematical model capable of identifying an author of a text message. Our intention is to analyze the performance in terms of time required for model training and provide guidelines for choice of implementation most suitable for a given task and scale. Accuracy, another important aspect of this selection process, it is not evaluated in this paper.

2 Methodology and data

Our intention is to build a machine learning model capable of identifying a politician who made a given speech. In machine learning the task described belongs to the group of classification problems.

2.1 Tools for solving machine learning problems

Multiple tools can be used to solve machine learning problems. Very simple questions, such as univariate regression, can be answered using common software like Microsoft Excel or even analytically. For more complicated problems, one can choose between application software, cloud solutions and programming language libraries designed specifically to solve machine learning tasks.

For this work, we chose Python, one of the most popular languages in the machine-learning field. There are many reasons, why this is the case. Some mentioned at Quora (2018) are its simplicity, community support and large number of libraries for machine learning and other fields of science and engineering. Reasons such as experience with the language and existence of multiple implementations of the algorithm we chose for this paper also played its role in the decision.

2.2 Classification problem and the SVM algorithm

Classification, i.e. creation of a model capable of assigning a label (class) to a data point, is a typical machine-learning problem with many applications.

For example, we might want to identify an object in an image or speaker's gender from an audio record.

Classification is a supervised learning problem. As described by Aggarwal & Zhai (2012), we need to train the model using a set of training samples so that each of these samples is assigned to one class from a finite set. In many cases, the data points within classes are linearly separable, i.e. we can find a hyperplane separating these data points. Figure 1 illustrates the principle in case of two variables.
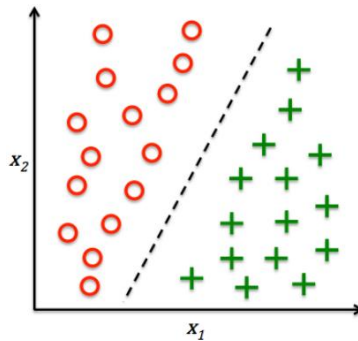
Figure 1 Linearly separable data (Raschka, 2015)

The goal of a linear classifier is then to find such a hyperplane, which is defined by its normal vector, often called *weights*. We can calculate so called *net input* as a dot product of weights and a specific sample added to *bias*. Class prediction is then made by applying an activation function such as *signum* (Kowalczyk, 2017).

Simple algorithms like the perceptron find any hyperplane separating the classes. Support Vector Machine (SVM) classifier tries to find the "best" hyperplane – one that has equal distance from the closest data points of both classes, i.e. maximizing the margin. Figure 2 illustrates such a hyperplane for a two-variable dataset. SVMs are recommended by both Li (2018) and Aggarwal & Zhai (2012) for text classification.

Many models can solve only binary classification problems (predicting assignment into one of two classes), including the SVM. There are multiple approaches to solving a multiclass classification. One of these approaches is a *One vs. Rest* strategy. It involves training a classifier for each class while transforming original class labels so that samples belonging to given class are labeled with a positive label (e.g. 1) and all the other samples are given

a negative label (e.g. -1) or a 0 label. Alternatively, *One vs. One* approach can be used to train a classifier for each pair of classes in the dataset.
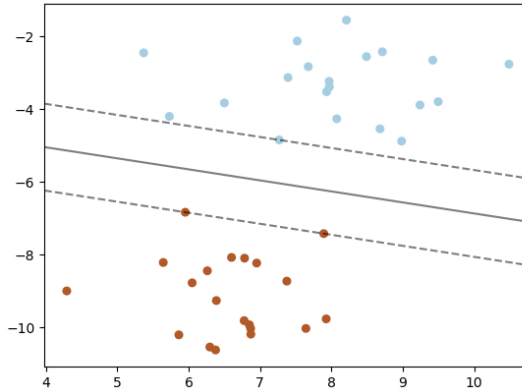
Figure 2 Example of a hyperplane maximizing margin, (Scikit-learn documentation, 2017)

2.3   Implementations of SVM classifiers in Python

One of the most used machine learning libraries for Python is *Scikit-learn*. It contains a range of classification algorithms, as well as tools for solving other tasks, like regression, clustering etc.

Classifiers are trained by minimizing a *loss function*. This function differs amongst classification algorithms and for SVMs, two different approaches are implemented by the Scikit-learn library. First one, which is available as the *sklearn.svm.SVC* estimator, utilizes solving of the following Wolfe dual problem (Kowalczyk, 2017):

$$
\begin{aligned}
&\underset{\alpha}{\text{minimize}} && \frac{1}{2}\sum_{i=1}^{m}\sum_{j=1}^{m}\alpha_i\alpha_j y_i y_j \mathbf{x}_i\cdot\mathbf{x}_j - \sum_{i=1}^{m}\alpha_i \\
&\text{subject to} && -\alpha_i \le 0,\ \text{for any } i = 1,\dots,m \\
& && \sum_{i=1}^{m}\alpha_i y_i = 0
\end{aligned}
\tag{1}
$$

According to Scikit-learn documentation (2017), in the *libsvm* library, there is the Sequential Minimal Optimization solver (Platt, 1998) implemented to find a solution and multiclass problems are handled utilizing the One vs. One strategy.

The second solution, which is available as the *sklearn.svm.LinearSVC* estimator, is based on minimizing the squared hinge loss function, by default extended by L2 regularization:

$$\min_{w} \quad \frac{1}{2} w^T w + C \sum_{i=1}^{l} (\max(0, 1 - y_i w^T x_i)^2 \tag{2}$$

The underlying *liblinear* library solves this problem using the Trust region Newton method (Fan, et al., 2008). Multiclass problems are by default solved with the One vs. Rest approach.

Scikit-learn library is not suitable for processing large datasets and for solving complex tasks. Therefore, other libraries were developed, to address problems at larger scale. Libraries like *Theano* or *Tensorflow* allow the user to utilize multiple CPUs, GPUs and even clusters of multiple computers.

Third solution we included into the performance comparison is a custom implementation of the hinge loss optimization using the Theano library. Theano itself allows for fast computations involving multidimensional arrays, but it does not provide ready-to-use functions to use machine-learning models. The user must implement such a model by herself, or use third party implementations built on Theano, such as *Keras*. These are mostly focused on solving deep learning tasks using neural networks and at the time of writing this paper, there are no implementations of SVM available.

2.4 Comparison of implementation performance

To train a classification model, a set of training records is required. In our case, we obtained the data from the official website of Slovak National Parliament. Our dataset consists of records containing speech transcriptions with names of politicians who made these speeches.

Data preprocessing

The SVM algorithm cannot process text data directly. Documents must be transformed into feature vectors, i.e. into numeric representations of the document content. *Bag of words,* i.e. transformation to a vector of word frequencies, is a common approach. Scikit-learn provides

a *feature_extraction.text.TfidfVectorizer* class, which handles this task using popular TF-IDF metric, while also normalizing the data.

One drawback of this approach is that the dimensionality of resulting feature vectors is very high. To reduce it, we employed the *feature_selection.SelectKBest* class and selected 300 features (word frequencies), which are most useful for speaker identification. The ANOVA *F*-value metric is used by the class.

Hardware and software configuration

We tested the training time on a Google Cloud Platform virtual machine with up to 10 Intel Xeon 2.60 GHz (Sandy Bridge) vCPUs equal to 5 physical CPU cores and 8 GB of RAM. Nvidia Tesla K80 was added to the VM for GPU tests. Benchmarks were performed also on Nvidia GT940M GPU inside an Asus Zenbook UX303 Laptop representing common consumer hardware.

As for software, we used following versions of tools and libraries:

- Python 3.6.5,
- Cuda Toolkit 9.0,
- Scikit-learn 0.19.1,
- Theano 1.0.2.

Measurement procedure

We measured training time for each SVM implementation at different levels of problem difficulty. We started with 2 classes (138 samples) and added 4 new classes with their data points until 158 classes (39347 samples) were reached. Custom Theano implementation was forced to recompile at each level. Classifiers were initialized with default configuration except for *sklearn.svm.SVC* where the *kernel* parameter had to be set to *linear*. Each measurement was repeated 5 times to ensure that the results were stable.

3   Comparison results

Figure 3 shows mean training time of compared implementations measured at different difficulty levels. Scikit-learn implementations cannot make use of multiple CPUs or a GPU. Therefore, measurement for only one hardware configuration is included. Theano implementation performance was tested

while utilizing 1, 2 or 4 CPU cores or GPUs mentioned in section 2.4. Average relative standard deviation was 1.4%.

At certain levels of problem complexity, Theano implementation starts to offer better training time than both Scikit-learn implementations even when utilizing only 1 CPU core. At this hardware configuration, Theano outperformed the *LinearSVC* estimator at 130 classes and at 110 classes when utilizing 2 CPU cores. On the other hand, the training time is well above zero even for trivial problems. This is caused by the necessity of compilation. During testing we forced recompilation for every measurement. By default, Theano uses compilation cache which can significantly reduce the compilation time.
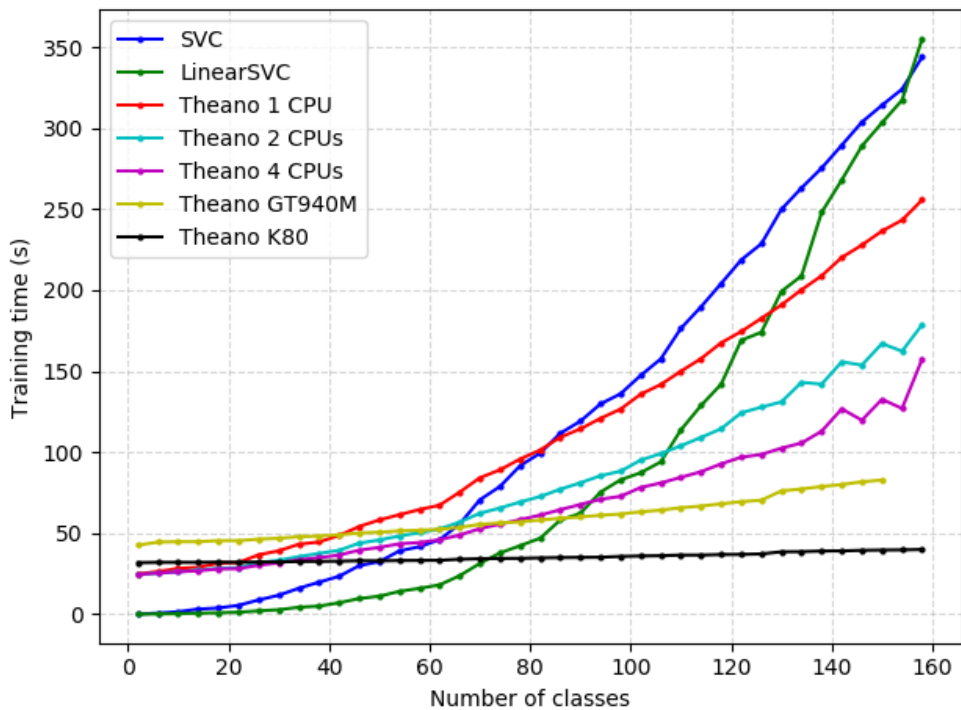
Figure 3 Training times of different SVM implementations utilizing different hardware resources at different level of problem difficulty

The plot also illustrates the benefit of using GPUs. The training performed at the K80 GPU took less than 10 s (excluding compilation time) at the highest level of difficulty (158 classes or 39347 samples), while Scikit-learn implementations required approximately 350s. Consumer oriented GT940M also provided much better performance than Intel Xeon CPUs.

4   Conclusion

We showed that usage of the Theano library might prove useful when solving more complex text classification tasks. As shown in results, depending on available hardware resources, at certain level of problem difficulty our custom Theano SVM implementation performed better in terms of training time than both Scikit-learn implementations. The latter provided better performance when solving simple problems with low number of classes and training samples.

We believe that the performance of the Theano implementation could be further improved by modifying conditions for training termination and adding adaptive learning rate.

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INFORMATION SOCIETY AND EDUCATION

Monetary Aspects of Cryptocurrency Behavior

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Abstract. In economic theory money is anything (any goods or book keeping record) that serves as a unit of account, a standard of deferred payments, currency and store of value. The aim of the paper is to analyze properties of major cryptocurrencies from the view of the economic theory of money, in particular from the point of strange dualism, where cryptocurrency can be regarded concurrently as commodity money and fiat money.

The economic aspects related to cryptocurrency mining and commodity money receiving and the relation of cryptocurrencies and fiat money is also investigated. The possible use of crypto¬currency as a standard of deferred payments and the related topic of cryptocurrency deposit multiplication is also studied. Attention is also given to the price of monetary gold and silver with respect to cryptocurrencies as a store of value. Presented topics are analyzed via real market data, when applicable.

Keywords: cryptocurrency, bitcoin, money, functions of money, money supply, credit non-expansion

JEL Classification: E44, E51, F31

1 Introduction and Literature Review

In August 2018, there are about 880 cryptocurrencies with some market capitalization and trading volume, according to Coinmarketcap.com (2018a). But only 15 of them have market capitalization larger than 1 billion USD (in August 2017, there were 11 such cryptocurrencies).

Bitcoin has market capitalization over 115 billion USD and market share over 50%. Ether (from Ethereum platform) has market capitalization almost 30 billion USD and market share close to 15%. All those numbers are rounded because of rapid changes, even in a few days.

Cryptocurrencies (by their nature) have a strong relation to cryptography and to IT. Creators of each cryptocurrency have set up important technical and cryptographic parameters with certain goals in mind. However, those parameters can have some unexpected or unwanted consequences.

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There are many publications about cryptocurrencies, but only few of them deal with the question if the established economic theory of money can be fully applied to cryptocurrencies and how the above-mentioned design parameters of particular cryptocurrency affect each function of money.

An article by Brennan et al (2018) investigates the evolution of assets and currencies. Great attention is given to regulation. In addition, the security threats specific or important to cryptocurrencies are analyzed. The quote at the beginning is a good example of a hyperbole (cryptocurrencies: everything you do not understand about money + about computers).

A paper by Claeys, Demertzis and Efstathiou (2018) has a detailed taxonomy of money and considers where cryptocurrencies fit in. Conditions for currencies to fulfill the functions of money are investigated, followed by an evaluation of the evolution of the money role and a discussion of some implications to monetary policy.

Harwick (2016) focuses on the problem of intermediation but some other important topics are also discussed (like technical and institutional hurdles for cryptocurrencies, useful properties of money and others).

An article by Zimmer (2017) investigates mainly the metalist currency regimes, specifically the silver mining economy around the Cerro Rico de Potosí but strong connections and implications for bitcoin are given.

2   Money in the Economic Theory

Money in economic theory (e.g. Mishkin, 2010) is anything (any goods or book keeping record) that is generally accepted as a means of payment for goods and services and has the following functions: (1) unit of account, (2) currency (medium of exchange), (3) standard of deferred payments and (4) store of value. Gold has been widely used throughout the world as money and from that role of gold another function is often described as (5) world money. Note: in research papers, the functions (3) and (5) are often omitted, because there are written from the view of the US internal market.

Money can be a *commodity money* (whose value comes from a commodity of which it is made: gold and silver are best known, but many others were used) or *fiat money*.

Currently money is typically in the *following forms:*

- Banknotes are emitted by one monetary authority, the reserve bank.
- Treasury notes are emitted by the Treasury (e.g. US coins).
- Demand deposits (book keeping records) are claims against financial institutions. From the economic view they are generally "banks" but the legal form can be different (e.g. a joint-stock company, a corporation). In addition, demand deposit withdrawals can be performed in different forms (in person, using ATMs, electronic banking etc.).
- Electronic (also digital) money exists only in digital form and is not directly interconnected to bank accounts. Cryptocurrencies are usually considered as a subset of electronic money (Brennan et al, 2018).

Payment cards (debit, credit, charge cards) are not electronic money (at least in the narrow sense) because there are directly linked to a cardholder's account or credit account and all transactions are recorded in the currency of that account (e.g. in CZK). Probably the first research paper about electronic money is by Chaum (1982). In 1990, Chaum created DigiCash, anonymous electronic cash, but DigiCash Inc. declared bankruptcy in 1998. Several other projects of electronic money from the 1990s had similar endings.

Those "first generation projects" are beyond the scope of this article, but the infancy of e-commerce before the year 2000 was an important factor. Bitcoin was released as open-source software in 2009, with some new concepts, namely blockchain (The Bitcoin Foundation, 2018). Bitcoin renewed interest in digital currencies and currently is the most widely used electronic money, followed by ether (Ethereum platform) and others.

Money creation is in principal via the following ways:

1. Emission of cash (banknotes, treasury notes) by a reserve bank or treasury used for paying their own obligations. Banknotes and treasury notes have "forced circulation": subjects in a certain territory have to accept them.
2. Cashless emission by banks is the money created by private banks through the recording of loans and the recipient of credit can reject offered loans. (There are also regulatory limits related to capital adequacy.)

3. Cashless emission by other subjects. Natural persons and corporate bodies shall provide each other goods and services on credit and payment will be in the future.

Generally, it is relatively easy to find how many banknotes, treasury notes and money held in bank accounts are in the given economy. There is no way to calculate the amount of money in the form of goods and services.

Any cryptocurrency exists only in the form of an electronic record and there is no single authority (e.g. the bank) for such evidence. However, you can quite easily find the current circulating supply for the cryptocurrency of your interest (e.g. Coinmarketcap.com, 2018b have lists of those values for several hundreds of cryptocurrencies).

Now have a closer look at cryptocurrencies from the view of *economic theory of money*. How well/bad can fulfill each function: the unit of account, currency, standard of deferred payments, store of value, world money.

For now, it is quite questionable whether cryptocurrency can be a *unit of account*. To our best knowledge, currently no economic subject systematically reports its business operations in a cryptocurrency (e.g. in bitcoins) or use it as an accounting unit. The great volatility of prices of cryptocurrencies (e.g. in USD, see Table 1) make that even more questionable.

Cryptocurrency can fulfill the function of *currency* relatively well. Selected shops (even some shops in the Czech Republic) accept payments for goods and services and the owners of cryptocurrency can settle their receivables and payables directly in a given cryptocurrency.

Still there are some practical problems. Bitcoin (by design) keeps the average time between new blocks at 10 minutes (The Bitcoin Foundation, 2018) and it also means quite high transaction costs (consumed computer power and electricity). Therefore, bitcoins are better for larger sums, for smaller payments and when such delays in payments processing are not acceptable, ether (on Ethereum platform) with block time of approximately 15 seconds (Ethereum, 2018) or some altcoins are more suitable. Rapid change of prices expressed in USD (or EUR etc.) is another obstacle.

Cryptocurrency in theory can fulfill a function of *standard of deferred payments* well, e.g. it is possible to make an agreement today to pay with

cryptocurrency in the future. However, to our best knowledge, that currently does not happen in the real economy. Besides, there is the problem of credit expansions in cryptocurrency - see later.

The history of bitcoin starts in the year 2009, the history of other cryptocurrencies is even shorter. It is too short time to responsibly judge if and how well some cryptocurrency can serve as a *store of value*. The given cryptocurrency is identical worldwide. From that point of view, a cryptocurrency has similar properties as gold; it can fulfill a function of *world money* quite well. In reality, there is a problem of general acceptance of a given cryptocurrency and there are legal restrictions in some countries. According to the Library of Congress (2018), there are about eight countries with an absolute ban on trading or usage of cryptocurrencies and some other countries with significant restrictions. Of course, it can change (for better or worse) in the near future.

To sum up, we can say that currently cryptocurrencies can fulfill some but not all function of money (as seen by the economic theory). Some authors are even more skeptical. According to an article in the Economist (2014) bitcoin functions well as a medium of exchange (currency) and its credibility in that function is increasing. It is not a very stable store of value and volatility can also prevent bitcoin from ever establishing itself as a unit of account (the remaining two functions are not discussed). A recent article in the same journal (the Economist, 2018) concludes that none of the three functions is fulfilled because of the lack of (general) acceptance and great volatility.

That doesn't look well for cryptocurrencies but we should also consider some properties money should have like durability, divisibility, security or portability. We can conclude that cryptocurrencies meet most of those requirements very well or even exceptionally well (portability).

Table 2 Annualized standard deviation of daily logarithmic yield, Source: own.

Year	BTC in USD	ETH in USD	Gold in USD	Gold in BTC	Gold in ETH
2015	13.03	50.96	2.22	11.10	45.29
2016	9.20	32.52	2.52	8.14	21.60
2017	17.97	32.45	1.66	13.59	22.34
2018	16.78	32.46	1.59	15.03	17.55

Note: for the year 2018 calculated from data to August 31.

3   Money Supply in Cryptocurrencies

If we accept the proposition that cryptocurrencies function as money in the economy, it is useful to see how the amount of money (seen by the central bank) can be increased (decreased). In the case of "standard currencies" that is done in the form of granting credits by banks (or repaying them), the so called raising (decreasing) of money stock. According to various economic theories, money may or may not influence the development of the economy.

What are the implication for cryptocurrencies? The amount of emitted cryptocurrency is generally limited. That is similar to the supply of the gold in the world economy at a certain date. Therefore we will first analyze the historical situation of the provision of credits in gold (gold coins) by banks.

Banks in Europe issued promissory notes (i.e. written promise to pay the amount of gold coins, which was written in promissory notes). These issued promissory notes were given to debtors and debtors (e.g. merchants) pay with promissory notes their payables.

In order to maximize their profits, the bank issued (with the approval of the authorities) more promissory notes than available gold. Thus, the "small" amount of gold held by banks could be used to buy and sell a "large" quantity of goods and services, allowing for the exchange of more goods and services than if banks only provided gold in the form of gold coins. That approach allowed greater consumption and, in the spirit of Adam Smith, contributed to the growth of the wealth of nations.

Let us try to apply the above example to cryptocurrency, in other words, is *credit expansion in cryptocurrency* possible? It is possible to lend more units of cryptocurrency than is currently held? (More generally: currently mined, issued, taken?) If such a possibility for holder of cryptocurrency exists, holders of cryptocurrency issue new money (in the form of promissory notes for cryptocurrencies) in face (nominal) value greater than the number of units of cryptocurrency kept by holders (issuers of promissory notes for cryptocurrencies). In addition, the other debtors have to accept such promissory notes in cryptocurrencies.

It is clear that lending promissory notes for cryptocurrencies causes a loss of anonymity of debtors and creditors. It does not matter, that bitcoin is only pseudonymous (some cryptocurrencies are fully anonymous).

Let us try another approach: only one subject, who repaid his payables, would emit a given cryptocurrency. That subject would become de facto central bank. However, that approach does not enable credit expansion in cryptocurrency, either. In addition, that approach is contradictory to the fundamental principal of cryptocurrency: the emission or transaction records should not be under the control of a single subject (even a private one).

To sum up: in today`s scheme of functionality of cryptocurrencies the multiplication of cryptocurrency deposits is impossible – e.g. it is not possible to increase the amount of "cryptocurrency money" above the level of "primary loans in cryptocurrencies".

4   What Are Cryptocurrencies Today?

In relation to the limitations analyzed above, the logical question is: What are the cryptocurrencies in reality today? First, it is useful to mention, that no cryptocurrency currently offered on the markets is the national form of currency. (It is not declared to be legal tender; it is not obligatory for persons or economic subjects to accept it as a form of payment.)

Currently the cryptocurrencies are presented to the public as:

a) An alternative to existing currencies (USD, EUR, CZK).

b) Speculative investment. Cryptocurrencies are presented as an instrument with „interesting yield" for holders. It can be true, but it can be also a very risky investment, see Table 1. Annualized standard deviation of the yield is three times to 20 times higher than for similar investment in USD.

c) The speculation at exchange or OTC markets on derivatives: their price (in USD) derives from bitcoins, e.g. since December 2017 Chicago Mercantile Exchange offers trading of bitcoins futures.

d) Cryptocurrency mining as a business activity. Currently that activity is meaningful only for investors capable of investing sufficient amounts of money for special hardware. Even so, it almost necessary to participate in mining pool and mining farms are usually located in places with a lot

of cheap energy (near hydroelectric power stations or when energy is subsidized: China) and preferably in cold climates (to reduce the cost of cooling).

Acknowledgements

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Digital Media and Evaluation of Information in the Internet Era

Roman Danel[1]

Abstract. The Internet has opened up new opportunities for access to information when accessibility has increased radically. However, the amount of information and its easy accessibility also raises the need for verification. With the rise of social networks, the spread of fake news has grown and so-called social bubbles have emerged (isolated groups of people who are mutually reinforcing in their opinions). When assessing news and facts, people often lack the ability to think critically. This problem is not new, but in the Internet era, the lack of ability to judge the credibility of reports is of a mass nature and can affect the functioning of society. Therefore, it is important for universities as one of the graduate training objectives to emphasize the understanding of the principles of critical thinking and the ability of students to properly evaluate available information. The article brings case studies that show how superficial consumption of information without validation can lead to totally incorrect conclusions.

Keywords: learning process, digital media, Manfred Spitzer, digital dementia, internet paradox, searching facts, critical thinking.

JEL Classification: D8, I2

1 Introduction

Computers and information technologies are playing an increasingly important role in our lives. In the first phase, computers functioned as a tool to help manage or solve tasks in business practice (accounting, wages, etc.). The next stage was due to the expansion of the Internet, mobile technologies and social networks. The Internet and digital media have become an easily accessible source of information. The task of planning a trip, booking a hotel, booking a ticket, etc. is now possible to solve within a few moments at a computer at home. If we need some information, we do not have to go to the library but just use Google.

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2   The impact of digital media on the learning process

The use of digital media and devices, though it brings a lot of benefits, has also some drawback and it is necessary to deal with it. There are studies that show some implications of using digital media for human psyche and brain activity. In connection with this, the term "digital dementia" appeared. Excessive reliance on digital media leads to the condition that if we do not have these media available, we do not remember anything and some life situation is becoming problematic. It has been documented that people who have repeatedly moved in the city by car with the help of navigation, did not orientate themselves when driving without navigation device. Although they had traveled many times there, they did not need to store the path into their memory. Using digital media can have a negative impact on the learning process.

Psychologists and scientists describe process of learning as a process where information is stored in the brain into a long-term memory. A substantial influence on memory has the so-called depth of information processing. If this depth is sufficient, a larger number of synapses are created to ensure "remembering". One can easily remember information that is associated with higher emotional activity or with more effort to concentrate on the matter. This is why it is important for children at school to write notes - writing more focuses on content, and the process of learning is deepening. Just listening or reading reduces the depth of processing and thus the learning speed.

The use of digital media and the fact that the study materials are downloadable from the Internet (or from Moodle-type resources) leads that the students don't do a written notes. This has an adverse impact on learning and remembering.

3   Dependence between brains function and hand movements

There is a direct dependence between brain functions and hand motoric – a therefore with writing. This link is bi-directional - the psychological aspects of human (personality type, emotionality, rationality, will, inner energy) are reflected in handwriting (Jeřábek, 2014). This fact is used in graphology, where with certain psychological knowledge and with

experience we can detect some personality features (Schönfeld, 2007). On the contrary, there are procedures where certain mental states can be influenced by a forced change of writing style.

Several years ago, a huge discussion appeared when the Ministry of Education of the Czech Republic recommended that elementary schools go from continuous style of handwriting to script writing - using Comenia Script font (Lencová, 2009). The proposed change had many proponents who argued that this font would facilitate the speed of learning the writing. Nowadays, when writing is less and less important, children will be able to devote themselves to "more important" things. The new script handwriting should also help children with dysgraphia, for which writing is problematic (problem with a letter omission). Interesting are the experiences from Sweden where they attempted similar reform in the 1980s. While dysgraphics were better able to write individual words, they again had a problem with understanding where the words ended and problems of another kind appeared. Children also could not read the handwriting of their parents. The process of learning did not accelerate or improve, and Sweden later retreated from this reform. Today, there are opinions from the professional public that learning handwriting using script fonts are inappropriate because it detracts from the strengthening of hand motoric and hence brain function, because writing in continuous lettering requires more concentration and hence more depth of information processing (Jeřábek, 2010).

4   Searching of facts on the Internet

In the research into the impact of digital media on learning and memorizing processes has recently attracted attention the work of German psychiatrist Manfred Spitzer. Spitzer (2017) concludes that excessive use of digital media at school (especially at the base level) does not lead to a better understanding of the subject, but reduces the learning speed, leads to superficiality and, in the long run, reduces the ability of a person to learn effectively and to process information. Spitzer is not against to the use of computers and the media in teaching, but notes that this must be accompanied by an appropriate pedagogical concept how to use these media. Today, unfortunately, this is largely absent. Teachers either do not know how to use the technique or use it only to replace old pedagogical practices, regardless of the impact. Using

Internet in the classroom then creates the so-called "internet paradox", a surprisingly reduced ability to find information.

This fact can also be found at the level of higher education. Students often resign from a deeper study of the subject, and if they have a semester work in the course of the subject, where the teacher expects the research overview as an output, the results are often very weak. Students will use Google to find the first usable resource for the given topic, do a copy-paste and submit the semester work. They do not seek further information, do not verify the accuracy of information, and do not investigate alternative solutions. This makes the sense of semester work completely lost.

Another problem we can encounter at the universities is that students often only use Czech-language sources on the Internet. In information technology and especially in new technologies, however, much of the information is available in English, in many cases only in that language. Relying on Czech-language resources can lead to a distorted and incomplete view of the issue. An example is a bachelor's thesis that was dealt with at the Faculty of Mining and Geology (VŠB-TU Ostrava) three years ago. The student had as a topic of his thesis the analysis of the Hadoop for processing Big Data (Hadoop, 2018). One of the tasks assigned was to research how much the Hadoop tool developed in the Linux operating system can be used on Windows operating systems, and whether this tool is somewhere used to handle a large volume of data in the raw material industry. The student concludes that for Windows, the Hadoop system is not suitable, lacking support, and can only be run in Linux emulation using CygWin. Student as a result of his search not recommended the use of Hadoop tool for processing technological data in the raw industry (Lambor, 2016). Despite the fact that the student worked very carefully, all the sources quoted properly and the work appeared to be of high quality, it turned out that the student used only Czech-language resources on the Internet. He did not find the existing Hadoop for Windows solution, which was available at the time of the thesis solving, because this solution was mentioned in English sources only. Nor did he find any published case studies on the use of Hadoop in information systems in the raw materials industry.

5 Example of absence of critical thinking when evaluating information from the Internet

The impact of the Internet and social networks on the behavior and thinking of people has already been written in a number of articles. We all know about the issue of so-called "fake news" that can influence political views and which are being successfully exploited (and abused) today. Similarly, the problem is the emergence of "social bubbles", groups of people with the same opinion, who are mutually reinforcing in this respect and do not know the real state of affairs. But the big problem is also the lack of critical thinking when evaluating information and facts from digital media. Paradoxically, easy access to a huge deal of information leads to theirs superficial consumption.

An example of the problem is the article "Krtek na návštěvě disappears from stores, Miler's daughter lost court" published at Novinky.cz on September 11, 2018. The content of the article is information about the outcome of the dispute between the daughter of the painter Zdeněk Miler and the custodian of heritage to Zdeněk Miler, Mrs. Fischer, about the right to sell the book "Krtek na návštěvě" (The Mole on a Visit). The article is wholly substantive, neutral, it informs about the outcome of the trial without evaluation, which side of the dispute is good and bad, without any subjective statement on which side is true. Within the article, a discussion of readers was available for a week, which was very interesting as the readers commented the article. There were 55 contributions in the discussion where writers automatically assumed that the true is on the daughter's side and began criticizing the functioning of the courts and blaming the counterparty for trying to get more money on Miler. There was no more information in the article about the judgement, and there were not publish reasons why it happened, yet people took a clear view only on the basis of their emotional feelings (sympathy with the daughter). Only one (!) reader from 55 admitted "maybe Mr. Miler did not have good relationships with his offspring." He admitted the possibility that there might be other facts in the background that are not mentioned in the article. Part of the contributors to the discussion accused the judges of corruption and there was also a finding of the generally poor level of the Czech judiciary.

From the above, it is possible to see how easily, on the basis of incomplete information; people come to completely different, unjustified conclusions. Without any effort to verify the facts or just think that there are more options and ways how to interpret the facts. Such access to information is quite typical for Facebook discussions. People share unverified messages or emotionally discuss political issues without deeper insight into issues. This situation is then easily misused for manipulation.

6   Conclusion

Digital media and the Internet have completely changed the functioning of the society. However, the negative impacts must be taken into account, and it is the role of the education system how to adapt to these impacts. Information technology must be actively exploited, but it is also necessary to respond to these negative influences. The use of digital media in education must also be addressed at the level of pedagogical concepts and deal with the negative impact on the learning process. Information literacy should be strengthened - the ability to navigate in a huge amount of information, the ability to select relevant information and to enhance awareness of the need for information sources to be verified. Prepare students how to evaluate contradictory information, how to recognize fake news and, last but not least, strengthen critical thinking - the ability to analyze and evaluate information provided. A critical thinker should be able to admit the legitimacy of an opinion that is not close to him, to absorb information that does not correspond to his point of view, to admit that the problem solving is not black and white. There are disputes and situations where both sides may be right. Easy access to information should not suppress the effort for a deeper analysis and understanding of the problem

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Programming Course Results at the Faculty of Informatics and Statistics – Gender Aspect

Petr Doucek[1], Milos Maryska[2]

Abstract. This paper describes key factors related to courses for programming which are educated at the Faculty of Informatics and Statistics, University of Economics, Prague. We are providing key statistical information about sample of 3.600 students, results of these students in programming courses and we mainly compare results of male and female and we are showing, that results of female are in general better than male' s results.

1   Introduction

The turbulent economic environment places elevated emphasis on economic, language, system and ICT skills in various fields on human activities. For example, increase of managerial abilities and skills in the area of ICT improves possibilities introduction and using of ICT in everyday economic practice and their subsequent operation. Ability to dispose different language knowledge reflects in intercultural approach to management processes in corporations and especially in international one.

Together with the way in which the demographic distribution of the population in the Czech Republic changes, there are also gradual changes in the models according to which the education system is regulated (Finardi, Fischer, & Mazouch, 2012; Sigmund & Pavlickova, 2014). The uneven population curve of different periods causes a shortage of pupils and students at individual levels of the education system, Demographic trends confirm, that we are almost at the lowest number of students leaving high schools (Doucek, Maryska, & Novotny, 2013). We will achieve this lowest point in the following one or two years, and the number of potential applicants to universities should then gradually go up (Doucek et al., 2013; Pecinovsky & Pavlickova, 2017).

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Although the number of potential applicants to universities shall soon go up (Kuncova & Wasserbauer, 2007), universities consider it necessary to increase not only the number of applicants but also the number of accepted students, while maintaining their quality, of course.

All of these mentioned facts lead us to current situation on Information Technology (IT) labor market, where is all the time increasing amount of required work force but supply of workfares is not increasing so fast. The requested amount of workforce can by satisfied by several approaches, for example:

- Improve quality of labor workforce, which can lead to increase productivity of this labor workforce
- Increase amount of labor workforce, which is strongly related to demand for labor workforce in another department.

2 Problem formulation

The ever-dropping number of students is forcing universities to find ways to motivate applicants to study a certain study program and to increase the success rate in number of graduates.

One of the requested roles on the IT labor workforce market is Programmer/IT Developer. The knowledge of programming language/languages is important and from long-term point of view it is interesting to investigate level of knowledge gained by students during their studies.

For this article, we chose the following Research Questions (RQ):

- RQ1: Male have better results from programming courses.
- RQ2: Pass rate in programming results is bigger than 90%
- RQ3: Male's pass rate in programming results are improving faster than females.

3 Methodology

3.1 Material and Methods (Data Collection)

The study information system (InSis) of the University of Economics, Prague, includes a huge volume of data about results of all student and applicants

for study. We can split these data into study results, entrance exam results and, practice entrance exam results. InSis contains data about all applicants and students who filed a practice entrance exam application, filed a standard application or were accepted to study at the University of Economics, Prague. In addition, the system contains data about passed exams and the number of points that an applicant or student obtained.

This article contains data from period school year 2009/2010 – 2016/2017. Newer data are not available for processing during preparation of this paper for the conference IT for Practice 2018.

The data collected for our research were anonymized in compliance with the provisions of Act No. 101/2000 of Coll., on the protection of personal data.

3.2   Methodology

All data are processed by way of different tools available in Oracle (key database for InSis) and Microsoft SQL Server, where is created data warehouse with data model required for analysis of required results.

We used filters and/or SQL questions to select data for a data sample for each analysis performed to find answers to the Research Questions. Key part of analysis is done in Microsoft excel, which provides related statistical functions.

3.3   General Data Characteristics

UEP currently has 156,492 records about entrance exams. These records have been kept since 2009. Each record contains information about the faculty to which a student applied, information about the student's entrance exam result, information about whether the student was accepted, information about which high school the student came from, information about the student's nationality and other information.

Faculty of Informatics and Statistics at University of Economics, Prague has 3,632 records about exams from programming courses from 3,342 students that have been monitored since 2009.

UEP monitors exam results (number of points obtained) and the date of a taken exam.

With respect to mentioned amount of records from programming courses and following analysis we must mentioned, that some students in case of 3 failures during exams are not repeating course again (they don't have any other info about second visiting of the course).

4   Results

4.1   General Overview

As part of UEP's research, 3,632 records about exams from programming courses were identified.

The details about the sample structure are provided in Table 1 and Table 2. Table 1 describes percentage of male students, which gains grade 1, 2 etc. from exam. The desh sign means, that student did not attende exams. 4+ is a special result from exam, where lecturer gives to student possibility to attend exam once again. E means, that student was excused form the course. This is usually based on medicines request and Recognized subject is a situation, when students starts with his study again or is coming from different university and already passed programming course there.

The Table 1 shows, that every year more than 68% of males students pass exam from programming courses. In average almost 30% of males students failed in their exam and more than 3% of students is excused from course. Really interesting in this context is school year 2015/2016 where we see, that 12.81% of students were excused from the course.

Another interesting finding is, that percentage of males students with grade 1 is increasing and during years 2009 and 2016 increase from 10% to 20%. On contrary percentage of students, which did not pass exam from programming courses is stable around 30%. We have 2 exceptions – year 2014 and 2015 where percentage of failed students drop to 17 resp. 19%

Table 1 Results from Programming Courses – Male only, Source: own.

Year/Grade	1	2	3	4	-	4+	E	R
2009	10.02%	29.13%	25.97%	30.80%	0.00%	1.30%	1.11%	1.67%
2010	13.23%	26.07%	30.93%	25.49%	0.00%	0.39%	2.53%	1.36%
2011	13.38%	23.03%	23.46%	33.33%	0.22%	0.00%	4.17%	2.41%
2012	10.78%	29.22%	26.27%	29.61%	0.20%	0.00%	2.16%	1.76%
2013	14.85%	34.16%	22.03%	26.98%	0.50%	0.00%	0.99%	0.50%
2014	20.45%	39.55%	12.73%	16.82%	1.36%	0.00%	3.64%	5.45%
2015	18.23%	36.95%	12.32%	18.72%	0.00%	0.00%	12.81%	0.99%
2016	20.43%	32.26%	17.20%	27.96%	0.00%	0.00%	2.15%	0.00%
Total	**13.57%**	**29.76%**	**23.74%**	**27.55%**	**0.24%**	**0.31%**	**3.03%**	**1.80%**

Legend: E = Excused from the Course, R = Recognized Subject

The Table 2 provides the same information like the Table 1 but in the context female students. We can say, that pass rate of female students is bigger than males one and failure is lower than mans one.

Table 2 Results from Programming Courses – Female only, Source: own.

Year/Grade	1	2	3	4	-	4+	E	R
2009	8.82%	26.47%	34.31%	25.49%	0.98%	0.00%	2.94%	0.98%
2010	8.18%	30.00%	32.73%	21.82%	0.00%	0.00%	3.64%	3.64%
2011	12.15%	28.04%	22.43%	28.04%	0.93%	0.00%	6.54%	1.87%
2012	10.34%	25.86%	27.59%	31.03%	0.86%	0.00%	4.31%	0.00%
2013	15.69%	33.33%	25.49%	20.59%	0.00%	0.00%	4.90%	0.00%
2014	14.29%	44.64%	14.29%	10.71%	0.00%	1.79%	3.57%	10.71%
2015	17.46%	36.51%	15.87%	17.46%	0.00%	0.00%	11.11%	1.59%
2016	11.11%	41.67%	30.56%	16.67%	0.00%	0.00%	0.00%	0.00%
Total	**11.85%**	**31.36%**	**26.30%**	**23.12%**	**0.43%**	**0.14%**	**4.77%**	**2.02%**

Legend: E = Excused from the Course, R = Recognized Subject

Based on Table 1 and Table 2 we can say, that answer to RQ2 is no, pass rate (overall) from programming courses exams is not bigger than 90%. Male have pass rate approximately 68% and female approximately 71% in average.

The Table 3 merge results from Table 1 and Table 2 and give us information, where percentage for male is bigger than percentage

for women. In this case table contains M, otherwise F. These results are based on distribution of the grades in analysed sample.

When we check the content of the Table we see, that in "positive situation" (grades 1-3), there is equal amount of "M" (12) and "F" (12). On contrary in case of grade 4, there is bigger amount of M which means, that bigger percentage of male in comparison with percentage of female's results failed in programming course exam.

Table 3 Results from Programming Courses – Male vs Female, Source: own.

| Year/Grade	1	2	3	4	-	4+	E	R
2009	M	M	F	M	F	M	F	M
2010	M	F	F	M	F	M	F	F
2011	M	F	M	M	F	F	F	M
2012	M	M	F	F	F	F	F	M
2013	F	M	F	M	M	F	F	M
2014	M	F	F	M	M	F	M	F
2015	M	M	F	M	F	F	M	F
2016	M	F	F	M	F	F	M	F

Legend: M = Male, F = Female

Next table, Table 4, compares results from programming courses exams in case of grade 1-3. We see, that almost in all analysed year (except 2012) the portion of female students, which pass exam from programming courses with grade 1-3 is bigger than pass rate of male students in programming courses. This is interesting finding, because usually is said, that males are better in studying programming courses and they are better in programming. The second interesting result is a fact, that overall pass rate for female is more than 3 percentage points higher than for male.

Table 4 Grade 1-3 vs All Students – Male vs Female, Source: own.

Year	Male	Female	Winner
2009	65%	70%	Female
2010	70%	71%	Female
2011	60%	63%	Female
2012	66%	64%	Male
2013	71%	75%	Female
2014	73%	73%	Female
2015	67%	70%	Female
2016	70%	83%	Female
Total	**68%**	**71%**	

Based on all previous tables we can say, that answer to RQ1 is NO, male does not have better results in exams from programming courses.

The Figure 1 extend information from Table 4 and shows, what we can expect in next years in case of results from programming courses. Usage of liner function shows, that female will have better result than male and speed of improving their results is bigger than speed of improving in case of male. In year 2019 (in next 3 year) the probability of successful passing of programming course will be in context of female more than 80% bug in case of male only 72% (which is a little bit bigger, than female have now).
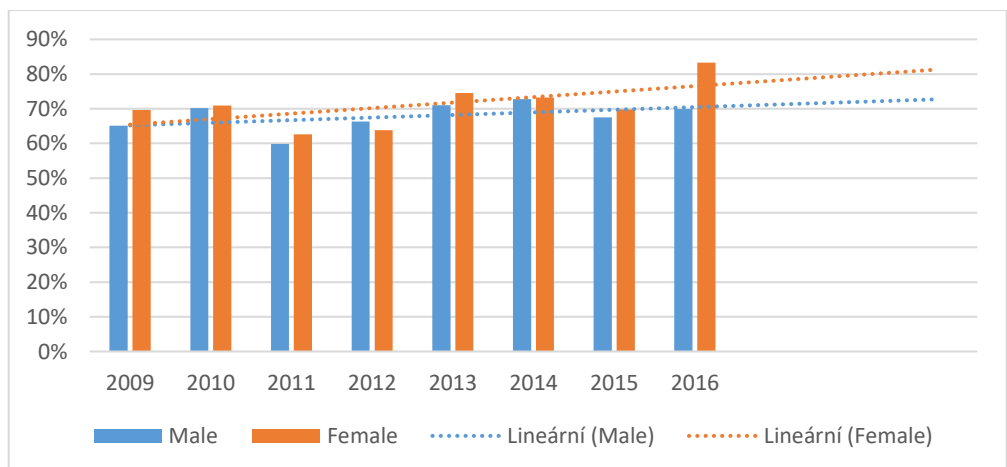
Figure 1   Male vs Female and Long Term Trends, Source: Taha, 2010.

The Figure 1 gives us answer to RQ3 and this answer is NO. Results of males from programming courses exams is not improving faster than results of female. On contrary female results are improving faster.

5 Conclusions

The paper provides interesting findings from exams from programming courses at the Faculty of Informatics and Statistics at the University of Economics, Prague. Although usually is said, that males have more abilities for studying programming and IT in general, we confirm that at the UEP females have better results than males.

Second interesting finding is a fact, that results from programming courses are improving in both cases (male, female) but results of females are improving faster and we expect that in next 3 year the pass rate for female will be more than 80% but for male over 70% only.

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CRM and IT Society

Milena Janakova[1]

Abstract. The article focuses on Customer Relationship Management (CRM) systems as one of the important information systems in enterprises. Special interest concerns the automation of processes with regard to small businesses. The controversy is that process automation has more forms, information is fragmented, and it is difficult to see suitable innovations for small businesses. The analysis carried out focuses on 17 CRM systems that demonstrate existing automation support in CRM. There are key automation features to add data to the lead profile, alerts and notifications, customer and history tracking, digital sales pipeline and life cycle, display schedule actions and events, synchronization of emails with customer profiles, marketing tasks, or transforming website visitors to leads. For small business, it is important to know the capabilities of automated processes that help to integrate customer contact based on appropriate innovations with a view to their future growth potential.

Keywords: CRM, Education and Training, Information and Knowledge, Innovation, Marketing, Other Computer Software

JEL Classification: D83

1 Introduction

For the 21st Century, information technology (IT) brings many changes in methodology and strategy. This reality has links to decentralized information work. There is a social network that transforms the Internet into an interactive medium. These social networks affect customer communication, product selection, marketing practices, and needed documents. (Grambs, 2008)

CRM (Customer Relationship Management) has a special position in business. Reasons are to support customer experience, diversity of channel integration, sales force automation, contact center variability, successful marketing and customer relationships. In 2016, CRM is still perceived as a process of managing detailed customer information and using points to maximize customer loyalty, but marketing redefines customer behavior

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in the digital era through personalized marketing and customer conversations based on omnichannel strategies. (Kotler et al, 2016)

Motivation to select CRM has requirements to understand and develop customer relationships for business sustainability into the future. There is big data and necessary analyzes for visible hidden information and estimates of new trends. These benefits take advantage of the optimal skills and time to set up the necessary processes, and in this matter it is a unique automation.

2 CRM and Automation

CRM and automation have the ability to manage marketing campaigns, customer care, sales force, data analysis through software solutions. It is about streamlining the necessary processes in enterprises. CRM solution brings new features and improvements each year, and automation is the place for it. Good examples of automation are:

- Ability to automatically record and store email, social media and phone interactions;
- Start automating adding forms to a lead list;
- Integrate some other CRM tools from third-party software;
- Track customer interactions and automate the business functions of the sales cycle to track leads and attract new customers in the process;
- Automatically add marketing materials (emails) according to pre-defined criteria;
- Automatically manage the prospect to become a customer;
- Automate customer service tasks based on live chat, basic FAQs, and automated response generation. (SelectHub, 2018)

And it is not all. Other benefits are provided by artificial intelligence, which provides customer care processes, marketing with leads identifiers using internal and external (social, socio-demographic) data, sales with products based on the highest importance to customers for CRM. Statistics show great importance for CRM and artificial intelligence. CRM will increase global business revenue by $ 1.1 trillion from 2017 to 2021, which could result in 800 000 new jobs. (Gantz et al, 2017)

From the point of view of business, automation is crucial to finding a market gap and finding that customers are buying the products and services. And for small business, it is important that they have a responsibility

for business operations, finance, sales, marketing, human resources, customer service, product development, or IT. It is an interesting group of businesses with great potential for future development. In numbers, more than 50% of Americans own or work for a small business. (Small Business Administration, 2018) About 23 million SMEs (Small and Medium-sized Enterprises) are in the European Union, accounting for about 99% of all European businesses. And nine out of ten SMEs are micro-enterprises with fewer than 10 employees. For small businesses, the European Union defines this business with less than 50 employees and a turnover (or balance sheet) less than EUR 10 million. (Delaney, 2011) There is existing controversy (problem) because CRM can help with their business, but in many cases it is not true and many IT projects end up failing.

3 Existing problem

The existing problem is visible in the controversy between the possibilities of CRM systems and their successful implementation in practice in small businesses. CRM is one from the heavy industry, and small businesses are also an important part of global economy, but they have difficulty meeting together. Small businesses need balanced support through information technology, and information technology has many options to do it.

You can choose a lot of information with advices for optimal implementation in small businesses. Information is a variable focused on price, available modules, vendor's website, user interface, import and export, flexibility, reporting, leads, integration with other tools and appropriate customer support based on chat and video learning. The most common CRM features are:

- Customer support;
- Follow-up tracking;
- Interaction tracking;
- Q&A tracking;
- Quotes and proposal tools;
- Referral tracking;
- Sales performance management;
- Social components;
- Specified cell-center management feature;
- Visitor tracking. (Burger, 2016)

The difficulty causes that information to be incomplete and the automation information is not available in detail for the implemented functions. You can see ratings, deployments, features, available modules, starting price, free trial, training, support, and contact. The situation is also complicated from the point of view of available information. The top lists and best CRM lists focus only on a few features, but small businesses need more information about automation that is deployed in a single feature to quickly use the selected CRM and have a time on their own business.

4   Small business solution

The solution for this is a special interest in automation and especially for process automation in CRM. Benefits are at the level of easy implementation and fast CRM usage in small businesses. These businesses do not have time to setup and install CRM, and there are also no IT specialists.

This paper focuses on automating CRM for small businesses. The adopted solution method is based on the selection of CRM systems that evaluate them in terms of automation support. Selected representatives are from the top, middle, and bottom of list of CRM systems. Individual information is in many cases scattered into several sources, or the necessary information in not available. For a better orientation in CRM capabilities, key automation features are available to create an appropriate view to better understand the help CRM brings. Please, see Table 1.

Based on this analysis, CRM with automation support (CRM$_{\text{AUTOMATION}}$) is created by relation:

$$CRM_{AUTOMATION} = \prod_{i=1}^{11} Features_i \qquad (1)$$

where individual variables create the available automated processes (Features$_i$, from i=1 to 11) in CRM (lead profiles, notifications, customer tracking and history, sales pipeline, schedule actions, distribution of templates, synchronization of emails, generating the proposal, inventory controls, marketing integration and marketing campaigns, transforming website visitors to leads).

Table 1 Key automation features in CRM, Source: own.

Features with automation support	Representatives of CRM
add data to the lead profile (using a business card scanner)	amoCRM
alerts and notifications (to the phone and notification center; various reminders to keep the customer in touch)	amoCRM, itracMarketer, Jumplead, HarmonyPSA, SuiteCRM, YetiforceCRM
customer and history tracking (from the initial stage to purchase; customer tracking to automatically enrich customer data based on booking behavior)	Esmerald, SuiteCRM
digital sales pipeline and life cycle (scheduling and notification)	amoCRM, Cooper, Jumplead, SugarCRM, Zoho CRM
display schedule actions and events (in the calendar and reminders, alerts)	Salpo CRM
distribution of templates (based on the email)	Zimplu CRM
synchronization of emails with customer profiles	amoCRM, Cooper, Salpo CRM
generating the proposal	Jigawatt Solar Tech
inventory control	ZeyOS
marketing campaigns (alerts for marketers for marketing content, multi-channel guides campaign, wizards)	Ivinex CRM, Jumplead, Saleforce, SugarCRM, SuiteCRM
marketing integration with back-office processes (revenue-generating management, and prepayment)	HarmonyPSA
marketing tasks (automatic creation and submission of customer invoices; Webforms, Google AdWords)	itracMarketer, Odoo, SuiteCRM, ZeyOS, Zoho CRM
transforming website visitors to leads (automated lead importer)	Jigawatt Solar Tech, Zoho CRM

This common relation demonstrates the capabilities that CRM brings into businesses. These variables are in the interest of many experts and businesses. They search a help for individual customer care solutions with the highest quality and in the shortest possible time. The focus is on:

▪ Use the big CRM data to identify the client profile (Talón-Ballestero et al, 2018);

- ▪ View of CRM with a sustainable competitive advantage (Bhat and Darzi, 2018);
- ▪ Marketing skills can be added with the use of content marketing and CRM (Marrs, 2017);
- ▪ Lead generation tactics using social media (Newberry, 2017).

These innovations are related to service capabilities, staff capabilities, and customer focus, and explore their impact with customer profiles, schedule actions, marketing campaigns, and the other variables listed above. For small businesses, it is crucial to monitor the capabilities of automated processes that help solve customer contacts based on implemented innovations.

5 Conclusion

CRM industry is an important part of information technology. It is similar for small businesses that affect the global economy. In terms of information technology, there areas have great growth opportunities based on innovations. CRM focuses on specific features such as customer support, follow-up tracking, sales performance management, social components, or cell-center management feature. Small businesses are responsible for many activities such as business operations, finance, sales, marketing, human resources, customer service, product development, or IT.

For better IT support, they need as many automated processes as possible, but this information is scattered and a comprehensive view of existing options is missing. The realized analysis shows the key CRM features that are automated. There is scope for individual variables (Features$_i$, from i=1 to 11) such as lead profiles, notifications, customer tracking and history, sales pipeline, schedule actions, distribution of templates, synchronization of emails, generating the proposal, inventory controls, marketing integration and marketing campaigns, transforming website visitors to leads. This common relation demonstrates the capabilities that CRM brings to businesses. These variables are in the interest of many experts and businesses, and it is good to transfer these opportunities even to a small business.

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Economics and Management as the Object of Individual Learning on Internet of Generation Z

Lisnik Anton[1], Janičková Jana[2]

Abstract. The article deals with the issue of individual learning on internet of the generation "Z" (Z) in economics and management. The aim is to define the current profile and potential of informatics and economic literacy in a generation Z, with the intention to implement selected innovative elements of individual electronical learning using Internet in economics and management into organized education in high schools and universities, with the expected benefit for their students and teachers at present, but also for the business environment and the public sector in the future.**Keywords:** ICT Specialists, real wages in ICT, Moravian regions, Silesians Regions, wages progress.

Keywords: Economics and Management, Generation „Z", Internet, Learning

JEL Classification: D89

1 Introduction

Michael Dimonc in his study: Defining Generations: Where the Millennials end and post-Millennials begin defines the generation of both the truly i-generation. The development of the technologies (and Phone) and the historical context of the company's development as of September 11 and the crisis in 2007 define this generation as nielan that they are people born after 2000 but they are people who are in the digital world real at home and use its possibilities to the maximum. Not only in communication but also in obtaining real and serious information in the learning process as well as in the working process. For this Generic, not so important institutional education, but to master the scholarship that allows them to join the work process into which they enter very early.(Dimonc, 2018).

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Generation X is one of the most highly educated generations. Factors that drive Generation X behaviour are their early disillusionment with cultural icons, ongoing preoccupation with the Internet and their seemingly infinite ability to simplify, streamline and enrich the activities and relationships of their daily lives (Jackson & Stoel et al., 2011). Members of this cohort are said to have the following characteristics; they (Jorgensen, 2003):

- Value autonomy and independence,
- Thrive to open communication,
- Do not believe in "paying dues",
- Seek to acquire skills and expertise,
- Do not have long term loyalty to a company (but are loyal to individuals).

Generation Y is the first generation that doesn't need and authority figure to gain access to information. They are the first global generation connected by the Internet, and social media (Espinoza et al., 2010). The social media are so important, they should be taken into formal education plans (Hanclova & Doucek, 2011). Culture is a significant predictor of self-disclosure in social networks. (Pavlíček &Střížová, 2017) In the value orientation of the X generation on a global scale, these value factors are comparable to Y generation. (Pew Research Center, 2010) A comparison of value reasons for purchasing generations compared to Slovaks can be found in several differences. Gen X is very motivated to search for purchase-related information and is adept at searching. X tends to use information not as a point of pride but as assurance that they are not being taken advantage of by marketers and are getting the best deal possible. Gen X is most likely to look for the lowest cost item or discount rather than thinking of the investment value of purchases. Is the first generation not to give or be given lifelong loyalty by their employers, this generation grew up with no desire to be loyal to corporations or brands. Gen Y buyers select and consume products that helps them to define who they are, what is important to them and what they value in life also serve to express some aspect of the their own personality or image. They use their considerable knowledge about the latest trends, images, and reputations of retailers, products, and brand names to be considered experts or leaders among peers (Ordun, 2015). Innovation "comes directly from two major areas: creativity and insight. Creativity can be spawned from the methods, processes, and applications" (Kovaľová, 2016).

2   Case study - aim, sources, methodologhy and methods

Qualitative primary survey was conducted as aggregated in the first quarter of 2018, at the same time, attitudes and opinions were examined in the target group of respondents, collectively referred to as the "Generation Z" - born especially after 2000 and just before, on two interrelated topics. The results of the survey on the first topic - Internet use and respondents' buying risk behavior - have already been published separately. In this article are only the results of the survey on the second topic - the current state of individual learning in economics and management science disciplines (E & M) using Internet. The interconnections of both topics into one survey has been following the aim, to identifying interaction, especially the identification of the informatics and economic literacy profile, respectively independence, of the Z generation.

The results have to the potential for the implementation of innovative elements in the education system in the existing and prepared study programs, primarily in the Pedghogical Faculty of the Catholic University in Ruzomberk, secondary – they will be a model of best practice of education - in others high schools and universities in the near future. Innovative elements of E & M learning with the use of the Internet, they shall be beneficial for individuals (students and teachers), study programs, schools, but also for society - particularly for businesses and diverse public sector institutions, in the E & M knowledge requirements area.

The technical tool of the survey was structured, formalized questionnaire, filled in by students in selected Slovak high schools and universities in the E & M study programs in the Prešov region. The questionnaire contained 12 questions, from respondents inquiring about Internet availability; generally preferred ways of individually seeking information and learning; level of the current state of individual information skills, knowledge E & M in relation to the requirements of school and practice; about the reasons, the purpose, the previous experience with the application of acquired knowledge gained from individual learning in E & M. It was completely to avoid the current offer of standard organized electronic education in schools and universities within the internal information system.

Together, 500 respondents were approached, 392 (78%) were recovered, 358 correctly filled questionnaires (91% of the returned) were used.

In the evaluation the median, the average values of the modus - the most frequent value of the statistical sign, the order and position maps were determined from the answers. To determine the dependence between characters the COVAR and CORELL functions in Excel were used:

$$r_{yx} = \frac{cov_{yx}}{s_x s_y} \tag{1}$$

For the purposes of the survey, respondents born after 1994 (ages 19-23) were also included in the target group of respondents of the Z generation too, except for high school's students (ages 14-18), because they are currently students on universities. The results of correctly completed 358 questionnaires were provided by 132 high school students (36%) and 226 university students (64%). Higher share of university questionnaires was provided by personal distribution.

3   Results

The results of the survey have been founded, that out of the total number of respondents, 13.5 hours per day are they connected to the Internet (online) on average, with secondary school pupils 16 and undergraduates 12 hours a day. Up to 117 respondents (33%) are online non-stop. During the time of connection, they are mainly engaged in entertainment (46%), then in the individual learning in their field E & M (33%); 22% of the online time they devoted to searching for other information. The results are very balanced in both groups (high school students, college students) in the structure of these activities.

Up to 89 high school graduates (67%) and 116 university students (51%), together on average 57% of all, are convinced, that they also need the Internet, when they preparing for school, while only 68 (19%) think, that they don't need to use Internet. By the home preparing for school, for the high school students are the most important online information on the Internet, then textbooks, and then notes, entries. For university students, they are the source – at first books, then Internet, and then own notes. According to the form of individual learning,

most of them are selected: 1. video and audio presentations (youtube, etc.) –
78 high school students (59%) and 166 college students (74%); 2. Text www -
35 high school students (27%); for the university students is this the third place
(27, 12%); 3. Online courses with certificates in the field of E & M - 19 high
school students (14%); for college students this type of learning
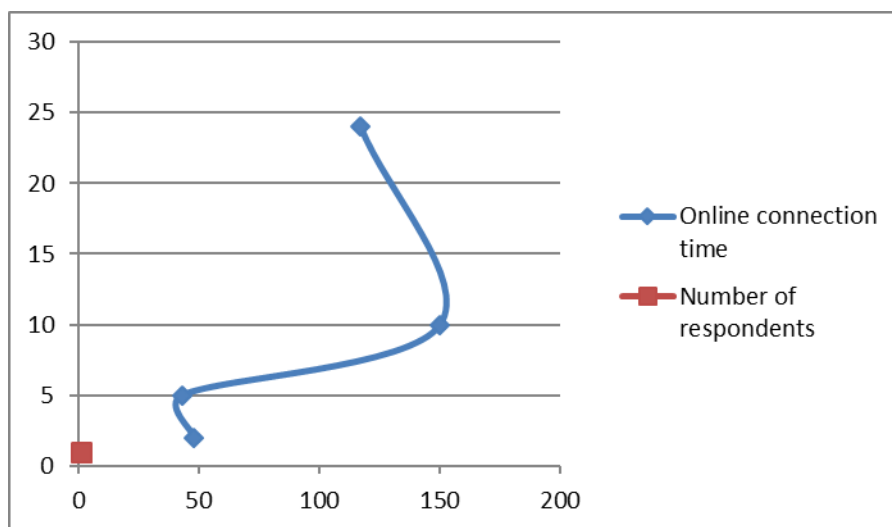is on the second place, 33 of them (15%) prefer it.

Figure 1   Relationship between the number of respondents in the age groups and the time
of online Internet connection, Source: own

As most of the respondents are learned individually in E & M using video
and audio online presentations, they have the most dominating of entities
(channels) in the structure: 1. YouTubers - who present their skills, knowledge
and experiences (40% of all, 48% of high school students and
32% of undergraduates); 2. experts and their online lectures, eg TEDx and
others (25%); 3. peers - who have similar interests (15%). Interestingly, up to
10% of all are attending training courses from businesses. Up to 285
respondents (80%) evaluate videopresentations, they tprovide feedback - the
results are evenly in both groups.

Follow the answers to the question of the types of activities and the
extent of respondents' involvement in E & M education. The results by high
school students are equal - the same amount of time devoted to creating,
sharing and receiving content. The results for college students are in favor of
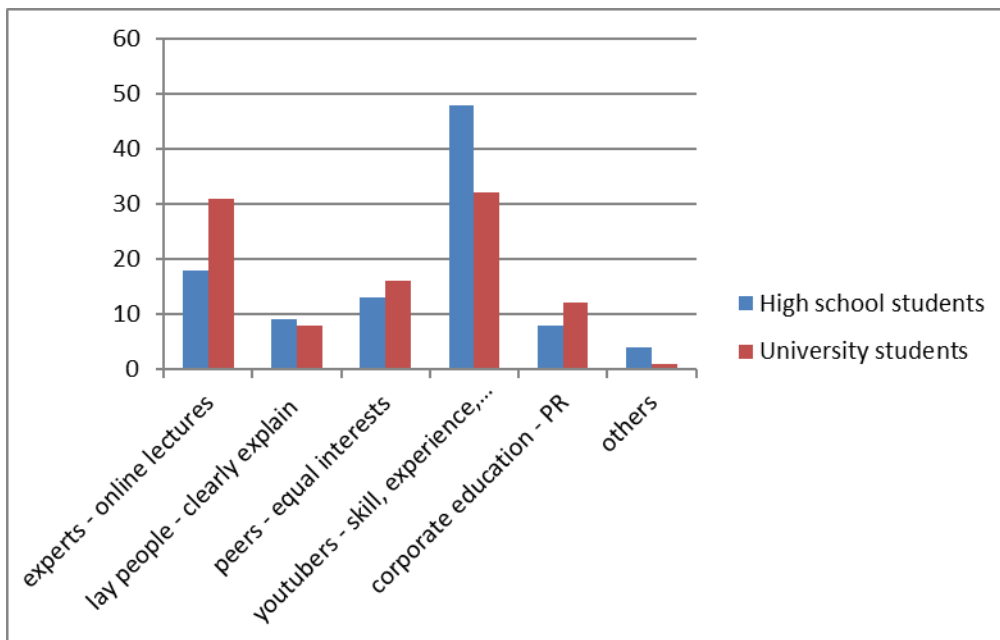receiving content (56%), sharing (32%) and ultimately creating content (12%).

Figure 2   Entities sought for individual student learning on the Internet at E & M,
Source own

The results indicate that, the social networking features are weakened in individual E & M learning on Internet. Only 71 respondents (20%) rated them very useful, 185 (52%) were less useful and useless. Social networks are more than ever relevant for college students (45%), high school students are already considered their like unfashionable (46%).

In the situacion, you need to pay for E & M education on the Internet, the total number is 229 willing to pay (64%) and 129 doesn't want to pay (36%). On this question, high school students are divided into two opposing poles - the answer „yes and rather yes" were choosing by 67, and „not and rather no" more than 65 of them answered. Undergraduates are clearly willing to pay for their individual leanrning - up to 162 (72%) have answered „yes and rather yes"; 64 answered „no and rather no".

In the structure of E & M topics marked according to obligatory subjects on the schools, most of the answers are with the largest share in both groups in the subject "Informatics", with the same share for high school students by the subject "Accounting" (29%), followed by "Management" (21%). The smallest share of high school graduates also are "other" (3% on average) and "business economics" (an average of 8%).

The ranking of reasons for using the Internet in E & M education is among respondents: better understanding, better results, better knowledge, better skills, others. None of the respondents wrote, that this kind of education helped him to improve his financial literacy or social situation. Up to 303 respondents (85%) follow, that this way of individual education is proved, to be insufficient for only 55 (15%).

In this context, it is interesting, that in the subject "Economics" - high school students have reached or expected an average mark of 3, universities mark 2 (C); by the subject "Management" they expected mark 2 (in universities B); by the subject "Informatics" - mark 3 (or C).

Were also expected the opinions on the weaknesses in the offer of learning using the Internet. 210 respondents (59%) indicated the greatest lack of unprofessionality of processed videos in their native language, the need to improve technical and graphic editing of video and audio recordings. Almost half of them have said, that similar videos in English are insufficient in terms of content, but their technical and graphic processing is more acceptable.

4   Character correlation

The tightness of the relationship between the quantities was determined by the correlation coefficients. The most significant results are by the identification of the interdependence between the characters: the age of the respondents and the length of their online connection to the internet, ryx = 0.85. The value of the correlation coefficient expresses a high degree of leakage of dependence, when the result is close to the value 1. Figure 3 shows the result as a dependence between age and willingness to pay for electronic individual E & M education on the Internet - with a covariance index of 118.75, that confirm a high leakage between them.
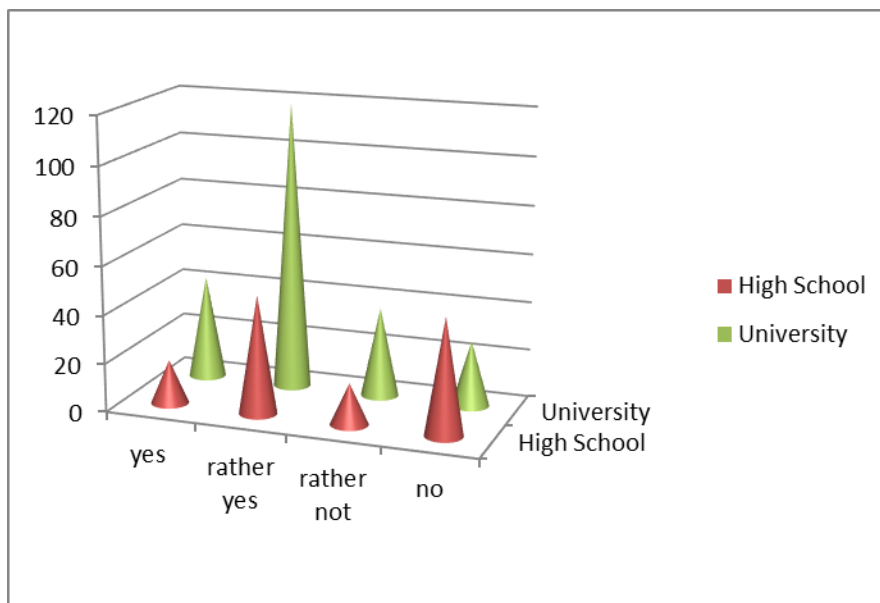
Figure 3   Frequency of respondents willing to pay for individual E & M online
education, Source: own

5   Conclusion

A. *Profile of the informatics and economic literacy of the respondent*
   according to the research results:

- the respondent is from the Z generation - is a high school or university
  student (aged 14-23), E & M studying, in the Slovak Republic in the
  Prešov region,
- is online in an average of 13.5 hours a day,
- online is dedicated to entertainment, but individually educates up to a
  third of the time,
- the Internet is an important tool in preparing for school, for to better
  understand - especially in „Informatics", but also in other E & M
  themes, because in the current period is rated by mark "good"
- uses videos in particular, watches YouTubers and experts, social
  networks are no more so important,
- for good internet education is willing to pay - especially with increasing
  age,
- is the recipient of information - evaluates and shares them, less creates
  them.

B. Proposals for implementation of innovative elements in the education system in existing and in-preparing E & M study programs:

a) to strengthen students' skills and competences in creating interactive educational content in the graphic, visual and audio recordings form and their placement on the Internet:

- to innovate a range of subjects with emphasis on digitization and internalization,
- to create conditions for inclusion in education between students and teachers in Informatics and in E & M study programs (fields) and to continually develop a "learning with each other" activity, that is a prerequisite for improving learning results,

b) to increase interactivity and involve students in an innovative educational market activities:

- to use smart phones to share, create and use applications,
- to cancel a prohibition to use smart phones and other technical electronic devices with Internet access directly on the teaching and learning process in the schools.

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Ontology-based System for Automatic Analysis of Job Offers

Paweł Lula[1], Renata Oczkowska[2],
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Abstract. The presentation of the system designed for automatic analysis of job offers is the main goal of the paper. The solution presented here is based on the knowledge base which has a form of the ontology describing competences as crucial features of candidates looking for jobs.

The proposed system allows to identify the contribution of every competence in a given job offer. It was implemented in R language and used for analysis of offers published on Polish web sites.

Keywords: ontology-based exploratory data analysis, text mining, labor market analysis

JEL Classification: C63, J20

1 Competencies in the theoretical approach

Nowadays both source the subject literature and economic practice stress the significance of the quality of human resources and the employee competencies as a root of competitive advantage of an organization. The subject literature does not agree as to what the employee competencies are.

There are many approaches to define employee competencies which differentiate competencies, inter alia, in terms of the following criteria:

- focus - from a general attitude to life to a realities-oriented focus on a specific situation,
- level of detail of components - from a general approach to a detailed classification,
- rationality of their creation and development (Gruszczyńska-Malec and Strużyna, 2011).

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In the opinion of R.E. Boyatzis (1982) competencies are the capacity of a given person to display behaviors compliant with the requirements of the job position specified by the organizational environment parameters, which, in turn, yields the desired results.

According to Woodruffe (1991) the concept of competencies is applied to refer to two meanings:

1) areas of work in which the employee is competent and the proven ability to perform a work competently,

2) the sets of behavior the employee must demonstrate in order to perform the professional tasks with competency.

In addition, the definitions of competencies presented in the subject literature indicate that the competencies consist of various components, for example:

- knowledge, abilities, motives, features, self-image and social roles (Boyatzis, 1982),
- knowledge, skills, motives, personality traits, self-evaluation (Spencer and Spencer, 1993),
- knowledge, skills, abilities, personality traits (Parry, 1996),
- knowledge, skills, abilities, personality traits (Lévy-Leboyer, 1996),
- skills, intellectual potential, attitudes (Gupta, Roos, 2001),
- knowledge, skills, motivation, personality traits (Jia, Fan, 2008),
- knowledge, skills, psychophysical features, experience, education, health state, internal motivation, talents, predispositions, attitudes and behaviors, permission to act (Oleksyn, 2010),
- knowledge, skills, attitudes (Yuvaraj, 2011),
- knowledge, skills, experience (Awang et al, 2013),
- knowledge, skills, abilities, experience (Gajdzik, 2013),
- knowledge, skills, predispositions, attitudes (Rostkowski, 2014),
- knowledge, skills, attitudes (Filipowicz, 2014).

However, it may be considered that the key elements of competencies are knowledge, skills and attitudes, which - when used during work - help implement the organization's strategy.

The subject literature includes various typologies of competencies. A complex typology of competencies is suggested by Filipowicz (2014) who divided them into:

- social – determining the quality performed tasks associated with contacts with people (e.g. commercial contacts),
- personal – related to performance of tasks by the employee, and their level affects the quality of the performed tasks,
- managerial – involve human resource management, both with soft areas of management, work organization, as well as with strategic aspects of management,
- professional (specialist, technical) – concern specialist tasks set for particular groups of positions.

2 Methodological foundations of the analysis

The proposed system of job offers analysis is based on three theoretical pillars:

- ontology-based competence model,
- lemmatization method,
- phrases matching algorithm.

Consecutive parts of the current section present the issues mentioned above.

2.1 Ontology-based competence model

The ontology model was used for representation of the domain knowledge concerning competences crucial for employers, employees and candidates looking for jobs.

For competence description the hierarchical ontology was used in which the root element corresponds to the general competence concept. Nodes located at the first level represent main groups of competences. In the project presented here social, personal and professional groups of competences were distinguished. For every group of competences any number of elements can be defined on second and lower levels of competence tree.

Ontology-based approach assumes that every concept represented by a node has attributes corresponding to its essential features and possesses a sequence of phrases taken from real job offers and pertaining to a competence

represented by a given node. These phrases will be used as patterns allowing to identify references to competences occurring in job offers.

The ontology-based competence model was implemented in YAML format to ensure its readability for people and computer programs.

2.2 Lemmatization method

Lemmatization process should transform all words in a given text into their basic form (e.g. verbs are changed by their infinitives, nouns are transformed into their nominatives). Usually lemmatization is supported by morphological dictionaries.

In the system presented here lemmatization process was realized by *hunspell* package[1]. The possibility of analyzing text prepared in many different languages is the main advantage of this package (it uses the same free dictionaries which are used in LibreOffice, OpenOffice, Firefox or Chrome programs).

2.3 Phrases matching algorithm

The calculation of similarity measure between two phrases is the main aim of the phrases matching algorithm. This task can be solved with the use of two different approaches (van der Loo, 2014). The first group of methods is based on the idea of edit distance. Generally speaking, the distance between two sequences of words can be defined as a minimal number of elementary operations which allow to transform the first sequence into the second one. The second approach ignores the information about words' order and uses measures of similarity appropriate for *bag of words* representation.

The results of preliminary experiments showed the advantage of Jaccard measures over other solutions. Assuming that X is a set of words appearing in the first phrase, and Y is a set of words which occur in the second phrase, the similarity between them can be defined as:

$$sim(X, Y) = \frac{|X \cap Y|}{|X \cup Y|} \qquad (1)$$

The calculations may be performed on phrases in original or lemmatized form.

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[1] https://CRAN.R-project.org/package=hunspell

3 The analysis process

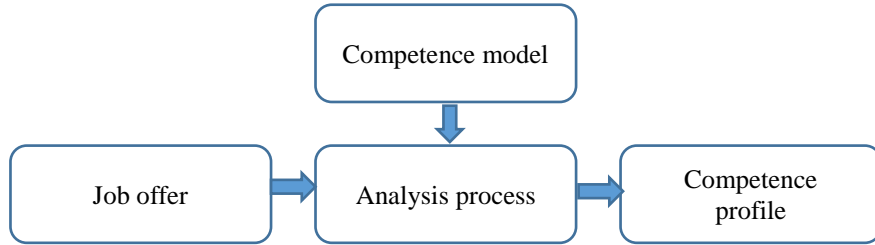The general schema of the analysis process is presented in Fig. 1.

Figure 1 Analysis schema, Source: own elaboration.

Competence model has a tree form with M leaves which correspond to individual competences. The j-th competence is defined with the use R_j patterns forming the $\boldsymbol{c}_j$ vector:

$$\boldsymbol{c}_j = \begin{bmatrix} c_{j1} \\ \cdots \\ c_{jR_j} \end{bmatrix} \tag{2}$$

The specialized notation for pattern definition was proposed. This formalism allows to define:

- words occurring in patterns,
- obligatory and optional elements of patterns (words preceded by "#" symbol are treated as obligatory elements, the others as optional),
- alternative elements (which can be defined with the use of the "|" symbol),
- groups of symbols (defined by using parenthesis),
- multi-word expressions (defined as sequences of words surrounded by square brackets) which are treated as one atomic element of a given phrase.

As input data a job offer is entered. During its processing its text is split into phrases. It can be assumed that a given job offer is represented by a vector of phrases called $\boldsymbol{o}$ having a following form:

$$\boldsymbol{o} = \begin{bmatrix} o_1 \\ \cdots \\ o_N \end{bmatrix} \tag{3}$$

The analysis process should calculate the contribution of every competence in a job offer. The detailed description of this process is presented below.

Input data:

- $c = [c_1, \ldots, c_M]$ where c_j is a vector of phrases for j-th competence
- $o = [o_1, \ldots, o_N]$ – vector of phrases representing a given job offer

Output data:

- $p = [p_1, \ldots, p_M]$ – job offer profile

Calculations:

for $i = 1$ *to* N

    for $j = 1$ *to* M

        $v[1, \ldots, R_j] \leftarrow 0$

        for $k = 1$ *to* R_j

            $v[k] \leftarrow sim(o_i, c_{jk})$

        next k

        $T[i, j] \leftarrow \max_k(v_k)$

    next j

next i

for $j = 1$ *to* M

    $p[j] \leftarrow \max_i(T[i, j])$

next j

In the above algorithm a *sim* function is used for calculation the similarity between o_i phrase and c_{jk} pattern. If c_{jk} contains alternative symbol "|" it is necessary to replace c_{jk} with a vector containing all possible alternatives of a pattern and then calculate the similarity between o_i and every element of a new vector. Finally the maximal value should be calculated and returned. The definition on the *sim* function which uses Jaccard coefficient can be defined in the following way:

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*function **sim**(o,c):*

       $o \leftarrow lemmatized\ version\ of\ o$

       $c \leftarrow lemmatized\ version\ of\ c$

       $\boldsymbol{c} \leftarrow all\ alternatives\ of\ c$

       $L \leftarrow length(\boldsymbol{c})$

       $\boldsymbol{v}[1, \dots, L] \leftarrow 0$

       for $l = 1$ to L

              $A \leftarrow set\ of\ all\ words\ occurring\ in\ o$

              $B \leftarrow set\ of\ all\ words\ occurring\ in\ c$

              $X \leftarrow set\ of\ all\ obligatory\ words\ occurring\ in\ c$

              if $(|X - B| > 0)$ *//not all obligatory words appeared*

                     return 0

              end if

              $v[l] \leftarrow \frac{|A \cap B|}{|A \cup B|}$

      next l

      return $\max\limits_{l}(v_l)$

As a final result, for a given job offer, a vector $\boldsymbol{p}[1, \dots, M]$ is calculated. Its elements can be interpreted as a contribution of the j-th competence in a job offer. In the Fig. 1 vector $\boldsymbol{p}$ is labelled as a "competence profile".

The algorithm presented above was implemented in R language and was used and positively verified by the authors in the system of automatic analysis of employers' expectations towards candidates looking for job.

4 Conclusions

Taking into account the results presented in the paper and experience gained during previous studies (Lula et al, 2018) the authors are convinced that the ontology-based approach is the best option for systems of automatic analysis of job offers.

However, the costs of building of ontology-based solutions is relatively high due to the necessity of creation of the knowledge base describing competences. Fortunately, properly designed knowledge base can be used several times.

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User Expectations in the Process of Implementation of Information Systems - the Case of Cracow University of Economics

Jan Madej[1], Paweł Konkol[2]

2. **Abstract**. Problems and challenges experienced during implementation of information systems are often linked with the discrepancy between end-users' expectations concerning the system and the set of functionalities it offers. Future users are often afraid that these final functionalities will not cover all necessary business processes even of normal daily routine activities. These circumstances encourage to put special attention to collect and evaluate these negative assumptions during all steps of implementation, starting from the very first steps of that process. This evaluation can serve as the source of warnings concerning implementation activities, serving from one side as an incentive to make modifications in the group of functionalities, from another as a motivation to start activities aimed at the reduction of fears through deeper involvement of end-users in all stages of the implementation.

The main aim of this article is the presentation of future users' expectations, skepticism or concerns in the key strategic moment of implementation of the University Study Oriented System (USOS) at Cracow University of Economics (CUE). These users represent CUE departments responsible for student services.

Keywords: information systems, IT project management, university management, integrated information system

JEL Classification: C80

1 Introduction

Cracow University of Economics (CUE) decided to launch new study oriented system in the beginning of the winter semester of the 2018/19 academic year. This is the milestone of the implementation project which started months ago, coordinated by the special University unit, IT Development and Maintenance Department. The decision was the result of the complex analysis of existing solutions available on the market. The comparison of functionalities, financial aspects, perspectives

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of customizations etc. led to the decision to implement USOS which is the management information systems providing tools and modules for wide range of activities concerning student and faculty staff. There are 60 higher education institutions using USOS and this number has been growing for several years (fig. 1). This group embraces 50 public institutions (which is 45% of HEIs in Poland) and 10 private (out of 302).

Figure 1   USOS in Polish Higher Education Institutions Source: Czerniak M, (2018). USOS
w liczbach, Retrieved from https://www.usos.edu.pl/node/3919/usos-w-liczbach

According to the data of Statistics Poland[1], as for the 2016 49% of students of Polish public universities used USOS. The system is owned by the the University Centre for Informatization (MUCI) which groups Polish higher education institutions contributing to the further development of USOS.

The aim of this article is to discuss how the USOS implementation at Cracow University of Economics relates to its future users' expectations and concerns.

2   User expectations – implementation challenge

User satisfaction of information system is perceived as one of the most important indicator of successful information system implementation. As the level of satisfaction can be relatively easily measured and can be adapted both at general level and within a very specific context it is an efficient method indicating at possible discrepancies between expectations and actual functioning of the system (Vaezi et al., 2016). These discrepancies may lead to implementation failure, which could mean completion

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[1] https://www.usos.edu.pl/node/3919/usos-w-liczbach

of the implementation steps and the further system rejection by end-users (Piccoli, 2008). Thus, the reflection of user expectations throughout the implementation process, even if discovering dissatisfaction, resistance or preconceptions, should not be seen as the threat but a possibility to raise the probability of the final implementation success.

The gap between user expectations and the actual performance of the systems may be analyzed using the theory of cognitive dissonance (Sau-ling Lai, 2012). It considers situations which involve disharmony and conflict between beliefs, attitudes, behaviors or performance. The conflict leads to discomfort resulting in alteration on those attitudes, beliefs, but also behavior or performance. Szajna and Scamell (1993) defined user expectations referring to the beliefs of end-users concerning information system from one side but also to actual performance of the system itself and the performance of users working with the system. What is important, these beliefs are usually formed in the very beginning of the IS implementation project. If there are discrepancy between these beliefs and opinions from one side and actual performance of the system from another side, users will be affected by the cognitive dissonance. It means that their expectations are greater than the perception of the performance of the system. As the consequence, they may reject IS as the whole, or, at the lower scale, they could produce a lot requests for change, modifications etc. However, the situation when the expectations of user are below the actual performance of the system, it leads to the system being undervalued by the users which also has negative consequences on the overall implementation project. Hence, the management of users' expectations and keeping them at the appropriate level is one of the important task in the IS implementation project. In particular, IT managers should not tend to raise users' expectations to an unrealistic position.

3 Expectations, skepticism and concerns – user's perspective

The moment of launching the USOS system at Cracow University of Economics has been chosen to conduct a survey referring to USOS user expectations. The survey has been addressed to staff members of University units responsible for students' services (30 respondents have answered). Questions were focused on expectations, skepticism and concerns related

to USOS. USOS implementation team is going to follow the survey with similar research at the end of the first year of the system usage.

The analysis of the results has proved that the idea of moving students' services to the new system is not widely supported (at the moment of implementation) among CUE administrative staff (fig.1) and over 70% of future users state that the current system provides sufficient functionalities (even though that, in fact, the set of those within USOS is more advanced).

Do you perceive imlepentation of the new system is neccessary?

- Definitely not
- Rather not
- Do not know
- Rather yes
- Definitely yes
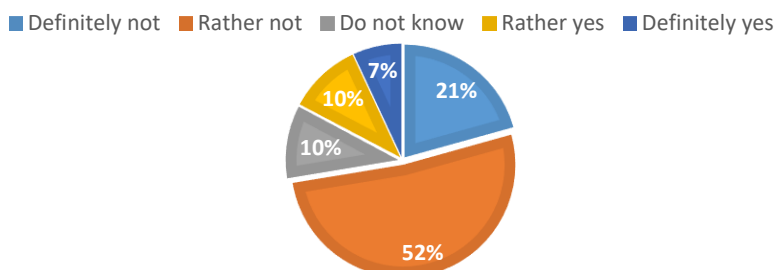
Figure 2 The perceive of implementation of new system Source: own

This could be the result of some concerns and worries about consequences the change of the system can bring to the working conditions of CUE administrative staff. While 45% of respondents think that implementation does not bring the risk of restructuring of University Departments focused on students', 31% think the opposite (fig.4) The skills needed for working with USOS is not considered as the biggest challenge of the implementation process (fig. 2). At the same time, almost 66% of respondents claim that the necessity of the adaptation to the new solution will bring disturbances in normal day-to-day activities. Other concerns and remarks mentioned by users included:

- difficulties of parallel working with the old and new system during first years of implementation (USOS will gradually assumes the roles of the old Apollo system)
- extension of worktime and the length of student visit in offices (70% of respondents expressed skepticism about decreasing the time spent by students visiting various departments)
- dissatisfaction of student community
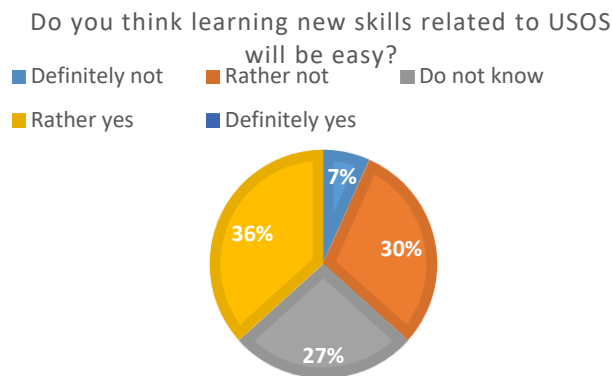- risk of disinformation

Do you think learning new skills related to USOS will be easy?

- Definitely not
- Rather not
- Do not know
- Rather yes
- Definitely yes

Figure 3 The opinion about teaching the new skills related to USOS Source: own

As far as USOS functionalities are concerned, the survey gathered expectations related to the following areas:

- faster performance of the study oriented system
- clear and cognizable user interface
- extended diversity of reports generated by the program
- functionalities offering tools for foreign students mobility services

One of the field in which skepticism has been clearly expressed refers to communication between various University departments, especially between administrative units and faculty staff (fig.3). Almost half of the respondents claim that the new system will not facilitate cooperation between student
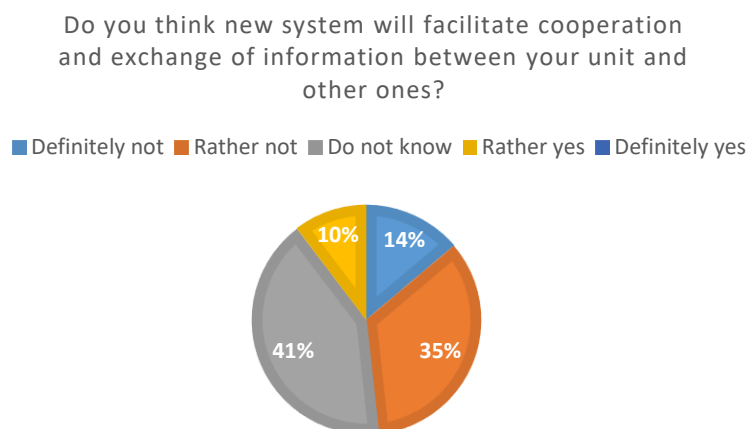
Do you think new system will facilitate cooperation and exchange of information between your unit and other ones?

- Definitely not
- Rather not
- Do not know
- Rather yes
- Definitely yes

Figure 4 The opinion about facilitate and exange information Source: own

Are you afraid that USOS implementation can bring
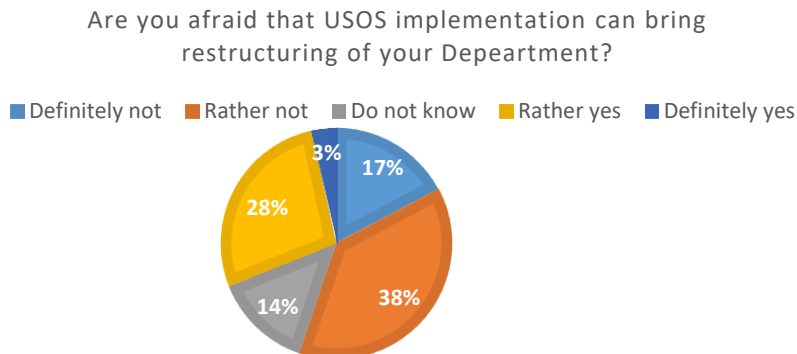restructuring of your Depeartment?

Figure 5 The opinion about restructuring department Source: own

One of the major concern of administrative staff relates to number of student visits at University offices and queues after the launch of the new system. Even though USOS implementation has been planned to solve this problem, almost 60% of respondents expressed their pessimistic opinion about the possible improvements in this area (fig. 5). Similar level of pessimism has been expressed with regards to the time of a student visit at student service units.

Do you think that new system will decrease the number
of students' visit and queues at your office?
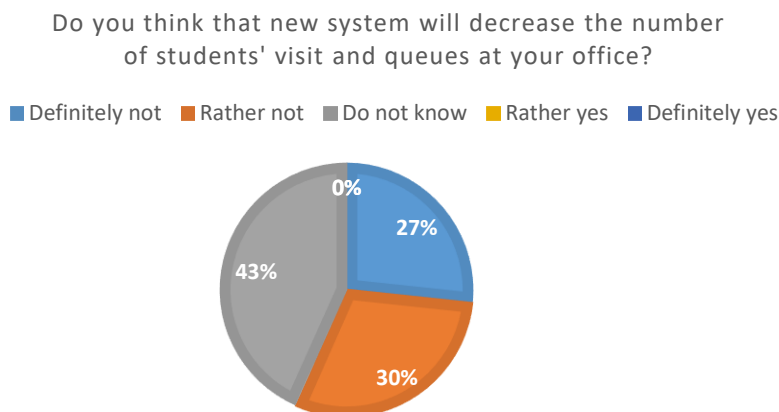
Figure 6 The opinion about decrase of student's Source: own

6 Summary

The decision of implementation of the University Study Oriented System at Cracow University of Economics had been preceded by the detailed study of the most popular systems of this kind used by Polish universities. This decision was disseminated among CUE academic community. It allowed to analyze and gather various users' expectations referring to the system functionalities. This analysis, enriched by the results of the survey conducted in the group of end users working as a staff of student services pointed at various concerns, worries, expectations and doubts related to the new system. Management of these expectations and concerns became a management challenge for the University leadership and the project implementation team. Next survey focused on user expectations planned after one year after the launch of USOS should prove whether management assumptions adopted facilitated the overall implementation process.

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Quality Culture in the Perspective of Polish IT Sector

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Abstract. The resource-based view that emerged in the 1990s and the focus on intangible resources, typical of the 21st century, result in the belief that the present organisational culture determines the success or failure and can be treated as a determinant of the organisation's future.

One of the cultures indicated as optimal for the conditions of the new economy is the quality culture, since focusing on quality is today the source of success of an organisation and, at the same time, one of the main tasks of managers.

Because of the fact that in some sectors quality culture has not been properly developed and also general agreement that there is a gap to be filled in the development of appropriate culture for quality - the main purpose of the study is to synthesise the literary achievements and diagnose of the organizational culture quality of the Polish IT sector on the basis of empirical research.

Keywords: organizational culture, quality, quality culture, polish IT sector, empirical study

JEL Classification: M12, M15, L22, L25

1 Introduction

Today, the focus on quality is a *sine qua non* condition of the functioning and success of an organization and, at the same time, one of the main tasks for managers (Ali, Musah 2012). It results in a different approach to competitiveness, relations with customers and suppliers or relations between managers and employees (Troy, Schein 1995). These actions should aim, among others, at building an optimal, under the conditions of the new economy, culture of quality as a special organizational culture, because organizational culture is recognized by many as a critical factor when applying quality management initiatives.

At the same time leaders lack an understanding about the key role of organizational culture in quality. They're ignoring the role of values, behaviors and attitudes in spite of the fact that there is a strong link between reaching full quality development and organizational culture (Ingelsson,

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Bäckström, Snyder 2018). Moreover, quality culture was introduced to provide a comprehensive approach to quality sustainability (Wu 2014).

Because of the fact that that instruments are in place but there is still a lack of quality culture, the study provides an initial verification of which stage of evolution towards quality culture is represented by companies from the IT sector in Poland.

Two objectives of the paper were adopted – synthesis of literary sources devoted to quality culture, including recommendations with regard to its shaping, and identification, on the basis of empirical research, of conditions and stages of development of quality culture in the Polish circumstances of the IT industry.

2   Quality culture as an object of management

In the subject literature, quality culture is perceived and defined in various ways, especially in the context of organizational culture (Ehlers 2009; Markowitsch 2018). It is characterized as overall attitude of an institution, which focuses on the concept of quality and applies it to all aspects of its activities (Ali, Musah 2012). Therefore refers to an organisational culture that intends to enhance quality permanently and it is characterised by two distinct elements: on the one hand, a cultural/psychological element of shared values, beliefs, expectations and commitment towards quality and, on the other hand, a structural/managerial element with defined processes that enhance quality and aim at coordinating individual efforts (Ngyuen Duy Nong Ha, Bi Ngoc Quang 2014).

The notion of quality culture covers three main elements – system wide philosophy (doing the right thing the first time), continuous improvement (striving for that), and customer focus (fulfilling customer needs) (Wu, Zhang, Schroeder 2011). Its symptoms include empowerment, full commitment of employees to quality, as well as qualitative leadership, and its products - satisfaction of internal and external customers and business performance (Bugdol 2013).

The most often listed activities focused on building quality culture are: focus on customer satisfaction, focus on processes, teamwork, open communication and exchange of knowledge, focus on making decisions based on facts (Ali, Musah 2012; Ingelsson, Bäckström, Snyder 2018). In shaping

quality culture, the greatest significance is thus attributed to interpersonal relationships, treatment of employees and customers with respect, focus on development, acquisition of licenses, and co-participation in organization management. Then, the central place is taken by the critical importance of trust in relations at the level of an individual, as well as in relations between the employee and the organization, and between the client and the organization (Ehlers 2009). It may be thus defined through a set of indicators attributed to 3 categories verifying its condition – the level of the employee, the superior and the whole organization.

3   Research methodology

Before beginning the empirical research, the general purpose of which was an initial analysis and diagnosis of the condition of quality culture in companies from the IT sector in Poland, the following research hypotheses were formulated:

1) the standards of behavior binding in companies contribute to evolution of their organizational cultures towards cultures promoting knowledge,
2) companies from the IT industry observe signs of quality culture in areas of the employee, the superior and the whole organization,
3) organizational cultures of IT companies have features of quality culture that determine their success,
4) organizational cultures of IT companies move towards the 3rd stage of the quality culture evolution, namely a condition of permanent creation of quality.

Theoretical presumptions so specified contributed to selection of specific experimental challenges in the form of identification of:

1) distinctions of organizational culture promoting knowledge in the verified companies from the IT sector in Poland,
2) activities aimed at building quality culture in the analyzed entities,
3) determinants of quality culture indicated in the examined organizations at the level of the employee, the superior and the organization,
4) the level of satisfaction of internal and external customers of the verified IT companies with their operations.

To verify the formulated research hypotheses and to implement the research challenges in practice, a survey questionnaire was used, which

was conducted in the 1st half of 2018. The research tool covered 20 closed-ended questions – mostly multiple choice.

With regard to the aspect of quality culture, it was decided to explore the IT sector in Poland for several reasons. Firstly, it is one of the five main industries with the greatest impact on shaping the conditions of operations in the knowledge-based economy, and therefore it should adhere to the rules of the new economy to the largest extent. Secondly, although it is comprised of the segment of computer hardware, software and IT services, its leading form of activity consists in services, which generates the need for knowledge orientation. Thirdly, the estimated development of new markets, in the form of cloud computing and big data, focused on specialized services, forces quality orientation.

As a result, 175 completely filled in surveys were managed to obtain. Each respondent came from a different organization operating in the IT sector in Poland – thus, the study was only of pilot character.

The respondents were employees with average professional experience, with average number of years worked of 3.5 years, and in the organization described in their answers - 1.5 year. The analyzed organizations represented a diverse business profile (45% services, 23% trade, 32% mixed) and their average period of operation amounted to 13 years.

The examined companies were also diverse in terms of size – in 25%, the research sample was represented by microenterprises, in 25% by small companies, in 19% by medium-sized companies, and in 31% by large organizations. All of them had a satisfactory (in the opinion of the respondents) financial standing (31% of the respondents answered that their organizations are in a very good financial situation, 55% in a good situation, and 13% in an average situation). Stable financial situation of the verified entities suggested that the examined companies should represent an attitude of openness, demonstrate more inclination to risk, seek new areas of development – function under the conditions of the new economy, be focused on knowledge and quality.

4   Signs of quality culture in companies from the IT sector in Poland – research discussion and conclusions

In search for arguments verifying the accuracy of the formulated research presumptions, reference was made to specific answers obtained from the respondents to different survey questions.

In the first place, efforts were made to identify the stage of evolution of the verified companies towards quality culture. The obtained answers suggest that the examined entities transition from the phase of absence of pressure on quality to the stage of detection and prevention of quality errors, and then to the state of permanent creation of quality. Nonetheless, the respondents indicate actions and attitudes that can be observed in their organizations which would substantially slow down this evolution and are a proof of the emergence of a culture promoting knowledge and quality rather than its existence in a crystallized form. Arguments confirming this thesis are provided by indications of the respondents referring to actions and attitudes most often visible in their organizations, which hinder the transformation of organizational culture into knowledge-promoting culture. These mostly include treating knowledge as a source of power (45.33% of responses), pushing full responsibility for the organization's functioning only onto managers (46.67% of responses), keeping financial decisions in full secrecy (38.67% of answers). Supplemented by a formal, strongly hierarchical structure (29.33% of responses), including strict divisions into organizational units (34.67% of responses), risk avoidance (29.33% of responses), and behavior mainly based on the set rules (32% of responses), they substantially limit the willingness to share knowledge, be innovative, search for new solutions, and show one's own initiative. Lack of transparency and rigidity of principles do not foster trust, openness, and hence limit creativity, commitment and determination to search for excellence, which is manifested in affirmation of quality.

At the same time, pursuits to put strong emphasis on quality are most often manifested in the following rules and behaviors identified by the respondents as prevalent in their organizations: knowledge sharing is a value (62.67% of responses), focus "on the customer" (61.33%

of responses), informal ways of communication (50.67% of responses), continuous training and additional education for employees (41.33% of responses), evenly distributed responsibility (36% of responses), culture of co-responsibility (32% of responses), promotion of entrepreneurship (34.67%). The determinants of quality culture in the 3 distinguished perspectives (the employee, the superior, the organization) are noticed by the respondents to an average extent (Table 1).

Table 1 The indicated determinants of quality culture in the perspective of the employee, the superior and the organization, Source: own elaboration.

the employee	
is fully involved in performance of his/her duties	**48,00%**
has a precisely determined scope of responsibilities	40,00%
is supported by managerial staff in the performance of his/her duties	41,33%
has the opportunity to improve his/her competences	**50,67%**
complies with the binding procedures, instructions	38,67%
commits to improvement of his/her job	29,33%
is thoroughly familiar with his/her duties	**60,00%**
has sufficient competencies to perform the assigned duties	38,67%
takes care of his/her workstation	**52,00%**
is well-motivated to perform his/her duties	38,67%
the superior	
supports employees in performance of their tasks	40,00%
is focused on fulfilment of customer's requirements	**60,00%**
enables employees to participate in trainings	**42,67%**
encourages employees to increase their qualifications	33,33%
the organization	
priority treatment of meeting customer's requirements	**46,67%**
mandatory fulfilment of legal and technical requirements by the product/service	37,33%
cooperation with the best suppliers	36,00%
continuous investment in the most advanced machines and devices	22,67%
very good cooperation between employees	**52,00%**
elimination of products/services inconsistent with the requirements from the order execution process	18,67%
use of techniques and methods of quality improvement	**38,67%**

In the perspective of the employee, the pursuit of quality culture greatly manifests itself in thorough familiarity with one's duties, the possibility of improving competences, care for one's working post, as well as full commitment in performance of duties. On the other hand, growth in involvement in improving one's working post is recommended – such opinions were indicated by only 29.3% of the respondents.

In the case of the superiors, their actions focused on shaping quality culture are related to focusing on fulfillment of customers' expectations and giving employees opportunities to participate in trainings. In turn, the superiors should pay more attention to encouraging their subordinates to increase their qualifications and should increase the strength of their actual impact on co-workers.

When referring to the organization's level of building quality culture, the respondents most often indicated: very good cooperation between employees, priority treatment of fulfillment of customers' expectations, as well as use of techniques and methods of quality improvement. The companies are slightly lacking in elimination of products inconsistent with requirements from the order execution process and continuous investment in the most advanced machines and devices. Such distribution of answers may result from the sector's characteristics, as many projects are dedicated to individual needs of customers. Investment in universal solutions does not lead to achievement of a sustainable competitive advantage.

Significantly, in the examined companies from the IT sector, the respondents indicated great freedom of action (52%), teamwork (73.32%), as well as efficient communication (58.66%) as observed factors stimulating the emergence of quality culture. To a smaller degree, the respondents identified other elements which should then be developed, and which should have special efforts focused on them. The respondents listed the following determinants of quality culture to a small degree: preference of openness to change and proactive attitudes. The respondents indicated that openness to change is an attitude they observed in their organizations to a small extent (59.99% of responses). The situation was similar in the case of proactive attitudes, which they identified to a small extent (42.65%).

In the opinion of the respondents, the most often used tools stimulating the emergence of a condition of permanent quality culture include: teamwork

(80% of responses), fulfillment of obligations towards employees (70.6%), raising awareness of the company's objectives and clear rules of procedure (65.33%), TQM (50.63%), the management being an example, among others, of openness and sincerity (64.03%). The companies relatively rarely promote (66.7%) and train professionals (72%). Thus, the pursuit of excellence remains more of a responsibility of employees themselves, and professionalism is not the center of attention. Maybe that is why the respondents emphasize that correct selection of personnel is a rarely encountered phenomenon (52% of responses). Finally, in the opinion of the respondents, external customers are more satisfied with the examined organization (high and medium level of satisfaction equal to 93.33% of responses) than the verified companies are with customer relationships (high and medium level of satisfaction equal to 83.99% of responses).

To sum up, the examined companies operating in the IT sector in Poland are transforming their organizational cultures towards quality culture, since their employees participating in the survey indicate characteristics of quality culture that determine their success and which they encountered their entities. These are: high standards of operation (45.3% of responses), significance of people in achieving the organization's success (44% of responses), and informal rules of behavior (38.7% of responses). Nonetheless, none of the distinguished attributes exceed 50% of responses, which may suggest that they are following the road to a permanent stage of quality affirmation in each of the mentioned dimensions. Therefore, efforts should be taken to develop the following mechanisms: widely shared philosophy of comprehensive quality management (13.3% of responses), popularization and consolidation of quality culture (25.3% of responses), as well as distinguishing successful people and publicizing their awards in the field of quality (28% of responses).

The key thus lays in changing the way of thinking at the level of the employee, the superior and the entire organization, namely shifting the focus to soft aspects of management and strong values constituting their basis.

5 Conclusions

Organizational culture is a complex phenomenon – changing it takes time and effort, especially from organizations' leaders. Managers must decide and be convinced that a culture of quality is worth pursuing. First of all, managers must have a deep internal conviction that affirmation of quality fosters the success of the contemporary organization. This conviction should be expressed in their actions and attitudes focused on both employees and customers. High quality of human capital management, supported by focus on quality, must be reflected in a culture promoting knowledge, trust, learning, and engagement – quality culture.

The analyzed results should be treated only demonstratively, as they have clear restrictions due to the size of the research sample. The study should be considered only as a pilot study, confirming the pursuit of transformation of organizational cultures of companies from the IT sector in Poland into quality culture. It can warrant further scientific exploration of the tackled problems in a cross-section of various sectors or types of operations and strive to create a comprehensive model of building quality culture, taking account of the perspective of the employee, the superior, the organization, the customer, and the whole sector embedded in the context of cultural diversity or the network society.¨

Acknowledgements

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Information technologies in the context of new European Union legislation

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Drahomír Foltan[4]

Abstract. The article deals with the use of information technologies in order to meet the requirements of the recently adopted European legislation in the field of waste management. It mainly concerns the circular economy package and EU Strategy for Plastics that originated due to the need of reducing the amount of waste produced within the European Union. The aim of this article is to introduce the ways information technologies may help to make the waste management process more efficient. This is needed especially in terms of waste reduction at least to reach the limits set in order to achieve the goals. The article is a result of a cooperation between members of the academic community and employees of the joint stock company EKO-KOM, which is the only authorized packaging company in the Czech Republic.
Keywords: organizational creativity, competences, computer system to develop a portfolio of competences.

Keywords: Circular Economy package; waste management; information technology; European Union; legislation

JEL Classification: Q56, M15, O325

1 Introduction

The issue of waste, either its quantity or the way it has been dealt with, has increasingly been the topic of general discussion. One of the main initiators of this discussion is the European Union, which, for many years now, has been devoting a lot of energy and resources to the subject of waste. At the end of 2015, the EU released the so-called Circular Economy Package, which contained several proposals to amend the waste management directives. Specifically, it concerns Directive 94/62/EC on Packaging and Packaging Waste, 99/31/EC on the Landfill of Waste, 2000/53/EC (car wrecks), 2006/66/EC on Waste Batteries and Accumulators, 2012/19/EU (WEEE)

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and 2008/98/EC on Waste. (Ministerstvo životního prostředí České republiky, 2015)

One of the major innovations in the context of this package is the introduction of limits for landfilling of recyclable municipal waste and setting targets for its recycling. Specific values that have to be achieved by individual member state have been long discussed within the European Union. The binding values were approved and published on 22 May 2018 and entered into force on 4 July 2018. From that date, each member state has exactly twenty-four months to implement these directives into their national legislations. Meeting the targets for municipal waste recycling is divided into three phases, every five years, with the recycling rate gradually increasing. In 2025, the recycling rate must be at least 55%, in 2030 it must be 60%, and 65% in 2035. On the top of that, by 2035, the municipal waste landfill rate must not exceed a maximum of 10% of the total amount of produced municipal waste. (European Commission, 2018)

Important parts of the package are also targets for recycling of packaging waste. The individual values are given in Table 1.

Table 1 New recycling targets for packaging waste, Source: European Commission, 2018

	By 2025	**By 2030**
All packaging	65%	70%
Plastic	50%	55%
Wood	25%	30%
Ferrous metals	70%	80%
Aluminium	50%	60%
Glass	70%	75%
Paper and cardboard	75%	85%

In addition, on 16 January 2018, the European Commission adopted the Strategy for Plastics, the main objective of which is that by 2030 only plastic packaging that is either reusable or recyclable will be used. All of the objectives above are related to the European Union's drive to move

from the linear to the circular economy. Mariana Vuţă (2018) states that this transition would have a significant impact on the economic growth of the Member States.

The possibilities of interconnecting information technologies and waste management are dealt by, for example, Swapan Das and Bidyut Kr. Bhattacharyya (2015), who have been trying to, on the basis of mathematical calculations, determine optimal collection routes. This interconnection of information technologies and the waste management process is one part of the Smart Cities concept. (Helfert, 2017)

2 Information technologies in waste management

Since the Czech Republic has been a member of the EU since 2004, it is also obliged to meet the agreed goals. Regarding the recycling rate, the Czech Republic is currently around the set goals, but with regard to landfilling it does not even get close to 10%. That is precisely why it is necessary to take measures to change it.

Basically, there are two options to accomplish this change. It may be done either by improving the process of final sorting on the lines or by making recycling more comfortable for the citizens. In both cases the use of information technologies may help.

2.1 Process of final sorting

At present, the design of the final sorting lines uses a variety of modern technologies, which are subsequently replacing human work. It is obvious that the introduction of these technologies will improve the process of waste separation in both aspects – quality and speed of sorting.

One of the most important technologies used in final sorting are the NIR sensors (Near Infra Red). These sensors recognise different materials on the belt as each material reflects infrared radiation in the light. The whole system works by first enlightening the subject, then the NIR sensor captures its reflection, which is then passed to the software to create a two-dimensional image of the object. Next the software determines what kind of material it is, what size it is, what kind of shape it has and where it is located on the belt. Based on the information about the position of a particular material received from the software, the object is then blown away from the belt with air nozzles.

The undeniable advantage of this technology is its ability to scan up to 320,000 points and perform 10 million operations per second, allowing it to sort out up to 10 tonnes of waste per hour with a purity of sorting being up to 90-93%. Depending on the input material, purity up to 98% can be achieved. The first company to come up with this technology was the Norwegian TiTech. (Šťastná, J., 2007)

Another possible implementation of information technology in the process of final sorting may be using optical sensors (VIS sensors). These sensors are able to detect transparent and opaque objects such as bottles made of polyethylene terephthalate (PET) and polyethylene (PE) or glass. This technology is basically an enhancement to a common RGB (Red-Green-Blue) camera, but it can capture a stronger signal from all colours, improving the whole process. (Šťastná, J., 2007)

2.2 Sorting process

The use of the technologies above results in easier recycling for the citizens, as they do not have to sort glass to clear and coloured one. The annual evaluation of sorting, done by the authorized packaging company EKO-KOM, a. s., shows that the citizens of the Czech Republic are trying and willing to sort waste. Nevertheless, it appears that when the recycled waste container is full, recyclable waste is thrown into the container for mixed communal waste. It is therefore necessary to make the waste collection system more efficient so the citizens are further motivated to sort their waste. There are several ways to achieve this.

In busy places of large cities, and also in more remote areas, it can be done by using waste containers with compression unit, which means that when the container is full its content is pressed and additional place is thus made. All that results in lower frequency of collecting the waste. The compression unit can be powered by solar power or from the grid.

Another option, which is suitable mostly where the standard containers would look anaesthetically, is the use of underground waste containers. These are containers with the collecting part hidden underground. The part above the ground is designed as a nice-looking container to insert the waste into modified drop-in openings, adapted to a specific commodity of recycling waste. Among the advantages of these containers can be named, for example,

easy handling while picking up the waste, possibility to monitor how full the container is and possible connecting the container to chip cards. The use of chip cards is suitable especially for residential areas or for businesses. The system works so that the lid of the container is only lifted after placing the chip card, which would be handed over only after the municipal waste collection fee has been paid. (Meva, 2018)

We could also monitor how full the container is and thus optimize pickup routes with sensors that can be located in both underground and aboveground containers. The sensors can also be placed in containers that are already in use. One of the providers of this technology is SENSONEO. Used sensors are operating on the basis of ultrasound, are resistant to water, impact and temperatures from -15 to 55 °C. For data transmission, the sensors use GSM, LoRaWAN and SIGFOX networks. In addition to monitoring how full the container is, these sensors detect fire or mishandling of the container. The sensors are connected to Sensoneo application, which has several modes, both for customers and for citizens. It is freely available for citizens to download to mobile devices supporting the android or iOS platform. In the application, citizens can find the closest free collection container according to the type and amount of waste they want to sort. This way they will be motivated to do so. As stated before, the citizens are discouraged because they often come to the waste containers with a lot of waste and have no place to put it. In this case, the waste will either end up next to the container or in the nearest mixed waste container. Probably a very few people would go back and wait for the container to be emptied.

Beside the fact that they can monitor how full the containers are, they can also report the state of various pick up points to the municipal waste collector. The customer mode, i.e. mode serving above all the waste collectors, it is possible to monitor the containers and plan the pick up routes accordingly. In addition to that drivers can inform the dispatcher about the condition of the containers, for example, that they are damaged and need to be replaced. And lastly the application offers the customers an evaluation of the collecting system efficiency in this application. (Meva, 2018)

A little bit different approach to increasing the comfort of recycling for citizens is the Probaze ODPADY (Probase WASTE) software. This software is mainly used when picking up waste from individuals,

or for family house owners. The system works as follows, each individual receives a sticker with a linear bar code that is placed to their container. And then when the waste is collected, by using the appropriate application software the code is loaded by a mobile terminal. The main advantage for citizens is that the amount of the municipal waste collection fee can be set individually. (Probaze)

In addition, the Probaze ODPADY (Probase WASTE) software also offers a possibility to take the waste directly to the collection yard. Similarly to the first scenario the individual receives a code, only this time it is placed on a card. The waste can then be taken to any collection yard where the person only shows this card. The waste is then checked and weighed. The advantage of this method is, on the one hand, the transparency for the citizen, as a statement of the amount of waste that has been dropped off in a certain period is issued and, on the other hand, like the previous case, there is a possibility of a rebate for the collection of municipal waste. (Probaze)

3   Conclusion

As it turns out, information technology can have a significant impact on whether the Czech Republic will meet the requirements of the European Union's Circular Economy Package for Waste Management or not. It concerns mainly reducing the amount of recyclable communal waste that ends up on landfills. Using the information technologies in the process of final sorting on the sorting lines is considered to be an efficient solution. This process mainly uses the NIR and VIS sensors, which are able to recognize different materials on the lines. The first one is based on NIR spectroscopy and the other uses RGB cameras.

Among other things, it is advisable to use the information technology to increase the sorting comfort for citizens and thus motivate them to recycle more. It is also suitable to use mainly containers with built-in sensors that monitor how full the containers are. With the use of Slovakian SENSENEO application, the citizens can find the closest empty container for a specific type and quantity of waste with their smartphones, or inform the transport company of the status of the site. Another increase in comfort is the Probaze ODPADY (Probase WASTE) software using linear bar codes.

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