I T H E A

# International Journal

# INFORMATION TECHNOLOGIES & KNOWLEDGE

2019 Volume 13 Number 2

# International Journal
# INFORMATION TECHNOLOGIES & KNOWLEDGE
**Volume 13 / 2019, Number 2**





**International Journal "INFORMATION TECHNOLOGIES & KNOWLEDGE" (IJ ITK) is official publisher of the scientific papers of the members of the ITHEA International Scientific Society**

IJ ITK rules for preparing the manuscripts are compulsory.
The **rules for the papers** for IJ ITK are given on www.ithea.org
Responsibility for papers published in IJ ITK belongs to authors.

**International Journal "INFORMATION TECHNOLOGIES & KNOWLEDGE" Volume 13, Number 2, 2019**

Edited by the **Institute of Information Theories and Applications FOI ITHEA**, Bulgaria, in collaboration with:
University of Telecommunications and Posts, Bulgaria,
V.M.Glushkov Institute of Cybernetics of NAS, Ukraine, Universidad Politécnica de Madrid, Spain,
Hasselt University, Belgium, University of Perugia, Italy,
Institute for Informatics and Automation Problems, NAS of the Republic of Armenia
St. Petersburg Institute of Informatics, RAS, Russia,

**Printed in Bulgaria**
**Publisher ITHEA®**
Sofia, 1000, P.O.B. 775, Bulgaria. www.ithea.org, e-mail: info@foibg.com
Technical editor: Ina Markova

Издател: ИТЕА®, София 1000, ПК 775, България, www.ithea.org, e-mail: info@foibg.com





**ISSN 1313-0455 (printed)** **ISSN 1313-048X (online)**

# CYBER-PHYSICAL PRODUCTION SYSTEMS AS A PREREQUISITE FOR THE DEVELOPMENT OF DIGITAL ENTREPRENEURSHIP

**Miglena Temelkova**

***Abstract***: *The present article studies the relation between the cyber-physical production systems and the development of digital entrepreneurship, and, therefore a synthesis of definitions of the two concepts is drawn, and their theoretical formulation is upgraded. The components of the cyber-physical production systems are examined as major prerequisites for the development of the digital entrepreneurship model in a global aspect. Determined is the relation between the technological value added chain, realized by the cyber-physical production systems and the added value obtained as a result of reorganizing traditional management with the development of entrepreneurial business in a digital environment.*

***Keywords***: *cyber-physical production system, digital entrepreneurship, technological added value chain.*

***ITHEA Keywords***: *Please use keywords from http://idr.ithea.org/tiki-browse_categories.php .*

## Introduction

The major challenge nowadays in defining the concepts “cyber-physical production system” and “digital entrepreneurship” is the lack of sufficient research works on these problematic issues. That requires that the definitions of both concepts should be based on the achievements of science to date, namely the basic definitions of the concepts “production system” and “entrepreneurship”.

There are three prevailing basic definitions of production system in research literature:

- ✓ production as a production system;
- ✓ production system as a part of an enterprise;
- ✓ production organization as production system.

The authors [Мирчев, 1996], [Цонков, 1989], [Попчев, Хинов, Цонков, Сотиров, Живков, Сапунджиев, Патаринска, 1987], [Nebl, 1981], [Nebl, 1997], [Nebl, 1998], [Nebl, 2001] define the production system as a part of business organization, determined by the material and cash flow and subjected to the rational structuring and organizing of production through the activities: delivery of element factors, their transformation and realization into a finished end product.

At the same time, production system is defined as an organizational unity [Nebl, 1981], [Nebl, 1997], [Nebl, 1998], [Nebl, 2001], [Suzaki, 1989], [Warnecke, 1993], having as a task bringing the production process in line with the relevant organizational principles (forms), created for achieving the best possible impact on the development of the economic effect /fig. 1./.

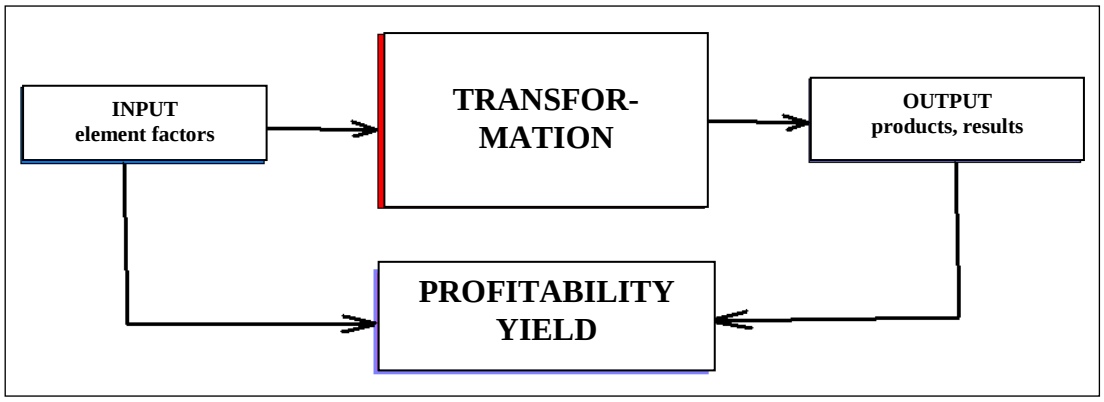


Fig. 1. Structure of the production system in a business organization

Generally, entrepreneurship is nowadays defined by theory as a process oriented towards permanent changes, where some business alternatives stand

out, moderate risk is undertaken and opportunities are searched for realizing innovations and/or innovative products in view of generating the so-called by Schumpeter [Schumpeter, 1939] “entrepreneurial profit” and ensuring, in a more global aspect, the economic development of a certain macroeconomic system. The entrepreneurial activities can be focused on the introduction of a new product, technology or organization, on entering a new market or using new raw materials and consumables for the production.

Peter Drucker [Drucker, 1985] reached the conclusion that entrepreneurship is predominantly a socio-psychological process, and only to a lesser extent an economic phenomenon, since it is focused on permanent searching for business and innovation opportunities.

## Nature of the problem

On the one hand – the production system is a spatial arrangement of the workplaces within the manufacturing process, as well as structuring the production timing and the type of the time-based running of the manufacturing process (the time-based organizational principle), and on the other hand – entrepreneurship is an activity related to moderate risks and investment of resources in view of creating something innovative and/or new (a product, a technical system, a technology or a method of producing something, which already exists) and/or penetrating a new market.

The time and space principle shape up the organizational forms in the production system, while interdisciplinarity and intermodality of entrepreneur’s knowledge, skills and competences set out the organizational forms of the entrepreneurial process.

Pursuing an economic effect, the production systems relate rationality of the economic activity with the higher value obtained at the output compared to the value entering at the input. With entrepreneurship, combining various unconventional, innovative and creative opportunities for realizing a business

idea leads to the option to create and add value through the formation of an economic entity – an entrepreneurial business.

Thus, on the background of the outlined traditional definitions of the concepts “production system” and “entrepreneurship” stands out the problem of upgrading them in view of responding to the new economic needs of the global environment, prompted by the already started Fourth Industrial Revolution and the intensive digitalization of economy related to it.

Object of study in the present article are the cyber-physical production systems.

Subject of analysis and synthesis in the research is defining the relationship between the development of the cyber-physical production systems and the prerequisites for the development of the digital forms of entrepreneurship.

The objective of the research is studying the cyber-physical production systems as a theoretical concept and defining them as a prerequisite for the development of digital entrepreneurship.

The tasks of the paper come down to:

- ✓ synthesis of definitions of the concepts “cyber-physical production system” and “digital entrepreneurship”;
- ✓ synthesis of the components of the cyber-physical production systems;
- ✓ involving the technological added value chain, realized by the cyber-physical production systems, with the added value realized by the reorganization of traditional management with the development of entrepreneurial business in a digital environment.

The restrictions set out in the present article are:

- ✓ the author does not integrate her scientific conclusions into a model;
- ✓ the impact of the separate components of the cyber-physical production systems on the added value of the entrepreneurial process in a digital environment is not studied.

## Synthesis of definitions of the concepts “cyber-physical production system” and “digital entrepreneurship”

In spite of the lack of sufficient research in the field of the cyber-physical production systems, there are some definitions of this concept in scientific literature:

- ✓ integration of in-built computers and networks, which monitor and control the physical processes, using feedback chains [Lee, Lapira, Bagheri, Hung-an, 2013];
- ✓ smart systems, which comprise hardware and software, and efficiently integrated physical components, which interact in view of reflecting the changes in the real-life environment [Foundations for Innovation in Cyber-Physical Systems, 2013];
- ✓ combination between real-life physical and virtual objects and information handling processes through open, partially global and perpetually interrelated information networks [**Broy,** 2010].

For the purposes of the present study, the concept “cyber-physical production system” is defined as:

- ✓ an innovative type of ecosystem, created in view of fulfilling certain tasks under certain conditions, where there are most often interacting physical components, blockchain networks, roboticized systems based on artificial intelligence and sensor technologies;
- ✓ a roboticized model, having the capacity through an accurately described and machine simulated algorithm, to analyze and evaluate the surrounding environment, and to undertake actions, which enhance the possibility to achieve specific goals;
- ✓ a technology based on sensors, which through abstract symbols try to reproduce human thinking on a hierarchical, logical level, or which imitate human brain through neurons and neural networks, organized in layers, connected between themselves by simulated lines, while those neural networks have the capacity to upgrade the acquired knowledge by gathering experience and growing.

Digital entrepreneurship is focused on generating innovative operative and production business models, whereby realizing higher surplus value. Digital entrepreneurship integrates in itself two major groups of skills:

- ✓ traditional – establishing and maintaining relations with clients, realizing sales, creating partnerships, managing projects, optimizing processes, analyzing the environment, processes and operations, financial management, applying flexible methodology;
- ✓ digital – analysis of large bulks of information, working in a blockchain network, virtualization, creating and developing mobile applications, creating and developing websites, creating and developing information technology architectures and platforms, observing cyber security, working with social media.

On the background of the presented above, it can be summarized that for the purposes of the present study digital entrepreneurship is the possibility to create new organizational forms, products or services, while undertaking a certain risk and by using team interaction and information technology systems.

## Synthesis of the components of the cyber-physical production systems

Studies show that the main components of the cyber-physical production systems are:

- ✓ the Internet of Things;
- ✓ the Internet of Services;
- ✓ cloud computing.

The Internet of Things can be defined as:

- ✓ a system established on the basis of connected technologies and platforms, through the interaction between products, services, places, buildings and people;
- ✓ a network of physical devices, transportation vehicles, buildings and other elements, which have in-built electronics, software, sensors,

executive mechanisms, and are also connected to the Internet network, while all that enables those entities to collect and exchange data between themselves;

- ✓ a connection between the physical and the digital world, where on the basis of an interaction with the World Wide Web, smart devices and technologies connect with each other and are controlled remotely.

The Internet of Services is:

- ✓ a specific concept enabling various service providers to offer their services through the Internet on the basis of connected technologies and platforms, ensuring the connection and interaction between the service infrastructure, the business models and the performers of the services;
- ✓ a network enabling the collection and summarization of data from the real world, and the exchange of information in a particular virtual environment;
- ✓ a connection between the physical and the digital world, where on the basis of interaction with the world wide web, providers and clients connect with each other, while the resource flows are managed remotely.

Cloud computing is a specific placement on the Internet of a request order for resources and data processing, where it is an important tool for providing services for processing and collecting data through the Internet, and creates communication of the automation systems with the non-conventional borders of a business organization.

The specified components of the cyber-physical production systems are core prerequisites for the development of entrepreneurship in a digital environment, since they create genuine conditions for the development of innovations, innovative solutions, creative products, while at the same time they create conditions for quick transfer of information, analysis in real time and an option for taking strategic decisions within seconds with reduced risk levels.

## Relationship between the added value realized by the cyber-physical production systems and the added value obtained with the development of digital forms of entrepreneurship

The components of the cyber-physical production systems have a specific added value in the activities of the nowadays business organizations. It is expressed in a better efficiency, accuracy and economic benefit, realized as a result of the digital process management through a certain network infrastructure and direct integration of the physical world into communication-based IT systems.

At the same time, the added value from the combination of various physical objects, providers, IT infrastructure with systematically established communication networks and channels, leads to higher level of satisfaction, greater speed and reliability of the production processes, and, hence, to substantial changes in the distribution of the activities along the individual value chain of each of the components of the cyber-physical production systems.

Digital entrepreneurship development requires not only knowledge and skills in the field of strategic management and leadership, but also digital competences. The fundamental added value from the development of the cyber-physical production systems and their components can be increased many times if on the basis of the Internet of Things, the Internet of Services and the cloud computing there are flexible, unconventional, innovative business models developed, generating new products and/or organizational forms. Within this context, the digital entrepreneurship model forms horizontal added value and should integrate production, logistic, engineering and management processes, Internet-based communication networks and channels, gathering from each other and from the physical world large bulks of information, as well as processing them, thus enabling quick taking of strategic entrepreneurial decisions.

The specific added value of the digital entrepreneurship model can be found in the stages, which determine it, since new value is added to each of them, which is obtained as a result of optimized timing, supplies, resources, price margins, etc. Thus, the digital entrepreneurship model adds value at four main stages:

- ✓ identification of the opportunities for generating a new product, technology or organization, entering a new market or using new raw materials and consumables for production through centralized information channels;
- ✓ studying the opportunities for generating a new product, technology or organization, entering a new market or using new raw materials and consumables for production through systems with precisely defined functions;
- ✓ applying network smart components with the realization of the idea for generating a new product, technology or organization, entering a new market or using new raw materials and consumables for production;
- ✓ quick feedback and verification of the strategy for introducing a new product, technology or organization, entering a new market or using new raw materials and consumables for production.

## Conclusion

The analysis and synthesis of the problematic issues related to studying the cyber-physical production systems as a prerequisite for digital entrepreneurship development requires the summarization of the following main conclusions:

- ✓ the cyber-physical production systems collect data from the physical world through sensors, whereby creating an essential prerequisite for the solution of actual problems through innovative entrepreneurial ideas in a digital environment;
- ✓ the cyber-physical production systems integrate a large amount of physical objects, services and processes, whereby facilitating the generation of entrepreneurial projects in a digital environment;
- ✓ the cyber-physical production systems analyze, evaluate and store huge volumes of data, whereby enabling the digital entrepreneurs to take prompt, timely and profitable management decisions;

- ✓ the cyber-physical production systems are based on a network of digital communication technologies whereby digital entrepreneurship operates in an innovative environment;
- ✓ the cyber-physical production systems have an impact on the physical and virtual world, an on this basis they facilitate the digital entrepreneurs in determining the added value from their activities along the value chain in the business organizations.

## Bibliography

[Broy, 2010] Broy, M. Cyber-Physical Systems. Innovation durch softwareintensive eingebettete Systeme. Springer. 2010. ISBN 9783642149016.

[Drucker, 1985] Drucker, P. Inovation and Entrepreneurschip: Practice and Principles. Harper & Row. 1985.

[Foundations for Innovation in Cyber-Physical Systems, 2013] Foundations for Innovation in Cyber-Physical Systems. Workshop Report. January, 2013. http://events.energetics.com/NIST-CPSWorkshop/downloads.html

[Lee, Lapira, Bagheri, Hung-an, 2013] Lee, J., Lapira, E., Bagheri, B., Hung-an, K. Recent advances and trends in predictive manufacturing systems in big data environment. Manufacturing Letters, Volume 1, Issue 1, October, 2013.

[Nebl, 1981] Nebl T., Ditl, H. Zur Typisierung von Produktionsprozessen. Wissenschaftlichen Zeitschrieft dar UR, Heft 6/1981.

[Nebl, 1997] Nebl T. Produktionsfaktoren und Makrostruktur des Produktionsprozesses. Lehr – und Handbücher der Betriebswirtschaftlehre. München – Wien. 1998.

[Nebl, 1997] Nebl T., Silberbach K. Einfluß technischer Gestaltungskriterien auf die Herausbildung von Organisazionsformen der Teilfertigung. Industrie Management, 13/1997.

[Nebl, 1998] Nebl T. Einführung in die Produktionswirtschaft. Lehr – und Handbücher der Betriebswirtschaftlehre. München – Wien. 1998.

[Nebl, 2001] Nebl T. Typologie der Produktionsorganisation – ein konfigurationstheortischer Ansatz. Business, Information and Communication. Rostock-Osaka. 2001.

[Schumpeter, 1939] Schumpeter, J. Business Cycles: A Theoretical, Historical and Statistical Analysis of the Capitalist Process. Mc-Graw Hill Book Company. New Jorkq 1939.

[Suzaki, 1989] Suzaki U. Modernes Management im Produktionsbetrieb. Strategien – Techniken – Fallbeispiele München, Wien, 1989.

[Warnecke, 1993] Warnecke H. Der Produktionsbetrieb, Produktion, Produktionssicherung. Berlin, Heidelberg, 1993.

[Мирчев, 1996] Мирчев, А. Производствен мениджмънт. Priceps. София, 1996. ISBN 954-806-723-4.

[Павлов, 2015] Павлов, П. Иновационен мениджмънт. ВСУ Черноризец Храбър. Варна, 2015. ISBN 978-954-715-645-6.

[Попчев, Хинов, Цонков, Сотиров, Живков, Сапунджиев, Патаринска, 1987] Попчев И., Хинов Х., Цонков С., Сотиров Г., Живков Д., Сапунджиев Г., Патаринска Т. Оптимизация на производствени системи. Техника. София, 1987.

[Цонков, 1989] Цонков С. Управление на сложни производствени системи. Техника. София, 1989.

## Authors' Information

***Prof. Dr. Miglena Temelkova*** – *University of Telecommunications and Posts; Rector; e-mail: megitemelkova@abv.bg*

*Major Fields of Scientific Research: management, leadership, controlling*

# OPPORTUNITIES AND CHALLENGES FOR DIGITAL ORGANIZATIONAL CULTURE CONSTRUCTION

**Ivaylo Stoyanov**

***Abstract**: The digital organizational culture helps organizations to adapt much faster to technological change, customer needs and quick response to stakeholder relationships. It creates conditions for development of people's talent, flat hierarchy leads to flexible decision making, relies on team potential and cooperation in the fulfillment of goals and tasks.*

***Keywords**: Organizations, Digital culture, Digital environment, Management*

## Introduction

The digital transformation is a complex process that requires not only the competencies of the human resources and high technology from the organizations, but also changes in the mechanisms of work in the digital environment. This means that they have not only technologies that will help them to transform into the digital business i.e. to offer digital products and services to engage quickly with customers to offer them high quality, but also to accept the challenges and changes in organizational culture.

The new technologies and systems cannot bring about to a change in the way people work and think unless they rethink their task performance as well as acquiring up-to-date competencies in the digital environment. Conventional methods and approaches are often incompatible in the digital world, which is why the managers and leaders are making strategic changes to adapt their organizations in the context of the Fourth Industrial Revolution. With the advent of the Internet, mobile and cloud technologies, the Internet of Things has made

it clear that the importance of the change in the digital age is imperative, especially for a digital organizational culture construction.

## Opportunities and challenges for digital organization culture construction

Unlike the traditional organizational culture, which reflects the mechanisms of work in the organization, from the implementation of operational and management processes to the values and standards of behavior of people working in it, the digital culture requires a radically different approach. The traditional organizational culture aims to improve the work and climate of the organizational structure, while the digital culture is targeted at external audiences, working closely with customers and stakeholders on the use of high technology, flexible projects and highly efficient teams. The big companies have an organizational culture that is unique and defines how people work, the rules they adhere to, and the behavior they follow. In the small and medium-sized companies, the driving force in defining organizational culture is the managers and leaders who set the parameters of work and the model of employee behavior [Temelkova, 2018 (a), Gupta, 2018, Sheninger, 2019]. The digital culture requires a new way of thinking and acting that is driven by the customer requirements and the development of competitors. They are at the heart of business change, process digitalization and accelerated innovation and technology development [Perkin & Abraham, 2017].

In the context of the Fourth Industrial Revolution, organizations find it difficult to adapt to digital transformation with old methods of work created by conventional organizational culture. Now, customers are informed and demanding buyers, new competitors are emerging with advanced technologies, knowledgeable and capable experts, adding business value to the organization and their customers. The digital culture is oriented primarily towards consumer preferences, because social media, Internet technologies and business applications give the customers ability to compare, evaluate and share opinions on the functionality and quality of the products and services. Thus forces companies to be "*always*

*online*", to have direct contact with consumers to monitor competitors and make technological and business decisions. The rapid response to the challenges of the environment and the digital transformation necessitate the creation of a digital culture that enhances the competitiveness and image of the organizations.

The main differences between Traditional Organizational Culture and Digital Culture are shown in Table 1.

Table 1.

| **TRADITIONAL ORGANIZATIONAL CULTURE** | **DIGITAL CULTURE** |
|---|---|
| ✓ Emphasis on organizational structure<br>✓ Hierarchy and authority in departments and units<br>✓ Human factor, behavior and values<br>✓ Internal changes and transformations<br>✓ Human resource satisfaction | ✓ Market orientation and customer focus<br>✓ Flat structure, delegation and team activity<br>✓ Knowledge, innovation and high technology<br>✓ Flexibility and adaptability to the environment<br>✓ Social responsibility and sustainable behavior |

From Table 1, one can make a basic characteristic of the dimensions that shape the specificity of the digital in relation to the traditional organizational culture [Sheninger, 2019, Perkin & Abraham, 2017, Temelkova, 2018 (b), Brett, 2018, Dimcheva, 2016, Angelova, 2017].

*1. Market Orientation and Customer Focus*

The organizations' digital culture is aimed to the customers and their attitudes and needs. The efforts and resources are directed to market processes and trends, direct contact with them or generation of data sets for interaction in social media and through Internet technologies. The role of marketing is being rethought; the importance of e-business and commerce, the “Internet of Things” and more is being strengthened. This approach to digitalization and construction of a digital culture enables organizations to respond and identify product needs, reduces direct costs for sectored market research, quickly and accurately justify the quantity, price and timing of the product/service offering, etc.

*2. Flat structure, delegation and teamwork*

Organizations' digital culture minimizes hierarchy and control, centralized decision-making and long-term planning. Designing teams for complex tasks and scrum projects [Perkin & Abraham, 2017] requires an integrated approach of interaction with an emphasis on short-term planning and situational decision-making. At the heart of this concept is real-time work i.e. directly addressing customer needs and meeting their needs, generating resources, utilizing new technologies and outsourcing activities. People are experts in various fields of business and IT, are empowered to make decisions in their areas of competence, promote risk and break the conventional stereotype of work. Collaboration, confidence and expertise of people are at the heart of good results, rapid career development, motivation and challenges in work.

*3. Knowledge, Innovation and High Technology*

An organization's digital culture cannot be constructed without knowledge, innovation and investment in high technology. Knowledge is a prerequisite for innovation, deployment and use of advanced technologies. It generates creativity, non-standard thinking and rational solutions typical of transforming

companies into a digital environment. This creates great ideas and efforts to turn them into a profitable business and strategy for success. The innovation and technology help organizations to be competitive and responsive to market dynamics and customer demands.

*4. Flexibility and Adaptability to the Environment*

The digitization in all areas of business requires companies to optimize work technology, business processes, management approaches and, accordingly to change the organizational culture from conventional to digital. The flexibility is achieved through appropriate strategies for change, overcoming people's resistance, instituting training, coaching and mentoring programs, stimulating creativity, etc.

*5. Social Responsibility and Sustainable Behavior*

The digital culture creates the conditions for rethinking the organization's business in terms of the social responsibility to the society and employees. Working in the digital environment can reduce harmful emissions in the nature. The digital technologies are part of the global policy of countries to reduce waste and pollution in society. The digital culture is a way of working, comfortable and satisfied with the people in the organization. Through block chain, clod technology and “Internet of Things”, experts can manage the supply chain, plan logistics operations, and perform operations and management tasks, save time, costs and money by working from the office.

The transformation from conventional to digital culture requires organizations' leaders to take advantage of opportunities to adapt quickly and appropriately to the new environmental trends. The construction of digital culture requires initiatives and efforts to adapt the organization to the digital transformation with a range of actions in order to create digital thinking and governance. Some of these are as follows [Temelkova, 2018 (b), Lambovska, 2018, Miller, 2011, Campbell & Garner, 2016]:

◊ *Define a Clear Vision Mission and Goals*

The transformation into a digital culture cannot be accomplished without the vision, mission and goals that the associates pursue. It is the responsibility of the leaders, who have the experience, routine and inspiration to drive change because people need to embrace the new culture, to know the technology they will be working with, and what methods they will use. When the leaders are well informed what they have to do and what is expected of them, the leaders will reduce resistance and stress and will activate their potential their creative thinking and innovation. It is not realistic to believe that digital culture is a mechanism that will work as soon as a strategy is defined and people and technology are provided. The digital culture requires to be implemented in stages in the different units of the company, taking into account the specificity of the work and what functions the human resources fulfill. The vision, mission and goals should be transparent and clear and people should have access to information and data in order to achieve high results.

◊ *Highly Effective E-Leadership and Commitment to Human Resources*

The leaders are the driving force of transformation because they set the direction; change not only the thinking, but also the technology of management in the organization. If the people do not follow the new methods of work, i.e. do not follow the vision, mission and goals of the digital culture, even if technology is introduced, the organization will not make significant progress. The engaging of the people is a key part of the digital culture policy because it affects the autonomy of teams and employees, given people empowerment, customer interaction and entrepreneurial thinking. Conditions are created for choosing a workplace and using the right IT technology that will best impress people's behavior, their roles and competencies. In the conditions of business digitalization, teams cannot work in separate units, which is why they set up joint workplaces where ideas are shared and information and communication flow in real time. Through connected IT platforms and business applications, teams communicate with customers, partners and external audiences.

◊ *Monitoring and System of Control Procedures*

The construction of the digital culture is a complex process that is subject to monitoring and evaluation. Whether designed or in process of being completed, leaders and experts report real results. They are regulated and implemented by institutional practices at individual, team and organizational levels. The aim is to determine the level of functioning/construction of the digital culture and its maintenance. When deviating from the targets, analysis and evaluation of performance indicators is made from communication strategies and technologies, to real-world training, coaching and mentoring of human resources. People's opinions are taken into account, how they understand the change, what they feel, what their difficulties, suggestions and so on.

Despite the benefits and the need for organizations to construct a digital culture, they face challenges with different contexts. The main challenges are as follows [Ross, Beath & Mocker 2019, Bollmer, 2018, Anguelov & Angelova, 2016]:

◊ *Behavioral Challenges*

The functions and elements of the traditional culture have been researched and applied for many years in the organizations, and it is difficult for the people to adapt to digital technologies and mechanisms of work. They prefer to adhere to conventional stereotypes while avoiding innovation, initiative and responsibility. The leaders have a role to play in convincing people of digital transformation and motivating them. Whether the digital processes are built, if people are oriented towards traditional approaches to work and do not take advantage of innovations, automation will not be effective. On the other hand, the problem for the organizations is the lack of talented people who do not have the necessary competencies to work in the digital environment, do not understand the trends in the digital industry or simply do not want to study and develop their careers.

◊ *Organizational Challenges*

If the organizations' leaders do not support the digital transformation, it is likely that it will not be put into practice. There are obstacles hindering the creation of a digital culture related to infrastructure projects and costs for various IT

products and systems, software platforms, mobile applications, cloud technologies and more.

## Conclusion

The digital organizational culture is a phenomenon requiring leadership competencies and a new approach to work structuring, asset management and customer relationships. Transforming organizations into a digital business cannot happen without a digital culture that drives change, innovation and a new way of thinking. This creativity and the introduction of new work models are key factors in corporate competitiveness and customer satisfaction.

## Acknowledgement

This publication is realized through Project № NID 18/26.03.2019, University of Telecommunications and Post, Sofia, 1 Acad. St. Mladenov Str., Sofia 1700, Bulgaria.

## Bibliography

[Angelova, 2017] Angelova, M. Change management through project management approach. // International Journal Knowledge, Vol. 17, N3, Skopje, 2017, pp. 1487-1495.

[Anguelov & Angelova, 2016] Anguelov, K., & Angelova, M. Methodology for evaluation effectiveness and efficiency in management of IT projects, SIELA 2016.

[Bollmer, 2018] Bollmer, G. Theorizing Digital Cultures. Sage, 2018.

[Brett, 2018] Brett, J. Evolving Digital Leadership: How to be a Digital Leader in Tomorrow's Disruptive World. Apress, 2018.

[Campbell & Garner, 2016] Campbell, H & Garner, S. Networked Theology: Negotiating Faith in Digital Culture. Baker Academic, 2016.

[Dimcheva, 2016] Dimcheva, G. Factors for increase of business clients' consumer satisfaction of telecommunication services. // 8th International Scientific Conference "Company Diagnostics, Controlling and Logistics", pp. 29-34, Zilina, 2016.

[Gupta, 2018] Gupta, S. Driving Digital Strategy: A Guide Reimagining Your Business. Harvard Business Review, 2018.

[Lambovska, 2018] Lambovska, M. Control on teams: A model and empirical evidence from Bulgaria. // Serbian Journal of Management, 2018, Vol. 13, Issue 2, pp. 311-322.

[Miller, 2011] Miller, V. Understanding Digital Culture. Sage, 2011.

[Perkin & Abraham, 2017] Perkin, N., & Abraham, P. Building the Agile Business trough Digital Transformation. Kogan Page, 2017.

[Ross, Beath & Mocker 2019] Ross, J., Beath, C., & Mocker, M. Design for Digital: How to Architect Your Business for Sustained Success. The MIT Press, 2019.

[Sheninger, 2019] Sheninger, E. Digital Leadership: Changing Paradigms for Changing Times, 2nd Ed. Crown, 2019.

[Temelkova, 2018 (a)] Temelkova, M (a). Skills for Digital Leadership – Prerequisite for Developing High-Tech Economy. // International Journal of Advanced Research in Management and Social Sciences, Vol. 7, N 12, November, 2018.

[Temelkova, 2018 (b)] Temelkova, M (b). Studying the Leadership Style of Business Organizations' Management under the Conditions of the Fourth Industrial Revolution. // Asia Pacific Journal of Resarch in Business Management, Vol. 9, Issue 2, February, 2018.

## Authors' Information

***Ivaylo Stoyanov*** *– University of Telecommunications and Post, Sofia, 1 Acad. St. Mladenov Str, Sofia 1700, Bulgaria, E-mail: istoyanov@vutp.bg*

*Major Fields of Scientific Research: Fundamentals of Management, Human Resource Management, Strategic Management, Business Process Management, Entrepreneurship.*

# ESTABLISHMENT METHODOLOGY OF A TRAINING CENTER FOR CONVENTIONAL AND DIGITAL MANAGEMENT AND ENTREPRENEURSHIP AT THE UNIVERSITY OF TELECOMMUNICATIONS AND POST

**Gergana Dimcheva**

***Abstract**: In this report is offered a methodology for establishment a training center for conventional and digital management and entrepreneurship in University of telecommunications and post.*

***Keywords**: Education, Conventional and Digital management, Entrepreneurship*

## Introduction

In the conditions of the information society and the dynamic environment in which the higher schools are located, the improvement of the educational process and the possibilities for the introduction of new models, methods and technologies in education are being improved. This, on the one hand, is a prerequisite for the development of new curricula and, on the other, the creation of a practical environment, through the establishment of training centers in educational institutions that are tailored to changes of the labor market and provide students with knowledge, skills and the competencies necessary for their realization.

The "Business - Education" relationship at the University of Telecommunications and Post (UTP) is very prominent, which allows maintaining adequate information on the state of the labor market. Particular attention is paid to the market-oriented training of students in all specialties and educational qualifications, i.e. consumer orientation is one of the main priorities of the higher education.

In order to maintain the competitiveness of the higher education institution, the main goals are:

- Continuous improvement of the educational process;

- Continuous technological updates, driven by digital and dynamic environments;

- Increasing of the student satisfaction;

The establishment of the Conventional and Digital Management and Entrepreneurship Training Center at the UTP is one of the main ways to maintain the competitiveness of the higher education institution (school).

The purpose of this publication is to present a methodological approach for the establishment of a Training Center for Conventional and Digital Management and Entrepreneurship at UTP.

## Methodological Approach for the Establishment of a Training Center for Conventional and Digital Management and Entrepreneurship at the UTP

The dynamic development of new technologies and the digitalization of business processes give rise to the need for new management and entrepreneurial skills, a new approach to decision making in conventional and digital business environments, which requires the training of highly qualified management personnel.

The high-tech economy needs people capable of generating new business models and tools which they will use to manage optimally the available opportunities and resources and to create value based on new economic concepts [Temelkova, 2018].

In the context of this development of the labor market, it is important to envisage and train specialists with skills in line with emerging technologies. New strategies for qualification are needed and the education system must adapt to these new conditions [Todorov, Kamberov,2018]

In order to respond adequately to the trends of the external environment, every organization (including educational institutions) must take into account the changes that occur in it [Stoyanov, 2017].

The idea of establishing a Training Center for Conventional and Digital Management and Entrepreneurship at the University of Telecommunications and Post is also conditioned by a real need for a change in the educational process, which was also confirmed by the studies conducted in this direction (Figure 1).

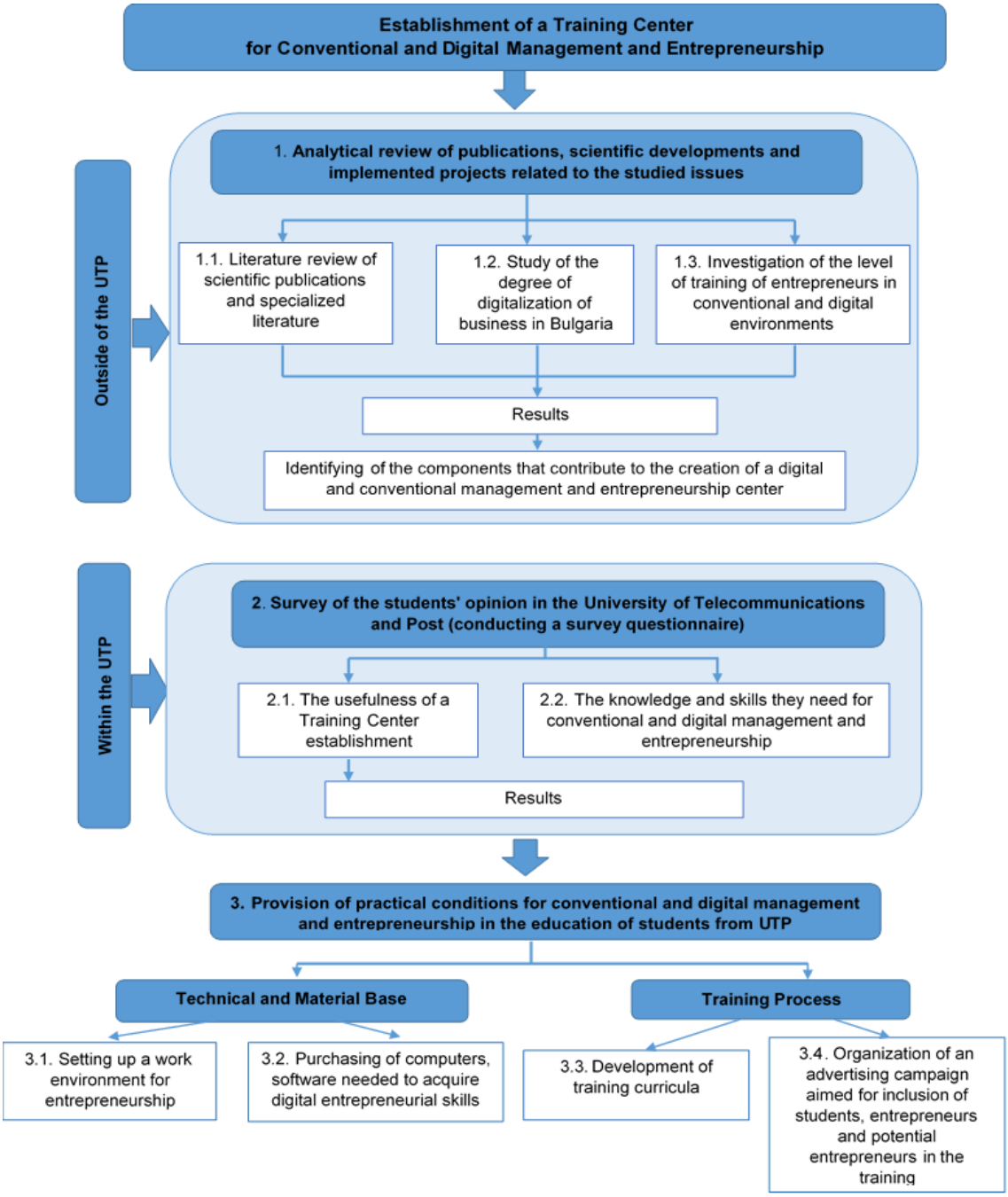


**Figure 1**. Methodological Approach for the Establishment of a Training Center for Conventional and Digital Management and Entrepreneurship at the UTP

The current methodology for establishing Conventional and Digital Management and Entrepreneurship Training Center involves conducting studies in two main areas:

- Outside of the UTP
- Within the UTP

***1. Analytical review of publications, scientific developments and implemented projects related to the studied issues. They are heading in this direction:***

1.1. Research and analysis of research related to entrepreneurship, digital entrepreneurship and management.

1.2. Analyzing the consumption of information and communication technologies in Bulgaria for the period 2016 - 2018, as part of the digitalization of business in Bulgaria. The purpose of the study is to trace the extent to which they are used by enterprises, which are grouped in three groups: the use of computers and the Internet by businesses; e-commerce and the use of automated data exchange.

1.3. Conducting a study on the level of training of entrepreneurs in conventional and digital environments

Based on studies done in this area:

- the environmental factors influencing the management and entrepreneurial business in conventional and digital environment are systematized;

- the components contributing to the construction of a center for digital and conventional management and entrepreneurship at the University of Telecommunications have been identified;

- the basic tools and business practices necessary for the establishment of a center for digital and conventional management and entrepreneurship in the University of Telecommunications and Post have been classified;

- it is concluded that in Bulgaria there is still a low level of use of information and communication technologies by the enterprises, as a basic criterion for the digitalization of business in our country;

- From research done [Bosma, Kelley, 2017/2018; Bosma, Kelley 2018/2019] found that although there is a growing trend, Bulgaria still scores low on entrepreneurship education, both at school and post-school levels.

### *2. Examination of the opinion of the students in the University of Telecommunications and Post*

The second stage of the methodology is the conduct of studies within the UTP.

The aim is to track students' opinions on the usefulness of building a Conventional and Digital Management and Entrepreneurship Training Center, as well as the need for the necessary knowledge and skills for conventional and digital management and entrepreneurship. For this purpose, a survey was conducted using an electronic questionnaire. In the survey were surveyed 120 university students.

The study found out that more than 80% of the students surveyed thought it would be beneficial to establish a Higher School Conventional and Digital Management and Entrepreneurship Training Center.

The studies carried out in the areas discussed above allow a great deal of depth to be done:

- Analysis of the need to establish a training center for conventional and digital management and entrepreneurship;
- Description of the conditions for implementation, forecasting the expected results, to reflect the specifics of this project, and in particular its complexity and degree of novelty;
- Identification and description of the scope, stages, tasks, resources, timetable, communications necessary for the implementation of the project for the establishment of the Training Center for Conventional and Digital Management and Entrepreneurship.

### *3. Providing practical conditions for conventional and digital management and entrepreneurship in the education of students from UTP*

In order to achieve the goal of the project for the establishment of the Training Center for Conventional and Digital Management and Entrepreneurship, it is necessary to provide technical and material and information base, which will

create appropriate practical conditions for conducting training in conventional and digital management and entrepreneurship. This is expressed in: opening entrepreneurial workshops; providing computer rooms with specialized equipment and specialized software products that enable real management decision making in a practical environment.

It is essential that one of the final stages of the methodology for the construction of the training center is its promotion. The aim is to reach both current students of UTP and current and future entrepreneurs

## Conclusions

The establishment of a Center for Digital and Conventional Management and Entrepreneurship in the University of Telecommunications and Post aims to develop practical competences, knowledge and experience in the students of UTP, which correspond to the modern business conditions. At its core is the promotion of managerial and entrepreneurial decision-making, the creation of entrepreneurship workshops, ideas for creativity and development, coaching and mentoring training, and entrepreneurial social responsibility. On this basis, the prospect of starting successful business and real entrepreneurial initiatives is rooted in the competitiveness of the modern management.

## Acknowledgments

This report is courtesy of Research Project No. NID 18 / 26.03.2019 from UTP's Research Fund, entitled "Building a Training Center for Conventional and Digital Management and Entrepreneurship at the University of Telecommunications and Post"

## Bibliography

[Bosma, Kelley, 2017/2018] Bosma, N., Kelley, D. Global Entrepreneurship Monitor 2017/2018 Global Report, ISBN: ISBN-13: 978-1-939242-10-5, 2018.

[Bosma, Kelley, 2018/2019] Bosma, N., Kelley, D. Global Entrepreneurship Monitor 2018/2019 Global Report, ISBN: 978-1-9160178-0-1, 2018.

[Temelkova, 2018] Temelkova, M. *Skills for digital leadership – prerequisite for developing high-tech economy*, International Journal “Information Theories and Applications”, Vol. 25, Number 4, pp 343 – 364. 2018.

[Стоянов, 2017] Стоянов, И. Стратегическо управление на услугите. Издателство „Авангард Прима“, София. 2017.

[Тодоров, Камберов, 2018] Тодоров, Г. Камберов, К. Индустрия 4.0 и предизвикателствата пред висшето образование, ИНДУСТРИЯ 4.0 - ПРЕДИЗВИКАТЕЛСТВА И ПОСЛЕДИЦИ ЗА ИКОНОМИЧЕСКОТО И СОЦИАЛНОТО РАЗВИТИЕ НА БЪЛГАРИЯ. с. 18-27, Българска стопанска камара. ISBN 978-954-2979-32-6. 2018.

## Authors' Information

***Gergana Dimcheva*** *– University of Telecommunications and Post, Sofia, 1 Acad. St. Mladenov Str, Sofia 1700, Bulgaria, E-mail: gergana_sl_dimcheva@abv.bg*

*Major Fields of Scientific Research: Economics of communications, Organization and management of telecommunication services, Project Management.*

# ENTREPRENEURIAL ORIENTATION OF COURIER OPERATORS IN BULGARIA

**Anna Otsetova**

***Abstract****: This paper investigates the relationship between entrepreneurial orientation (EO) and the business performance of Small and Medium Enterprises (SMEs) operating in the courier services sector in Bulgaria. The original Hughes and Morgan EO Scale was developed to assess the level of EO of courier operators. All scales are 7-point Likert-type scales in which respondents are obligated to choose between pairs of opposing statements. Business performance is assessed in terms of growth (in sales and in employees over the last 5 years) and overall performance. The finding revealed that there is a positively correlation between EO and business performance of courier operators in Bulgaria.*

***Keywords****: Entrepreneurial orientation, Business performance*

## Introduction

Entrepreneurial activities are increasingly regarded as important to every organization, but in today's complex global economy, entrepreneurship has become even more crucial towards obtaining a sustainable competitive advantage. During the last three decades the Entrepreneurial orientation has become one of the most established constructs in entrepreneurship and management research. EO is the most widely used constructs to assess company entrepreneurship. EO is an organizing marketing approach that an organization adopts and which enables it to identify and exploit the emerging business opportunities.

EO is an organizational decision-making proclivity favoring entrepreneurial activities [Covin, Wales, 2011]. Entrepreneurial orientation is a strategic focus

on new opportunities and a willingness to move beyond existing competencies and company resources. Some authors define EO as the sum total of a firm's radical innovation, proactive strategic action, and risk taking activities that are manifested in support of projects with uncertain outcomes [Cools, Van den Broeck, 2008; Pearce et al., 2010].

An organization is considered to be entrepreneurial if it is innovative, proactive and risk-taking [Rezaei, Ortt, 2018]. Many researchers argue that EO is closely reflect to actual entrepreneurial firm behavior [Stambaugh et al., 2017; Rauch et al., 2009; Rosenbusch et. al., 2013] and is that it is positively related to firm performance [Wang, 2008]. The implementation of EO as an internal resource facilitates a company to effectively identify first and then exploit the opportunities that come across and improve its business performance.

Nowadays, business environment in courier services sector can be described as complex and uncertain. Over the past decade the role of courier services has changed fundamentally. Today, courier services play an integral part in the success of many businesses by providing the vital link between suppliers and consumers. The courier services market is being challenged by new customer habits and has had to adapt new technologies. E-commerce trade is one of the major drivers of the global courier services industry [Otsetova, Dudin, 2017].

This can place emerging young courier operators in vulnerable positions by compromising their ability to compete against established competitors. To compete under such conditions, the young courier operators have to hone their entrepreneurial capabilities so as to launch speedy and stealthy attacks on competitors.

Hence, the aim of this paper is to investigate the relationship of entrepreneurial orientation and business performance of courier operators in Bulgaria and to emphasize its most characteristic aspects that can attribute to a stable and profitable business development.

## Entrepreneurial Orientation Measurement

The majority of studies in the field of EO tent to adopt Miller (1983) definition of an entrepreneurial firm and extrapolate it to EO [Hughes, Morgan, 2007]. The author suggests that EO as a construct is composed of three dimensions: innovativeness, risk taking, and proactiveness. In the Miller/Covin and Slevin (1989) scale (Table 1). EO is measured as a first-order reflective construct.

**Table 1. Miller/Covin and Slevin EO Scale (adapted for services sector)**

| | | |
|---|---|---|
| ***Innovativeness items*** *In general, the top managers of my firm favor…* | | |
| A strong emphasis on the marketing of tried-and-true services | 1 2 3 4 5 6 7 | A strong emphasis on Research and Development (R&D), technological leadership, and innovations |
| *How many new services has your firm marketed in the past five years (or since its establishment)?* | | |
| No new services | 1 2 3 4 5 6 7 | Very many new services |
| Changes in service lines have been mostly of a minor nature | 1 2 3 4 5 6 7 | Changes in service lines have usually been quite dramatic |
| ***Proactiveness items*** *In dealing with its competitors, my firm ...* | | |
| Typically responds to actions which competitors initiate | 1 2 3 4 5 6 7 | Typically initiates actions to which competitors then respond |
| Is very seldom the first business to introduce new services, administrative techniques, operating technologies, etc. | 1 2 3 4 5 6 7 | Is very often the first business to introduce new services, administrative techniques, operating technologies, etc. |
| Typically seeks to avoid competitive clashes, preferring a “live-and-let-live” posture | 1 2 3 4 5 6 7 | Typically adopts a very competitive, “undo-the-competitors” posture |
| ***Risk-taking items*** *In general, the top managers of my firm have ...* | | |

| | | |
|---|---|---|
| A strong proclivity for low-risk projects (with normal and certain rates of return) | 1 2 3 4 5 6 7 | A strong proclivity for high-risk projects (with chances of very high returns) |
| *In general, the top managers of my firm believe that...* | | |
| Owing to the nature of the environment, it is best to explore it gradually via cautious, incremental behavior | 1 2 3 4 5 6 7 | Owing to the nature of the environment, bold, wide-ranging acts are necessary to achieve the firm's objectives |
| *When confronted with decision-making situations involving uncertainty, my firm ...* | | |
| Typically adopts a cautious, "wait-and-see" posture in order to minimize the probability of making costly decisions | 1 2 3 4 5 6 7 | Typically adopts a bold, aggressive posture in order to maximize the probability of exploiting potential opportunities |

Later researches use more detailed conceptualizations of EO, include extra dimensions of EO, and suggest more formative measurement models of EO where the dimensions of EO are allowed to vary independently. Lumpkin and Dess (1996) expanded the number of dimensions that characterize EO. According to the authors EO is composed of five dimensions: innovativeness, risk taking, proactiveness, competitive aggressiveness and autonomy.

The first dimension, risk-taking, is often used to describe the uncertainty that follows from behaving entrepreneurially. Risk-taking reflects an acceptance of uncertainty and risk and is typically characterized by resource commitment to uncertain outcomes and activities.

Innovativeness includes propensity for toward embracing and supporting creativity and experimentation, technological leadership, novelty and R&D in the development of products, services and processes. Innovativeness is about pursuing and giving support to novelty, creative processes and the development of new ideas through experimentation.

Proactiveness relates to a forward-looking perspective where companies actively seek to anticipate opportunities to develop and introduce new products and services to obtain first-mover advantages. Proactiveness represents behaviors in anticipation of future problems, needs, and changes. It involves taking the initiative, anticipating and carrying out new opportunities, and the

creation of or participation in emerging markets. Proactiveness includes the tendency to be the first on the market with new products or services. Indeed, proactiveness concerns the importance of initiative in the entrepreneurial process.

Competitive aggressiveness conveys the intensity with which a firm chooses to compete and efforts to surpass. Autonomy describes the authority and independence given to an individual or team within the firm to develop business concepts and visions [Hughes, Morgan, 2007].

Based on Lumpkin and Dess (1996) study, Hughes and Morgan (2007) developed an EO scale, recognizes the multidimensionality of the EO construct (Table 2).

**Table 2. Hughes and Morgan EO Scale [Hughes, Morgan, 2007]**

| | |
|---|---|
| ***Risk-taking items*** | |
| **(Risk-taking 1)** The term "risk taker" is considered a positive attribute for people in our business | 1 2 3 4 5 6 7<br>"Strongly disagree" (=1) to "Strongly agree" (=7) |
| **(Risk-taking 2)** People in our business are encouraged to take calculated risks with new ideas | 1 2 3 4 5 6 7 |
| **(Risk-taking 3)** Our business emphasizes both exploration and experimentation for opportunities | 1 2 3 4 5 6 7 |
| ***Innovativeness items*** | |
| **(Innovativeness 1)** We actively introduce improvements and innovations in our business | 1 2 3 4 5 6 7 |
| **(Innovativeness 2)** Our business is creative in its methods of operation | 1 2 3 4 5 6 7 |
| **(Innovativeness 3)** Our business seeks out new ways to do things | 1 2 3 4 5 6 7 |
| ***Proactiveness items*** | |
| **(Proactiveness 1)** We always try to take the initiative in every situation (e.g., against competitors, in projects when working with others) | 1 2 3 4 5 6 7 |
| **(Proactiveness 2)** We excel at identifying opportunities | 1 2 3 4 5 6 7 |

| | |
|---|---|
| **(Proactiveness 3)** We initiate actions to which other organizations respond | 1 2 3 4 5 6 7 |
| ***Competitive aggressiveness items*** | |
| **(Competitive aggressiveness 1)** Our business is intensely competitive | 1 2 3 4 5 6 7 |
| **(Competitive aggressiveness 2)** In general, our business takes a bold or aggressive approach when competing | 1 2 3 4 5 6 7 |
| **(Competitive aggressiveness 3)** We try to undo and out-maneuver the competition as best as we can | 1 2 3 4 5 6 7 |
| ***Autonomy items*** | |
| **(Autonomy 1)** Employees are permitted to act and think without interference | 1 2 3 4 5 6 7 |
| **(Autonomy 2)** Employees perform jobs that allow them to make and instigate changes in the way they perform their work tasks | 1 2 3 4 5 6 7 |
| **(Autonomy 3)** Employees are given freedom and independence to decide on their own how to go about doing their work | 1 2 3 4 5 6 7 |
| **(Autonomy 4)** Employees are given freedom to communicate without interference | 1 2 3 4 5 6 7 |
| **(Autonomy 5)** Employees are given authority and responsibility to act alone if they think it to be in the best interests of the business | 1 2 3 4 5 6 7 |
| **(Autonomy 6)** Employees have access to all vital information | 1 2 3 4 5 6 7 |

The results from EO measurement can be used to revisit the firm EO capabilities. Each dimension of EO can vary independently, indicating that firms should manipulate only those that add value.

## Analysis and Findings

Small and medium enterprises operating in the courier services sector in Bulgaria are the main units of the study. The courier operators included in the survey met the official European Union (EU) criteria for SMEs, e.g. they employ less than 250 employees.

According to the Communication Regulation Commission at the beginning of 2019 the number of registered courier operators in Bulgaria is 172. 57 of them declared that they did not perform activities. The number of courier operators in

Bulgaria that meet the criteria for SMEs is 101. Using the apparatus of mathematical statistics at significance level α=0,05 and margin of error ε=0,05 minimum sample size determined to be 80 [Creative Research System, 2019]. The number of returned and valid questionnaires is 83.

The study was conducted between May and October 2019.

Most of courier operators (72.29% of the sample) fit in the category of small firm, meaning 10 to 49 employees. Fewer firms (27.71% of the sample) are medium sized firms; employing 50 to 250 people.

The questionnaire was send to top level managers or founders. The respondents had an average age of 53 years, 81,93% were male, 75,90% held a university degree (of which 11.10% had a doctoral degree).

The original Hughes and Morgan EO Scale was developed to assess the level of EO in small and medium courier operators in Bulgaria. All scales are 7-point Likert-type scales in which respondents are obligated to choose between pairs of opposing statements.

Business performance is assessed in terms of growth (in sales and in employees over the last 5 years) and overall performance.

Three questions were thus asked to measure performance:

- Evolution of turnover over the last 5 years
- Evolution of the number of employees over the last 5 years
- How would you rate your overall performance over the last 5 years? (1 to 7).

A confirmatory factor analysis is conducted in order to assess the discriminant validity and reliability of the EO scale. To assess the validity and reliability of the scale the absolute fit indices (Confirmative Fit Index (CFI) and root mean square error approximation (RMSEA)) and incremental fit indices (Tucker-Lewis Index (TLI) and Normative Fit Index (NFI)) were calculated.

The factor loadings for the individual items, as well as for the first-order factors are presented in Table 3. The results indicate good convergent validity of the scale. All factor loadings are significant at $p \leq 0.001$.

**Table 3. Results from Confirmatory Factor analysis**

| First order factor | Factor loading |
|---|---|
| Risk-taking items | 0.73 |
| Innovativeness items | 0.84 |
| Proactiveness items | 0.68 |
| Competitive aggressiveness items | 0.62 |
| Autonomy items | 0.58 |
| ***Items*** | |
| Risk-taking 1 | 0.61 |
| Risk-taking 2 | 0.69 |
| Risk-taking 3 | 0.71 |
| Innovativeness 1 | 0.87 |
| Innovativeness 2 | 0.82 |
| Innovativeness 3 | 0.73 |
| Proactiveness 1 | 0.58 |
| Proactiveness 2 | 0.75 |
| Proactiveness 3 | 0.68 |
| Competitive aggressiveness 1 | 0.63 |
| Competitive aggressiveness 2 | 0.58 |
| Competitive aggressiveness 3 | 0.61 |
| Autonomy 1 | 0.59 |
| Autonomy 2 | 0.67 |
| Autonomy 3 | 0.54 |
| Autonomy 4 | 0.65 |
| Autonomy 5 | 0.67 |
| Autonomy 6 | 0.71 |
| **CFI=.874, RMSEA=.071, TLI=.841, NFI=.917** | |

Internal consistency of the scale was estimated by Cronbach's coefficient. The internal consistency is considered to be excellent if $\alpha \geq 0.9$, and if $0.7 \leq \alpha \leq 0.9$, it is considered to be good. All the extracted factors have good internal consistency (Table 4).

**Table 4. Cronbach's coefficients of first order factors**

| Factor | Cronbach's coefficient |
|---|---|
| Risk-taking | 0.801 |
| Innovativeness | 0.839 |
| Proactiveness | 0.729 |
| Competitive aggressiveness | 0.702 |
| Autonomy | 0.738 |

The next step of the study is the evaluation of the relationships as shown in Figure 1. This model tests whether EO has a positive correlation with business performance. The findings of the correlation between EO and performance are shown in Table 5.

**Table 5. The relationship between EO and Business Performance**

| | Pearson's correlation coefficient (r) | Direction | Strength | Coefficient of determination ($r^2$) |
|---|---|---|---|---|
| EO | 0.589 | + | Moderately positive | 0,347 |

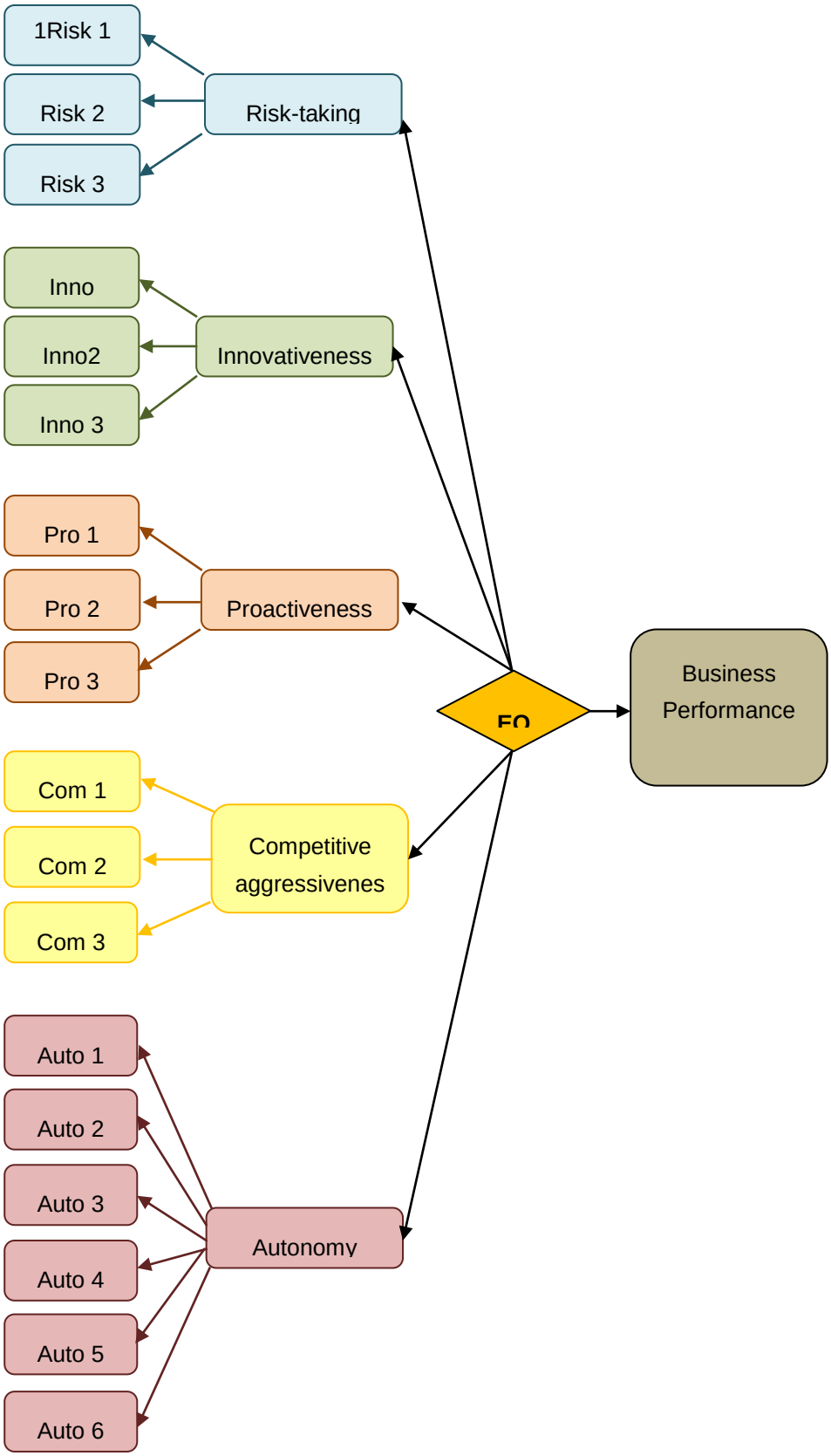


Figure 1. Hypothesized Structural Model

According to the results it can be concluded that the entrepreneurial orientation is positively correlated to business performance, on the base of a medium relation. However, the relation is almost large as the Pearson's correlation coefficient is higher than 0.5. Furthermore, the coefficient of determination explains that EO is responsible of 34.7% of the variance in business performance of courier operators.

## Conclusion

This study examines how EO can affect the business performance of SMEs operating in courier services sector in Bulgaria. Significant conclusion from this study is that EO has a positive effect on business performance. It means that as the EO level increases, the degree of business performance also increases. Entrepreneurial orientation contributes to performance of courier operators in Bulgaria with an outlook on business growth as well as business development and improvement. Results from this study could foster SMEs manager to encourage and develop entrepreneurial behaviour within their organizations to achieve sustainable growth.

It can be concluded that there is a necessity of educating entrepreneurs towards entrepreneurial orientation and for entrepreneurs and managers to improve on applying the dimensions of EO in the business environment.

## Acknowledgement

Author is grateful for the financial support provided by University of Telecommunications and Post under the project НИД № 18/26.03.2019 (Establishment of a Training Center for Conventional and Digital Management and Entrepreneurship in the University of Telecommunications and Post).

## Bibliography

[Cools, Van der Broeck, 2007] Cools, E., Van den Broeck, H., The hunt for the Heffalump continues: Can trait and cognitive characteristics predict entrepreneurial orientation. Journal of Small Business Strategy, 2007, 18(2), 23-41.

[Covin, Slevian, 1989] Covin, J.G., Slevin, D., Strategic management in small firms in hostile and benign environments. Strategic Management Journal, 1989, 10(1), 75–87.

[Covin, Wales, 2006] Covin, J. G., Wales, W. J. (2011). The Measurement of Entrepreneurial Orientation. Entrepreneurship Theory and Practice, 2011, 36(4), 677–702. doi:10.1111/j.1540-6520.2010.00432.x.

[Creative Research System, 2019] Creative Research System, Sample Size Calculator, Available at <http://www.surveysystem.com/sscalc.htm> Accessed on October 5, 2019.

[Hughes, Morgan, 2007] Hughes, M., Morgan, R., Deconstructing the relationship between entrepreneurial orientation and business performance at the embryonic stage of firm growth, Industrial Marketing Management, 2007, 36, pp. 651-661.

[Lumpkin, Dess, 1996] Lumpkin, G.T., Dess, G.G., Clarifying the entrepreneurial orientation construct and linking it to performance, Academy of Management Review, 1996, 21(1), 135-172.

[Miller, 1983] Miller, D., The correlates of entrepreneurship in three types of firms, Management Science, 1983, 29(7), pp. 770–792.

[Otsetova, Dudin, 2017] Otsetova, A., Dudin, E., A study of courier services market in Bulgaria, International Journal of Advanced Research in Management and Social Sciences, 2017, Vol. 6, No. 8, pp. 85-100.

[Pearce et al., 2010] Pearce, J., Fritz, D., Davis, P., Entrepreneurial Orientation and the Performance of Religious Congregations as Predicted by Rational Choice Theory, Entrepreneurship Theory and Practice, 2010, Vol. 34, Issue 1, pp, 219-248.

[Rauch et al., 2009] Rauch, A., Wiklund, J., Lumpkin, G.T. and Frese, M., Entrepreneurial orientation and business performance: an assessment of past research and suggestions for the future, Entrepreneurship Theory and Practice, 2009, Vol. 33, No. 3, pp. 761-787.

[Rezeai, Ortt, 2018] Rezeai, J., Ortt, R., Entrepreneurial orientation and firm performance: the mediating role of functional performances, Management Research Review, 2018, Vol. 41, No. 7,pp. 878-900.

[Rosenbusch et. Al., 2013] Rosenbusch, N., Rauch, A. and Bausch, A., The mediating role of entrepreneurial orientation in the task environment–performance relationship: a meta-analysis, Journal of Management, 2013, Vol. 39, No. 3, pp. 633-659.

[Stambaugh et al., 2017] Stambaugh, J.E., Martinez, J., Lumpkin, G.T. and Kataria, N., How well do EO measures and entrepreneurial behavior match?, International Entrepreneurship and Management Journal, 2017, Vol. 13, No. 3, pp. 717-737.

[Wang, 2008] Wang, C.L., Entrepreneurial orientation, learning orientation, and firm performance, Entrepreneurship Theory and Practice, 2008, Vol. 32, No. 4, pp. 635-657.

## Authors' Information

***Anna Otsetova*** *– University of Telecommunications and Post, Sofia, 1 Acad. St. Mladenov Str, Sofia 1700, Bulgaria, E-mail: aotsetova@abv.bg*

*Major Fields of Scientific Research: Postal services, Quality of services, Operation management, Customer satisfaction, Supply Chain Management*

# CENTER FOR CONVENTIONAL AND DIGITAL MANAGEMENT AND ENTERPRENEURSHIP ESTABLISMENT

**Dimitar Kolev**

***Abstract****: This research paper is dedicated to the need for establishment of Center for Conventional and Digital Management and Entrepreneurship by University of Telecommunications and Post – Sofia. A theoretical framework about the necessity for educational institutions to have more digital and entrepreneur skills courses has been drown. In order to determine if the students also consider them important a survey has been done. On that basis, some key conclusions and recommendations about the establishment of the educational center and the possible courses to be conducted there have been outlined.*

***Keywords****: entrepreneurship, digital skills, management, education.*

## Introduction

Small organizations are the bearers of technical progress and innovative entrepreneurship. It has been considered, entrepreneurship, to be the fourth main resource in the economy with land, labour and capital being the other three. Nowadays, it has become more and more difficult and it has moved to pivot role for economic growth with its essence of discovering new products and services or exploiting resources. Moreover, entrepreneurship is strongly connected with new technologies and very often entrepreneurs are considered to be good innovative leaders. Having this into consideration it is obvious for educational institutions and centers to have entrepreneur courses which involve digital skills, leadership skills and entrepreneurship trainings or practices.

On the other hand, in Bulgaria and other Eastern European countries, there is rapid interest in business startups and entrepreneurship indicated by the

willingness of not only the managers of the old enterprises but also the thousands of other people to achieve the material basis of their independence (small business ownership) and take advantage of the opportunities offered by economic freedom.

Therefore, the main purpose of this research paper is to analyze the need of Center for Conventional and Digital Management and Entrepreneurship established by the University of Telecommunications and Post - Sofia.

The goals are:

To make a theoretical and methodological framework;

To analyze the need of Center for Conventional and Digital Management and Entrepreneurship by survey among students of University of Telecommunications and Post - Sofia;

To underline some key conclusions and recommendations.

## I. Theoretical and methodological framework

According to some researchers [Mariotti, Towle, 2010], Entrepreneurship is the ability to search and exploit the changes, create, innovate and be willing to take the risk, which can make old industries obsolete. Some of the key personal attributes for it are:

- Creativity as the spark that drives the development of new products or services, or ways to do business;
- Dedication as what motivates the entrepreneur to work hard, more than 12 hours a day;
- Determination as the extremely strong desire to achieve success;
- Flexibility as the ability to move quickly in response to changing market needs;
- Leadership as the ability to create rules and to set goals. It is the capacity to follow through to see that rules are followed and goals are accomplished [Druker, 2002], [USINFO.STATE.GOV, 2016].

These attributes required for entrepreneurship very often come from personal background, but it is not enough just to have them, you need to develop and deploy them. To do it you need to start from early age development. This is possible with the right education which is correlated with the idea of establishing Centre for Convectional and Digital Management and Entrepreneurship by the University of Telecommunications and Post - Sofia.

Moreover, in the near future 65% of the existing jobs will be very different as a result of technological developments, and individuals should develop their skills and competences in order to remain competitive in the digital economy [Temelkova, 2018]. Furthermore, in the European Union the need for IT professionals with competences to sustain innovation and competitiveness in the world market is growing rapidly. They will have to face the challenges of the fourth industrial revolution and the high-tech economy, which can be described as: the combination of interrelated digital technological decisions assisting the development of the automation, the integration and the exchange of data in real time in the production processes, delivering several times higher norm of added value compared to the traditional economic system [Temelkova, 2018].

According a report [European Commission, 2017] from 2017, around 48% of the experts agree that private sector should initiate effort to improve high-tech skills in their employees and managers and 44% are willing to fund such kind of training courses.

This requires to change the focus of **Business and Management** curriculums not only in their field but also involving more **IT based classes**. Thus, leading to the higher demand of educational institutions to open more computer labs in which IT business classes could take place, which is the main aim of the Center for Conventional and Digital management and Entrepreneurship.

In addition, entrepreneurs are considered to be modern age leaders and to do that they need to be able to: set goals, create rules and follow through or in other words to plan, organize and control assets and management of business processes. Moreover, in the fourth industrial revolution the leaders or managers must have digital knowledge to comprehend with the resource planning and management, this includes: information technology tools, complex business

systems, artificial Intelligence, Internet of Things, Cloud technologies, virtualization and so on [Temelkova, 2018].

According to the European Union agenda [European Commission, 2017] for digital leadership there is a need for:

- **Integration of high-tech savviness in formal education** (nearly 60% of experts participating in the survey agree);
- **Promotion of training course for high-tech skills for managers** (about 53% of respondents agree).

The aforementioned information confirms the need for Entrepreneurship and Digital skills training courses for educational institutions and gives a solid basis for the methodology of the following research. The main observation and key indicators analysis is done by **empirical data survey research**.

The **questions** in the current research are divided into several groups by their purpose. In the **first** group, are the questions that make it possible to divide the respondents. They are placed at the beginning or end of the questionnaire, but they can also be in the main part of it as long as the logic is not broken. Basic dichotomous questions and interval scales are used [Banchev, P., 2012]. In this case, the selected questions are about gender, age and education.

The **second** group of questions is the most important one. It is about key factor for establishing and running the Center for Conventional and Digital Management and Entrepreneurship, such as:

- To state if the respondent considers the establishment of the center useful;
- To select some additional courses which are interesting to him/her – which would be useful for the organization and the training courses selective options are correlated with the aforementioned information – so they are **IT based**, **Digital management** and **Entrepreneurship**;
- To refer how many hours per week respondent could participate in such course organized by the center;
- To state which is the most important characteristic of the additional courses – this question aims to further quantify and determine key factors for maintaining training courses.

The **third** group is one Likert scale question to evaluate students' current experience with the educational institution, as follows (see Table 1):

***Table 1. Students' evaluation scale***

| Value | Evaluation |
|---|---|
| 1 | Very Bad |
| 2 | Bad |
| 3 | Sufficient |
| 4 | Average |
| 5 | Good |
| 6 | Very Good |
| 7 | Excellent |

The selection of respondents is limited process due to the purpose of the research, which is to evaluate the need for establishment of Center for Conventional and Digital Management and Entrepreneurship by the University of Telecommunications and Post – Sofia, which means that they are students from this educational institution.

## II. Results and discussion

The research has been conducted among more than a hundred students from University of Telecommunications and Post – Sofia to verify the need for Center for Conventional and Digital Management and Entrepreneurship. The survey has been designed in Google forms and distributed via a social network – Facebook. The age of the respondents is as follows: 54.62% between 19 and 30, between 31 and 40 – 32.77%, from 41 to 50 – 7.56% and above 51 years old – 5.04%, of which 64% males and 36% females. This distribution is satisfactory for the research.

Almost all respondents from both genders agree that the Center for Conventional and Digital Management and Entrepreneurship would be useful for the University of Telecommunications and Post – Sofia (See Fig. 1).

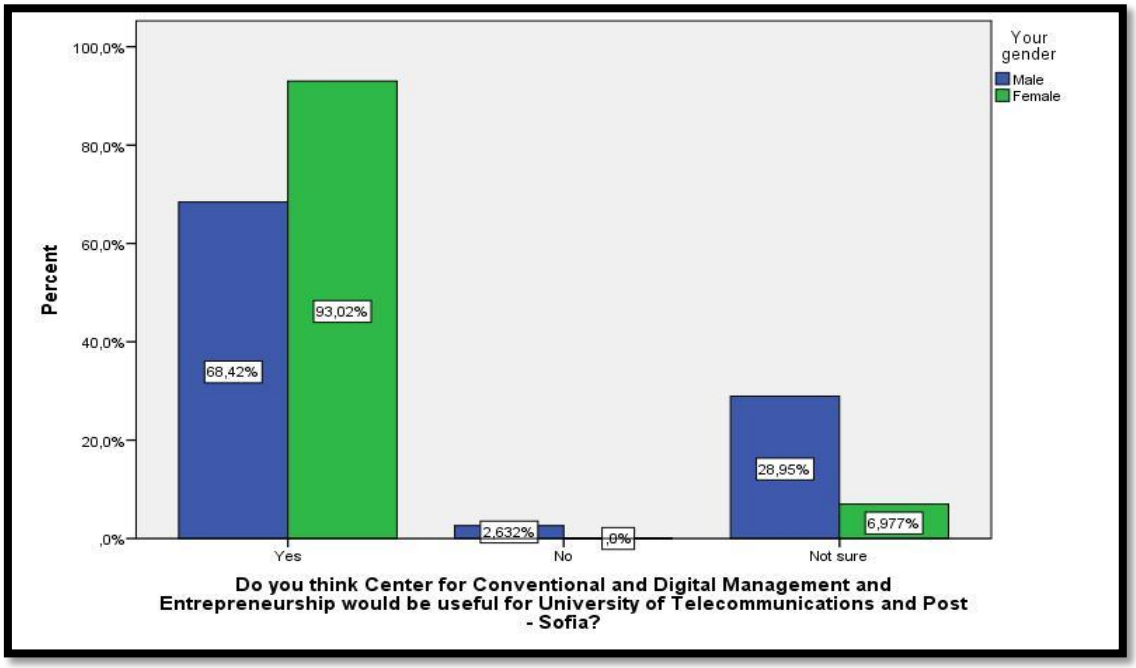


Figure 1. Usefulness of Center for Center for Conventional and Digital Management and Entrepreneurship

Only men have some doubt with about 29% of them being not sure about the benefit of the Center and about 2% think it won't be useful. Contradictory to them 93% of the females consider the establishment of such institution beneficial and only 7% are not sure. These results confirm the need and the desire of students of this institution to receive better education in the field of management and digital skills.

In terms of what possible courses could be organized by the center as selective options for the respondents the basic idea is for digital skills, management, entrepreneurship and online security. This is correlated with the aforementioned European labor market needs and their fulfillment and the forth industrial revolution demands. As evident from the figure (Fig. 2) below the respondents have a very diverse desire in terms of additional courses. Most of the students require Entrepreneurship (20.34%) and Computer systems and networks (21.19%) as an additional course. Next are the Internet security, Digital management and Private data security with 16.95%, 15,25% and 15.25%

respectively. It seems like there is a good distribution among the possible courses which means that the Center for Conventional and Digital Management and Entrepreneurship would have high interest in the respected courses if organized.

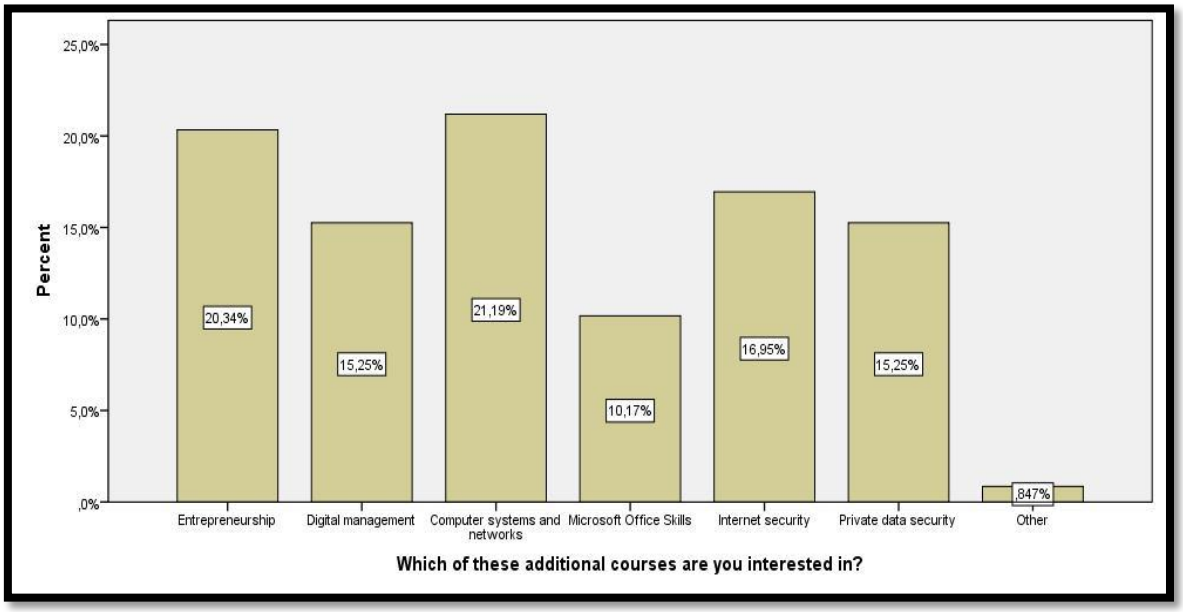


Figure 2. Additional courses interest

On the other hand, if the management of University of Telecommunications and Post – Sofia wants the Center to be successful they have to consider two more important factors –what are the features required by students to visit such a course and how many hours do they wish to spend on a weekly basis for additional education. Firstly, some key features of the additional courses are presented in the survey so the respondents could outline their preferences, which would be guidelines for the institution to organize and manage the courses.

As evident from the figure (Fig. 3) the students consider trainer competences with 31.36% responses to be the most important factor for them to visit additional courses. The second feature is the adjustable timetable of the course with around 20%, which might be due to the fact that a lot of the students work so they need to have free time to visit the classes. The distribution of the other

possible features of the courses is almost even (16%) between three – price of the course, certification and the course content.

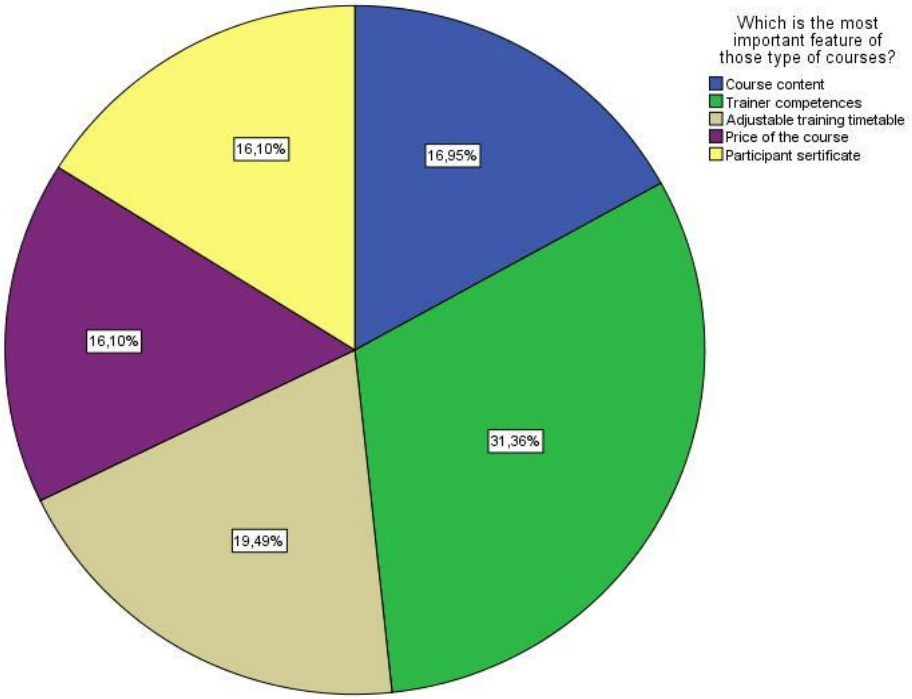


Figure 3. Additional courses interest

Although, certification and course content could be considered similar due to their relatedness to the course outcome for the respondents, it seems a bit odd to put the price of the course on the same level. Maybe, because Bulgaria is relatively poor country for the European Union and people here tend to value their money. Moreover, for some job opportunities it is a requirement to have curtain knowledge and certificates.

It is valuable for the educational institution to have this on their mind when they decide to organize a course – to hire well known trainers, to adapt the timetable according the need of the majority of the students enrolled in the course and to make a balance between price and outcomes for the students.

As aforementioned, the hours spend for additional courses is an important factor for the students and it has been considered in the survey. They have been asked to state how many hours on a weekly basis they could spend on an

additional course (see Fig. 4). Most of the respondents could spend between 1 and 3 hours per week for such a course and only 26% are able to have additional classes for more than 4 hours. On one hand, males are almost equally spread among 1 hour per week – about 43% and 2 to 3 hours – 40%, with only 16% stating they could spend more than 4 hours per week on a course. On the other hand, the females tend to be more willing to spend 2 to 3 hours per week – 51% and 39% having only 1 hour for additional course. This result clearly shows that if the University of Telecommunications and Post – Sofia establishes a Center for Conventional and Digital Management and Entrepreneurship to conduct such courses they have to be on a short timetable for week approximately 2 hours per week.

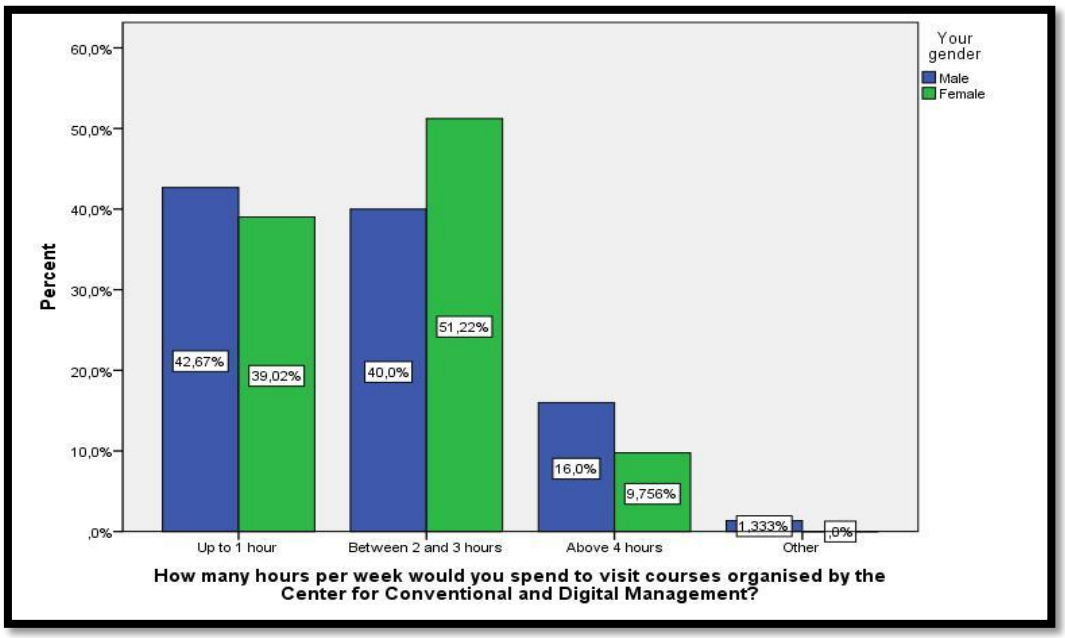


Figure 4. Hours per week to spend on additional course

To conclude, this research has confirmed the need for establishment of Center for Conventional and Digital Management and Entrepreneurship by the University of Telecommunications and Post – Sofia. There is a diverse requirement by the students for additional courses which complies with the

general labor market needs. It would be beneficial for the institution to organize such courses and they have to consider the trainers' competences and the timetable.

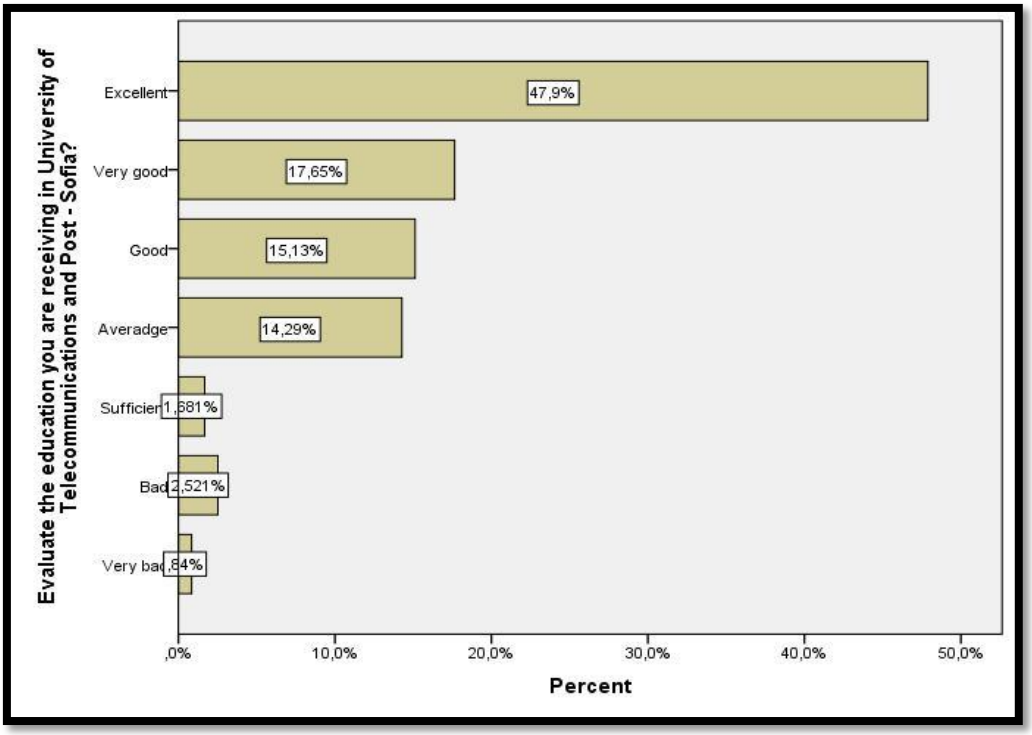


Figure 5. Evaluation of University of Telecommunications and Post – Sofia

Finally, to confirm if the institution is on the right track a Likert scale evaluation has been done (Fig. 5). It clearly shows the satisfaction of the students – about 48% of them consider the education given by the University of Telecommunications and Post – Sofia as excellent and around 18% think it is very good. Only 2% responded that the education given by the university is bad. These results confirm that this institution is on the right way of providing quality educational service and they will continue to grow by establishing Center for Digital Management and Entrepreneurship.

## Conclusion

In the context of the fourth industrial revolution, starting small business or entrepreneurship is very difficult especially in Eastern European countries, which are considered to be relatively small markets. This requires additional set of skills like IT knowledge, digital management and entrepreneurship.

Establishing a Center for Conventional and Digital Management and Entrepreneurship would be good addition to the education provided by University of Telecommunications and Post – Sofia. As it stands form the research, there is a diverse requirement by the students for additional courses which complies with the general labor market needs. It would be beneficial for the institution to organize such courses and they have to consider the trainers' competences and the timetable.

## Acknowledgement

Author is grateful for the financial support provided by National Science Fund of Bulgaria under the project № НИД 18/26.03.2019.

## Bibliography

[Banchev, P., 2012] Banchev, P. Marketing research, VelikoTarnovo, 2012, p. 153, 182, ISBN 978-954-400-661-7.

[Druker, 2002] Druker, P. Inovation and Enterpreneurship, Harper & Row, ISBN 0060546743, 2002.

[European Commission, 2017] European Commission Directorate-General for Internal Market, Industry, Entrepreneurship and SMEs. "HIGH-TECH LEADERSHIP SKILLS FOR EUROPE – TOWARDS AN AGENDA FOR 2020 AND BEYOND", empiricaGesellschaftfürKommunikations- und Technologieforschungmb H, 2017.

[Mariotti, Towle, 2010] Mariotti, S., Towle, T. Entrepreneurship owning your future, 11nd Edition, Pearson education, 2010

[Temelkova, 2018] Temelkova, M. Skills For Digital Leadership – Prerequisite For Developing High-Tech Economy. International Journal of Advanced

Research in Management and Social Sciences, Volume 7, Issue 12, December, 2018. ISSN: 2278-6236.

[USINFO.STATE.GOV, 2016] International information programs USAINO.STATE.GOV, Principles of Entrepreneurship, 2016,https://china.usembassy-china.org.cn/wp-content/uploads/sites/252/2016/12/principles_of_entrepreneurship_.pdf

## Authors' Information

***Dimitar Kolev –*** *University of Telecommunications and Post – Sofia;, Sofia-1700, Bulgaria; e-mail: dimitarkolev84@gmail.com*

*Major Fields of Scientific Research: Economics, Marketing, Management.*

# ANALYSE AND DEVELOP THE SOFTWARE OF AUTOMATIC SEARCH FOR AN ANONYMOUS PERSON IN THE VOICE DATABASE

**Yana Bielozorova**

***Abstract****: Objective of the proposed development is to investigate efficiency and develop a program system for formation of the voice databases of information messages involvants. Automatic search for involvants in the database by means of similarity of the voice characteristics.*

***Keywords****: Voice database, probability density, main tone, phonogram.*

## Objectives

Sound recording materials are considerable part of evidences used during criminal investigations and proceedings related to corruption, bribery, extortion, racketeering, kidnapping etc. But there are special digital phonograms which contain messages being recorded, for example, in different monitoring and field services. They form a separate type of expert sound recording materials. It can be explained by the fact that the phonogram digital copy is usually used during the expert examination of the materials and examination of originality and authenticity of phonograms is not performed. Another feature of such phonograms is short-duration of the recorded messages.

Such messages are combined and stored in the voice databases. Very often the messages are anonymous. In many cases such messages are made by the same persons but there can be considerably long period between messages made by the same anonymous author. Very often these messages cause significant property and moral damage. On the other hand, sometimes anonymous messages can be related to terrorist activity or have serious social consequences. In view of these reasons sometimes it is required to identify anonymous person (involvant). And during operative investigations, if they are

required, at initial stage it is very important to determine whether the messages of the involvant are of repeated nature. And in this case assistance for investigation and retrieval can be performed in expert way. The first task of such expert examination is to identify voices of involvants with similar parameters of signals of their oral speech, contained in the database. This can reveal both recidivism and potentially suspected persons and thus facilitate investigation process. The main tasks of such expert examination include:

- personal identification of the involvant, suspected in delivery of anonymous message or his available voice tokens, obtained during operation by means of parameters of his speech signals;
- identification of the involvants' voices with similar parameters of signals of their oral speech, contained in the database in order to identify persons, potentially suspected in delivery of information (or false information).

Appropriate expert departments can ensure completion of these tasks. However, the database of these messages even within the same country can contain thousands of records, and experts are not able to perform this task without automation of the process. In order to facilitate the involvants identification task it is required to develop automated system of quick search for suspected persons in the available voice database for further personal identification through the physical parameters of his (her) oral speech signals.

## Model of voice characteristics identification

Spectrum analysis of audio data based on Fourier transform mathematical apparatus is the key factor in majority of modern systems for solving the tasks of speaker identification by means of voice characteristics. It is caused by several factors. On the one hand - by known neurophysiological rules of audio information processing by primary auditory receptors. On the other hand - by absence of more effective analysis methods and, to a certain extent, by historical traditions in this field.

However, in spite of creation of rather effective systems for voice characteristics identification and development of systems of identification and text entering of

voice information, there is no enough clearness in the principal theoretical and practical issues concerning speech technology till now.

In spite of a lot of investigations in this field and use of powerful computers for last twenty years there is no principal breakthrough in the field of physical and mathematical concepts for effective processing of voice information (comparable with effectiveness of acoustical apparatus).

In opinion of many specialists, mainly, it is caused by absence of effective mathematical tool for analysis of voice audio information.

Concept implemented in the experimental system of instrumental identification of speaker voice characteristics is described below. This concept is based on presentation of speech fragments as a set of multifractal structures. In order to determine parameters of multifractal structures the wavelet analysis with special basis in form of two-parameter Morlet wavelet is used.

Let’s consider the fragment of voice audio file shown in Fig. 1 (fragment of phoneme [a]).

In the years since H. Helmholtz [Helmholtz, 1863] there has been known the evident fact, mentioned several times by investigators (particularly the classic work of G. Fant [Fant, 1960]), that majority of phonemic structures of speech can be formed on the basis of similar geometric components (“atomic” structures) of acoustic wave. Usually these structures are limited by time intervals which are equivalent to the main speech tone frequency. Geometric similarity of these structures is approximate, but in many cases it is visually evident (see Fig.1). Time intervals seized by these structures are opposite to the frequency value of the main tone and located within range from 2 to 15 ms. The present atomic structures, considered independently, are not perceived by ear due to their short duration of sound.

It is evident that following the works of Mandelbrot these structures can be interpreted as atomic components of multifractal [Mandelbrot, 1972, Mandelbrot, 1982, Mandelbrot, 1999, Mandelbrot, 1969]. Provided that there was created a mathematical model ensuring effective determination of parameters of “atomic” structures and multifractal in whole, the correct

description and solution of all the main tasks of voice and speech identification at the phonemic level may be expected.

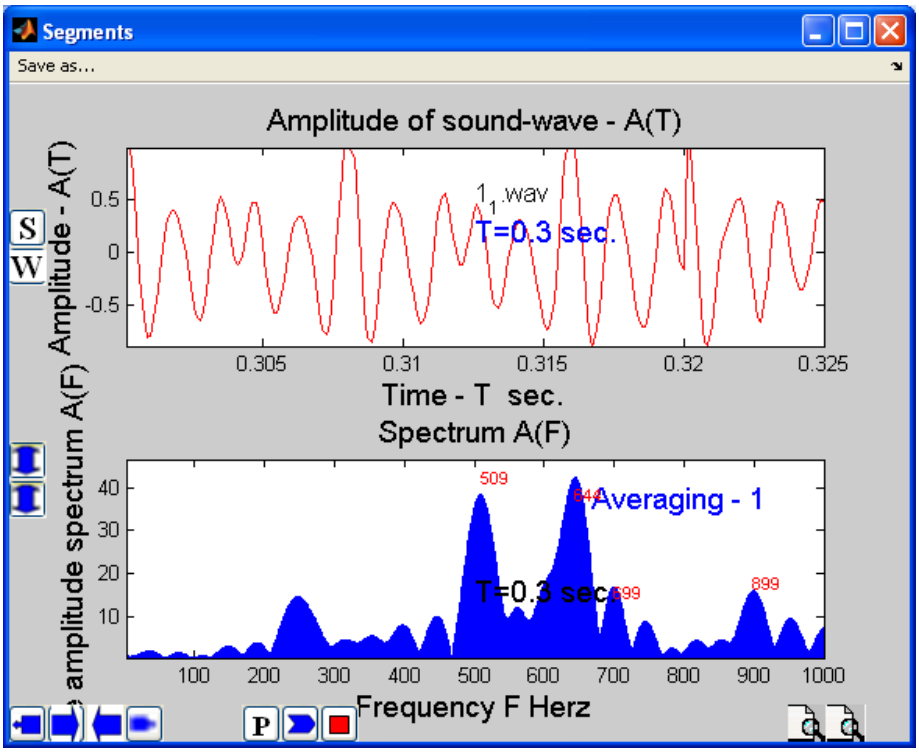


Figure 1. Fragment of phoneme [a]

Till now, actually, the single methodological direction for building the mathematical models for calculation of phoneme parameters and voice characteristics is the application of some of modifications of spectrum analysis based on Fourier transform. However, the application of this spectrum analysis method has number of serious disadvantages (known in the years since Helmholtz). Analysis of formant spectrum structure in small time intervals (approximately 20 ms) has considerable disadvantages caused by precision of formant localization. It is the sequence of Heisenberg principle for information technologies and features of orthogonal discrete Fourier transformation with fixed frequency step [Mandelbrot, 1969]. Thus, for the most interesting intervals within the range of 10 to 20 ms such analysis requires the frequency step from 50 to 100 Hz correspondingly.

It is known that wavelet analysis is an alternative to Fourier spectrum analysis [Mandelbrot, 1969]. However, many attempts to use wavelet analysis methods for processing of voice information has not produced important results up to now.

On the one hand, the obstacle is the complexity of physical interpretation of investigation results for the majority of wavelet bases. On the other hand, application of wavelet bases which are similar to utterances (for example, Morlet basis) is complicated due to high computational complexity for two-parameter bases.

Let's consider utterances in audio data as a discrete time series of acoustic wave amplitude. We'll set the task to extract the characteristics of the self-similar structures in the obtained time series for atomic utterances extracted in the previous section. For identification of similar structures the wavelet analysis methods are used [Mandelbrot, 1969]. For this purpose complex Morlet wavelets are selected [Mallat, 1999].

$$C_{mor}\left(t_i, T_k, F_b, F_c\right) = \left(\pi F_b\right)^{0,5} \exp\left(2j\pi F_c t_i\right) \exp\left(-\left(t_i - T_k\right)^2 / F_b\right) \quad (1)$$

$F_b$ – parameter the width of the wavelet, $F_c$ – the central frequency of the wavelet, $t_i$ – digital time samples, $T_k$ – timing corresponding central part of the time window, $j$ - complex unit.

Suppose $A\left(t_i\right)$ – is the value of acoustic wave amplitude of utterance in audio file at the time moment $t_i$. Let's consider the time slot of utterance with $\delta T$ interval lower than 20 ms. Width parameters of complex Morlet wavelet $F_b$ is selected as constant for all transformations and based on experimental investigations. Its value was selected from the condition of practical attenuation of Morlet wavelet absolute values at $t_i - T_k$ values equal to $\delta T / 2$. Let's determine convolution of Morlet wavelet for every utterance with fragment of the time series of acoustic wave amplitude in the following form:

$$C(T_k, F_b, F_c) = (1/N)\, abs\left( \sum_{t_{ij}=0}^{N_m} C_{mor}(t_i, T_k, F_b, F_c) \otimes A(t_i) \right) \quad (2)$$

$C(T_k, F_b, F_c)$ – the value of the wavelet transform coefficient module, $N$ – the number of discrete samples in the interval $\delta T$ time window.

If complex Morlet wavelet width parameter $F_b$ is fixed, the module value shall be the frequency function $F_c$ of Morlet wavelet and position of the time slot in time – $T_k$. Typical diagram of space skeylogrammy $C(T_k, F_b, F_c)$ in function $F_c$ and $T_k$ for utterances, which are under consideration, is shown in Fig. 2. This diagram is three-dimensional Morlet spectrum for phoneme fragment [a] shown in Fig. 1.

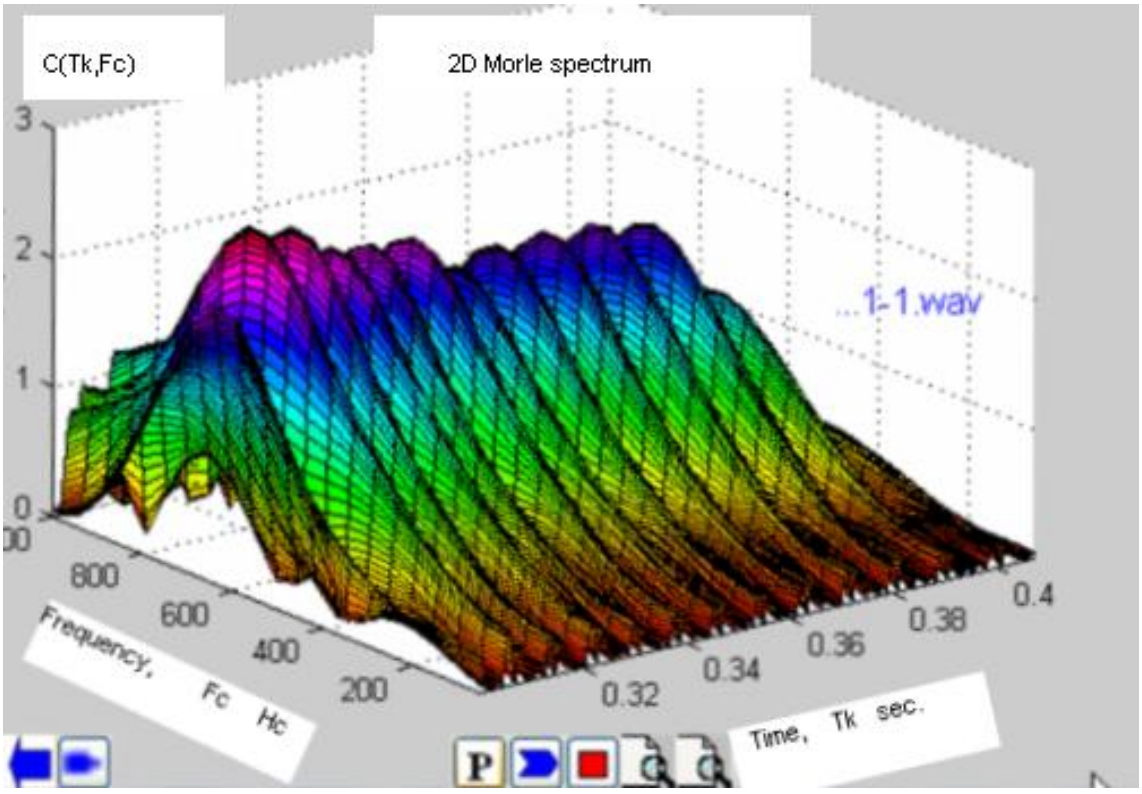


Figure 2. Utterance skeylogrammy

Time and frequency presentation of the utterance as a space skeylogrammy based on Morlet basis has a number of important features which allow to significantly increase the efficiency of identification of self-similar structures. Particularly, local maxima of wavelet transformation are rather informative for analysis of atomic components of multifractals in audio data.

It is important to mention the following investigation moments for further analysis. Frequency step $F_c$, further on is considered as independent of sizes of transformation window. It will be the step equal to 1 Hz. Frequency resolution according to Heisenberg principle [Mallat, 1999] doesn't impose considerable restrictions to formant structure analysis in small time intervals. The fact is that the distance between formant maxima in speech spectrum in small time intervals corresponds to the frequency of the main speech tone (approximately 85-600 Hz). And similarity frequency resolution of two maxima in transformation interval of 20 ms is approximately 50Hz. If transformation frequency step is 1 Hz the precision of distance assessment between formant maxima in small time intervals is of the same order. This precision of assessments doesn't contradict Heisenberg uncertainty principle for information technologies.

It is also important to mention, that the use of Morlet wavelet doesn't pose the problems of physical interpretation of frequency transformations. Because this wavelet is a short time Fourier transform with a Gaussian function [Mallat, 1999].

Analysis of skeylogrammy shows that arrangement of skeylogrammy ridges under the time parameter in Fig.2 strictly corresponds to local extremes of acoustic wave amplitude in the time domain. At that, these local extremes correspond to acoustic wave amplitude bursts, caused by the main tone frequency.

The important factor of high similarity of Morlet basis with the self-similar structures in utterances is the higher level of skeylogrammy smoothness comparing to, for example, analogous Fourier transform. The higher level of function smoothness ensures rather effective possibility for mathematical analysis of ridges parameters.

At that, frequency formant maxima can be very different from their maxima in Fourier spectrum.

Distances between local skeylogrammy maxima in frequency size are the assessment of the main tone speech frequency in this approach. The important factor for stability and reliability of assessments of the main tone frequency for this methodology is a possibility to estimate the main tone frequency not only by local maxima, but also by correlation between fragments of maxima areas. In small intervals these areas are approximately self-similar structures. During the analysis of such self-similarity it is possible to cut at random the structures of the same size of the time slot and not be guided by skeylogrammy maxima [Solovyov, 2014].

Thus, for example, let's consider utterance of 1 s duration, at a sampling frequency of 44100 Hz. We'll analyze its spectral characteristics and parameters of the main tone frequency using the time slot of 20 ms based on the studied model. Let's accept a minimum possible discrete step of the analysis window displacement equal to the reciprocal value of the sampling frequency. Then, a number of assessments of the window spectra and parameters of the main tone frequency for 1s will be approximately 44080. These values are correlated between each other. But such a number of statistics for the short-duration utterances allow obtaining the reliable and stable assessments of speech characteristics of short-duration messages.

The developed model allows implementation of the effective identification of utterance atomic components in frequency-time area. It is possible to build the stable and reliable frequency characteristics and assessments of the main tone frequency and spectral characteristics of short-duration utterances.

## Experimental program modulus based on developed approach

Experimental model of the program product, created on the basis of investigations, for realization of these tasks was approved in the expert departments of the Ministry of Justice and the Ministry of Internal Affairs of Ukraine.

This approach was realized and approved using the developed experimental program modulus for search for involvants of information messages in the voice database [Rubalsky et al, 2014].

Experimental program system (EPS) for search of involvants of information messages has a form of a search engine. Thus, the search results are not identical to identification of person by voice, because they are just results of ranking by the similarity degree of separate parameters of voice signals.

Using digital records of information messages the EPS performs an automatic calculation of parameters of voice characteristics and further ranking of these characteristics in the voice database.

The EPS uses a ranking method by four different criteria. They include:

- calculation of similarity of two-dimensional probability density functions curves for the main tone frequency (MTF) and arrangement in the spectrum of seven formants, extracted from the speech recorded in the phonogram;
- calculation of similarity of probability density functions curves for each of these signs separately;
- calculation of similarity degree for the absolute maxima of formats spectra, extracted from the speech recorded in the phonogram.

Peculiarity of the used method for spectrum calculation is that the calculation of spectrum characteristics is performed with resolution ability of 1 Hz (non-orthogonal transformations in a small time slot). Maxima of the first seven formants are distinguished in the spectrum of each time slot.

For calculation of similarity of two-dimensional probability density functions curves, the function Ff – voice characteristics function should be calculated. This function is a non-linear empirical function of formant maxima amplitude and frequency.

For all utterances the two-dimensional probability density is determined by means of two coordinates – MTF Fb and voice characteristics function Ff. Thus, a combined method for assessment based on MTF and formant spectrum characteristics is the fundamental element of the system. Similarity degree of

these characteristics of two voices is determined by absolute differences between the two-dimensional probability densities.

It is clear, that projections of two-dimensional probability densities per each of one-dimensional axes of coordinates provide distribution of MTF $F_b$ and distribution of voice characteristics function $F_f$, which also can be presented in a form of separate dependences. It allows making calculation of similarity of probability density functions curves for each of these signs separately.

For ranking by the densities of distribution of the main tone $F_t$ and voice characteristics functions $F_f$, the value equivalent to Kolmogorov fitting criterion is used as a similarity degree [Mallat, 1999]:

$$F_n(x) = \frac{1}{n}\sum_{i=1}^{n} I_{Xi} \le x \tag{3}$$

Where $I_{Xi} \le x$ indicates whether the value $X_i(-\infty, x]$ on condition

$$I_{Xi} \le x = \begin{cases} 1, & X_i \le x \\ 0, & X_i > x \end{cases} \tag{4}$$

For calculation of similarity degree of absolute maxima of formants spectra, extracted from the speech, recorded in the phonogram, the following criterion is used

$$S_i = abs\left\{\left[\max P_1(x_1, x_2) - \max P_2(x_1, x_2)\right]\right\} \tag{5}$$

where $P_1(x_1, x_2), P_2(x_1, x_2)$ – are two-dimensional probability densities for two different records with arguments both as the main tone frequencies and voice characteristics functions, compared separately.

Results of search for voices with similar characteristics are presented as rank tables.

It should be mentioned, that all calculations of voice characteristics are made for the record fragments containing speech signals. Division into pauses and speech fragments in the system is made automatically based on two criteria – level of normalized audio signal and availability of record fragment which contains the speech sound [Solovyov et al, 2014, Solovyov, 2013, Solovyov, 2013]. System for sound extraction is additional and integrated into the EPS. It performs general division of the fragments in which the speech sounds are present, based on the special method, similar to the methodology of hidden Markov chains.

## Conclusion

An experimental program system ensuring automatic search in the database of persons with voices which are the most similar to the involvant's voice, recorded in the phonogram pattern was created.

However, further improvement of the system in order to create the prototype requires carrying out of many investigations and approval of the program system. In particular, it requires:

- accumulation of large databases with different language groups presented;
- investigation of efficiency of voice characteristics ranking in the databases;
- correction and adaptation of the program product to conditions of different real tasks of recording of information messages involvants' voices;
- creation of multi-language versions of program product localization.

## Bibliography

[Helmholtz, 1863] Helmholtz H. von, Die Lehe von Tonempfindungen. Brannschweig, Vieweg, 1863.

[Fant, 1960] Gunnar Fant. Royal Institute of technology Stockholm MOUTION & GO. 'S-GRAVENHAGE 1960

[Mandelbrot, 1972] Mandelbrot B. Statistical Methodology for Non-Periodic Cycles: From the Covariance to R/S Analysis. Annals of Economic Social Measurement 1, 1972.

[Mandelbrot, 1982] Mandelbrot B. The Fractal Geometry of Nature. New York: W. H. Freeman, 1982.

[Mandelbrot, 1999] Mandelbrot B. A Multifractal Walk Down Wall Street. Scientific American, 1999.

[Mandelbrot, 1969] Mandelbrot B.B. Robustness of the rescaled range R/S in the measurement of non-cycling long-run statistical dependence // Water Resources Research. 1969. V. № 5. P. 967-988.

[Mallat, 1999] Mallat S., A wavelet tour of signal processing, Courant Institute, New York University, 1999, 671 pp.

[Solovyov, 2014] V. Solovyov. Spectral analysis and speech technology (Russian) // V. Solovyov, O. Rubalskiy / Journal of Kiev National University T. Shevchenko, Military special sciences, - Kiev, Vol, 42, p. p. 145-151, 2014.

[Rubalsky et al, 2014] O. Rubalsky, V. Solovyov, A. Shablja, V. Zhuravel. New tools to identify the person for voice of Data (Russian) Protection and Security of Information Systems: Proceedings of the 3rd International Scientific Conference (sity. Lviv, 05 - June 6, 2014). - Lviv: - p.p.. 110 - 112.

[Solovyov et al, 2014] V. Solovyov, Y. Byelozorova: Multifractal approach in pattern recognition of an announcer's voice. Polish Academy of Sciences University of Engineering and Economics in Rzeszów, Teka, Vol. 14, no 2, p.p. 164-170, 2014.

[Solovyov, 2013] V. Solovyov. Using multifractals to study sound files (Russian). Visnik of the Volodymyr Dahl East Ukrainian national university. Vol 9 (151). – p. p. 281-287, 2013.

[Solovyov, 2013] V. Solovyov. Using the fractal dimension of audio files in the problem of segmenting the audio file (Russian). Visnik of the Volodymyr Dahl East Ukrainian national university. Vol 5 (194). – p. p. 165-169, 2013

## Authors' Information

**Yana Bielozorova** – Senior Lecturer of Software Engineering Department, National Aviation University, Kyiv, Ukraine.

**E-mail:** bryukhanova.ya@gmail.com

M**ajor Fields of Scientific Research**: Speech Recognition Models, Wavelet analysis, Software Architecture

# E-SERVICES FOR THE BETTER CITIZENS LIFE: THE SCHOOL'S EXAMPLE AND INTEGRATION WITH E-GOVERNMENT

**Zainab Saadi Hussein Al-Hilali, Mohammad AlHawawsha**

***Abstract****: Distance learning is constantly reaching a new level. Its coverage, content, and significance for everyday life are difficult to overestimate today. Those projects that are aimed directly at providing online communication and training services have taken off. Learning management systems have become very popular. Thanks to its functionality, which allows you to support the learning process, monitor homework, conduct online communication and monitor the progress of homework and the ability to evaluate them. And if in small groups scheduling is not necessary, then for schools and universities the basic functionality of learning management systems is not enough. It becomes clear that for the convenient conduct of the educational process, educational institutions and universities lack the functionality for personnel management, such as planning (scheduling) and reporting.*

*In this article, we offer a developed solution that will help solve the problem described above and ensure quality scheduling at school or university, taking into account the requirements, restrictions and wishes of the administration of the institution. An innovative approach has been applied to the learning management system (LMS).*

*The proposed solution is based on previously known techniques for managing employee change. Following the implementation of the relevant annex, the first positive feedback was received from Iraqi schools where the decision was implemented. All the above circumstances provide grounds for further development and improvement of the system. The article focuses on the implementation of the module of planning and scheduling in the learning*

*management system. The importance and prospects of such implementation are indicated.*

*The article also outlines the context of the task, ie the scope. The prototype of the really existing system is shown. Thus, we managed to develop a functional application that can be adapted to any needs of the educational institution. E-government services are mentioned and the possibility and need for integration of these services is shown.*

***Keywords**: distance learning, learning management system (LMS), scheduling, optimization of the educational process, development prospects, e-Learning, e-Government, e-Services.*

***ITHEA Keywords**: K.3.1 COMPUTERS AND EDUCATION, H.4.1 INFORMATION SYSTEMS APPLICATIONS, I.2.8 ARTIFICIAL INTELLIGENCE, F.2.2 ANALYSIS OF ALGORITHMS AND PROBLEM COMPLEXITY, J.1 COMPUTERS AND EDUCATION.*

***ACM Classification Keywords**: J.1 Computer Applications - ADMINISTRATIVE DATA PROCESSING - Education, K.3.1 Computing Milieux - COMPUTERS AND EDUCATION - Computer Uses in Education, I.2.8 Computing Methodologies - ARTIFICIAL INTELLIGENCE - Problem Solving, Control Methods, and Search - Scheduling, H.4.1 Information Systems - INFORMATION SYSTEMS APPLICATIONS - Office Automation - Time management (e.g., calendars, schedules), F.2.2 Theory of Computation - ANALYSIS OF ALGORITHMS AND PROBLEM COMPLEXITY - Nonnumerical Algorithms and Problems - Sequencing and scheduling*

## Introduction

The first step on the path to online learning was the transition from streaming content via CDs to online. The network was originally used only as a means of distribution. The content was still monolithic, that is, intended for certain programs and virtually indivisible. To use the first educational online programs, the user had to download certain developer programs. Navigation and information systems did not always work in all environments.

In the development of the second generation of content management systems, it became obvious the need to separate content from its representing programs, and the creation of learning management systems (Learning Management Systems). With regard to quality standards in LMS, given the development of IT and the increasing use of these environments, it is important to identify those that meet the minimum requirements. These requirements can be expressed in reliability, scalability, safety, sustainability and adoption of international quality standards.

Scale is needed to attend a large number of students, which is a fundamental characteristic of e-learning. But it is impossible to achieve scale without the help of scheduling. Planning is a complex and important task in the learning environment. Establishing work schedules to manage the working hours of employees in educational institutions is one of the key factors of stability for the Contact Centers and other companies that have work organization based on change [Chernichenko, 2016], [Lytvynenko, 2015], [Panchenko, 2003], [Panchenko2, 2003], [Panchenko, 2004].

As for schools and universities, the class schedule is one of the important documents that governs the educational process. At the entrance we have:

• "restrictions": restrictions relate to the time of classes, their sequence, sequence and the maximum number of classes per day / week;

• "requirements": this parameter characterizes the workload of each teacher (or teacher) - the number of hours and what subjects will need to be taught for a certain period of time;

• "wishes": this characteristic is not key in scheduling in case of high workload of all teachers. However, if necessary, it can take into account the wishes regarding the date and time of the lesson (for example, in case of illness, vacation, training).

• "locations": depending on the type of lesson, the system selects the most convenient classrooms or classes.

Also, in the case of scheduling for a school or university, an additional important interchangeability requirement should be considered (or, a kind of flexibility in understanding scheduling change management). We mean that changes (another teacher or class, or to move a class to another day of the week or another time) should be made on request at no additional cost to the planning manager.

It is important to note that such functionality can rarely be seen in systems aimed at supporting the learning process [AlHilali, 2015], [AlHilali, 2016], [Aggrwal, 2018], [Nagar, 2018]. This task is not a priority for the LMS, which is primarily a Learning Content Management System (LMS) and is primarily intended for managing the content and structure of the courses. But the main reason for such avoidance is the relative complexity of the task. This task is quite complex without obvious advantages for the developer.

Therefore, the task is to make a schedule that would meet all the above requirements.

## Approaches to automated scheduling

Today, there are a number of approaches to building an automated schedule. Much depends on the specifics of a particular task. Thus, CPU time planning is different from WorkForce Management (WFM), ie scheduling shifts. Usually Markov processes, algorithms of "brute force" (full search), optimized search algorithms, genetic algorithms are used to create a graph [Panchenko, 2003], [Panchenko2, 2003], [Panchenko, 2004]. Machine learning methods [Panchenko, 2003], [Panchenko2, 2003] and gradient descent methods can

also be used here. We will try to improve the flexibility of the schedule by introducing an innovative method into the generation process.

Complete search algorithms have become popular because of their simplicity, but they require a lot of computational time. With large variations in the input data (more than 100 employees, many different activities - classes in our case - etc.), the process may become inapplicable in real time. Due to this fact, many optimizations and heuristics appear, which help to reduce the required computing power and consider only the best cases due to a set of predefined heuristics. Moreover, gradient descent optimization was applied to further simplify the full search algorithm.

The goal is to create a school schedule that is flexible enough for further change management and meets the above requirements and constraints as much as possible.

Of course, this level of flexibility requires additional resources. To do this, we need:

• the availability of additional teachers who can teach a certain lesson (say, geometry for 7th graders) to replace another teacher who was supposed to teach in that class but could not come for some reason,

• availability of additional audiences to simplify the implementation of the "location" parameter for our application.

A handy visual tool to support this kind of change and visualize the effects of change is also needed.

## Developed an application for scheduling

We developed our application on the foundation of the WFM system, which turned out to be in line with the ideas behind the foundation, although it was not obvious in advance. WFM program planning solves the problem of assigning employees (contact center operators) to changes, where the schedule of changes is formed from the previous stage of resource planning and forecasting the number of staff for each specific time period of the week [Panchenko, 2003],

[Panchenko2, 2003], [Panchenko, 2004]. (Time periods are usually hours, half-hours, or a quarter of an hour.)

The weekly classic schedule for the school is presented in Fig. 1.

| | Monday | Tuesday | Wednesday | Thursday | Friday |
|---|---|---|---|---|---|
| 8:20 | Arrival and Groden Relaxation Practice | | | | |
| 8:45 | Calendar and Current Events | | | | |
| 9:00 | Adaptive Physical Education | Media | Adaptive Physical Education | Media | Adaptive Physical Education |
| 9:30 | Art | Home Economics | Health Education | Music | Home Economics |
| 10:00 | Speech and Communication | Internship Preparation | Community-Based Instruction | Travel Training | Social Skills Instruction |
| 10:30 | Library | Internship | | Speech and Communication | Bowling |
| 11:00 | | | | Social Skills Instruction | Community-Based Instruction |
| 11:30 | Health Education | Self-Advocacy | | Computer Skills | Leisure Skills |
| 12:00 | | | | | Science |
| 12:30 | Math | Social Studies | Math | Social Studies | |
| 1:00 | Lunch | | | | |
| 1:30 | Reading | | | | |
| 2:00 | Groden | | | | |
| 2:20 to 2:30 | Classroom Jobs, Pack Up and Dismissal | | | | |

Fig. 1 - Classic schedule in the school

Thus, the classical form of the compiled schedule is presented in Fig. 1, which provides a detailed ("expanded") view of one day and an overview of the week as a whole.

The schedule in our application for school is presented in Fig. 2. and Fig. 3. The system interface is quite different from Fig. 1, but if we look at these schedules from the point of view of the teacher, we get almost the same picture. Moreover, as we noted earlier, the requirements and approaches to scheduling are very similar.

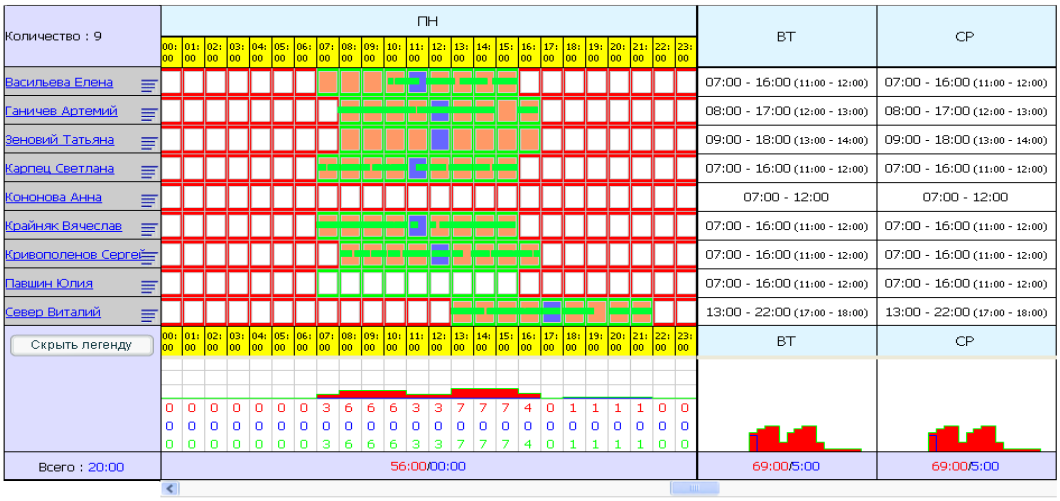


Fig. 2 - Daily schedule of teachers


Fig. 3 - Interface of the weekly schedule and workload of teachers in the application

So, we have developed new software based on workforce planning principles. To develop MVP (minimum viable product), we used an optimized full search algorithm for scheduling, leaving a deeper search optimization for further development. This application is part of the learning management system, which is already on Beta test and is being implemented in two schools in Baghdad. Currently, the authors are collecting feedback to improve the system and move on to developing new planned features.

The main modules of the developed application are:

- planner,
- viewing the schedule for different roles: teacher, weekly class schedule, classroom load,
- change management subsystem,
- API for integration with external LMS,
- API for data exchange.

The first feedback from users is positive, so we continue to further develop the developed application.

Further plans include the implementation of more sophisticated approaches to better schedule (for the resources needed to accomplish this task). We would like to make this software more convenient and adaptable to different types of scheduling restrictions. Also, the system needs to be more integrated into the learning process, which involves the development of an open source application for external developers who will be interested in developing additional functionality - system modules.

## Integrations and further work

Here we would like to state that the integration between e-Government portal and this developed and proposed LMS with unique additional functions have been started. This integration includes the following directions:

• exchange of resources used in schools from the government for the teaching,

• the load of teachers and their interconnection in schools through classes and common resources,

• the schedule in classes and thus the possibility to check the difference in schools and divergence of one from another.

Of course, there we listed not all possible ways of interconnection and information exchange. Open Data allows to use broad range of algorithms and optimizations to improve the teaching and management quality, and, thus, we

hope, the citizens lives [Bakhouyi, 2019], [Alhawawsha, 2019]. Fig. 4 presents the very high level, general plan of this new work.

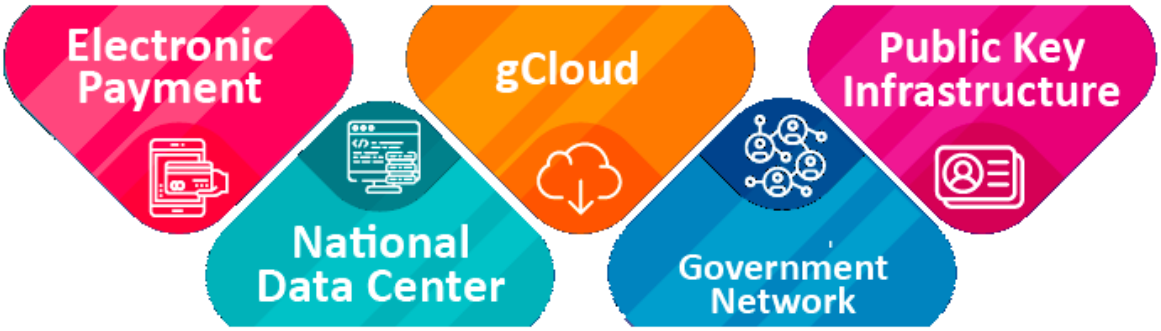


Fig. 4 – Interconnection API for School and e-Government e-Services

## Conclusion

So, we have developed new software based on workforce planning principles. To develop MVP (minimum viable product), we used an optimized full search algorithm for scheduling, leaving a deeper search optimization for further development. This application is part of the learning management system, which is already on Beta test and is being implemented in two schools in Baghdad. Currently, the authors are collecting feedback to improve the system and move on to developing new planned features.

The main modules of the developed application are:

- planner,
- viewing the schedule for different roles: teacher, weekly class schedule, classroom load,
- change management subsystem,
- API for integration with external LMS,
- API for data exchange.

The first feedback from users is positive, so we continue to further develop the developed application.

Further plans include the implementation of more sophisticated approaches to better schedule (for the resources needed to accomplish this task). We would like to make this software more convenient and adaptable to different types of scheduling restrictions. Also, the system needs to be more integrated into the learning process, which involves the development of an open source application for external developers who will be interested in developing additional functionality - system modules.

As to the integration to the broader context and with the country-wide or ministry-wide services, we are going to organize it via the e-Government API. This way the next features will be obtained:

- centralized schedule view on the country level,
- good understanding of resources involved in schools,
- clear view of how many classes being held by teachers, level, school and other parameters,
- better information exchange between all stakeholders.

## Bibliography

[Aggrwal, 2018] AGGRWAL, A., VERMA, R., SINGH, A. (2018): An Efficient Approach for Resource Allocations using Hybrid Scheduling and Optimization in Distributed System, “International Journal of Education and Management Engineering (IJEME)”, Vol.8, No.3, pp. 33-42

[Alhawawsha, 2019] Alhawawsha M. Open Data Platform Architecture and its Advantages for an Open E-Government / Mohammad Alhawawsha, Taras Panchenko // Advances in Computer Science for Engineering and Education (Advances in Intelligent Systems Series, Z.B. Hu, S. Petoukhov, I. Dychka, M. He Eds.). – 2019. – Issue 1247. – P. 258-266.

[AlHilali, 2015] AL-HILALI, Z.S.H. (2015): Programmed, distant, mobile learning… what's next? "Bulletin of Taras Shevchenko National University of Kyiv; Series Physics & Mathematics", No. 4, pp. 75-81

[AlHilali, 2016] AL-HILALI, Z.S.H., SHEVCHENKO, V.P. (2016): The structure of e-Learning system for the discrete mathematics. In Proc.: "Theoretical and Applied Aspects in Program System Development (TAAPSD'2016)", Kyiv, pp. 252-256

[Bakhouyi, 2019] Bakhouyi A. A Semantic Web Solution for Enhancing the Interoperability of E-Learning Systems by Using Next Generation of SCORM Specifications / A. Bakhouyi, R. Dehbi, M. Banane. // In: Ezziyyani M. (eds) Advanced Intelligent Systems for Sustainable Development (AI2SD'2019). AI2SD 2019. Advances in Intelligent Systems and Computing, Springer. – 2019. – №1102. – С. 56–67.

[Chernichenko, 2016] CHERNICHENKO, K., KAPKANETS, A., PANCHENKO, T. (2016): Contact center load forecasting and operator schedule planning, "Problems of Programming", No. 2-3, pp. 227-236

[Lytvynenko, 2015] LYTVYNENKO, T.I., PANCHENKO, T.V., REDKO, V.D. (2015): Sales Forecasting using Data Mining Methods, "Bulletin of Taras Shevchenko National University of Kyiv; Series Physics & Mathematics", No. 4, pp.148-155

[Nagar, 2018] NAGAR, R., GUPTA, D.K., SINGH, R.M. (2018): Time Effective Workflow Scheduling using Genetic Algorithm in Cloud Computing, "International Journal of Information Technology and Computer Science (IJITCS)", Vol.10, No.1, pp. 68-75

[Panchenko, 2003] PANCHENKO, I. (2003): An Alternative to the Erlang C Formula, "Corporate Systems", (Kyiv), No.2, pp. 57-59.

[Panchenko, 2004] PANCHENKO, I., PANCHENKO, T. (2004) Optimization of Call-Center Using Automated Computer System Scheduling ISS v.1 [in Ukrainian]. In Proceedings of the International Conference "Theoretical and Applied Aspects of Program Systems Development". Kyiv. pp. 272-274

[Panchenko2, 2003] PANCHENKO, I. (2003): Computer Modelling of the Mass Service Task, In Proc. Int. Conference “Informational research, applications and the study”, Varna, FOI-COMERC, pp. 55-61

## Authors' Information

***Zainab Saadi Hussein Al-Hilali*** *– PhD student at the Faculty of Computer Science and Cybernetics, Taras Shevchenko National University of Kyiv, 64/13, Volodymyrska Street, Kyiv, Ukraine, 01601*

*e-mail: sufyanvpsh@gmail.com*

*Major Fields of Scientific Research: e-Learning, m-Learning, Distant Learning*

***Mohammad AlHawawsha*** *– intern at the Faculty of Computer Science and Cybernetics, Taras Shevchenko National University of Kyiv, 64/13, Volodymyrska Street, Kyiv, Ukraine, 01601*

*Major Fields of Scientific Research: e-Government, Open Data, e-services, e-Learning, Distant Learning*

# ADAPTIVE MODELING OF BUSINESS OBJECTS

**Georgi Mitov, Ilia Mitov, Metodi Vlachkov**
**Ilia Tiniokov, Lyubomir Maksimov**

***Abstact.*** *This study examines the main points in building business models and the possibilities for their information provision. The current modeling mechanisms for business processes and the impact of the model on the implementation of software projects in the field of business management are examined. The problems of the software development of adaptive business structures, generated by the application of the existing modeling and programming technologies, are analyzed.*

*The study aims to find a new approach of creating business processes which are evolving over time using non relational data bases with external logic. This type of data bases can provide flexibility and ability to make changes easily and without consequences for the data integrity. As a result we can achieve an easily maintained business object which is sustainable to drastic changes and manipulations in the course of time.*

***Keywords:*** *Business object; adaptive model of business object; information provision; non-relational database with external logic of the data.*

## Introduction

The building process is always preceded by modeling, in some cases modeling may be unconscious, but there is always such a modeling process. Of particular importance is the modeling of activities carried out by automated systems, their work is unthinkable without prior clarification of the essence of the processes that are automated and the results to be obtained. One of the goals of the present work is to show the mechanisms in building efficient models so that the automated systems they perform will work as efficiently as possible.

Modeling has a relatively universal character in the sense that models can be made of any kind of processes, activities and structures from adaptive objects. In this article, we will look at the modeling and information provision built on its basis, mainly in the sphere of business activities.

## 1. Business Objects (BO) and Business Processes

Definition:

**The business object is a unified structure that carries out external and/or internal creative activities.** [1]

Business object (BO) usually identifies itself with a company (a business entity, an enterprise), but this is a very limited consideration. These structures form a large class of objects, which include not only corporate business objects but also public, state, military etc. structures. It is important to emphasize that these objects have the same behavior and are close to external (relative to the environment) and internal (relative to the single structure) reactions with similar external and/or internal effects. This circumstance makes it possible to make sufficiently precise assumptions about the possible reactions of the BO to specific external and/or internal impacts, i.e. they lend themselves to modeling and management.

Although there are no reliable mathematical models to describe them, the workings of these objects can be modeled with satisfactory accuracy based on abstract or more specific models of the processes that take place in them.

Definition:

**The business process is a connected set of single and/or iterative actions that convert inbound and/or internal resources into pre-established rules to create benefits for the business site.** [1]

For example, if BO is a company, then business processes cover the flow of business and commercial activities carried out by and in the company to achieve a commercial (organizational, production) goal.

## 2. Models and modeling of business processes.

The model, as a concept and means of achieving different goals, has always been used in practice and science.

We distinguish different types of models depending on:

- The subject area being modeled;
- The techniques used in their construction;
- The goals to be set when building them, and so on.

There are different aspects of building the business model [2]. Depending on the goals that are set in the implementation of a model, we can distinguish models of:

- Methods of doing business;
- Business architecture of the company;
- Information provision of business activities, etc.;

Often the successful work of BO - economic growth, good work with contractors, automation of its activities, is attributed to the viability of the built model.

The business model concept [3]:

- Helps to determine the goals of BO;
- Facilitates the identification of the indicators to be implemented with the BO management systems;
- Enhanced integration between the activities carried out and the tools for their automation;
- Helps to develop new IT security at BO;

An essential part of each model is the description of processes and activities that run in/from the modeled object. By analogy, processes in BO are called business processes. There are different methodologies and standards [4] that describe business processes: Unified Modeling Language [5] (UML); Process Modeling Notation Business [6] (BPMN); Business Process Execution Language [7] (BPEL), etc.

A characteristic feature of modeling is:

1) Processes that are relatively self-contained and generally do not describe the overall work (activity) of the site in which the process is performed are modeled;

2) High abstraction when describing the elements of the model;

This holds true for BO modeling - in this case it is straightforward to talk about Business Process Modeling (BPM). **The "BO model" is not used and it does not make models of the entire business object.**

## 3. Information provision of business objects.

The management decision to perform modeling of activities and processes in BO is usually dictated by the need to:

- increase the economic profitability of BO
- increase the quality of the activities carried out in the BO
- reduce the working time of production activities
- realize new productions
- automate current activities, etc. (economic, organizational, production, logistics tasks)

Several tools are used to implement different models, but in any case more complex models can’t be implemented without the availability of appropriate software products. For the purposes of our research under the information provision of BO we will understand the definition below.

Definition:

**The set of software products, information technologies, computer hardware and network hardware, as well as the relevant human resources used in the management and operation of a business site, will be called information provision of BO.**

There are various tools to build the BO models, but when it comes to providing information on the work of the BO there are not always ready information solutions. It is then necessary to develop and implement appropriate software with the appropriate supporting IT solutions.

The business information process of the business object is cyclical (Figure 1) and in this respect the rules of the traditional approaches and technologies for software development (Extreme Programming - XP, Adaptive System Development Method (DSDM), Adaptive Software Development (ASD) Feature Driven Development - FDD, Kanban, Scrum). From the diagram shown in Figure 1, it can be seen that the better the business object model, the better information tools for management and work will be obtained, so exploring the opportunities for creating good business models is essential.

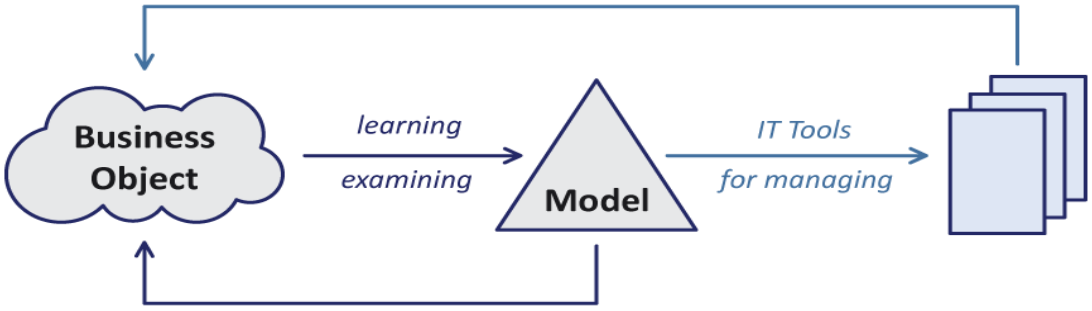


Figure1. Process of Information provision of Business Objects. [1]

Building support software puts more specific and strict requirements to the previous model. In this case, the model should be sufficiently detailed, accurate and consistent with the IT capabilities to build its informational provision, including instructions on the format, type, and functionality of the user and programming interface.

## 4. Problems in building BO models

The increased requirements in the implementation of quality information provision of BO to the contents of the model show some shortcomings in the existing approaches and modeling tools.

### 4.1. A complete model of BO can't be built

The construction of the model is considered as "Simplified description and presentation of a complex entity or process" [3].

This belief is confirmed by the actual design of the model. BOs are complex structures, and in their study (modeling) the abstraction and generalization principle is applied to facilitate modeling work. When a model of an object is made, it is practically modeled not the object itself - as it is, but something more abstract and with more limited functionalities, which, although it resembles the model object, is not it.

No matter how well a business object model is built, it is at some point. Over time, conditions and parameters change, and the original model no longer fully corresponds to reality. The business activities and processes are dynamic, i.e. they change over time for various reasons: financial, technological, legal, target, etc. This dynamics also needs to be taken into account when modeling the processes and in practice means that the BO model should change over time if we want to have some good match between the model object and the model.

Because of the great complexity of processes and volume of parameters, it is not possible to build a complete business model. Hence there are some serious limitations, inaccuracies and discrepancies that contradict the goals of creating its software base and are an obstacle to building quality service software.

In all cases, the built-in BO model has a high degree of abstraction. Under these conditions, it is difficult to assess the quality of the model obtained, the extent to which it corresponds to the BO, and how accurate the conclusions of such modeling are. This approach may well be good for some types of models, but models are not good for building information security. For example, as much as the cycle to do in building the business information (Figure 1), there will

always be something different in the service software that needs to be completed and/or build(either due to a change in time or due to an inaccurate description).

### 4.2. The data model has a significant impact on the modeling capabilities of BO

Each model (including the business site) consists of two relatively independent parts (Figure 2):

- model of business processes;
- data model;

It is important to build an accurate model of business processes in BO, because in the process of building the information provision the business process model directly affects the type and functionality of the user interface of the software products built on its base (Figure 2).

The modeling technologies used, the model of processes and the data model are practically two separate models. They differ not only in the syntax of their description (Figure 3 and Figure 4), but also in influencing the end result of the modeling process - the development of information provision of the BO. Practically, the data model directly affects the process of implementing the serving software. The process model should be reflected in the data model because whatever processes we have, if they are not provided with the relevant data, the implemented software will not serve the quality parameters set in the process model.

From a practical point of view, the data model is leading to the end result of the business model. If the databases can’t provide the appropriate quantitative and qualitative characteristics of the data needed to process the process, no matter how good the process model is, the service software will not be good and the corresponding goals in the business model will not be achieved.

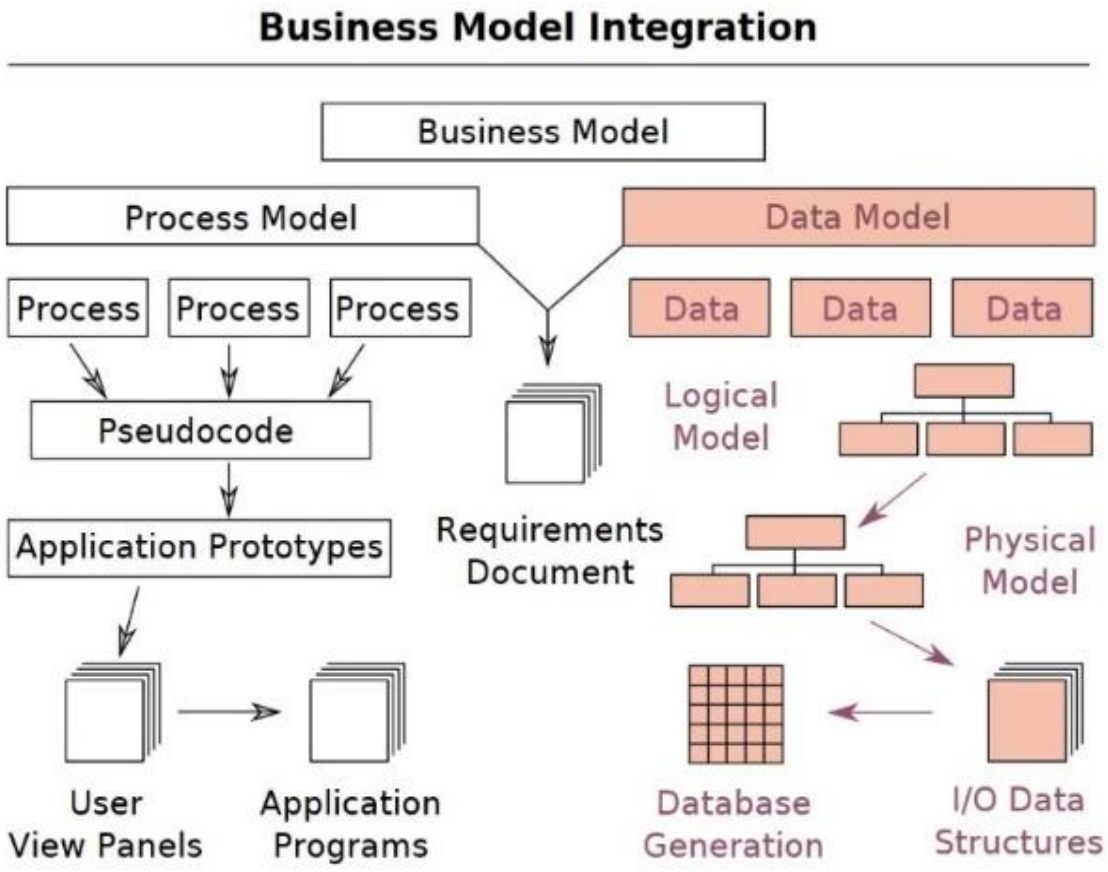


Figure 2. Business model scheme and relationship between process model and data model [8]

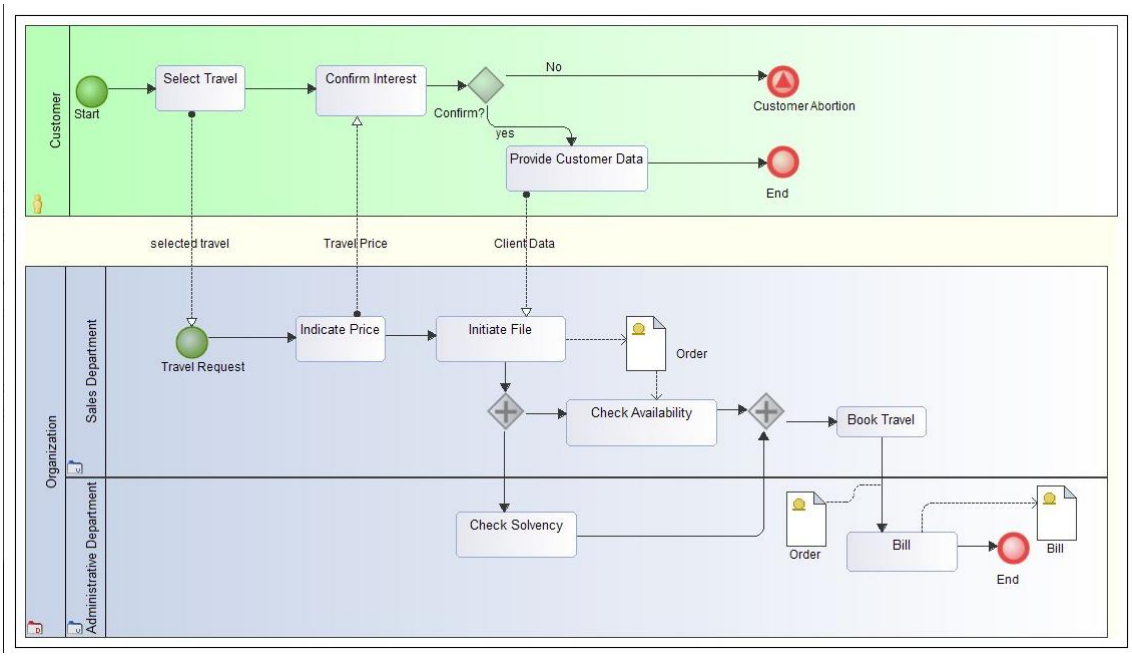


Figure 3. BPMN process model for customer orders

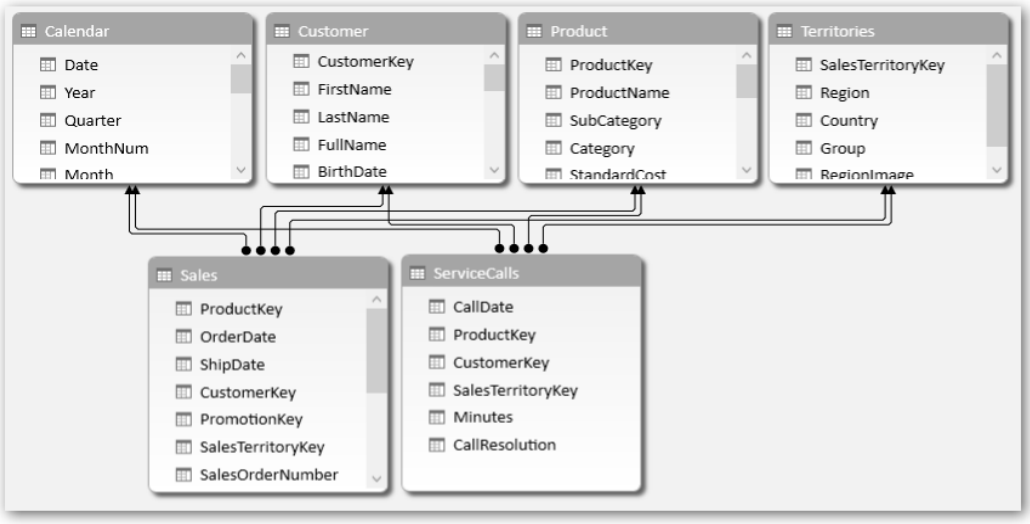


Figure 4. ERT scheme describing the data and the links between them, the sales process

### 4.3. Building models requires a lot of time and resources

With graphical modeling tools, complex, multi-dimensional and temporal objects can't easily be modeled. In some cases, the construction of the model takes months of work of highly qualified specialists. More significant changes to the model engage resources that are comparable to those initially built.

As a consequence, business processes are usually modeled, but business modeling (or comparable objects) is not done.

## 5. Problems in the information provision of the BO.

Information technologies are widely used at all levels of management, production, public and private life. They have their well-deserved successes and achievements. The task we have set is to examine the failures in the work of these technologies and in particular in their application in the field of information security of the BO in order to analyze the reasons for these failures and to propose a mechanism for their overcoming.

There are many examples of how poor models, poorly implemented information technologies, poor performance, etc. can be found. Software projects for hundreds and billions of dollars have failed. Due to the objectives of our work, we focused on the analysis of failures due to poor modeling and improperly applied information technologies (failures due to program code errors are not subject to work).

In 2006, the US Census Bureau made a plan to use 500,000 portable devices purchased by Harris Corp. under a $ 600 million contract. After doubling the cost of devices and order problems, a representative of Miter Corp., who advises the Bureau on matters of information technology, recommends to the Bureau: "It is unclear whether the system will respond to the operational needs and the quality objectives of the census."

Extreme costs are unpredictable: immediate and significant changes are needed to save the program. However, the risks are so high considering the

time available, so we recommend immediate development of contingency plans for returning to paper operations."

In the early 1990s, FoxMeyer, a healthcare provider, was the fifth largest drug wholesaler in the United States with annual sales of $ 5 billion and about 500,000 items delivered daily. FoxMeyer decided to build a real-time ERP system for real-time sales based on SAP technology, costing $ 65 million, of which: 4.8 million for HP server configurations; 4 million are SAP software; about 35 million for consulting services; the rest for the construction of an automated warehouse. After spending over $100 million, the project is a complete catastrophe for FoxMeyer. It is reported [11] that "failure is the result of:

- Poor planning: bad selection of ERP;
- Do not taking into account the advice of other consultants;
- Lack of contingency plans;
- No end user involvement and poor performance;
- No business process restructuring;
- Insufficient testing;
- Overly ambitious scope of the project;
- Dominating the interests of IT specialists;
- Poor support for project management;
- Lack of cooperation between end-users."

In the middle of 2018 the eLWIS project was declared dead [12]. After 7 years of work, and after approximately € 500 million, Lidl and the German software company SAP have been discontinuing their joint project - building a new inventory control system across the company, which has nearly 100 billion Euros of annual revenue. The main reason why the introduction of the new software necessitates a reassessment of almost every process in the company is that the Lidl's management is not in the position to do it. In a letter to the staff, Lidl's chief Jesper Hoyer writes: "Initially defined strategic goals were not

possible at an acceptable cost." In Lidl, the desired adjustments led to extremely high costs for consultants and system integration. Changing existing software is like changing a prefabricated house, say IT experts - you can put kitchen cabinets elsewhere, but when you start moving the walls there is no stability.

On the other hand, Jean-Claude Flori, an IT manager working in the pharmaceutical industry, and also head of the DSAG SAP Consumer Group, says: "If a company wants to use standard software, it needs to adapt its own processes to the software. Responsible for the failure is the company, not the software." [13]

The German IT consultancy company KPS, which was supposed to lead the transformation, was identified as a scapegoat for the failure. SAP only provided the software - KPS had to manage the Lidl adaptation procedures. Lidl critics say KPS is too slow.

But Matthias Nollenberger, KPS Senior Manager, responsible for overseeing the eLWIS project, says his company is working too soon in relation to other similar projects and that the pilot phases of the project in Austria, the United States and Northern Ireland have been achieved on time [12].

Although SAP AG is one of the world's most popular software developers in the corporate segment, it has a brilliant image and the client can’t "go wrong" in choosing SAP, it does not yet offer the right solution for any project / company. The lack of correction flexibility, excessive use of numerous external consultants and complex performance complicate the success of the project, especially for companies that do not want to completely change their previous processes but rather "only" want to improve. And this is not typical of SAP alone.

## 6. Adaptive modeling of BO

The examples presented above show:

1 The main reason for the failure was the changes in the initial model of the project and the inability to quickly implement the changes in the practical implementation of the service software.

2 Another important conclusion that can be made is that when a business process is automated in the business model, it is not only the specific process that should be considered, but it is good for the model to cover a wider area. However difficult it may be, the model should cover the whole object. Ignoring this rule leads to unsatisfactory results, and often to a complete failure of the project.

3 There is no good opportunity to rapidly change service software when changes to the original project model in the existing BO are made. The coverage of changes in already-made software in many cases leads to substantial adjustments in both the program code and the need for complex migration of databases, which, in addition to taking a lot of time to implement, is also a very expensive process. In some cases, it may not be possible to fix the software in this way and the only solution is to make a new software product.

In existing modeling technologies, there are opportunities for changes and upgrades to a built-in model of processes. We can combine different patterns, but usually this unification takes place successively, with the relationship between the two models taking place over a single point. While there may be some unification in the process model, merging two or more data models is virtually impossible, and in general, when a pattern reunion is required, a new data model is made that reflects the changes that are taking place.

It can be said that the built business models have a relatively static character and difficult to cope with reflecting changes in the modeling environment.

To solve these problems, we offer a new approach to building business models, which we will call **Adaptive modeling**.

Definition:

**The possibility of a BO model to change, complement and develop over time including through the possibility of uniting two or more models we will call adaptive modeling of this BO**

A prerequisite for the availability of technology that supports and carries out the development of adaptive models and their associated software is:

1 Introduce changes to the basic scheme of the static business model (Figure 2). It is necessary for the database model to lose its importance as a determinant and leader in the development of the common business model. In this regard, we propose a new approach to describe the business model in which the data model becomes part of the process model rather than separated into a separate structure. In this way, the change of the process model leads to the change of the data that serves these processes, which also allows the manipulation with several models (merging and deleting).

2 Have a DBMS with more specific data handling features available:

a) to be able to adaptively change the types (semantics) of the data

b) possibility of adaptive connections between data, i.e. which can be changed and/or created new in the operation of the serving software

3 Have a program framework available to implement such projects.

## 7. Information provision of adaptive models

The main reason for the emerging problems in building the information provision of the BO in the change of the initial model of the project is the use of relational databases in the work of the servicing software. Relational databases have shown their good points in relatively static models, but we can see (examples) that there are significant drawbacks when using them when a change is made to the service software already built.

Disadvantages in these cases are related to:

1 The presence of metadata in the description of the data, which is an integral part of the DBMS.

2 Hard links between data whose change becomes difficult (migrations).

3 Metadata are the basis for the implementation of data management processes.

4 Serious increase in the process of building and maintenance of software products (Figure 5), and in some cases the impossibility of upgrading the built-in software products. It is reported that the quality of the relational database models, on the basis of which the applied information systems and the corresponding user interfaces are being developed, is not good because [9]:

   – Business process rules describing how things are done at a particular location in a business site are often fixed in the structure of the data model. It follows that minor changes in the way the business process takes place lead to major changes in the information system interfaces;

   – Kinds of entities are often not identified or misidentified. This may lead to duplication of data, data structures and functionalities, as well as the costs associated with such development, correction and maintenance iterations;

- Data models for different information systems are substantially different. The result is that additional complex interfaces between the systems that need to share data need to be built. These interfaces may cost from 25 to 70% of the value of the particular systems;
- data can't be shared electronically with other business objects because the structure and meaning of the data are not standardized.

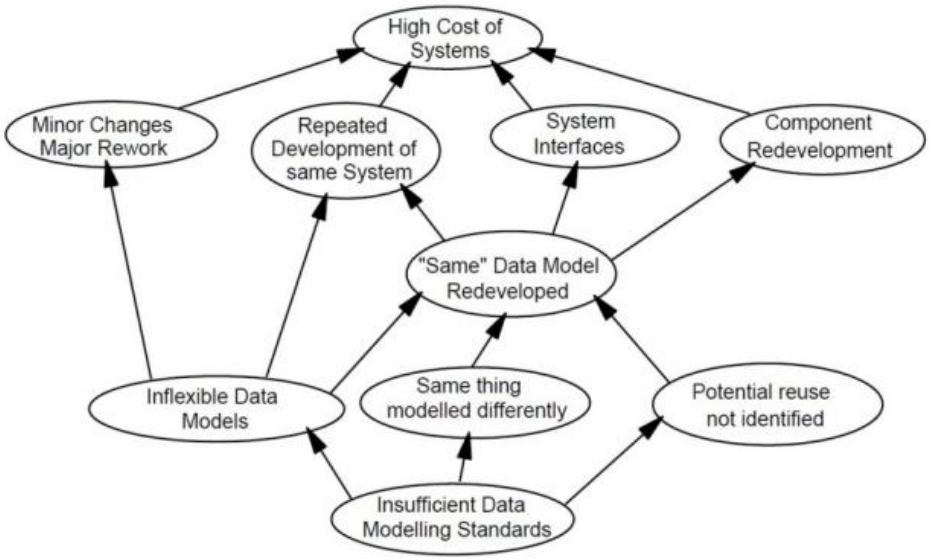


Figure 5. Some problems stemming from the current approach to the description of the data model [9]

We have found out that an appropriate tool for the program implementation of adaptive business models is non-relational databases. Essential requirement is that the data in them is not related to any additional descriptions and links (table and relationship schemes, or JSON documents and keys).

A potential candidate for such a means of realizing adaptive business models is nonrelated external logical databases [1]. They meet all the requirements mentioned above:

1. The description of the type of data is outside the scope of the DBMS. These features are defined in the programming interface and may vary or vary depending on the situation;

2. Links between data that are reflected in some way in databases are not supported. Between the data, it is possible to build dynamically connections for the specific part of the supporting software. This feature of external logic databases is reflected in Figure 6 and practically work only on a physical data level. The work of the logical and conceptual level is exported to the programming interface;

3. Access to data is done with spatial coordinates (similar to mathematical coverage of spatial coordinates). The variety of access capabilities provided in this type of database corresponds to a great extent to the requirements of dinamics and changes, both in existing structures and in the growth and integration of different models;

4. Enables easy online analytical processing (OLAP) of data;

5. It is possible to apply different mathematical algorithms for both processing and access to data. For example, the built-in natural language addressing mechanism (NLA) [10] is a powerful tool for accessing data with the same characteristics regardless of which model the request will be made to;

6. Last but not least, these databases can be embedded in the program interface of the BO service programs, which facilitates the work of both software producers and end-users;

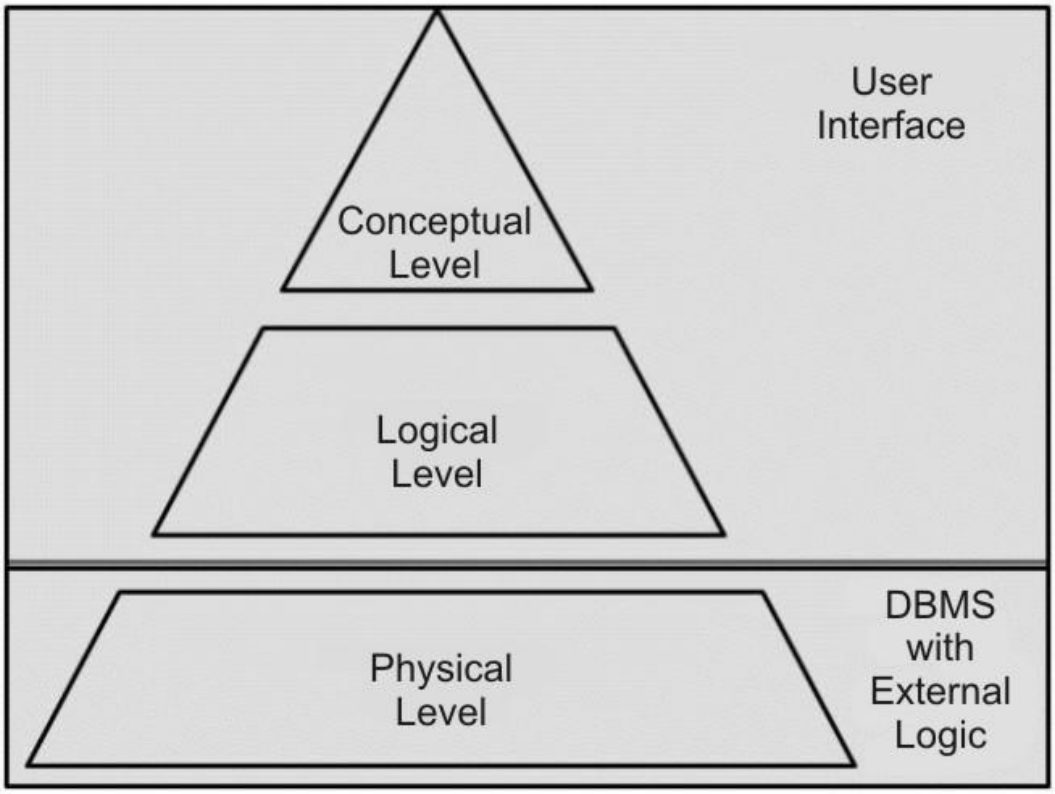


Figure 6. Scope of DBMS with external logic of data on the data model [1]

## Conclusion

From the practical experience, we have in the implementation of various software projects, we think that relational databases as a tool for building models for their informational provision have significant drawbacks. Our search for new tools and technologies in this direction shows that good alternatives for building quality business models are the non-relational databases with external logic of the data.

In our next work, we will focus on demonstrating the specific advantages of these databases and comparing comparable software built with relational database models and non-relational databases with external logic. Our goal will be to show with practical examples the faithfulness of our statements in this material.

## Bibliography

[1] А. Ризов, И. Митов, Кр. Иванова; Моделиране на бизнес обекти чрез СУБД с външна логика на данните; Национална конференция по информатика, посветена на 80 г. от рождението на проф. П. Бърнев, София, 2016

[2] Amy Lo and Eric Yu, From Business Models to Service-Oriented Design: A Reference Catalog Approach, ftp://learning.cs.toronto.edu/public_html/pub/eric/ER07-Lo.pdf

[3] Osterwalder, A., Pigneur, Y., Tucci, C.L. Clarifying Business Models: Origins, Present, and Future of the Concept. In Communications of the AIS, Vol. 15, Article, May 2005.

[4] http://tuj.asenevtsi.com/BIS09/BIS47.htm

[5] Petre, Marian (2013). UML in practice (PDF). 35th International Conference on Software Engineering 18–26 May 2013. pp. 722–731. The majority of those interviewed simply do not use UML, and those who do use it tend to do so selectively and often informally

[6] Ramollari, E., D. Dranidis, A. J. H. Simons: A Survey of Service Oriented Development Methodologies, In Proceedings of the 2nd European Young Researchers Workshop on Service Oriented Computing, 11-12 June 2007, Leicester, UK, pp. 75-80.

[7] http://www.service-architecture.com/articles/web-services/business_process_execution_language_for_web_services_bpel4ws.html

[8] Paul R. Smith & Richard Sarfaty (1993). Creating a strategic plan for configuration management using Computer Aided Software Engineering (CASE) tools. Paper For 1993 National DOE/Contractors and Facilities CAD/CAE User's Group.

[9] Matthew West; Developing High Quality Data Models; EPISTLE; Shell International Limited ISCL/4, Shell Centre, London, SE1 7NA, UK; 12 December 2015

[10] Krassimir Markov, Krassimira Ivanova, Vitalii Velychko, Koen Vanhoof, Juan Castellanos; Natural Language Addressing; ITHEA; Sofia – Hasselt – Kyiv – Madrid 2015

[11] https://www.exoplatform.com/blog/2017/08/01/5-of-the-biggest-information-technology-failures-and-scares/

[12] https://www.handelsblatt.com/today/companies/programmed-for-disaster-lidl-software-disaster-another-example-of-germanys-digital-failure/23582902.html?ticket=ST-1128831-bjUmxXwvozNKLII4cBNJ-ap5

[13] https://www.consultancy.uk/news/18243/lidl-cancels-sap-introduction-having-sunk-500-million-into-it

## Authors' Information

***Georgi Iliev Mitov*** *- Student of South-West University, Blagoevgrad, Bulgaria*

***Major Fields of Scientific Research****: Development of non-relational databases with external data logic; Research on modeling of processes and business objects; Developing data modeling techniques; Architecture and construction of complex software systems.*

***Ilia Mitov*** *– Institute of Mathematics and Informatics, BAS, Bulgaria;*
*e-mail: mitov@mail.bg*

***Major Fields of Scientific Research:*** *Multi-dimensional information systems; Data Processing and Mining*

***Metodi Vlachkov*** *- SWU "Neofit Rilski", Faculty of Economics, Blagoevgrad, Bulgaria*

***Ilia Tiniokov -*** *Computer Engineer, EJ Group Sandansky, Laboratory, Bulgaria. PhD student at Southwestern University "Neofit Rilski", Blagoevgrad,*

***Major Fields of Scientific Research:*** *Computer Systems, Complexes and Networks, Delphi application software development, Internet programming, remote control of systems via the Internet, computer design.*

***Lyubomir Maksimov -*** *EJ Group Laboratory, Sandansky, Bulgaria.*

***Major Fields of Scientific Research:*** *business process modeling, Delphi application software development, custom program design.*

# TABLE OF CONTENT