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Analyzing and visualisation of indoor airpollution

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Abstract: *The exposure on high concentrations of PM particles causes various serious diseases such as cardiovascular, respiratory related diseases and cancer as discovered in more scientific studies. According to experts, there is no immediate victory for pollution, but action must be taken, as this problem cannot wait for future times and generations. In this paper, we will analyze air pollution with PM10 and PM2.5 in indoor urban areas (apartments, workplaces, etc.). This will help the competent authorities to model an urban development plan, traffic density and air quality measures for the population that spends most of the day in an indoor environment. Another benefit would be to obtain information from the results of the online indoor monitoring - to decide whether purifiers should be purchased to reduce air pollution in permissible limits. Visual modeling with GIS (interpolation) gives a dynamic visual representation of the indoor space, clearly showing which parts of the place are polluted and accordingly take action.*

KEYWORDS: INDOOR AIR POLLUTION, PM PARTICLES, GIS INTERPOLATION

1. Introduction

The Republic of North Macedonia faces a significant public health problem caused by ambient air quality. Each year, concentrations of pollution exceed the limit values that affect human health. The problem is evident throughout the country, and to a greater extent is present in urban settlements. The most problematic pollutants are suspended particles that can have a serious impact on health.

The impact of external pollution is also reflected on indoor pollution, as the need for daily fresh air ventilation requires doors and windows to open in order to allow fresh and "clean" air to enter into the apartments. If the outside air has high concentrations of PM particles, then accordingly the indoor air is also polluted. This makes our living conditions worse and potential increase of health problems. It is important to know the exposure from indoor sources of pollution, as we spend most of our time indoors. For this purpose, it is crucial to identify the source of pollution and then to determine their impact on pollution from that exposure. And to understand where the pollution comes from, it is necessary to measure the PM concentration levels.

The Ministry of Environment and Physical Planning of the Republic of N. Macedonia manages the State Ambient Air Quality Monitoring System, consisted of a number of automatic air quality monitoring stations (occasionally out of use), as well as two mobile monitoring stations. The data from all monitoring stations are collected into a database where they are verified, validated, processed, analyzed, presented and reported on daily basis.

Indoor air pollution monitoring can be measured via mobile intelligent pollution monitoring devices or personal pollution meters (carried with them). The results of the measurements used in this paper are obtained using a PM particle pollution instrument for PM10, PM4, PM2.5, PM1, TSP particle size, and model Aerocet 831 (Met One Instruments).

Many pollution studies focus on measuring concentrations of pollutants in residential buildings, offices, shops, malls, and restaurants where people spend most of their daily time in order to compare different indoor environments and identify sources of pollution [1]. Furthermore, several studies have shown that indoor air quality depends on the location of buildings, ventilation characteristics and sources of air pollution in the area, and it has been shown that indoor air pollution levels can often exceed the level of outdoor pollution [2]. The study [3] that analyzed indoor air quality at two different locations - two apartments and two offices.

Quality has been assessed during two experimental campaigns. Both offices reported higher particulate values that could be linked to indoor smoking, as well as poor room cleaning and other human activities. Next related paper [4] examined dust in the house (sampling) and soil around the building. The objective was to identify sources (by chemical analysis of the particles) and quantitative levels of toxicants. Another paper [5] addresses the health risks for infants from dust pollution in homes, which may be much greater than for the adults. Studies on asthma have shown that air pollution can lead to increased asthma prevalence [6]. The aim of this study is to examine the association between air pollution (fine particulate matter (PM2.5), sulfur dioxide (SO2) and ozone (O3)) and human health. The study case [7] makes an analysis of health risk in an office building in Taipei. At any sampling point, it is easy to ascertain whether the measured value exceeds the regulatory standards and subsequently to calculate its health hazards. However, at non sampled points, the possible concentrations and corresponding health effects caused by indoor air pollutants can only be interpolated by using spatial statistical methods such as Kriging.

The paper is organized accordingly as follows. In section II we present Data collection and Analysis, while in Section III we present the Results and Discussions. Section IV presents the GIS visualization and interpolation of the data. Section V concludes the paper and presents possible solutions for future work.

2. Data collection and Analysis

All measurements were made during the winter, when outdoor air pollution is at its highest. Multiple series of measurements have been made at different times and different environments where PM particles (PM10, PM4, PM2.5, PM1 and TPM) might be present using a calibrated instrument. Moreover, the concentrations of the same pollutants (PM10, PM2.5) from the operating measuring stations in the City of Skopje (State Automated Air Quality Monitoring System - MOEPP, Center and Karposh measuring stations) were used for comparison with the external pollution.

The selected facilities for analysis were: a residential apartment in the center of Skopje, a microbiological laboratory in the Faculty of Medicine and a classroom for lab exercises full with students. Time series of measurements were made in different PM particle pollution environments. Different scenarios have been created in order to get the level of pollution without using a purifier and then using a purifier.

The limit values of the pollution parameters according to European standards (which are also implemented in our country) are as follows (the color scheme corresponds to the concentration levels on Table 1).

	PM ₁₀	PM _{2.5}
Very high	180-	110-
High	90-180	55-110
Medium	50-90	30-55
Low	25-50	15-30
Very low	0-25	0-15

Table 1. Concentration limit values (in $\mu\text{g} / \text{m}^3$)

A value comparison of all campaigns in a residential apartment is shown on Fig. 1. Pollution values are obviously lower when using a purifier (fourth-14/15 and fifth campaign-26/27).

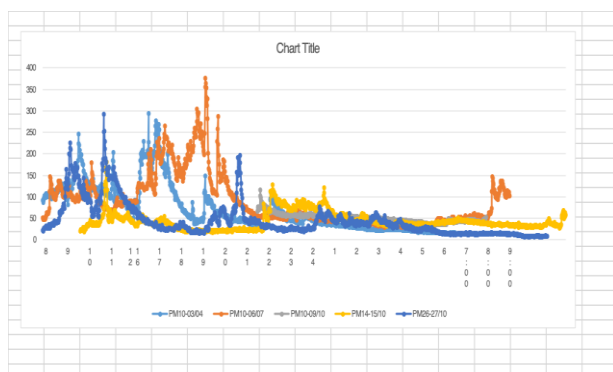


Fig 1. Comparison of all PM10 measurement campaigns

Fig. 2 presents the situation with PM10 pollution levels at the outdoor station 24h on average. It shows at what time of the campaign the external pollution exceeds the permissible limits of $50 \mu\text{g}/\text{m}^3$. Almost for the whole period of 04-22/12 the values are above the permitted limits and from 22-28/12 they are within the permissible limits.

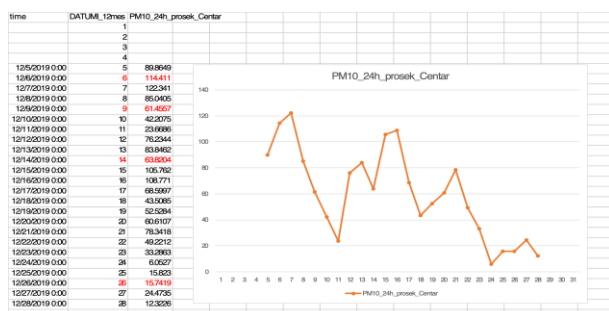


Fig 2. Average 24h PM10 measurement values for 12-2019 (outdoor pollution)

3. Results and Discussion

From the results above, it can be concluded that the connection of indoor air pollution and outdoor air pollution is evident. Due to

the need of indoor ventilation on a daily basis, pollution cannot be reduced (especially when outside concentrations are high). However, when the outside concentrations are low, it is crucial to open doors and windows for extensive indoor ventilation. For this purpose, the monitoring of outdoor air pollution is required, and the use of an air purifier is required in our apartments.

If ventilation is used to purify rooms or air conditioning inverters for heating, regular cleaning or replacement of filters is necessary (as recommended by the manufacturer). This is especially relevant in office spaces.

When all the measurements are completed, the following conclusions can be drawn with the respect to measurements of PM10 parameters in all campaigns. The average values are given in Table 2.

Measurement location - PM10	c-1	c-2	c-3	c-4	Total (Average $\mu\text{g} / \text{m}^3$)
Residential apartment	116.47	120.3	36.38	93.82	91.75
Microbiology -ical laboratory	63.49	66.92	109.9	46.07	71.39
Student Lab	110.70	73.76	55.19	74.64	78.57

Table2: - Average PM10 values for all measurements

Table 2 shows that, in average, pollution levels are highest in the residential apartment (due to kitchen use), but decreases significantly when the purifier is activated (campaign 3) and when activities are reduced.

The measurements of PM2.5 parameters in all campaigns with its average values are given in Table 3.

Measurement location - PM2.5	c-1	c-2	c-3	c-4	Total (Average $\mu\text{g} / \text{m}^3$)
Residential apartment	49.0	65.3	21.0	20.9	39.09
Microbiological laboratory	31.0	45.2	68.4	23.0	41.94
Student Lab	47.8	50.7	23.5	47.7	42.45

Table3: - Average PM2.5 values for all measurements

Table 3 shows that the average air pollution is above the permissible limit of $25 \mu\text{g} / \text{m}^3$. The most contaminated is the student lab, but the levels are significantly reduced when the air purifier is switched on (used in campaigns 3 and 4 in the apartment) as well as when activities are reduced.

4. GIS Visualization and Interpolation

Geographic Information Systems (GIS) or so-called Spatial Information Systems is an advanced tool for obtaining spatial relationships and for facilitating the proper understanding and resolution of related complex problems.

The apartment is on the fifth floor of a building, covers an area of 80 m² and is occupied by 4 people. It is located in the center of Skopje and 50 meters away from a frequent road. Measurements were taken in several places: in the kitchen, in the living room and near the balcony, while the daily activities such as cooking or opening the balcony door were performed. Measurement were made for PM₁₀ and PM_{2.5} particles every minute, in order to visualize the pollution at different locations in the apartment.

To visualize the indoor pollution in the apartment, the GIS tool of the ArcMap software ver. 10.4. is used. The living room and the layout of the measuring points are given on Fig. 32.



Fig3: Arrangement of measuring points in the apartment

Campaign 1 and 2 were conducted at measuring point 2, campaign 4 was performed at measuring point 3, while campaign 3 was at same measuring point. Equation [1] is applied to all of these points.

$$HQ = C_i/RfC \dots \dots \dots [1]$$

Where:

C denotes the exposure concentration ($\mu\text{g}/\text{m}^3$),

RfC denotes reference concentration ($\mu\text{g}/\text{m}^3$).

If Equation 1 is applied to all of these places relative to the average value of the respective campaign, the following quality indices are obtained. For measuring point 1:

$$HQ1 = C1/RfC = 36.38/50 = 0.7276 \dots \dots \dots [1]$$

For measuring point 2:

$$HQ2 = C2/RfC = 120.35/50 = 2.4$$

For measuring point 3:

$$HQ3 = C3/RfC = 93.82/50 = 1.8764$$

In order to get an idea of the pollution levels in the whole apartment and not to make additional measurements in the space, one of the interpolations available with the ArcMap tool can be done.

IDW (inverse distance weighting) is a deterministic interpolation that determines the cell values in combination with a set of surrounding points. The IDW process uses an interpolation method that evaluates the cell values with the average values of the environmental data point samples.

On the other hand, Kriging interpolation interpolates a raster surface from points that use Kriging. Execution speed depends on the number of dots stored in an access database and the size of the search window.

After applying the interpolation, the following pollution visualization is obtained from the average data measured.

The Fig.4 shows that the areas of the apartment that are most exposed to external pollution and pollution from kitchen activities are the most critical places in the apartment.

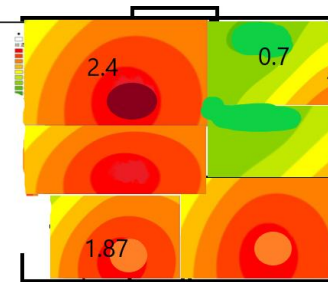


Fig4: Arrangement of measuring points in the apartment

Interpolation from ArcMap measurement data is given on Fig.4. Figure 4 shows different parts of the apartment and the level of pollution concentration implemented in three points with randomly assigned coordinates over the period of measurement. IDW interpolation is applied.

Also time visualization from the measured data is done. This is presented on Fig.5.



Fig5: Time visualization of GIS data

5. CONCLUSION

One of the benefits of the paper is the air pollution information in urban indoor areas (apartments, workplaces, etc.). This will allow the competent authorities to remodel urban development, to manage traffic density, which are connected to air quality in order to improve the quality of life of the population that gravitates to these urban environments. Another contribution would be to obtain information from the results of the online indoor monitoring and to determine the need to use air purifiers in order to reduce air pollution in certain rooms within permissible limits.

Visual modeling with GIS (interpolation) in the paper gives us a dynamic visual representation of the indoor situation, where we easily conclude which parts of the apartment are polluted and take appropriate action.

5. ACKNOWLEDGMENTS

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Automatic generating linear programming problems based on the interface data to determine the optimal number of techniques

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Summary: *This article considers the generation of the canonical form of linear programming to determine the optimal number of techniques. The linear programming problem was solved using the created software interface as a result of solving the problem during the generation process.*

KEYWORDS: *DECISION-MAKING, CANONICAL, GENERATION, LINEAR PROGRAMMING*

1. Introduction

The use of mathematical methods in the development of modern economies, including the solution of many economic issues, and the adoption of correct and effective decisions as a result are of great importance. The famous management researcher, Chuster Bernard, considered management as a form of management decision making [1]. Decision making is an integral part of any management function, such as information sharing. The need for management decisions occurs at all stages of the management process and relates to any aspect of management activities. The decision-making process clearly confirms the continuity of management activities, reflecting the real problems, relationships and interrelations within the organization. In addition, learning about the process of making and implementing decisions allows us to learn the content of governance. The following models are used in making management decisions:

- 1) Games theory model.
- 2) Model of the theory of sequences
- 3) Resource management model
- 4) Linear programming model.
- 5) Economic analysis model.
- 6) Physical model.
- 7) Analogical model.
- 8) Mathematical model.

The linear programming model is used to design optimal production programs. In this case, the main goal is to determine how many products are manufactured to generate the maximum profit mass with a certain amount of raw materials, details, equipment working hours and profitability of product types. Most of the optimization models used in the management system are usually combined with the requirements of the linear programming model. Since the optimization process is expensive, it is used to develop the strategic and tactical tasks of any subsystem of the management system. Operative tasks, however, usually need to be addressed using simple, heuristic methods. These methods are mainly:

a) analysis; b) forecasting; c) modeling.

In the economic application of linear programming theory, most of the issues are considered where finding of the maximum or minimum value for any linear function is required [2].

2. Problem statement

It is worth noting that you can come up with web software designed to solve the linear programming problem by simplex, which is software for mathematical data entry. As an example, the website "Simplex Method Tool" by Stefan Waner in 2016, however, has not created a friendly interface for user. On such web pages, user input data directly solves the problem using the simplex method [3]. The issue is dedicated to the elimination of this deficiency. Thus, software had been created to determine the optimal number of techniques. It has built enough comfortable interface for user. After entering user input in the

created software, the problem comes to linear programming and generates the canonical form for solving simplex [4].

The problem is the generation of the canonical form of linear programming on the basis of interface data to determine the optimal number of techniques. The number of weapons and technical ammunition to be deployed by both parties, owing to the choice of combat operations, solution of the problem should ultimately calculate the optimal number of techniques and find the estimated number of personnel losses.

If we focus on the written form of linear programming, there are different types of writing that affect the generation process. Depending on the solution method, it is necessary to apply the appropriate form of writing in the generation process. The interface to be built as a result of the problem must be as written as possible so that the generation process is properly run.

The availability of sufficient information about the enemy forces means that it has information about its weapons and technical potential [5]. One of the most important tasks is to divide technology into specified categories and know the number of different types of techniques. With the developed software interface, the information needed to automatically generate the canonical form can be stored in a file with a specific structure. It should be noted that generally reading data from a file and writing data to a file are of particular importance in this software. Interface data should be read only from certain files and transmitted to the user. The user should be able to save the data in a specific file to use the data he or she chooses for the next period of time, even if it does not fully resolve the issue for any reason or excuse after launching the software. The file structure needed to read the interface data and the file structure needed for writing are different. The process of reading and writing files should be set up that for any time it will enter to the base of its side so that it is possible to notice new weapons and used these weapons in the software. With this information, the canonical formulation of the necessary data for the complete solution of the problem and based on this data the linear programming problem are solved.

3. Problem Solution

The establishment of an algorithm for determining the number of different techniques based on the interface data is a prerequisite for solving this problem. Thanks to the interface of written software during the solution, the user can choose different category techniques, weapons, and include the coefficients needed to solve the problem [2].

The user can saved the available forces and their number for the battle from his own, the weapons that can be dispatched and their maximum number, in which types of operation (attack or defense) of battle from his own and the enemy in the file which has predefined structure after selecting from software interface (to use the file as a base). The enemy's choice of attack or defensive action during the war (as well as his own) ensures the changing of coefficients used in the generator.

Based on the entered interface data, the number of confused is found with the numbering of different weapons. Based on this number, the basic coefficients for the canonical

form of linear programming problem are defined and base variables are generated. The input data for the number of selected available forces and the number of weapons that can be ordered creates a called right side vector in the canonical writing form. The simplex method of linear programming problem was chosen as the solution. Generation of the canonical form allows a complete solution of this problem with the simplex method.

4. Conclusion

As a result, knowing the enemy forces and operating conditions, it was possible in the case of solution of this problem to determine the optimal number of techniques for defeat. The software created as a result of the solution of problem not only determines the optimal number of each technique during the battle, but also finds the estimated number of personal staff losses.

In the software files with a certain structure had been used as the base. The data displayed on the interface is read from the files defined at the start of the program, and the selected data can be stored in the newly created files using the interface.

When software is created, generation process is completely done correctly and the optimum result is achieved.

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The influence of transnational corporations on the economy of developing countries (Contemplating the example of how the Coca - Cola Company influences the economy of Ukraine)

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Annotation. *Transnational corporations' manufacturing and commercial activities are connected to national and regional markets. Taking this fact into account, the authors identify the main causes of the active development of transnational corporations around the world and determine five levels of economic growth of developing countries. The authors also consider directions of transnational corporations' influence on developing countries and inquire institutional means and methods of regulating the influence of transnational corporations in Ukraine. Attractive sectors of the Ukrainian economy for transnational corporations' activities are proposed, the Coca-Cola Company's activities performed in Ukraine are analyzed, and conditions for further development of transnational corporations in Ukraine are named in the paper.*

KEYWORDS: *ECONOMIC DEVELOPMENT, INTERNATIONAL MARKET, TRANSNATIONAL CORPORATIONS, MECHANISM OF INFLUENCE.*

1. Introduction

In the context of globalization, there has been an enhancement of the interdependence and interconnectedness between countries. Advantages of such processes mostly pertain to developed countries from which transnational corporations originate as the main actors operating in international markets. Transnational corporations' activities have a huge impact on the development of global society and developing countries in particular.

The economic growth of developing countries is primarily reflected by such national indicators as Gross Domestic Product (GDP), GDP per capita, income levels, employment rates, and so on. These components of the national economy are directly influenced by transnational corporations' activities in the country. Transnational corporations actually connect their national and regional markets to their manufacturing and commercial activities, which in turn ensures the integrity of the world economy. It should be noted that, on the one hand, they stimulate their economic growth by contributing to the GDP of the country, raise tax revenues and employment rates, and on the other hand, they establish their own conditions regarding the development of their countries, and consequently bring on a certain dependence on their activities.

The main causes for the active development of transnational corporations are as follows [1]:

1. Imperfection of the market mechanism in the implementation of ownership on technology and manufacturing experience. Within a transnational corporation, such assets become mobile and capable of being transferred to other countries, and the external effects of using these assets do not extend beyond a transnational corporation.

2. Additional opportunities to increase efficiency and competitiveness through access to cheap or more skilled labor, raw materials, research potential, manufacturing capabilities and financial resources of the host country.

3. Proximity to consumers of products provided by a foreign branch of the company and the ability to obtain information about the prospects of markets and the competitive potential of companies of the host country.

4. Possibility of using state policies, including tax policies, differences in exchange rates, etc. for their own benefits in different countries.

5. Ability to continue the life cycle of their technologies and products.

6. By means of foreign direct investment, the company may be able to avoid barriers to enter the market of a certain country.

2. Features of the economic development of countries

When researching the nature of transnational corporations' influence on the economic growth of the countries, the theory of Investment Development Path (IDP) proposed by Henry Dunning [2] is of particular importance. This theory argues that the level of economic development of countries is related to the degree of maturity of its companies and enterprises, the volume of participation in the international capital movement. In his theory, there are five levels of economic development of countries. Each of them has the following specific features:

1. At the first level, the economies of the countries are underdeveloped, which means that there are not any conditions for the accumulation and export of investments, as well as the import of investments, except for those countries that have significant reserves of natural resources.

2. At the second level, the economy of the countries is characterized by a trend of growing GDP up to 2.5 thousand dollars per capita. Due to this, domestic demand in the consumer market is expanding. Through the involvement of foreign transnational corporations, imports of Foreign Direct Investment (FDI) increase. However, the level of development of national enterprises is still low, which does not facilitate the export of investments, and if this kind of export takes place, it is aimed mainly at regional markets or countries with similar economic levels of development.

3. At the third level, up to 10 thousand dollars of GDP per capita is provided in the countries. Imports of investments are slowing, amid increasing exports. However, as before, the amount of accumulated investments due to imports is greater than their export volume.

4. At the fourth level, GDP per capita is equal to 10-36 thousand dollars. The country is showing a particular development of national transnational corporations, and exports exceed FDI imports.

5. At the fifth level, according to a number of economists, the economy of the United States of America is situated with the largest number of transnational corporations and FDI imports and exports actually balanced.

Thus, this theory argues that the number of transnational corporations established in the country is a kind of indicator that displays the level of excess investment in a particular area of production, and in general the degree of economic development. By increasing FDI imports, the effect of "investment demand swelling" in various economic sectors is created, which stimulates some processes related to the growth of national investment exports. Under these conditions, transnational corporations have the highest interest in going beyond national borders and expanding their

activities abroad. Such interest in expanding the market is associated with a number of factors, including access to resources, cheap labor, and lower levels of taxation.

3. The influence of transnational corporations on developing countries

The influence of transnational corporations operating in the recipient country on its development and security is ambiguous. On the one hand, they are a structural part of the economy, a leading force in the development of the country and enhancement of the efficiency of its production. On the other hand, they act as a generator of a number of negative processes connected with the motives of their activities.

In the emerging consumer markets, there is a saturation of consumer goods and services, stimulation of manufacturers' activities, aggravation of struggle for the consumer, sources of raw materials and conditions of sale. However, the common vector and direction of evolution is that transnational corporations determine stable economic links between different subsystems and states, and thus bring together individual national economies into a single world economy. The global development trend is characterized by increased concentration of production and capital, both at the micro-level of enterprises and at the mega-scale of transnational corporations.

Therefore, the positive aspects for the host country of transnational corporations are the acquisition of foreign investments, job creation, use of technology, best business organization experience and more. Yet, there are negative ones: firstly, they are capable of destroying the competition of national manufacturers in certain sectors of the economy, and secondly, they have a significant impact on the economic policy of the country. Nevertheless, to implement independent policies, effective engagement policies concerning transnational corporations need to be developed. The main task is to align the interests of transnational corporations with the strategic interests of the country's economy. China is a good example. Thanks to attracting foreign investments of transnational corporations, this country has received a huge stimulus for economic development. The policy of attracting foreign investments in China is still in place, and at the beginning of its successfulness, there were more than 500 largest corporations in the world. China has succeeded in combining transnational corporations' interests with the national interests [3].

4. Institutional means and methods of regulating the influence of transnational corporations in Ukraine

The adaptation of Ukraine's consumer market as a developing country to international institutional requirements has led to the need to review the regulating instruments and methods. At present, Ukraine's foreign economic policy is based on a fundamentally new regulatory framework developed in accordance with the conditions of a market economy and integration into the world economic space. To develop and implement this regulatory framework and to attain some progress for the consumer market, the relevant governing entities are established and functioning. A number of laws regulating foreign trade activities have been adopted. Having signed a number of international agreements, including the agreements with the European Union, Ukraine sets the most important goal for its foreign trade activities, in particular to provide conditions for equal trade and economic cooperation with developed countries and use opportunities deriving from international economic organizations for the interests of promoting economic reforms in the country.

Implementing its foreign trade policy, Ukraine is forced to apply elements of protectionism and free trade, to develop its own concept in foreign trade, directions and tools of implementation, and a set of economic and administrative methods.

Economic methods are related to the use of customs tariffs and direct financial stimulation of participants in international trade (see Table 1) [4].

By the beginning of 2019, there were more than 30 world transnational corporations operating in Ukraine, including Apple, British Petroleum, Coca-Cola, Danone, Hewlett Packard, Huawei, McDonalds Corporation, Metro Cash & Carry, Microsoft, Nestle, PepsiCo, Procter & Gamble, Samsung, Shell, Toyota, Unilever and more. However, the biggest influence is carried out by transnational corporations engaged in manufacturing of products in the territory of Ukraine [5].

The most attractive sectors of the economy for foreign transnational corporations are food and mining, agriculture, insurance, financial and trade sectors (see Table 2). One of the conditions for the attractiveness and activity of transnational corporations is the presence of important factors for the growth of production: natural resources, cheap and high-quality labor, developed regional transport infrastructure and so on.

Table 1: Institutional Methods for Regulation of Transnational Corporations' Activities

Methods		Trade policy tools		Scope of regulation	
Tariff		Impost			Import
		Tariff quotas			Import
Non-tariff	Quantitative	Quotas			Import
		Licensing		Export	Import
		Voluntary restrictions		Export	
		Customs procedures			Import
		Public procurement			Import
	Hidden	Requirements about including local components		Export	
		Technical and sanitary barriers			Import
		Taxes and fees		Export	Import
		Subsidies		Export	Import
		Credit		Export	
		Dumping		Export	
		Currency restrictions		Export	
		Discount lending		Export	
	Export promotion	Discount insurance		Export	
		Government orders		Export	

5. The Coca-Cola Company's activities performed in Ukraine

One of the largest multinational corporations in the world, whose production also takes part in the Ukrainian market, is the Coca-Cola Company. The company's profile sector is consumer goods, the industry is food, and the market niche is carbonated drinks. This consumer market giant is the world leader in soft drink

production. The main brand of the manufacturer is the Coca-Cola carbonated drink of the same name. The company's share in the carbonated beverage profile segment exceeds 40%, with its products presented worldwide. The company is also a sponsor of numerous international non-profit organizations, such as FIFA, IIHF, as well as the World Olympic Games [6].

Table 2 Attractiveness of Ukrainian Economy Sectors for Transnational Corporations' Activities

Attractiveness		Long-term attractiveness	
		High	Between low and medium
Relative competitive advantage	High	Prospective areas that need investment for modernization of domestic manufacturing facilities	High maturity areas that generate significant resources for economic development and national investment
	Between low and medium	Metallurgy, agricultural processing, mechanical engineering	Extractive industry (oil, gas, minerals)
		Investment strategy: achievement of leading positions in the developing markets	Investment strategy: implementation of modern technologies with long-term investments ensured
		Prospective areas that are available under the stable competition of other large markets	Low competition areas that require constant subsidies to obtain some profits
		Finance, agricultural sector, food industry, transport, logistics, electric power industry	Tourism, pharmacy, medicine, nanotechnologies, microelectronics, information technologies, telecommunications
		Investment strategy: reduction of dependence on alternative imports	Investment strategy: providing government support and modernization

The company is one of the largest in the USA, its shares are admitted to trading on the NYSE market and included in the DLA and S&P 500 indexes [7]. The corporation sells concentrates, syrups and beverages in 193 countries to companies that directly manufacture beverages. It owns 5 of the 6 largest global non-alcoholic beverage brands, namely Coca-Cola, Diet Coke, Fanta, Schweppes and Sprite.

The Coca-Cola Ukraine Limited is responsible for the development of consumer marketing and brands. The company is engaged in market analysis, market research and the creation of marketing strategies to promote the products and brands of the parent company, which the Coca-Cola Company is. It also supplies ingredients and concentrates, beverage basics and beverage syrups. As a result of the development in 2018, the Coca-Cola Company showed a 7% growth in production in Ukraine. It would be appropriate to add that significant contributions have been made to the economy, industry and society (see Table 3). The company's products are widely represented in Ukraine and Moldova and exported to Belarus and Armenia.

Table 3

Key Performance Indicators of Coca-Cola in Ukraine, 2018

Contribution	Performance indicators
Business	7% increase in production volumes
	90 thousand customers
	a 26.2% increase in the share of non-calorie drinks
	a 26.2% increase in the share of non-calorie drinks
Agricultural sector	12% of the value of Ukrainian exports of soft drinks, juices, and water
	157 million Ukrainian hryvnias (UAH) of added value to agriculture due to Coca-Cola purchases
Society	Investing in separate waste collection under the principle of manufacturer's extended liability as part of a pilot project in the town of Vyshgorod
	80,000 participants in more than 50 communities have been involved in training on packaging waste treatment
	1200 graduates from 15 boarding schools have been employed
	1500 Ukrainian women have participated in women's empowerment programs

The first plant in Ukraine was opened in Lviv in 1994. And in 1998, the newly built plant of the Coca-Cola Beverages Ukraine Company near the town of Brovary, in the Kyiv region [8], got fully operational. To effectively interact with the outer world, outside the ordinary business processes, the Coca-Cola Company in Ukraine takes an active position, sharing principles and commitments within the following external initiatives: International Labor Organization Declaration on Fundamental Principles and Rights at Work; The International Commission for the Protection of the Danube River (ICPDR); Union of European Beverages Associations (UNESDA); The UN Global Compact; UN Sustainable Development Goals, etc.

The economic impact of Coca-Cola occurs as a result of its activities performed in the Ukrainian market through a mechanism containing all entities that are directly or indirectly related to the production of Coca-Cola (see Figure 1).

This approach involves the estimation of direct, indirect (first, second and third circles) and secondary economic effects. The economic impact calculation is based on Coca-Cola's data in Ukraine pertaining to labor costs, taxes, purchases of goods and services from local suppliers, and estimation of the margin of trading companies from the sale of Coca-Cola products in Ukraine.

The direct effect of Coca-Cola's activities performed in Ukraine is its direct employees' wages, product taxes (VAT), other taxes, and production-related budgetary deductions (see Figure 2). The amount of taxes and deductions paid to social funds was equal to 300 million UAH in 2018, with deductions to social funds – almost 70 million UAH, which in turn is equal to the level of pension payments for 26 thousand people. The amount of tax on personal income of employees equaled 67 million UAH.

The Coca-Cola Company maintains 24 900 jobs in the economy. This is a cumulative indicator of the number of jobs, which includes directly employed ones in the branches of transnational corporations in Ukraine (1,326 jobs), the companies with the indirect effect in the first circle (14,860 jobs), second and third circles (6,940 jobs), and the companies with the secondary effect (3,100 jobs). Coca-Cola's investments in the local production have contributed to the development of the food industry in Ukraine and the development of the following positive trends over the last 15 years:

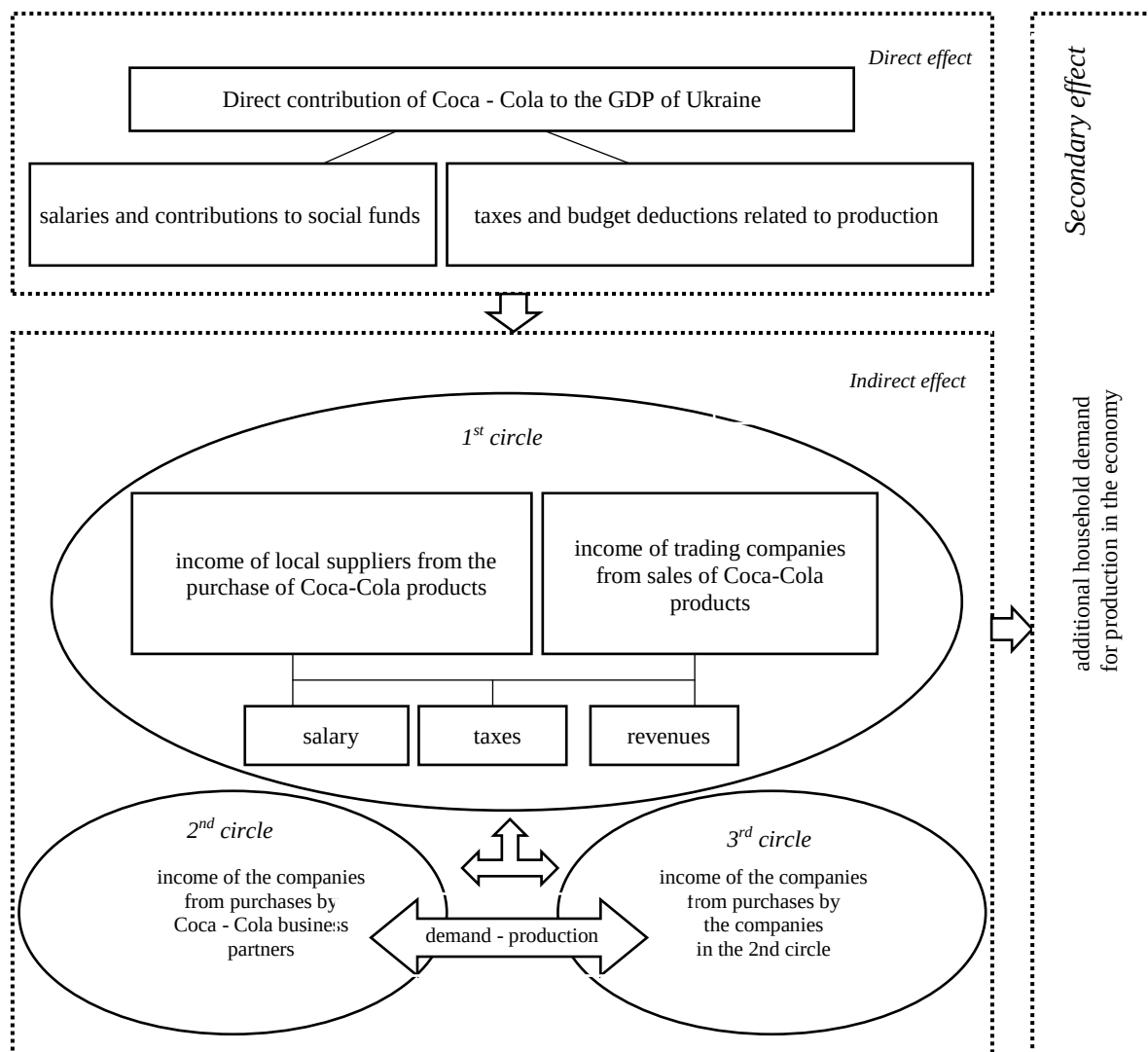


Fig. 1 Mechanism of influence carried out by Coca-Cola on the Ukrainian economy

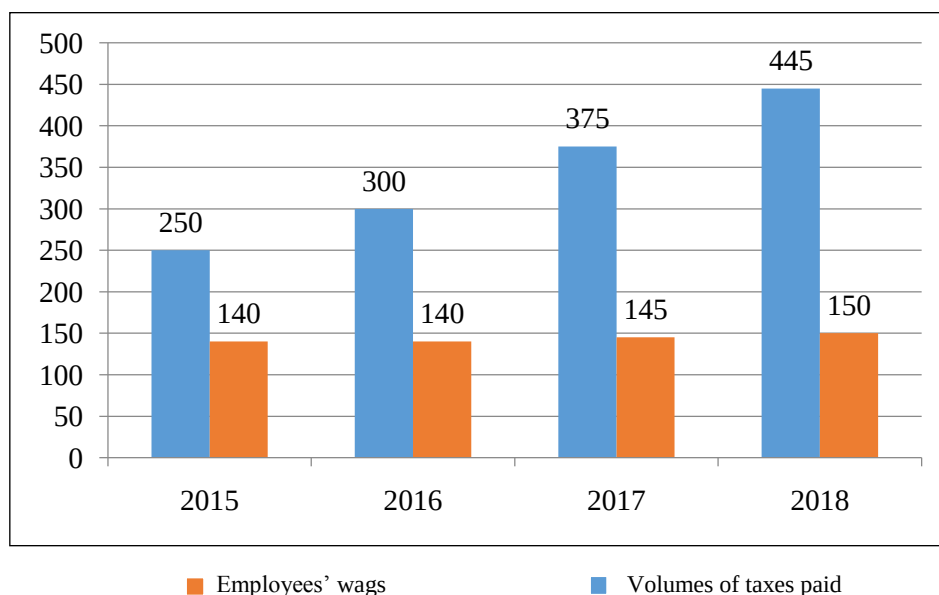


Fig. 2 Direct effects of Coca-Cola's activities performed in Ukraine, million UAH

1. Decline in imports of consumer goods.
 2. Development of industries related to the food industry, in particular agriculture, wholesale and retail trade, transport, and production of packaging materials.

3. Promoting standards for safe, environmentally friendly and resource efficient production in the food industry.
 4. Creating legal and secure jobs.

At the end of 2018, the Coca-Cola Company launched a 'World Without Waste' campaign. The goal of the initiative is as follows: by 2030 to ensure that, the same amount of packaging which the company releases is collected and processed. This requires a complete change in focus on the packaging life cycle: from how the packaging is designed and manufactured to how it is collected, reused or recycled [9]. In the same year, Coca-Cola announced its commitments to sustainable development by 2025. These commitments include the following components: emission reductions; reduction of water use; improving nutrition; special measures for individuals and the whole community.

6. Conclusions

At the beginning of 2019, there were over 30 transnational corporations operating in Ukraine. The most attractive sectors of the economy for foreign transnational corporations were the food and extractive industries; agriculture; insurance, financial and trade sectors. Transnational corporations' activities are directly related to Foreign Direct Investment (FDI), which was 8% higher in 2018 in comparison with 2017.

The research has revealed a positive economic influence of Coca - Cola's activities on the Ukrainian market, namely: providing 0.18% of Ukraine's GDP (6.2 billion UAH) and 1% of total investment in Ukraine (490 million dollars). Each hryvnia of Coca -Cola's added value contributes 9.5 UAH to the GDP of Ukraine, and 19 jobs in related industries are maintained by one job of the company.

Further development of the Coca-Cola Company in Ukraine is going to directly depend on the economic situation in the country. The rapid and steady growth of the Ukrainian economy can be achieved only through simultaneous efforts in the three following directions:

- 1) maintaining macroeconomic stability;
- 2) uprising productivity through attracting investments, greater efficiency in the use of natural resources, development of infrastructure and improvement of the business climate;
- 3) increasing the quantity and quality of human capital.

Further economic growth in Ukraine requires immediate implementation of reforms and concrete actions aimed at stabilizing the economic situation; development of major sectors of industry and optimization of specific manufactures; control over the quality of products and their orientation to the domestic consumer, as well as stimulating the development of domestic production.

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On predictability of precious metals towards robust trading

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Abstract: Large amounts of liquidity flow into several precious metals every day. Investment decisions are mainly based on predicting the future movements of the instrument(s) in question. However, high frequency financial data are somewhat hard to model or predict as stochastic processes and many other random factors are involved. It would be valuable information for the investor if he or she knew which precious metals were quantitatively more predictable, that would also be a good basis for more robust trading decisions. The objective in this study is to build predictive models on high frequency precious metal data and compare predictabilities of different metals using only past price and volume values which should be a basis for robust trading decisions. The data used consist of various frequencies from 1-minute to 4-hour covering a period of almost 20 years for each instrument and frequency. Artificial Neural Network (ANN) and Gradient Boosted Decision Tree (XGB) methods are applied. Comparable results are achieved.

Keywords: PRECIOUS METALS, PREDICTABILITY, ARTIFICIAL NEURAL NETWORKS, XGBOOST

1. Introduction

Large amounts of liquidity flow into the markets all around the world for the trade of various financial instruments such as stocks, commodities, precious metals, foreign exchange (FOREX), futures, and so on every day. Per experts and professionals, average daily turnover in precious markets alone is more than 50 billion US dollars. Investment and trading decisions, whether they tend to be long term or short term, are mainly based on predicting the future movements of the precious metal(s) in question. There has been an ongoing debate among researchers on whether financial markets are predictable or not for a long time. Some think that financial market movements are nothing but random walk, and some findings support that claim: for example, VIX futures prices were found to be unpredictable by Konstantinidi & Skiadopoulos [1]. Furthermore, some researchers even claimed that none of the conventional predictive models proposed in the literature on stock prediction seems capable of systematically predicting stock returns in long range of time horizons, and speculators do not earn significant profits in commodity and interest rate futures markets in aggregate [2, 3, 4]. On the other hand, many researchers disagree with this random walk approach. Some of them claim speculators can gain profits on commodity and currency futures [5, 6, 7, 8, 9]. Some others believe that financial instruments, commodities in particular, are predictable, at least to a certain extent [10, 11]. The debate has not been settled yet; however, it is fair to say that financial instruments are hard to model or predict, if not totally unpredictable. Obviously, it would be valuable information for the investor if he or she could know in advance which way an instrument would go. In this paper an investigation is carried out to give the investor a potential advantage by trying to answer the following question: would a certain precious metal price be likely to go up or down in the following hours? Technical (quantitative) analysis i.e. past price values of the instruments is solely used, and fundamental analysis is not in the scope of this study.



Fig. 1 Sample OHLC price graph for platinum (XPTUSD)

2. Data

The data used in our model consisted of 1-minute (1m), 5-minute (5m), 15-minute (15m), 30-minute (30m), 1-hour (1h), and 4-hour (4h) intraday frequencies covering the period between 2000 and 2019. High frequency data were preferred, because in lower frequencies more and more non-technical fundamental factors might start to affect price movements. Three types of precious metals were considered in this study: platinum (XPTUSD), silver (XAGUSD); and gold (XAUUSD). A sample graph of platinum (XPTUSD) is given in Figure 1.

3. Methodology

Twenty-three out of the twenty-four features used for our prediction model are related to past price movements (past high/low values, etc.), and one is related to seasonality. The output was the prediction of the actual result i.e. the maximum price value into the next eight periods (8x1-minute, 8x5-minutes, and so on).

The chosen state-of-the-art Machine Learning (ML) tools are: Extreme Gradient Boosting (XGB) method and Artificial Neural Network (ANN). Usage of ANNs is quite popular for modeling, prediction, and decision making over financial data and ANNs are regarded as an excellent tool for the purpose [12, 13, 14, 15, 16, 17, 18]. On the other hand, usage of XGB method is very rare [19].

XGB is chosen as one of the prediction methods, mainly because it has gained much popularity in the recent years, due to its overwhelming success in data science competitions [20]. Despite its reputation, XGB method has not yet achieved popularity in the literature accordingly.

ANNs are inspired from biological neural networks, and are well known for their high approximation and modelling capabilities [21, 22]. ANNs are used in a wide range of applications from job satisfaction performance evaluation [23], solving capacitated P-median problem [24] to prediction of aircraft accident occurrence [25]. ANNs are trained in order that they learn a set of input-output data that represent usually a very complex or even undefined function. With sufficient number of hidden layers and neurons, they can model any given input-output relationship [26]. All nodes (artificial neurons) are interconnected, thus form a massive parallelism, and each connection has a weight that changes as the ANN is trained, and also each node has an activation function. There are numerous activation functions, ranging from simple linear functions to various nonlinear ones. The nonlinearity of activation functions enables the ANN to learn even the most complex patterns. In this study; following a parameter optimization, an ANN model is constructed with a multi-layered feed forward network, having 2 hidden layers with 55 and 3 neurons, respectively. Hyperbolic tangent is chosen as activation function. The network is trained by back propagation gradient descent algorithm.

4. Training, Testing and Results

The data are randomized to achieve a fair distribution. 70% of the data is chosen to train the models, 20% for testing, and 10% for validation. Python software [27] is used for ANN and XGB modelling.

Both XGB and ANN models were trained until no improvement was brought about in the cross validation set. One of the main issues concerning machine learning is over-learning or over-fitting problem, in which the system memorizes a certain data set rather than learning it, because of too much training. The performance of the system can be excellent on that data set; however, it performs poorly on different data due to the lack of generalization. The opposite of this issue is the under-learning problem. Therefore, sufficient training or hyperparameter tuning is crucial for an optimum model performance. The criterion of training until improvement in the cross validation set stops is a trade off in this study.

Performances on test sets were averaged to obtain NMSE values. NMSE is mean square error divided by variance of desired output. Being a normalized value, it could easily be used for comparing different instruments of different prices and of different frequencies. Since it is an error term, values closer to zero denote better predictability.

Another statistically meaningful variable we used for predictability performance comparison is the correlation coefficient R. R is used to measure how well one variable fits on another, linear regression wise. In our case, these variables were predicted against desired. R value is calculated by the formula below:

$$R = \frac{\sum_i (x_i - \bar{x})(d_i - \bar{d})}{\sqrt{\sum_i (d_i - \bar{d})^2} \sqrt{\sum_i (x_i - \bar{x})^2}} \quad (1)$$

Where N = number of exemplars in the data set, x = model output, and d = desired output. The size of the mean square error (MSE) can be used to determine how well the network output fits the desired output; however, it does not necessarily reflect whether the two sets of data move in the same direction. For instance, by simply scaling the network output, we can change the MSE without changing the directionality of the data. The correlation coefficient R solves this problem. The correlation coefficient between a model output x and a desired output d is defined by formula (1). The correlation coefficient is confined to the range [-1 1]. When R = 1 there is a perfect positive linear correlation between x and d, i.e. they vary accordingly, which means that they vary by the same amount. When R = -1, there is a perfect linear negative correlation between x and d, i.e. they vary in opposite ways (when x increases, d decreases by the same amount). When R = 0 there is no correlation between x and d, i.e. the variables are called uncorrelated. Intermediate values describe partial correlations. All recorded and calculated performance comparison values in terms of R and NMSE for all metals and all frequencies are given in Table 1 and Table 2 which hopefully could give hints about predictability.

Table 1: Detailed predictability performance comparison for the precious metals on lower frequencies

Instrument	4h		1h		30m	
	R	NMSE	R	NMSE	R	NMSE
XPTUSD	0.36	0.91	0.4	0.94	0.42	0.85
XAGUSD	0.41	0.84	0.44	0.81	0.46	0.79
XAUUSD	0.40	0.84	0.45	0.80	0.36	0.87

Table 2: Detailed predictability performance comparison for the precious metals on higher frequencies

Instrument	15m		5m		1m	
	R	NMSE	R	NMSE	R	NMSE
XPTUSD	0.30	0.90	0.39	0.87	0.36	0.87
XAGUSD	0.37	0.86	0.25	0.94	0.27	0.93
XAUUSD	0.36	0.87	0.38	0.85	0.27	0.93

5. Conclusion

As can be seen from Table 1 that silver (XAGUSD) has the highest overall predictability both R and NMSE wise on lower frequencies. We can say that 30m frequency has the best predictability performance again both R and NMSE wise among the lower frequencies. On the other hand, gold (XAUUSD) has the best 1h performance. As per higher frequencies which are shown in Table 2, there is no clear winner metal. Silver and gold perform similarly in higher frequencies, while platinum is considerably better in 1-minute and 5-minute frequencies. Overall metals perform better on lower frequencies. Therefore, from the investor's point of view, trading decisions based on 1-hour or 4-hour data should probably be more profitable, considering commissions and spread margins are usually more disadvantageous in higher frequencies like 5-minute or 1-minute.

Adding more metals such as copper and palladium could be considered as future work. Of course, building a robust trading strategy using predictability as a metric is also in the scope of future work.

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Conceptual model for investigating the innovation activity of enterprises

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Abstract: The paper presents a conceptual model for investigating the innovation activity of enterprises from the wine industry in Bulgaria. The study aims to submit a unified methodological framework for application by experts in researching, analyzing and bench-marking the innovation activity in the sector. Many researchers confirm that different innovation models are appropriate for different sectors, regardless of best practices in innovation management, and it all depends on the specificity of innovation and its relationship to sector specificities. Thus, the examination of wine sector requires a specific approach and an empirical research, based on own questionnaire focused on the individualism and the need to study the innovation niches and opportunities of wine sector.

KEYWORDS: INNOVATION, WINE INDUSTRY, CONCEPTUAL MODEL, METHODOLOGICAL FRAME

1. Introduction

The significance of the topic is central to discussions, research and organizational activities in the field of manufacturing and services. An important prerequisite for improving quality are the opportunities for innovation. The latter provides a potential for ensuring a higher level of economic development, but the problem of its more efficient management is still valid. This is even more difficult as innovation requires a specific approach depending on the industrial sector, because each industry and region have their own specifications. Some studies indicate that the development of radical innovations requires completely different management approaches than those needed for further innovations.

The wine industry, as a specific and traditionally strong sector for the Bulgarian economy, is the **main object** of the present study and the innovation is an extremely important element for further development of the sector and for achieving competitiveness. The paper presents a methodological framework for investigating the innovation activity of enterprises from wine industry.

The subject of this paper is the utilization of the methods and instruments with a view to establish the innovation potential and innovation activity of the enterprises.

The researcher's **thesis** is that creating a conceptual model for researching the innovation activity of enterprises will contribute to better analyzing the development of the wine sector as a whole. In line with this, the proper use and implementation of specific methods and techniques for investigating the innovation activities of enterprises provides opportunities for bench-marking and analyzing the innovation strategies of wine enterprises in Bulgaria.

Affidavit of support of the above mentioned, **the paper aims** to contribute for better understanding the necessity of taking right decisions in applying innovation.

The article is structured as follows: following the introduction, in the second part is described the methodological framework for investigating the innovation activities. This analysis paves the way for the third part, in which is highlighted the development of the survey instruments, i.e. an own questionnaire. The article closes with conclusions and recommendations for future research in the field of investigation the innovation activities in wine industry.

2. Methodological Framework

2.1. Theoretical Background

Wine production in Bulgaria has a rich long-term experience and outline the sub-sector as one of the main sub-sectors for the Bulgarian economy. A significant part of Bulgarian wine producers are also focusing on differentiation and diversification strategies, seeking ways to promote their business, expanding their markets and increasing their sales, and offering uniqueness to achieve and develop competitive advantages [1]. In this context, the

establishment of a methodological framework for investigating the innovation activity has the potential to enrich the scientific knowledge and provide a good practice in this field of research.

At the 40th World Congress of Viticulture and Wine Production held in Sofia, between 29.05.17 - 02.06.17, Bulgaria was ranked 21st in the world regarding wine production and 23th as for the area of vineyards. The information provided is based on data from the International Organization of Viticulture and Wine [2], and the fact that a forum of such magnitude is held in our country, puts Bulgaria in the focus of the world wine community. Our wine production is characterized by a wide assortment of white and red wines (bottled and bulk) as well as those with protected trademarks that compete on the domestic and foreign markets. Legislative framework related to regulation of the sector is unified in line with the European one so that our products can compete with other EU countries.

Innovations in wine industry in terms of its management and competitiveness can be reduced to technological (process), product, marketing, management, organizational and information. Despite the well-developed, relatively deeply researched and analyzed theory of innovation as a management tool and a key factor for competitiveness, innovation in the certain industry is less analyzed. This is particularly true in the case of specific regions and local individualities which are prevalent in the wine sector. There is no comprehensive research to include innovation as a tool for achieving competitiveness in the wine industry. However, there is a significant research base to step on, to be put in a systematic way as a starting point and to serve as a foundation for further research.

2.2. The Necessity for Investigating the Wine Industry

The recent context is marked by a decline in wine consumption and a highly competitive environment in which the wine industry operates. Thus, it is crucial for the wine producers to seek opportunities to develop their competitive advantages (their leading strengths), to overcome the weaknesses and develop their own competitive potential. A prerequisite for the realization of these goals is the development and approbation of innovation.

Such opportunities, corresponding to some of the goals set in the *National Strategy for Development of Viticulture and Wine in the Republic of Bulgaria 2005-2025* [3], should be sought in view of:

- Building a modern structure of the sector and increasing its competitiveness through the implementation of technological (process), product, marketing, management, organizational and information innovations;
- Stimulating SMEs in the industry to focus on concrete improvements and approbation of innovative solutions;
- Establishing a methodical framework for investigating the innovation activities in the sector that will create opportunities for analyzing and bench-marking the applied innovation strategies;

- Increasing the human resources capacity in the sector to explore and improve the innovation strategy of their enterprises.

2.3. Conceptual Model: Research Methodology and Techniques

The conceptual model for investigating the innovation activity of enterprises is a part of a project № KP-06-M25/5/17.12.18, financed by the Bulgarian National Science Fund. It includes a wide range of research methods to successfully achieve the goals and tasks of the survey. The activity of each organization is a chain of interrelated processes - from marketing and planning to sales and after-sales. The desired outcome is achieved more efficiently when the activity and relevant resources are managed as a process. It is based on the fact that management is a continuous series of interrelated actions or functions that are presented as processes. The development of methodological situations is based on the **process approach**, i.e. integrating the key conditions and processes in the work of the specialists, defining competencies for **re-engineering** the business processes, and a **diagnostic analysis** of their condition. The use of **retrospective analysis** over the last years of the development of economic and political processes and laws that directly affect the innovation activity of organizations helps to analyse and establish trends and regularities. It also includes a **secondary processing of quantitative data** concerning certain economic indicators during the period under review.

The research method uses a quantitative method, namely a **structured interview** - an inquiry card, which aims at obtaining feedback from the company's specialists on the innovative solutions in the organizations. The method of **expert assessment** is used and it is conducted with the support of scholars from the economic universities as consultants. The processing of the information should be done with a specialized software product.

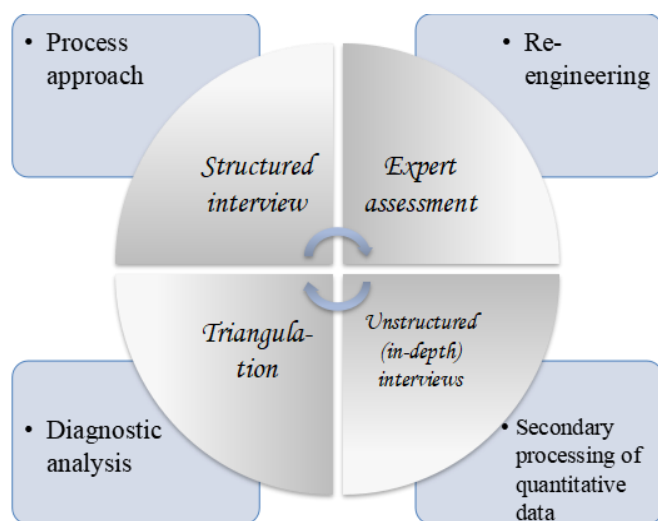


Fig. 1 Conceptual model, Source: Own interpretation

Secondary analysis of empirical data

Empirical data collected from national and international quantitative studies conducted by private and state sociological agencies, as well as authors' teams of scientific and educational institutions, are the arrays on which secondary data processing [4] can be done. For the purpose of this investigation, several information arrays have been selected. NSI and Eurostat [5] data are used for the overall innovation activity of Bulgaria during the period under review, as is also true for the Global Innovation Index [6].

Structured interview

Regardless of the specific technique used for registering the information – a questionnaire¹ or an interview², the structured interview allows the accumulation of massive data sets. In view of the persons included in the survey, it may be exhaustive (when all units of the population are included) or a sample (when units of the population are selected) [7]. In the specific case, after identifying the units of the general population (i.e. wine specialists and enterprise managers), it's elaborated a specific method for implementing the structured interviews using an online questionnaire [8].

Unstructured (in-depth) interviews

The type and content of the in-depth interview toolkit may vary depending on the following four factors: (1) the person who conducts the survey; (2) the subject of the study (it is important whether facts, assessments, opinions, ideas will be studied about a particular political or social phenomenon); (3) the subject of the survey; (4) the selection of respondents.

A major advantage of in-depth interviews is the opportunity they provide to analyse unexplored facts and events. In literature, in-depth interviews are referred to as pilot studies. Therefore, the researcher is interested to meet with as many people as possible in order to maximize his/her understanding of the subject of analysis and to get an immediate impression of how the different actors interpret the studied events.

In the current research, conducting in-depth interviews with some wine growers in SMEs would give a more in-depth and specific picture of the nature of their innovation challenges and provide additional explanations for some of the responses to the structured interview.

Triangulation: combining quantitative and qualitative research methods

Various options and approaches for combining quantitative and qualitative research methods are presented in the scientific literature. In combining, it is important to answer to the following questions: whether it is a combination of methods, data or results [9]; is equal weight attributed to both approaches; will the results of the two approaches be compared or will they be presented separately; in what sequence will they be used.

This conceptual model combines the results of the quantitative and qualitative method used, giving them equal weights. The methods will be applied independently from each other by first processing the quantitative empirical information, then structuring interviews, and then performing in-depth interviews. In this way, combining quantitative and qualitative research presents in more detail the subject of research through complementarity and triangulation. The principle of triangulation is that the results of one study can be verified and validated by the other [10].

2.4. Instruments: an Inquiry Card

The digital era brings all kinds of information thanks to the centralization and accessibility of data. For example, people now rely heavily on computers and mobile phones with internet, which gives an immediate answer to any questions they might have. Online surveys are a great way to reach and engage with the target audience. The benefits that they provide are: (1) Increase response rates by reaching the target audience fast; (2) Conduct market research at a fraction of the usual cost; (3) Get real-time results for quick and easy analysis. The time span needed to complete an online survey is on average two-thirds shorter than that of traditional research methods. Because information is being gathered

¹ In the survey the respondent himself completes the questionnaire drawn up by the researcher.

² In the interview, the interviewer's questionnaire is filled in not directly by the respondent, but by the interviewer who asks the questions and notes the respondent's answers.

automatically, there is no necessity to wait for paper questionnaires to come back - response time is almost instant. Online marketing experts say that more than half of responses are received within the first three days of the research project.

To sum up, online surveys are a great option for people and organizations who would like to conduct their own research – they are less time consuming, they are cheaper, you get the results faster, and you can transfer and use the data in various applications to answer important questions. Our team of researchers apply an online inquiry card using free software (for instance: Lime Survey, Google Forms, etc.).

The questionnaire starts with **introduction** of the research purposes, presents the basic aims and instructions in line with fulfilling the card anonymously. Followed by the **first section** that includes information about the respondents in accordance with gender, age, education, and length of service.

The **second section** includes enterprise data in connection with the number of employees; a field of production/service; import/export orientation; a form of ownership; funding sources; sources of materials; diversification of products and services; types of wine.

The **third section** starts with next questions (close type of question with multiple answers): “Do you implement innovative strategies in your enterprise?; At what stage is the implementation of innovation strategies in the enterprise?; What result do you expect from the implementation of innovation?” After that the respondents must indicate what kind of innovation they are applying in the enterprise, selecting among the following options: 1 - Not applicable to us; 2 - We know about this opportunity but we would not apply it; 3 - We know about this opportunity and we would apply it; 4 - We are currently applying it; 5 - We have applied it in the past. The next table presents next six questions that are grouped according the kind of innovation and multiple answers according different opportunities that can be applied.

Table 1. Section Innovation

Raw material innovation	Market Innovation
Introduction of new grape varieties - Organic production	Export orientation to new foreign markets
Production of new types of wine, incl. BIO	Increasing the number of distributors in foreign markets
New plantations (in view of local conditions)	Increasing the number of distributors in the internal market
New plantations (with a higher wine class)	A new form of product promotion on the market
Improvement of varieties	New strategic agreements
Limiting varieties to more noble ones	A new form of merchandising
Use of wild yeast	Acquisition of new quality certificates
Improving the quality of vineyards through the use of vineyard experts	Focus on a specific geographic market
Product innovation	Focus on a specific market segment
Production of products in price segments of super premium and ultra premium	Increasing brand popularity
Introducing new services such as tourism and recreation	Striving for inclusion in expert wine charts
New packaging, incl. organic packaging	Participation in contests for winning prizes
New labeling	Brand development
New types of bottles	More successful use of retailers as a distribution channel for online distribution (online sales)
New caps	Investment in advertising
Process/Production innovation	Investment in packaging
Improvement of the production process	Investment in labeling
Acquisition of new equipment	Management innovation
Acquisition of new machines	Review of organizational procedures
Broad use of technology transfer	Further training and advanced training of employees
Utilization of alternative energy sources (solar)	Optimization of business processes
Utilization of alternative energy sources (photovoltaic)	Exchange of knowledge regarding production
Utilization of alternative energy sources (geothermal)	Research initiatives
Reduce water use	Use of private consultants
Reduce energy consumption	More efficient use of resources
Production waste management	IT Innovation
Production emissions management	Increasing cyber security
	Introducing GDPR
	New software for managing different processes

Source: Own interpretation

3. Conclusion

There are clear prospects for the wine industry, as this is a sub-sector, significant and distinct for the Bulgarian economy on a global scale - a fact that has been proven over the years. Many authors and researchers claim that wine will become one of the symbols of Bulgaria. There is a competitive potential in this industry, which, if properly identified and successfully developed, would enhance the competitiveness on international markets' level.

The current conceptual model for investigating the innovation activity of enterprises from wine industry can be enriched in the context of competitiveness. Based on the fact that the implementation of innovation provides an up-to-date competitive advantage for enterprises, the methodology can be supplemented by issues related to the competitiveness and competitive positioning of the company. Moreover, it is an opportunity for future research in the field of innovation and competitiveness of the wine sector.

ACKNOWLEDGEMENTS

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The impact of global change on consumer preferences of the Moravica District

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Abstract: The aim of the research, the results of which are presented in this paper, is to research the consumer preferences of the Moravica District towards the consumption of domestic and foreign products. As globalization alters market conditions, creates new sources of competition, it is impossible not to think about protecting domestic products and the impact of the increased import of foreign products on the preferences of domestic consumers. Liberalization, as a regulator of market, certainly influences the need to create mechanisms for the protection of domestic production, and the changed consumer preferences are an important factor in monitoring and defining new protection measures so that domestic producers of the Republic of Serbia are ready, primarily for the European market. For this reason, we decided to investigate what consumer ethnocentrism is like in the central part of the Republic of Serbia, in the Moravica District. As the results show, the challenges posed by globalization have greatly influenced consumer attitudes and changes in attitudes towards ethnocentrism.

Keywords: GLOBALIZATION, CONSUMERS, DOMESTIC PRODUCTS, CUSTOMERS, WHOLESALE

1. Introduction

Consumer behavior is extremely difficult to define, considering that there are numerous factors having a direct or indirect impact on the consumer. In the globalization era, this impact is extremely powerful. The globalization implies a free flow of goods and services, which can significantly affect the competitiveness of domestic products of nation-states facing the stumbling economies undergoing revitalization. The propensity of domestic consumers towards ethnocentrism, that is, the dominance of domestic culture and the propensity of consumers to buy domestic products over foreign ones, can be a significant factor in maintaining domestic producers. On the other hand, it can be an extremely aggravating circumstance for foreign producers in product marketing due to consumer attitudes that buying imported products is a source of economic distress for the nation. Sociologist Ludwig Gumplowitz pointed to the concept of ethnocentrism as early as 1879. Gumplowitz's understanding of ethnocentrism was similar to geocentrism and anthropocentrism, with particular emphasis on one ethnic group (Bizumic, 2014). Some studies indicate that the degree of ethnocentrism is much higher in the rural and central regions of nation states. This information instigated us to carry out this research in central Serbia.

2. Prerequisites and means for solving the problem

Globalization has affected all spheres of society, but its influence is particularly apparent from a technological and economic standpoint. When it comes to Serbia, imports of goods are higher than exports, which results in the increased use of foreign brands over domestic ones. (www.pks.rs) Based on these results, a strategy that will protect the domestic economy to the best extent will be created. Yormirzoev, Teuber, Li, found that "It has been argued that domestic purchasing bias may be particularly pronounced in emerging economies and societies subject to major economic or political changes (Dmitrovic et al., 2009). In such a situation, consumers' concern for their ethnic and cultural identities may become even more pronounced - normative and affective dimensions are likely to play a significant role in consumer behavioral responses (Dmitrovic et al., 2009)." (7, pp. 6).

In Serbia, as a country that has been stuck in transition for years, with an apparent aspiration for European Union integration, positions differ. In the Balkans, there is still the view that German products are of proven quality and that price justifies quality. Uyar, A. (2018) states in his research the reasons for this phenomenon "In order to punish Germany, which had been defeated as a result of World War I, and to ensure that its products could be sold more difficultly in the European market, the Allied Powers made it mandatory to mark the expression "Made in Germany" on products originated in Germany. This turned out to be a favorite of Germany in the following years as products of German origin began to be perceived as more valuable on the market over time (Senir, 2014:

52-53)." (6, 1121-1143). Another result of the research conducted by Ujar produced a conclusion „When Turkish consumers are to choose between import and domestic products, they decide according to product quality, price and brand rather than origin". (6, 1121-1143) The starting point and prerequisite for taking domestic product protection measures is to examine the attitudes and preferences of consumers. Based on these results, a strategy will be created that will best protect the domestic economy.

3. Solutions

The research was carried out in order to determine the preferences of consumers of the Moravica District towards domestic and foreign products. By applying the method of survey, the research was carried out in the period from July to August 2019. The created questionnaire used in the research process was of a closed type. By convenient sampling, the questionnaire was distributed to the respondents electronically, via e-mail, in 24 wholesale companies, which is 80% of wholesale companies in the Moravica Region. In total, 18 companies responded, accounting for 60% of the total number of respondents, thus making this questionnaire statistically valid. Data analysis was carried out in SPSS statistical software. In order to test the statistical hypotheses, descriptive statistical and reliability analysis were applied and the statistics of the Hi-square test. The results are presented in tabular and graphical form.

X (0): Domestic consumers prefer foreign over domestic products.

Respondents who replied to the questionnaire and participated in the survey were: Agrofinacacak, Vasovic fish market Cacak, Juko company Cacak, Harizma pro team Cacak, KafatexCacak, TGKCacak, KiM Gornji Milanovac, Dallmayr Serbia Gornji Milanovac, Kumovi doo Gornji Milanovac, Maksim Gornji Milanovac, Maksim Gornji Milanovac, MV Petrovic VelpoIvanjica, Principal DUO Cacak, BarkaCacak, MD Product Cacak, Delta DMD Cacak, MakrobellaCacak, Zeta SZTR Gornji Milanovac, DicaIvanjica.

4. Results and discussion

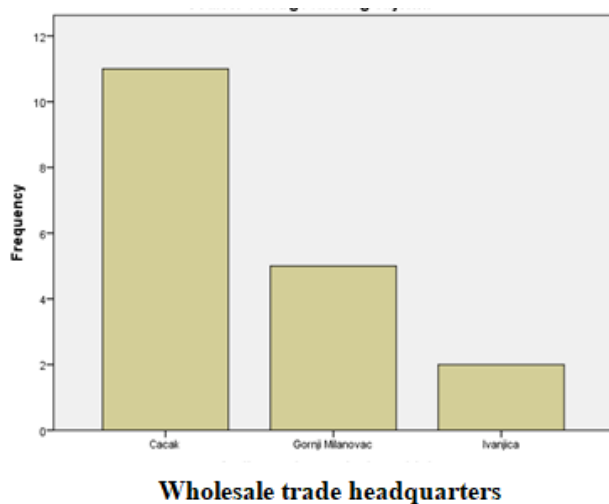
Table 1. - Distribution of wholesale facilities by location

Sediste veletrgovinskog objekta				
	Frequency	Percent	Valid Percent	Cumulative Percent
Valid Cacak	11	61.1	61.1	61.1
Gornji Milanovac	5	27.8	27.8	88.9
Ivanjica	2	11.1	11.1	100.0
Total	18	100.0	100.0	

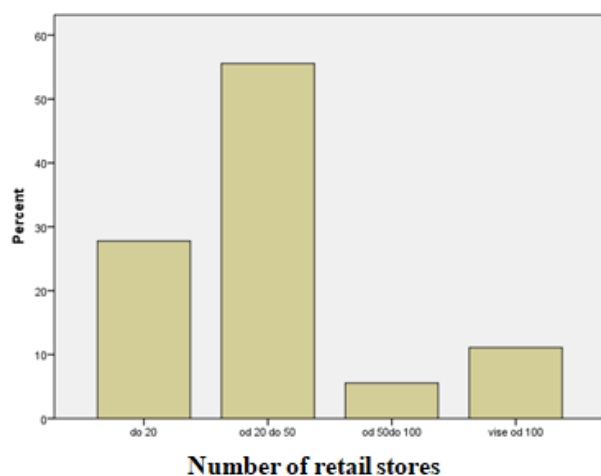
Table 2. - Modus, median and arithmetic mean by number of employees in wholesale facilities

Statistics		
Number of workers in a wholesale facility		
N	Valid	18
	Missing	0
Mean		1.94
Median		2.00
Mode		2

Most of the wholesale stores that participated in this research are operating in the territory of the Municipality of Cacak (Graph 1). Which can be concluded from Table 1 and Graph 1.



Graph 1. - Distribution of wholesale facilities by location



Graph 2. - Number of retail stores supplying the surveyed wholesalers

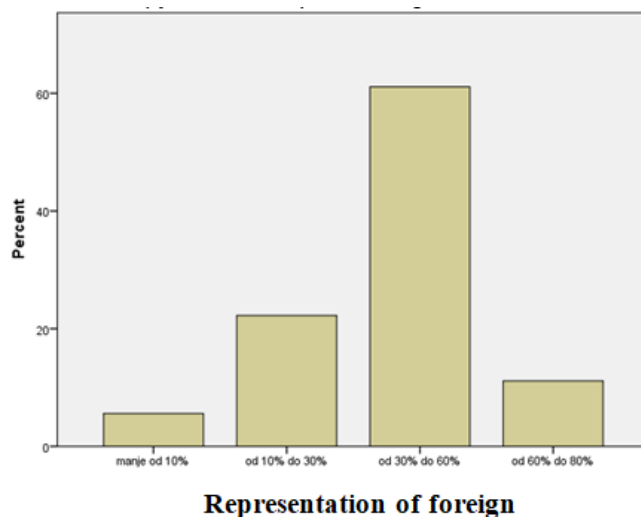
Table 3. Number of responses and percentage participation in the sample by number of employees

Number of workers in a wholesale facility				
	Frequency	Percent	Valid Percent	Cumulative Percent
Valid manje od 50	3	16.7	16.7	16.7
od 50 do 100	13	72.2	72.2	88.9
od 100 do 200	2	11.1	11.1	100.0
Total	18	100.0	100.0	

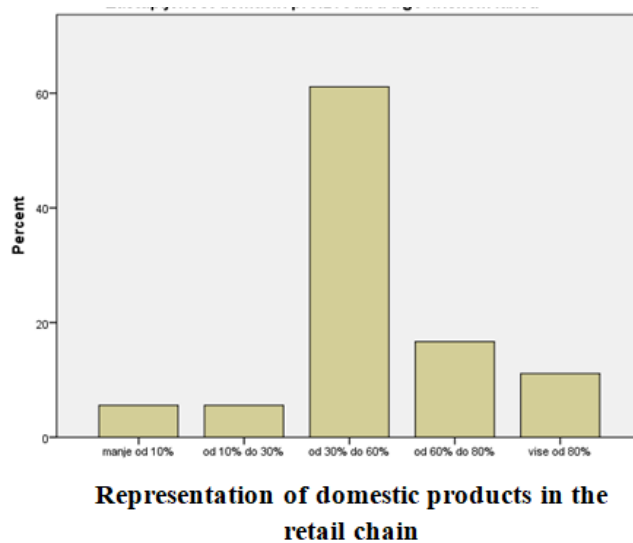
Based on the results in Tables 2 and 3, it can be concluded that the median is in sample 2, the mode is also 2, while the arithmetic mean is 1.94. On the other hand, if one considers more closely the

number of employees of wholesale companies that participated in the survey, as many as 72.2% of the companies surveyed employ between 50 and 100 workers. That is, 43.33% of the total number of wholesalers operating in the Moravica District.

Graph 2 shows that most wholesale stores supply between 20 and 50 retail outlets. Only two respondents supply more than 100, which have their own brand. Supply is made on the territory of the whole Republic of Serbia. Thus, 27.8% of respondents supply up to 20 retail stores, 55.6% supply between 20 and 50, only 5.6% between 50 and 100, while the rest, which makes 11.1% supply over 100 retail stores.



Graph 3. - Representation of foreign products in the retail chain



Graph 4. Representation of domestic products in the retail chain

Graph 3 represents the percentage of foreign products in the surveyed retail chains. As a percentage, most companies have between 30% and 60% of foreign products in their range, accounting for 61.1% of the total sample. Then, only 5.6% have up to 10% of foreign products, 22.2% between 10% and 30%, and the rest, or 11.1%, between 60% and 80%.

The percentage share of domestic products (Graph 4) in the range varies from respondents to respondents. 5.6% of respondents have less than 10% and 10% to 30% of domestic products in the range. Then, in 61.1% of respondents, the share of domestic products is between 30% and 60% of the total range. 16.7% of respondents and from 60% to 80%, while the rest, 11.1% have over 80% of domestic products in the range.

Table 4. - Relationship between foreign products and domestic consumer choices

Case Processing Summary

	Cases					
	Valid		Missing		Total	
	N	Percent	N	Percent	N	Percent
Representation of foreign products in the retail chain * The most common choice of domestic consumers	18	100.0%	0	0.0%	18	100.0%

Table 5. - Relationship between foreign products and domestic consumer choices

Representation of foreign products in the retail chain * The most common choice of domestic consumers Crosstabulation

			The most common choice of domestic consumers		
			domestic pottery products	products of foreign consumers	Consumers only care about the price, until they pay attention to the origin of the product
Foreign trade representation in the chain of	less than 10%	Count	1	0	0
		Expected Count	.3	.1	.6
	od 10% do 30%	Count	3	0	1
		Expected Count	1.1	.4	2.4
	od 30% do 60%	Count	1	0	10
		Expected Count	3.1	1.2	6.7
	od 60% do 80%	Count	0	2	0
		Expected Count	.6	.2	1.2
	Total	Count	5	2	11
		Expected Count	5.0	2.0	11.0

The given criterion in the previous table is $p \geq 2$, since it satisfies the previous condition, it can be concluded that domestic consumers prefer foreigners over domestic products.

Table 6. - Hi-squared ratio Relationship between foreign products and domestic consumer choices

Chi-Square Tests

	Value	df	Asymptotic Significance (2-sided)
Pearson Chi-Square	27.312 ^a	6	.000
Likelihood Ratio	21.232	6	.002
Linear-by-Linear Association	3.791	1	.052
N of Valid Cases	18		

Based on the data obtained, it can be concluded that domestic consumers prefer foreign products over those produced in the territory of the Republic of Serbia. This is also a confirmed starting assumption (hypothesis) set in the paper.

5. Conclusion

Consumer behavior is constantly changing due to the many consequences of globalization. From an economic point of view, consumer preferences can have a significant impact on the national economy. Due to the arrival of a large number of companies into the domestic market, there have been changes in attitudes and consumer requirements. Customer requirements are becoming more complex. Compared to the traditional business, consumers have become increasingly interested in the range of after-sales services. Confirmation of the hypothesis set out in this research paves the path for further search for factors that have led to changes in the preferences of domestic consumers of the Moravica District. External factors and their increased impact are the result of global changes. Hence, we were not concerned with measuring

ethnocentrism on various adopted scales (the so-called NATID scales, the National Identity Impact Scale, or GENE, the Gudykunst Scale and the Singelis Scale, then the most famous and most used CET scales (CET-Consumer Ethnocentric Tendency Scale). We have identified changes in preferences and the measurement of ethnocentrism and the impact of demographic factors on it will be a challenge and an additional motive for conducting new research in this area. The results of the research confirm that globalization significantly influences the consumer profile in the Moravica region. The following question needs to be answered: how to protect domestic products and the economy, as well as what marketing activities need to be used in order to complement the mechanisms to protect and increase the competitiveness of domestic producers, both domestically and globally?

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Ways to reduce costs energy at the regional water company “prishtina”

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Abstract: Energy efficiency is a new domain in our country, so it is very much realistic and possible for us to succeed in implementing this field. The first EU-wide energy efficiency target was set in 1998. Member states agreed to improve energy efficiency by 1 percent a year over twelve years. Pristina Regional Water Company Utility is one of the largest companies in the state of Kosovo. Regional Water Company "PRISHTINA" cover 60% of the total population of Kosovo., with 8 municipalities included capital of Kosovo, Prishtina. This paper discusses energy issues facing public water utility sector, exactly for Regional Water Company “PRISHTINA”, steps that responsibility personnel can take to understand and reduce their energy use and costs, and funding resources for energy efficiency. Main focus in this paper is to perform possibilities for increasing energy efficiency of the Pumping Station in Milloshevë which supply with raw water Treatment Plant in Shkabaj, Kosovo.

Keywords: REGIONAL WATER COMPANY “PRISHTINA”, COSTS ENERGY, ENERGY EFFICIENCY, PUMPING STATION, DRINKING WATER SYSTEM, BILL.

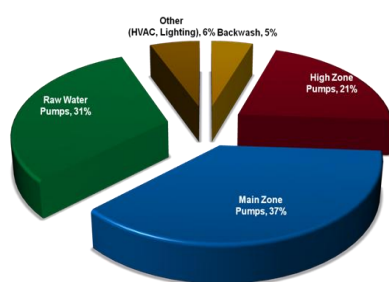
1. Introduction

Energy efficiency plays an important role in all water sectors. Energy is third of the largest operating costs for water system in Regional Water Company “PRISHTINA”. For Regional Water Company “PRISHTINA” systems, energy is needed for transports of raw water, water treatment process, water storage and distribution to the costumer. Energy usage can vary based on water source, treatment type, facility age, storage capacity, topography, and system size, which encompasses volume produced and service area. Regional Water Company “PRISHTINA” is well known with importance of reducing energy consumption and costs as a means to optimize overall system performance and to provide a safe water supply. But managing staff of the Regional Water Company “PRISHTINA” and operators may not be fully aware of the options available to them to manage their energy budget or to identify, prioritize and fund energy improvement projects. By applying energy efficiency, water utility sectors can build a successful energy management program and achieve energy savings.

Energy Consumption in Water Sector

In the United States / Europe, Water Utilities are one of the largest energy consumers by 3% of annual electricity consumption.

Similar situation is also Kosovo. Pumps station contribute about 90% of consumption of electricity in Water sector.



Typical Energy Use in Water Utilities

Energy Efficiency Needs in the Region

Targets for 2020

Republic of Kosovo has taken obligation to implement targets of the policy framework EU 20-20-20 which require:

- 20% reduction of greenhouse emissions,
- 20% of consumption to be from renewable energy, and
- **20% increase in energy efficiency.**

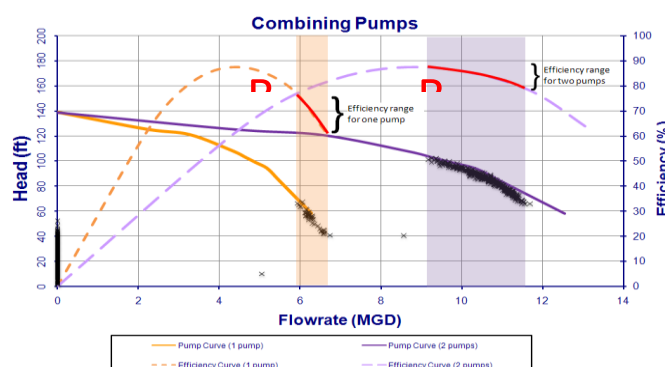
Targets for 2030

At least **27% energy efficiency** in savings electricity compared with the business-as-usual scenario.

Improving pump efficiency

Improving pump efficiency could be achieved by:

- Selecting pumps according to duty requirements,
- Measure pump performance regularly at least one per year,
- Replace or refurbish poorly performing pumps,
- Polish or coat pump surfaces,
- Use automatic pump, scheduling / pump selection software targeting efficiency



Case study: Refurbish or replace pump?

Pump Installed	1985
Duty (Flow & Water head)	Q=250 l/s @ H=48 m
Present Pump Efficiency	70%
Present motor efficiency	92%
Present Input Power	182.80 kWh
Price of Electricity	10 Cents / kWh
Hours running	24 h
Present running cost	160,132 €/year

Refurbish 20,000 €

Pump efficiency	82%
Motor efficiency	92%
Potential Savings	11%
Input power	162.962 kWh
Running cost	142,518 €/year
Saving after refurbish	17,613 €/year

Replace 60,000 €

New pump efficiency	84%
New motor efficiency	96%
New input power	153.11 kWh
Potential Savings	16.24%
New running cost	134,124 €
Saving after replace	26,007 €

The Regional Water Company “PRISHTINA” provide service for around 0.5 million inhabitants. The total water demand is predicted to increase from currently 49 Mio m³ to 66 Mio m³ in 2040.

In order to fulfill this water demand, it was necessary to build New Water Treatment Plant “SHKABAJ” which will enable water supply beyond 2030. The location of the water source, the Gazivoda Lake, the Iber Channel and the proposed location of the raw water intake at Mihaliq as well as the WTP Shkabaj are presented in Figure 1.

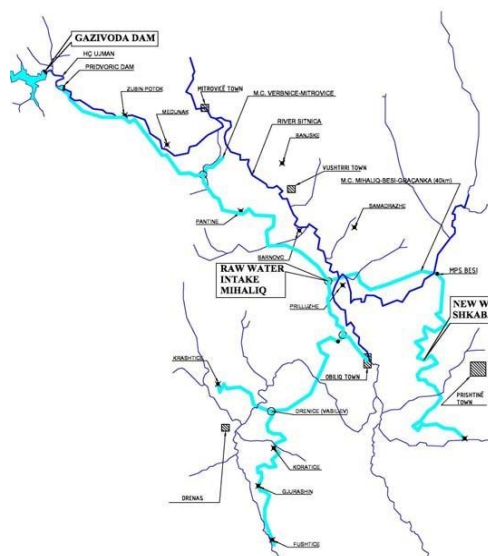
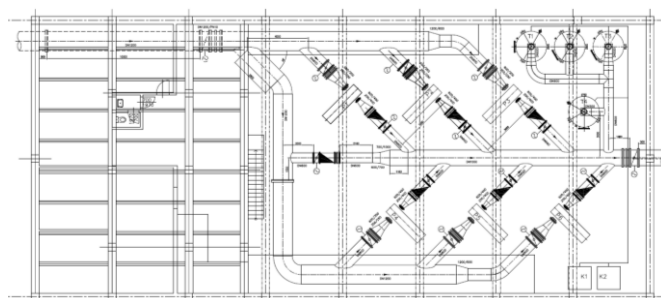


Figure1: Layout of Source, Pump Station and WTP

The pump unit is mounted on a substantial channel section base plate. The required static head is 49 [m]. The driven motor is a 400 kW, 4 pole machines, designed for use on a 400 V, 3 phase, 50Hz supply, and with a frequency inverter.



Hydraulic power in shaft of pumps can be calculated by expression:

$$P_{hydraulic} = \frac{\rho \cdot g \cdot H_{tot} \cdot Q}{1000} \quad (1)$$

Pump efficiency is determined by the following expression:

$$\eta_{pump} = \frac{Hydraulic\ power}{Pump\ shaft\ power} [\%] \quad (2)$$

Power in shaft of the pump is determined by the following expression:

$$Pump\ shaft\ power = Hydraulic\ power \cdot \eta_{mot} [\%] \quad (3)$$

Where are:

$\rho = 1000$ [kg/m³] – density of water

$g = 9.81$ [m/s²] – gravity acceleration

H_{tot} [m] – total head

Q [m³/s] – water flow rate

η_{pump} [%] – Pump efficiency

η_{mot} [%] – Motor efficiency

Table 3. Measured data from Pumping Station in Miloshevë

Nr.	Description	Unit of measuring	Present pump
1.	Head, H	[m]	69.6-12.4 = 57.2
2.	Flow rate, Q	[m ³ /s]	0.311
3.	Motor voltage, U	[V]	409
4.	Motor current, I	[A]	472.15
5.	Motor speed, N_R	[rpm]	1245
6.	Number of pumps in work	[pc]	1

Estimation of the hydraulic power is:

$$P_{hyd} = \frac{1000 \cdot 9.81 \cdot 57.2 \cdot 0.311}{1000} = 174.51 \text{ kW}$$

Finally estimated pump efficiency is:

$$\eta_{pump} = \frac{Hydraulic\ power}{Motor\ shaft\ power} = \frac{174.51}{282.26} = 0.618$$

Pump efficiency is: $\eta_{pump} = 61.8$ [%]

This mean installed pump consume **24.2 [%]** more energy for transport of the same amount of water compared with efficiency of designed pump. The annual of saving energy from only one pump for one year is: 70.92 kWh x 24 x 365 = 621 285.83 kWh.

If assuming price for 1 [kWh] is 0.10 €, then for one year company will save at list ~ **62 000 €**.

Conclusion

Based on comparison of the actual values with the design performance test values is found a deviation in pump efficiency from **86.6%** into **61.8 [%]**. This difference has direct impact in consuming **24.8 [%]** more energy for transport of the same amount of water compared with designed pump. Based on the actual operation parameters, are highly recommendations to be taken this actions for improving pump efficiency:

- Replacement of inefficient pumps,
- Correcting inaccuracies of the pump sizing,
- Impeller trimming.

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Radical innovations as a drive of Industrial Revolutions

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Abstract: The purpose of this publication is to elucidate the nature of radical innovations as drives of various industrial revolutions, as well as the conditions that led to their emergence. They incorporate substantially different technologies from existing ones and meet the needs of consumers in a new way and better than the current ones.

This article will discuss factors that can be used to evaluate an innovation as radical. A new view of Industrial Revolution will be presented, explaining critical factors and their relation to sectors of production. An invention may lead to the production of a new, unknown product at a certain time or to the provision of an unknown service. The use of these unfamiliar products or services on the market is characterized as a radical innovation. Relevant radical innovations in turn lead to industrial revolutions. It is argued that a paradigm shift takes place and we call it Industrial Revolution.

KEY TERMS: SCIENTIFIC BREAKTHROUGH, INVENTION, RADICAL INNOVATION, INDUSTRIAL REVOLUTION, SECTORS OF BUSINESS ACTIVITY, PRODUCTION PROCESS, PARADIGM SHIFT

1. Introduction

1.1 Definitions of basic terms used in the paper: scientific breakthrough, invention, radical innovation, industrial revolution.

The aims of this research is to find out what leads to a new industrial revolution and the correspondent paradigm shift that happens in businesses. Such a change is of enormous importance since there should be preparation prior to the change. If the business is not prepared then this might have detrimental effect on it. The practical value of the research paper is to outline some of the characteristics of radical innovations in different stages of the production process. Recognizing these features will help managers to start management of change in the enterprise. The result would be that when a paradigm shift occurs the business will be prepared to carry on with its daily activities instead of trying to survive.

According to the Center for Science and Technology Studies¹, “scientific breakthrough are those sudden discoveries that have a major impact on follow-up scientific research” (1). The Cambridge dictionary defines breakthrough as “an important discovery or event that helps to improve a situation or provide an answer to a problem”². Merriam-Webster dictionary states it as “a sudden advance especially in knowledge or technique”³. We do make a difference though between a breakthrough and invention. The Cambridge dictionary defines invention as “Something that has never been made before, or the process of creating something that has never been made before”⁴. But as we can see from this definition it is not evident that this ‘something’ is breaking new grounds and/or is a cutting edge technology. Thus, we have to distinguish between a breakthrough and invention. In accordance with a paper presented at the DRUID Celebration Conference in Barcelona, the large majority of all inventions are incremental, while only a small portion are breakthroughs (2).

From the interpretations of the term and with an aim for the objective of the research, the definition of breakthrough can be stated as: **Sudden advances or events in science or technology made through consistent, focused and synergistic efforts that help to improve the situation or to respond to a problem.**

Next we will define a very contradictory term, for which various definitions have been written. This is **radical innovation**. Some authors call it **revolutionary innovation** (Abernathy and

Clark, 1985) “it is an innovation that has a destructive effect on a particular part of the production process or on the product itself because it renders the established technical and production competence obsolete” (3). In 1990 Kim Clark and Rebecca Henderson upgrade the definition, thus innovation becomes **radical** and “... introduces a new meaning, potentially accepted as a paradigm shift” (4). Jim Kalbach proposes a model of innovation types where he describes that a “**breakthrough innovation** refers to large technological advances that propel an existing product or service ahead of competitors” (5). He specifies that breakthroughs often result from R&D, “striving for the next patentable formula, device and technology” (5).

One of the latest interpretations for explaining both breakthrough and radical innovation was given by a McKinsey consultant, Emma Muckersie in 2016. Breakthrough innovation is “difficult as it requires the introduction of **either** a new technology **or** a new business model”. While radical innovations require both the introduction of new technology and the adoption of a new business model. Both processes are difficult, since “they need a different approach to research that involves significant business changes as well as huge investments” (6).

Radical innovations then can be defined as: **revolutionary innovations that create new products. Through their widespread use, new industries are being created or existing ones are being destroyed. Radical innovations employ both the introduction of new technology and the establishment of a new business model, a paradigm shift can happen.**

We can see that a breakthrough is distinguished from a breakthrough innovation and radical innovation. A breakthrough is when something has been invented. But unless it is implemented in practice only then it can become an innovation.

The last term that should be identified is industrial revolution. It is interesting to note that most definitions of Industrial Revolution actually include a definition of the First Industrial Revolution. Encyclopedia Britannica defines “Industrial Revolution, in modern history, the process of change from an agrarian and handicraft economy to one dominated by industry and machine manufacturing”⁵. There is no definition that clearly explains exactly what is meant by the general term industrial revolution. This is most likely due to the fact that the first revolution saw a dramatic change in production, creation of machines, materials, production methods and others that completely changed the way people live. Although statistically, the number of inventions and innovations put into

¹ <https://www.cwts.nl/blog?article=n-r2u2c4&title=is-it-a-scientific-breakthrough>

² <https://dictionary.cambridge.org/dictionary/english/breakthrough>

³ <https://www.merriam-webster.com/dictionary/breakthrough>

⁴ <https://dictionary.cambridge.org/dictionary/english/invention>

⁵ <https://www.britannica.com/event/Industrial-Revolution>

practice, in the Second Industrial Revolution, is likely to top the rankings (7).

If the term is considered, according to the Cambridge dictionary industrial means “the companies and activities involved in the process of producing goods for sale, especially in a factory or special area”⁶. While revolution “is a very important change in the way that people do things”⁷.

2. Factors that bring about industrial revolutions.

Since the Industrialization Age, human kind develops more and more complex activities. During the last century, people talked about the First and the Second Industrial Revolutions. Then a Third was acknowledged. Today we discuss the Fourth and the Fifth Industrial Revolutions, known as Revolution 4.0 and 5IR. A new way to look at what are the important factors leading to different industrial revolutions is presented by Dr. David Brown⁸. In an interview for Forbes he stated that there are three characteristics that drove the first two revolutions. These factors are also present now in the Third Industrial Revolution. They are: a **new energy source**, a **new communication system** and a **new financial system** (8). In every industrial revolution these factors develop and become more complicated.

The research led to an interesting co-relation. The factors of production could be linked to a certain Industrial Revolution. In the past 100 years, developed economies have seen a transition from an agrarian economy (primary sectors of production), to manufacturing-based (secondary sector) economy, to an economy where the tertiary sector dominates. The use of better technology led to improved labour productivity, which enabled a higher output of manufactured goods and agriculture with less labour. The increased productivity helped in: increased income to spend on leisure activities and spare labour to work in a labour intensive tertiary sector (9). “Technological advances has enabled new service sector industries to develop. Tertiariation started.” (9). Since this trend continued to develop, a **quaternary sector** has been established, somehow as a subdivision of the tertiary. It has been improved from the tertiary because it is focused on knowledge, intellectual activities, and is often associated with technological innovation. That is why sometimes it is called the “knowledge economy” (10). Various types of e-services, IT, the media, government, culture, education, scientific research, and web-based services become typical of the “post-industrial” economies (11). The workforce involved is typically well educated. Another subdivision of the tertiary sector is the **quinary sector**. It incorporates the “highest level of decision-making in a society” (10), who formulate policy guidelines in the different industries, the various government departments, in the sciences and technology, which have a far-reaching impact on the economy.

In the following table the sectors of business activity are linked to a corresponding industrial revolution and their features, according to Dr. Brown are outlined and further developed.

3. Identifying factors that can be used to evaluate innovation as radical.

From a managerial point of view, one of the most important processes is manufacturing, or in general terms – the production of the product/service. In the process, a product is produced that will be sold and will lead to a profit for the enterprise. With this profit,

materials will be purchased again, other resources needed for production will be paid and the process will continue and become self-sustainable. Let's look at figure 1.

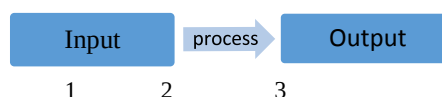


Figure 1: The production process

The figure expresses the three main parts of the production process, which are important to managers: input, process and output. Each part can be discussed in order to consider where in the production process would be possible to obtain a scientific breakthrough, so invention can be made that might lead to radical innovation.

Component 1: Input

This component takes into consideration the so-called input factors, which can be the following:

- Value of materials
- Materials
- Other resources needed

Value of materials - When choosing basic materials for the production process, materials that are with low value are always selected so that the cost of the finished product is not too high to sell at a certain price. What can affect the value is finding a supplier that offers material with the quality required by the manufacturer, but with a lower purchase price (*part of a new business model*). New material cheaper than the previous one can be discovered, too (*scientific breakthrough*).

Materials – some materials can be replaced by substitutes, in case they have the necessary physical and chemical qualities required for the properties of the material (*scientific breakthrough or invention*); a scientific discovery of a new chemical element, an alloy, a polymer, etc. (*scientific breakthrough, invention*).

Other resources - human resources, such as lower-paid workforce, skilled and trained personnel (*new or improved business model*).

Component 2: Process

The following factors are distinguished:

- Transformation
- Processes
- Machines, apparatus and equipment

Transformation is the alteration of raw material into a ready-to-use or semi-finished product. The methods of transformation may differ in whether the same physical and chemical processes are used. In the research and development process it is possible to discover changes that can be performed under better conditions, or without the use of expensive material. For example, the use of newly discovered materials, compounds, or alloys can make the process cheaper, faster or more profitable for the manufacturer (*scientific discovery, invention, business model change possible*).

Processes - The production of a particular product follows specific steps. Each phase of the production process is important for the quality of the product. When discovering new material, a new machine, or a new production method, there may be a reduction in the number of processes leading to the end product (*breakthrough, invention*). It can also lead to cost reductions of these processes. Some of them are more labor intensive, others are more expensive, so finding a cheaper alternative will be a good source of radical innovation.

⁶<https://dictionary.cambridge.org/dictionary/english/industry>

⁷<https://dictionary.cambridge.org/dictionary/english/revolution>

⁸https://www.researchgate.net/profile/David_Brown22

Table 1: Relationship between Sector of business activity and Industrial revolution
 1 – a new energy source; 2 – a new communication system; 3 – a new financial system

Sector of business activity	Industrial revolution	Features
Primary Secondary	First Industrial Revolution mid-18 th to beginning of 19 th century (12)	1. Wood → Coal Use water and steam power to mechanize production (13) 2. Steam-powered printing press, cheap paper & magazines, delivered rapidly (via trains) 3. London Stock Exchange (8) A paradigm shift in production, transport
Secondary Tertiary	Second Industrial Revolution – end of 19 th to beginning of the 20 th century (7)	1. Coal → Crude oil Electric power to create mass production 2. Telegraph, telephone, electrification, internal combustion engine 3. Limited liability corporation, reduce risks for entrepreneurs A paradigm shift in the use of energy
Tertiary	Third industrial Revolution – 1969 (14)	1. Crude Oil → Renewable resources 2. The Internet, WWW 3. The financial markets are less advanced, crowdfunding, peer-to-peer finance Truly global is the paradigm shift; Knowledge Economy; On-line education; Digitalization – use of Electronics; automated production
Quaternary	Fourth industrial revolution 1980s (15); (16)	1. Tries to increase to the 50-100% range of using renewable resources, battery storage technology, biomass 2. IoT, healthcare advances, needs more stable internet, better security, cheaper components, augmented and virtual reality, block chain 3. Google-wallet, Apple-pay, Africa-led mPesa. US Internet giants registering as banks – cheap infrastructure and billion-size customer base; cryptocurrencies The paradigm shift is unlimited access to knowledge through the use of technology; industries are disrupted; transformation of entire systems of production, management and governance; AI, Robotics, IoT, 3D printing
Quinary	Fifth industrial revolution, Davos, 2019 (17)	1. Sustainable development goals (17) 2. New, undeveloped methods of communication based on augmented and virtual reality 3. To change from “for profit” to “for benefit” operating model Humanity, trust, culture, values, ethics (17)

Machines, apparatus, equipment – During the development of technology, new, improved and sophisticated machines are produced (*scientific breakthrough, invention*). Usually, they are more expensive (but the payment is one-off if purchased). On the other hand, this implementation leads to a decrease in labor used, which reduces the cost of production (*change of business model*). The use of new technology can lead to the introduction of completely new processes.

Component 3: Output

The following factors influence the output needed to reach the end consumer.

- Distribution channels
- Time
- New use of the product
- New product

Each manufacturer has its own **distribution channel** which supplies the finished goods to consumers. The channel can be long, consisting of many stages, before reaching the end user. Or it can be really short, when the product is purchased directly from the manufacturer. In case there is a change in the way products reach the end user, this might be because of an introduction of a *new business model e.g. radical innovation*.

Time - The widely used proverb "Time is money" applies to businesses. Time is an important component of the whole

production process. The significance to receive materials on time (JIT method), process them in a timely manner (use Kaizen), leads to the last phase – output. It might be of great importance for some products to reach the customer on time or as soon as possible (*invention, change of business model*).

A **new type of product** or new use can be achieved when at least one of the previous two components is changed. For example, if a product is made of new material and has new properties, it may possibly be used in a different, previously unknown way, which could lead to a change of the *business model*. This applies to products that have been modified. New products can be *invented*, so they can become part of a *radical innovation*.

4. Analysis of findings

The above information can be synthesized and some conclusions can be reached. The discovery of the steam engine, the use of coal and the creation of factories leads to a change not only in the inputs, but in the process component, too. That is why the outcome is different. Steam engine is considered a radical innovation, which led to mechanization of the production process. This on its own, caused a paradigm shift to happen. Not only cheaper and higher quality material started being produced, in large quantities for a very short amount of time (manufactured goods), but also the railroads and the steamships used to transport them (12). In the Second Industrial Revolution, the paradigm shift has happened when a new source of energy has been discovered – crude

oil. Thus, electric power initiates the creation of mass production. Some examples of scientific breakthroughs and inventions are: the discovery of petroleum and its properties, the wide use of electricity, standardization of goods like soap, clothing etc., the internal combustion engine and many others. As a conclusion we state that the secondary sector of business activity can be directly related to the First and Second Industrial Revolutions, since it includes manufacturing, processing and changing raw material into finished goods. The first two revolutions had changed greatly the input and the process phases in the production process. The Third Industrial Revolution is driven by technologies of the digital engine of the Internet, renewable energy, AI and 3D printing. The transformations that had started already are changing everything we do, make, use and plan for the future (14).

The failures of economic systems that we are observing now: insufficient use of renewable resources, expensive materials for 3D printing and building AI, breach of security in some countries and many other factors, lead to the Fourth Industrial Revolution, which is knowledge based. Scientists, businesses, start-ups and other organizations are trying to educate people, to find solutions to the recurrent problems. That is why the Founder and the Executive Chairman of the World Economic Forum (WEF), Klaus Schwab in 2016 calls this period a Fourth Industrial Revolution, or 4.0 and states that "... it is evolving at an exponential rather than a linear pace,... it is disrupting almost every industry in every country. And the breadth and depth of these changes herald the transformation of entire systems of production, management, and governance" (13).

Some of the discussions in the WEF in Davos 2019, were focused on the global climate crisis becoming a catastrophic problem. But there is still something larger, leaders have said; "the march of successive industrial revolutions intensifies the risks of dehumanizing economic progress, to the point that we face now an existential threat in both environmental and humanitarian terms" (17). That is why the Fifth Industrial Revolution will be dedicated to humanity. Another goal would be to try to prepare human kind for the challenges ahead. A big obstacle, though is presented by the fact that "65% of children entering education today will end up in careers that don't yet exist" (17).

5. Conclusion

The research has outlined some fundamental points. Radical innovations are changing the paradigm of industries and this is being described as an industrial revolution. In relation to this, a distinction is made between the Third, Fourth and Fifth Industrial Revolutions.

Society undergoes different stages of development. Each stage marks a significant change in the way of human existence caused by a corresponding change in the way of thinking. This has been stimulated by a change in the tools of labor. Inventions and innovations are an integral part of this evolutionary process. Changing the tools of labor is drastic, that is why it leads to striking transformations in people's lives. If radical innovations are recognized and acknowledged, then successfully implemented by managers into the business, they may alter a business entirely by changing existing market, eliminating competition, or completely creating a new market.

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Ways to improve the information and telecommunication industry in the republic of kazakhstan

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Abstract: the article proposes a number of measures that may increase investment attractiveness of the information and telecommunication industry in Kazakhstan, lead the industry to a long-term economic growth and have positive impact on the country's economic diversification.

Keywords: STAGNATION OF THE INFORMATION AND TELECOMMUNICATION INDUSTRY, TAX BURDEN, TECHNOLOGIES

1. Introduction

Comprehensive analysis of socio-economic development forecast for the Republic of Kazakhstan for 2019-2023 [1], the Ministry of National Economy Statistics Committee data [2] and the financial reports of the major players in the information and telecommunication market of Kazakhstan [3] do not allow us to expect any improvement in the industry in Kazakhstan without action from the government.

The industry has been stagnant for more than 3 years, and first of all it concerns the telecommunication sector which represents more than 70% of it. The share of the industry in the total gross domestic product (GDP) of the country has a steady downward trend (see figure 1).

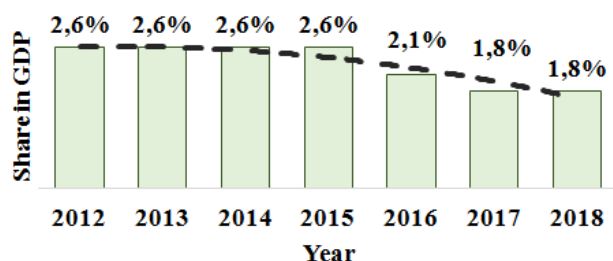


Figure 1. The decline in the share of information and telecommunication industry in Kazakhstan's GDP

The average annual rate of outflow of investment in fixed assets of the industry amounted to 6% from 2012 to 2018. Only investment from the state budget which share in the investment structure does not exceed 2% and is of little importance shows a positive trend of 16.9%.

Historically up to 90% of investments are accounted for by market participants own funds and their outflow indicates a low investment attractiveness of the industry.

2. Analysis of factors that have a negative impact on the development of the industry

The article does not consider the global factors such as slowdown in the world economy, the impact of sanctions against Russian Federation and others. It analyzes only the factors that, in my opinion, can be regulated by the government and the market participants in Kazakhstan.

According to the State Revenue Committee of the Republic of Kazakhstan data for the period from 2012 to 2018 [4] the budget revenue from the information and telecommunication industry grows at an average annual rate of 6.0% while the income of the participants of the industry grows at 4.6%. Tax proceeds are not adjusted once the market situation changes and it leads to increase of tax burden on the industry. Here the government has to develop regulatory mechanisms and perhaps make one-time point solutions to eliminate the imbalance.

Now let us consider the situation from the customer's point of view. The information and telecommunication industry in Kazakhstan is almost completely focused on the domestic market,

where the negative trend of social indicators still remains. The purchasing power of population is declining because the consumer prices increase faster than wages so there will not be a significant increase in ARPU. We also need to consider the outflow of fixed-line subscribers and the saturation of mobile communications and pay-per-view TV markets, in other words we should not expect a noticeable growth in the overall number of subscribers in the medium term. The low rate of natural population growth (2% per year) and the high rate of emigration (65% per year) [2] confirm this conclusion.

Since we know about the strategy and the new services of the telecommunication companies and other participants of the industry only from the open sources, in theory there may appear a new trend that would dramatically increase the income of the industry at minimum cost as was the case with explosive income growth in mobile network. The problem is that the investments in the new technologies development, expansion of the product list, etc. for the previous period have not paid off yet, while the emergence of new technologies and new solutions from the vendors, as well as the increasing demands on quality characteristics of the products and services already require new investments.

3. Measures required for the recovery of the industry

The information and telecommunication industry is strategically important for Kazakhstan and corresponds to its long-term development interests. It is the basis for transition to the digital economy based on the introduction of digital technologies. The development of the industry will contribute to both long-term economic growth and economic diversification of Kazakhstan, and now it needs government support.

For the last 10 years, in my opinion, there have been no government programs aimed directly at developing the industry, only the ones that affected it indirectly like Digital Kazakhstan and some others. Due to the development of 5G a direct government program would be very useful. It is also important to draw the attention to the industry's payments. For the period 2012-2018 the average annual income growth rate of the industry amounted to 4.5% while the growth rate of the payment for using long-distance fixed and mobile telephony reached 8.4% and the payment for using radio spectrum reached 5.2%. In general the indicators of the tax burden on the information and telecommunication industry in Kazakhstan are 2-3 times higher than the same indicators in such large countries as Russia and Canada. Since there are no government programs aimed at developing the industry, significant reduction or cancellation of payments for a long period could be the only real way to increase its investment attractiveness.

In Kazakhstan the B2C segment demand lags behind the new technologies supply at the moment. First of all it affects the structure of income. The growth rates of income from B2B and B2G segments are already significantly higher than the growth rate of income from B2C segment. The ordinary subscribers do not actually use even the capability of 4G while the B2B customers already have a practical interest in 5G and the FG NET-2030 focus-

group organized by the International Telecommunication Union is already working on 6G/NET-2030.

Today global trends in the industry include 5G, artificial intelligence, blockchain, IoT, OTT Services, cybersecurity, augmented and virtual reality, biometrics, network virtualization, cloud computing and Big Data. The list goes on, but in my opinion there are 4 main areas where we should allocate the resources to obtain both quick and long-term results at the current level of development:

1. 5G
2. IoT
3. Blockchain
4. Big data

All these 4 areas focus primarily on B2B and B2G market.

Obviously the most time-critical technology is 5G that is expected to reach its peak of investment in the next 2 years. In order to prevent technology gap from other countries Kazakhstan should invest €0.5-1 billion in 5G in the next 5 years according to various estimates. The IHS Economics & IHS Technology forecast in their article [5] the global economic activity in 2035 after 5G implementation. According to it 5G deployments will positively affect virtually every industry sector. The estimated 5G enabled global output will reach \$12.3 trillion and the enablement percentage by industry will range from 11.5% in the information and telecommunications sector to 2.3% in the hospitality sector. If we apply world scenario to Kazakhstan the expected 5G enabled output in its information and telecommunications sector may range from 0.4 to 1 trillion tenge.

Implementation of 5G projects will enable to scale up the deployment of IoT projects and prepare the ground for its widespread use. According to PRNewswire's report [6] the 5G services market will grow to \$123.27 billion by 2025. In the outlook the number of Internet connected devices in Kazakhstan will reach 100 million in 2025. Telecommunication companies have all the conditions to increase their revenue both from providing Internet access to IoT service providers and from their own projects of smart home, smart city and smart office.

The predicted average annual growth of 17% in the world market for public cloud services should attract the investments in building of data centers. At the moment the main customers of data centers are banks and financial organizations. According to the statistics made by profit.kz website [7] presented in Figure 2, their share is 68%.

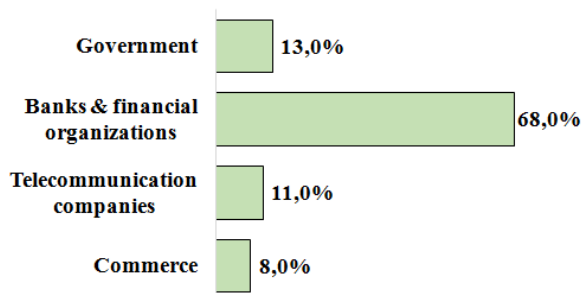


Figure 2. Data centers income structure

As we can see the potential of small and medium businesses has not been fully realized yet, while in the government sector there are conditions for growth.

It is worth to note that Kazakhstan has competitive advantages in building of data centers, such as low electricity costs which account more than one half of total operational costs, relatively cold climate in some areas which is ideal to maintain optimal

temperatures for the equipment, low prices for land and property leasing, modern data network and qualified specialists. On the downside, there is no support from the government.

Implementation of the data centers projects will not only provide profit from their rent, but also pave the way to the markets of blockchain, big data and cloud services.

The Statista website gives the average annual growth rate 49.4% for big data stored and maintained in data centers, and it is expected that the big data market will reach \$90 billion by 2025 [8].

The average annual growth rate of investment in blockchain is forecast to increase to 64% before 2025 and it is expected that the blockchain market will reach \$2.3 billion by 2021 [8].

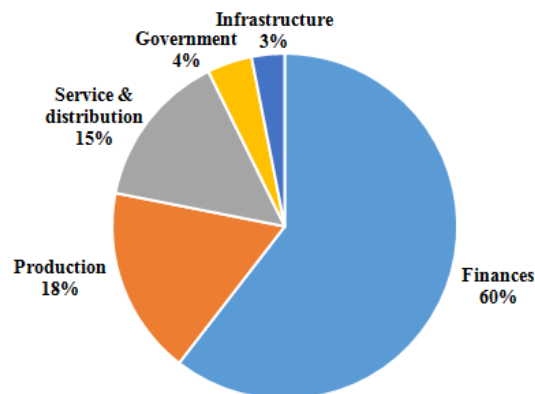


Figure 3. Global blockchain market shares by economic sectors

Figure 3 shows the distribution of blockchain between different economic sectors. In my opinion this is a prospective area that will allow Kazakhstan telecommunications market follow the world trends, get high incomes and attract investments.

4. Conclusion

Since the industry has been stagnant for a long period and its participants lack resources, the list of priority areas should be either reduced or revised. The final result will depend on the form and the level of government support. For example in spite of the long and low payback from the projects financed by the telecommunication companies themselves under public-private partnership, the project to increase Internet access in rural areas is attractive enough because it is guaranteed by the government and has minimal risks.

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8. <https://www.statista.com/>

Application of the method of clustering educational content in a social network

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Abstract: Currently, modern social technologies are used by hundreds of millions of users, are available free of charge, attractive and interesting. The article discusses the possibility of the use of social networks to improve e-learning institution of higher education. Considering the large amount of information disseminated by university students on the social network, it is proposed to use methods of data clustering - k-means (k-means) in the article, to personalize the content of educational materials. The results of the research can be used by teachers and instructors of higher education institutions to improve the content of the e-course and personalize e-learning.

Keywords: SOCIAL NETWORK, E-EDUCATION, PERSONALIZATION OF EDUCATIONAL CONTENT, CLUSTERING METHODS.

1. Introduction

Scientific achievements in the field of information technologies at the beginning of the 21st century led to the development of the concept of personal education (PLE - Personal Learning), the idea of which was to provide educators and curators of e-courses with the ability to customize training to the needs of each individual trainee. The concept of "Personalization of education" is broader than simply "individualization" or "differentiation", since it gives the learner a definite choice of what is being studied, when it is studied and how it is studied.

Personalized learning is the adaptation of the pedagogy, curriculum and learning environments to meet the needs and styles of the individual students learning. The key elements that are customized in personalized e-learning are: the pace of learning, the learning approach, learning activities, educational content. In a truly personalized e-learning environment, students are given the opportunity to learn what they want, when they want, and even the method of teaching! [1-4]

The personalization of education is directly related to the need for a transition to a knowledge society, when the learner is at the center of the educational process and the learning is carried out at the place of his finding, and the educational environment is being built up for him.

Many foreign universities, realizing this, have started creating educational management systems (LMS) that allow personalizing educational environments [5], such as the Bolton University of Manchester in England.

Currently, it is common to use the Learning Management System (LMS) throughout the world at universities. However, these platforms are used mainly for administrative purposes, and its educational effect is of little importance. In such systems, for the educational perspective, students have the opportunity to check the learning content, and they can interact with their classmates and teachers. However, the rigid structure of the general systems of e-learning management does not stimulate the active participation of the learner in the learning process and the improvement of his knowledge.

The understanding of this led in the first decade of the 21st century to numerous attempts to create a learning environment in which the students learning environment was linked to the personal spaces of other learners to effectively share knowledge and create new knowledge together. The use of social applications and social networks provides a different approach to e-learning than that provided by the use of learning management systems.

The social network expands the individual needs of the student in the learning process, and also provides contact with a large number of people who share the same interests and goals. Therefore, this article explores the possibilities of using social networks to improve e-education by personalizing the content of educational materials. To identify similar content educational materials distributed by students in a social network, the method of k-means data clustering is used.

2. Related work

The analysis of social networks is based on the mathematical theory of graphs. It is presented in the work of the Hungarian mathematician Erdos [6]. Mathematically, a network is a set of nodes (in our example, these are the students of the universities) connected by lines characterizing the relations between nodes. Each relation connects several nodes. The first fundamental research of social networks dates back to 1979 and is reflected in the work of Welman [7]. He developed cluster modeling algorithms and basic metrics for analyzing social networks.

In the publications of some researchers - Bennett S., Bishop A., Dalgarno B., Purcell B.K., Xe X., Schröder A., Minokha S., Schneider S. and others discuss the possibilities of wide use of social networks in higher education. [8-11]. They even argue that social technologies support constructivist approaches to learning and have the opportunity to exchange online learning more than it did in traditional learning environments. They highlight the benefits of using social networks as tools for developing a new style of learning, and negative impacts that can affect the learning process in order to provide a justification for using social networks in higher education. In their works, they show that social networks have become a ubiquitous tool for communication, entertainment and non-formal education for both students and teachers.

Social technologies support flexibility in learning processes and ensure easy publication, exchange of ideas and re-use of study content and comments. They also support links to relevant resources in the information environment run by students and lecturers themselves. In addition, some authors argue that educational activities in social networks are valuable for the development of students' collaborative work skills, where students use attractive social technologies, and in some cases the use of social networks has contributed to higher indicators in learning activity [12].

In addition, thanks to the use of social technologies such as blogs, wikis and social networking sites, students are more likely to become more active. It allows students to express themselves more freely, as they are given the freedom to publish their work on the Internet through blogs and wikis. Using social technologies can further increase the motivation of students and draw attention to detail, which will lead to a general improvement in the quality of work. The authors noted that when students publish their work in a social network, their work is mostly original, interesting and attractive to others, is positively evaluated by peers and teachers [13].

So, Terry Anderson and Jon Dron Anderson[14] in his article "Integrating learning management and social networking systems" told about the Athabasca Landing system (Athabasca University in Canada) that uses a social environment to improve teaching or learning. This system uses the Elgg (elgg.org) based social media and network platform to create a social networking application that can be used by any teacher, administrator or student at Athabasca University to create many different kinds of individual, group, network and set communications.

Another author - Veeramanickam Murugappan [15] from Department of Computer Sciences and Engineering, Karpagam

University (India) in article “A Smart E-Learning System for Social Networking” describes a smart cloud e-learning system with social networking based on architecture level of social networking and E learning cloud system to support E learning interactions in worldwide environments.

Julian McAuley and Jure Leskovec from Stanford university (USA) have developed [16] a novel machine learning task of identifying users' social circles. This model is used to detect ego-nodes in a social network that combines the structure of a network, as well as user profile information. For each such node, they identified its members and a profile similarity profile for a particular circle.

Tianyi Hao and Longbo Huang (Institute for Interdisciplinary Information Sciences, Tsinghua University) in their work “A Social Interaction Activity based Time-Varying User Vectorization Method for Online Social Networks” [17] are considering the problem of user modeling in online social networks, and propose a social interaction activity based user vectorization framework, called the time- varying user vectorization (Tuv), to infer and make use of important user features. This method allowed them to extract hidden user properties in a social network and study the interaction of students and teachers.

3. Distinctive features of standard education management systems and systems using social networks

Although most social networks that currently exist have not been designed for educational purposes, they have certain functions that can be very interesting and important in the educational process. There are some tools for supporting e-learning, including blogs, discussion forums, chat rooms, file sharing, video conferencing, electronic portfolio and wiki. All of them can be used to support activities related to the learning process. Some of these tools can be integrated into e-learning platforms. Figure 1 shows a diagram of the joint training platform, using a social network.

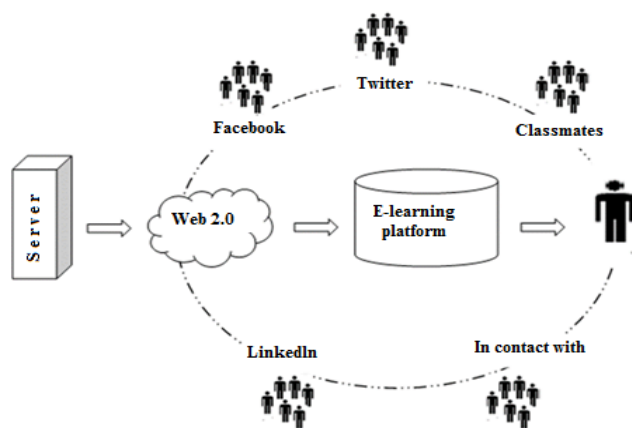


Fig. 1 Collaborative e-learning environment with online social networks

For example, social networking blogs can be used by students to spread their ideas, publish their work, and bookmarks allow students to add hyperlinks to view certain sites by students with similar interests. To place multimedia information, you can use the file sharing network - YouTube.

Social technologies can be used by students to jointly study ways to solve their problems with group members or to organize joint training and learning groups. Cooperating with peers, they expand their formal and informal interactions, establish an active relationship with them, seek to work with concrete results or produce results in online and offline modes.

The use of social networks to support e-learning is part of an active and social type of education in which students are problem-oriented. The main points of the learning process are self-regulatory actions to solve problems, which involves an approach to social constructivism, in which the student must manage his own learning process. This type of training means that it is impossible to structure and determine in advance the student's actions in the learning process. Actions should start with a problem or project, and the network in turn provides tools and resources that support the learner in the problem-solving process. Table 1 shows the distinguishing features of e-learning platforms and the use of social networks [18].

4. Using methods of clustering social networks to personalize educational content

In order to draw certain conclusions about the influence of social networks in education, to simulate student interaction and to predict their behavior, it is necessary to analyze the information existing in them.

Information that can be extracted from the social network to analyze the interactions between users (in this case, between students, teachers and students, instructors and students, etc.) can be the following:

- Username;
- the number of subscribers of this user (the number of users who read his messages);
- number of friends of this user;
- the number of messages sent by this user to another user;
- the number of messages sent by the user;
- external links found in the messages of this user.
- number of mentions of this user by another user;
- the number of mentions of some external link by the given user.
- the number of times a particular user's entry was viewed by other users;
- the number of likes (approvals) of a particular record of this user.

One of the directions of social networks analysis is the study of its structure, where all network participants (in this case, students, teachers and instructors) are considered as graph vertices connected by ribs to other network members. This method is used to simulate communication links between network users, analyze information flow and find communities on the network. Here the main attention is paid to such characteristics of the network nodes as centrality, relative location, intensity (edge weight) and directionality of interactions, clustering coefficient (measure of connectivity of network nodes) [19-21].

Visualized graphs allow us to identify the nodes that are closest, to find dense clusters of activity. One of the main parameters of the graph is "degree centrality", which expresses the ratio of the number of links of a particular node to the total number of other nodes. If for some node this parameter is 1, this means that this node is connected to all other nodes of the network, if it is 0, then this node is isolated. This indicator shows the degree of "celebrity" node, shows that the student has a great influence on the rest. Figure 2 shows a fragment of the visualized graph for analyzing student interaction in a social network. Figure 2 shows that the user of the network R1 has a higher degree of centrality than the user R3 (less communication lines are drawn from R3 than from R1).

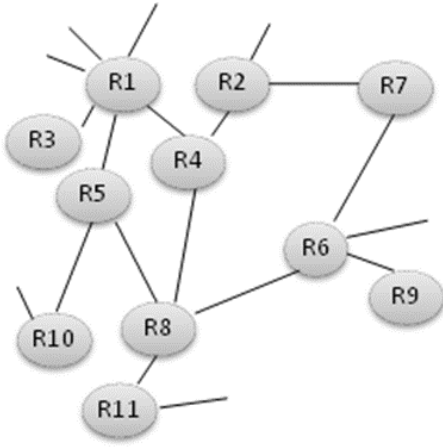


Fig.2. Fragment of visualization of interaction of students in a social network

5. The use of k-means for clustering educational information distributed by students on a social network

In social networks, communications can be strong or weak, depending on the intensity and frequency of communication. In order to select the necessary information from a large amount of heterogeneous data, it is necessary to use methods that allow analyzing the most important. For example, you can reduce the number of users viewed, limited to relatively popular (leaders) of them, which form the majority opinion. The leader of opinions has a large number of subscribers (friends), created messages, likes and comments from him, the information spreads faster and it affects more users.

According to some authors [22, 23], the cumulative analysis of the structure of social graphs and text data obtained from social networks is the most effective method of investigating the interactions between network users. In our article, to analyze the structure and content of information exchanged by university students in a social network, we will use data clustering methods.

For the clustering of social networking data, various methods are used: k-means and c-means, a binary cluster tree and a number of others [24, 25].

In our article, for clustering of educational information disseminated by students in the social network, we will use k-means, which is the root-mean-square deviation of the sum of the distances from each clustering object to the cluster center.

To this end, we denote by N the number of students registered in a particular social network who are enrolled in a related specialty at the same higher education institution course, and through $\{X\}$ - the total number of training materials on the same subject matter that they exchange on the network.

Next, through X we will denote the specific i educational material exchanged in the network by the N_i number of students. Then, to compare the popularity of X_i educational material, we introduce the following coefficient:

$$\kappa_i = \frac{N_i}{N} \quad (1)$$

The closer this ratio is to 1, the specific training material will be considered popular among students, closer to 0 - unpopular.

But very often we do not know the content of the educational material in advance and unite the texts that are not very similar in content to one group. For comparison of texts, such characteristics as frequency and number of used keywords in the text are widely used.

Denote by λ_k^i - the frequency of using the k -th keyword in some i -th educational material, and through $\bar{\lambda}_k$ the average frequency of the k -th keyword in all n documents.

The average value of the metric of some k -th keyword in all n documents:

$$\bar{\lambda}_k = \frac{1}{n} \sum_{i=1}^n \lambda_k^i \quad (2)$$

When comparing 2 texts of the same length, the frequency of using a certain keyword, should not be much different.

The root-mean-square deviation of the k -th keyword is found as:

$$\sigma_k = \frac{1}{n} \sum_{i=1}^n (\lambda_k^i - \bar{\lambda}_k)^2 \quad (3)$$

We will include teaching materials in one group, in which the root-mean-square deviation of the frequencies of occurrence of k keywords is in a certain admissible range, that is, the density of the cluster core is below a certain value.

The cluster nucleus, in a general sense, is the part of the cluster elements closest to the center. It is assumed that most of the cluster data is concentrated in this area.

The radius of the cluster nucleus from the Chebyshev's inequality [26,27] is defined as:

$$R_i = \bar{r}_i + \sqrt{2} * \sigma_i \quad (4)$$

Here $\bar{r}_i$ is the average distance between the cluster center and the cluster elements, and σ_i - is the root-mean-square deviation. At least 50% of the frequencies of the keywords of the teaching materials are removed by no more than $\sqrt{2}$ standard deviations from their average value.

The cluster density is calculated as follows:

$$\rho_i = \frac{R_i}{M_i} \quad (5)$$

R_i is the radius of the cluster core, M_i is the number of elements that make up the nucleus. The coefficient of clustering of training materials will be the average density:

$$\bar{\rho} = \frac{\rho_1 + \dots + \rho_m}{m} \quad (6)$$

The clustering coefficient is a measure of how well the nodes of a graph are associated with a particular node. When the clustering factor is closer to the specified value - it means that the graph is tightly grouped around some nodes; when it is much smaller than the set value - this means that the links in the graph are relatively evenly distributed among other nodes. In the clusters found, the nodes of the graph are concentrated, which reflect tight connections between students of the social network exchanging the same content in the same content.

As a result of the study, it is possible to identify which educational materials are of interest to students, and which are not of particular value to them. Information obtained from social networks can be used by teachers of higher educational institutions

to improve the content of educational materials and their adaptation to the individual characteristics of students.

7. Conclusion

In this sense, a person's hobbies, presented as a graph of teaching materials exchanged by students in some social network, provide the means for further personalization of educational content. Based on the analysis of the information received from the network, teachers and instructors of the higher educational institution have ideas about the interests and preferences of both individual students and groups of trainees. This information gives teachers the opportunity to improve the content of the e-course and tailor it to the individual needs of the learner.

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Diatom endemic species in Albanian part of Ohrid lake

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Abstract: The presence of endemic species in Lake Ohrid exhibit significant spatial variation, related to prevailing climate, lake morphology and fluvial input into the lake. The high biodiversity of the lake was supported by the subaquatic inflow of cool, effects of climate change on the entire lake ecosystem, affects deep water oxygen availability, nutrient cycling and trophic linkages may yet be profound as the structure of the endemic diatom taxa. The dilution of time by time lake waters with pure spring waters is important for the oligotrophic status of Lake Ohrid and its subsequent low algae productivity. We found the highest number of endemic species at different depths from the lake shore, compared to the littoral area, where almost endemic species are either very widespread or almost absent.

Key words: ENDEMIC SPECIES, LAKE OHRID, BIODIVERSITY.

1. Introduction

Lake Ohrid has a surface area of 358 km a maximum depth of 288.7 m, and a mean depth of 155 m (Albrecht and Wilke 2008), it is one of the most voluminous in Europe. The lake has a maximum length of 30 km and maximum width of 14.5 km; its coastline is 87.5 km long, 31.5 km of which are within the borders of Albania. Lake Ohrid has very early Pleistocene or Pliocene origins, and how we make them one of the most ancient lakes in the world (Albrecht & Wilke, 2008; Kabo, 1990-91; Qirjazi, 2019; Pano, 2015). As a result of early age, there has been independent development of endemic biodiversity. Although the total number of endemic species is higher in the lakes Baikal, Tanganyika, Victoria and Malai, Ohrid remains the most diverse lake in the world by size, with an average of about 36% of the species are endemic. Within the Ohrid watershed, endemism occurs at different spatial scales with some species being endemic to the lake proper and other restricted to its adjacent and surrounding springs or only certain locations isolated by horizontal and vertical barriers. As a result of early age, there was independent organization of endemic biodiversity in Lake Ohrid (Albrecht et al. 2010). Based on data from the National Biodiversity Strategy and Action Plan (MEEPP, 2003), there are 212 taxa endemic of Lake Ohrid. Using these data Albrecht and Wilke (2008) argued that Lake Ohrid is probably the most diverse lake in the world considering its surface as compared to other lakes. Although the total number of endemic species is higher in the lakes Baikal, Tanganyika, Victoria and Malawi, Lake Ohrid is much smaller than these lakes and thus remains the most diverse lake in the world by its size. Based on the studies by Albrecht and Wilke (2008), the level of endemism in Lake Ohrid is about 36% for all taxa and 34% for wildlife. According to these authors there are more than 1,200 species of plants and animals in Lake Ohrid, including about 500 species of diatoms. More recently, however, Levkov and Williams (2012), summarizing a century of diatom research on Lakes Ohrid, listed 789 taxa (species, varieties and unidentified species) bringing the total number of species in the lake above 1489. Most of diatom species of the Lake Ohrid are oligotrophic species, which they growing up only in very clean waters with low nitrogen and phosphor. However, in littoral habitats, there were observed tolerant species, belonging to a wide range, from oligotrophic to eutrophic waters. The presence of hypertrophic diatoms is observed, especially nearby Pogradeci town from Pogradeci and Verdova rivers. It should be a direct consequence of the high content of nutrients, mainly total phosphor, caused by agriculture, tourism and industry, etc.

1. Materials and Methods

Lake Ohrid has many endemic species covering the whole food-chain, from phytoplankton to fish. Sampling and monitoring of the diatoms were performed on during the summer of 2011 year. Samples are collected in different depth, in total are 7 transects T1 (Pojske); T2 (Hudenisht); T3 (Hudenisht/Memelisht); T4 (Memelisht); T5 (Gur i Kuq); T6 (Pogradec); T7 (Verdove) and we analyzed about 70 samples. In each sample we have determine many diatoms endemic species. The biological investigation was based on a microscopic examination of diatom communities. The

diatom community are collected like epiphyte in different macrophytes in different depth from shoreline; the resulting suspensions collected in small bottles and preserved in 4% formaldehyde (Kelly et al., 1995; Prygiel et al., 2002; Kupe L., 2006; Kupe et al., 2013). The cleaning of diatom frustules was done by boiling the material, first with HClcc and then, after washing, boiling them again with H₂SO₄cc, adding during the last procedure some crystals of KNO₃, as described by Krammer & Lange-Bertalot 2001. About 500 valves per slide were counted using 100 oil immersions, yielding a 95% confidence for the data on species composition (Lund et al., 1958; Kelly et al., 1995; Prygiel et al., 2002). Diatoms were identified using standard literature (Levkov, Kristic, Metzelin, Nakov (2007); Krammer & Bertalot 1996-2001). In each samples we have identified the endemic species.

3. Results and discussion

In this paper, about 70 samples are analyzed in different depth of Ohrid Lake and about 40 rare and endemic diatom species known to Ohrid were found in the peritonitis samples of the Albanian part, about 1/6 of the species found. Among the most widespread and abundant endemic species in Lake Ohrid: in the Pojska transect (T1) *Epithemia ohridana* has a prevalence of over 90% of the samples and an amount exceeding 12% of the periphyton community at 3 m depth; in the same transect *Cocconeis robusta* has a prevalence of over 80% and a relative amount in the sample over 9% at 11 m; also, *Amphora ohridana* here has a prevalence of over 50% and a relative amount that ranges to about 3% at 8 m; this species in the Vërdova transect (T7) is 100% present, and quantities exceeding 6% at 12 m depth. *Encyonema ohridanum* is nearly 90% present in the monthly transect (T4) and relative amounts exceeding 5% at 12 m; in this transect *Cymbella ohridana* has a presence of 50% and a relative amount of 3% (at 12 m), whereas in the Hudensisht transect (T2) this species has a presence of over 80% and a relative amount of almost 6% at depth 4.5 m.

Levkov & Williams (2012) report 789 diatom taxa (species, unidentified species and species), including all recent publications of new species (Lange-Bertalot, 2001; Levkov et al., 2007; Levkov & Williams, 2011; Miho & Lange-Bertalot, 2006); of them 117 species or 15% are considered endemic, most of them (114 species) found in the Macedonian part; 15 species are tertiary relicts (about 2%), or previously known only from fossil deposits in Romania (Köpecz & Bodos) (Jurilj, 1954). Concerning endemic diatom species, early studies noted several spatial levels of their distribution in Lake Ohrid (Levkov et al., 2007; Levkov & Williams, 2012). Our results indicate that some endemic species, such as *Amphora ohridana*, *Caloneis acuta*, *Sellaphora krsticii*, appeared to have limited distribution, while others, such as *Caloneis biconstrictoides*, *Cymboplectra juriljii* and *Sellaphora macedonica* were confined to the sublittoral area. We found the highest numbers of endemic species at different depths compared to the littoral zone, where endemic are almost absent. According to Matzinger et al. (2007), the large number of endemic species and their evolution is due to the influence of fresh, clean and oxygen-rich underwater resources.

Table 1. List of rare and endemic species found in the periphyton of Lake Ohrid, in the Albanian part, July 2011.

	T1	T2	T3	T4	T5	T6	T7	Total number of valves
	Number of valves							
<i>Amphora ohridana</i> Levkov 2007	112	86	34	17	10		234	493
<i>Aneumastus ochridanus</i> Levkov & Metzeltin 2007	12	2	2		2	4		22
<i>Aneumastus subapiculatus</i> Levkov & Nakov 2007	2							2
<i>Cymbella ohridana</i> Levkov & Krstic 2007	35	66	18	56	6	2	24	207
<i>Cymbella neoleptoceroideus</i> Levkov 2007			2	93				95
<i>Cymbella modica</i> Levkov & Nakov 2007		6					2	8
<i>Cymbella melovskii</i> Levkov & Krstic 2007	2	6					2	10
<i>Cocconeis robusta</i> Jurilj 1954	448	393	185	22	26		158	1232
<i>Campylodiscus marginatus</i> var. <i>tenuis</i> Jurilj 1949	6							6
<i>Caloneis acuta</i> Levkov & Metzeltin 2007	12							12
<i>Caloneis meridionalis</i> Levkov & Krstic		2						2
<i>Diatoma densicostata</i> Levkov & D.M.	2		2	2	2			8
<i>Encyonema macedonicum</i> Levkov, Metzeltin & Krstic 2006	4	16	6			2		28
<i>Encyonema pseudoceasposum</i> Levkov & Krstic 2007			8	7	12		26	53
<i>Encyonema ochridanum</i> Krammer 1997	34	24	8	126	28		52	272
<i>Epithemia lunata</i> Jurilj 1954	48		6	6	4	2	8	74
<i>Epithemia ohridana</i> Levkov & Metzeltin	824	128	78	14		84	894	2022
<i>Gomphoneis ohridana</i> Levkov 2007	16	6	20	10	14	2	12	80
<i>Gomphonema irroratum</i> Hust. 1945	2							2
<i>Gomphonema fonticolum</i> (Hust.) Levkov		2	12					14
<i>Gomphonema sancti-naumii</i> Metzeltin & Levkov 2007			34				4	38
<i>Gomphonema balcanicum</i> Levkov & Krstic					15			15
<i>Navicula paraobesa</i> Metzeltin & Levkov	4			6				10
<i>Navicula perturbata</i> Jurilj 1954	6	8	8	8				30
<i>Navicula splendicula</i> Van Land. 1975			14		2		4	20
<i>Nitzschia macedonica</i> Hust. 1945		4		2	52			58
<i>Nitzschia sigmaidea</i> (Nitzsch) W.Sm. 1853	4			8	6	2	6	26
<i>Neidium majus</i> (Jurilj) Levkov 2007	4	2						6
<i>Placoneis tumidula</i> Levkov 2007	6	2		2			6	16
<i>Placoneis macedonica</i> Levkov & Metzeltin	2	14						16
<i>Placoneis ohridana</i> Levkov & Metzeltin	4	10	2		6		54	76
<i>Placoneis signatoides</i> Metzeltin & Levkov		6		16			8	30
<i>Placoneis subgastriformis</i> (Hust.) E.J. Cox							2	2
<i>Sellaphora macedonica</i> Levkov & Metzeltin 2007	2		2					4
<i>Sellaphora ohridana</i> Levkov & Krstic 2007	4							4
<i>Sellaphora pseudomutatoideus</i> Levkov & Metzeltin 2007				4				4
<i>Sellaphora krsticii</i> Levkov, Nakov & Metzeltin 2006							2	2
<i>Stauroneis smithii</i> var. <i>elliptica</i> Hust. 1945*			2		2		4	8
<i>Rhoicosphenia macedonica</i> Levkov & Krstic 2007	12	4		2			4	22

Underwater resources contribute to the creation of endemic species-specific habitats as they supply oxygen, nutrients, and create conditions for the development and growth of endemic species in Lake Ohrid (Stankovic, 1960; Matzinger et al., 2007; Albrecht & Wilke, 2008; Hauffe et al., 2010; Trajanovski et al., 2010).

3. Conclusions

As a conclusion, in 70 samples, we have identified about 40 endemic species in Ohrid Lake (Albanian part). Highest number of endemic species at different depths from the lake shore was found

compared to the littoral area, where endemic species are almost absent. The littoral habitats are under stressing conditions all around the lake.

High abundance of endemic species of *Epithemia ohridana* occurs in every sampling site. The contribution of endemic diatoms to phytoplankton biomass also varies from different depth, but endemic species usually dominate. The most dominant taxa belong *Epithemia ohridana* Levkov & Metzelin; *Cocconeis robusta* Jurilj; *Amphora ohridana* Levkov 2007; *Encyonema ohridanum* Krammer; *Cymbella ohridana* Levkov & Krstic 2007, etc.

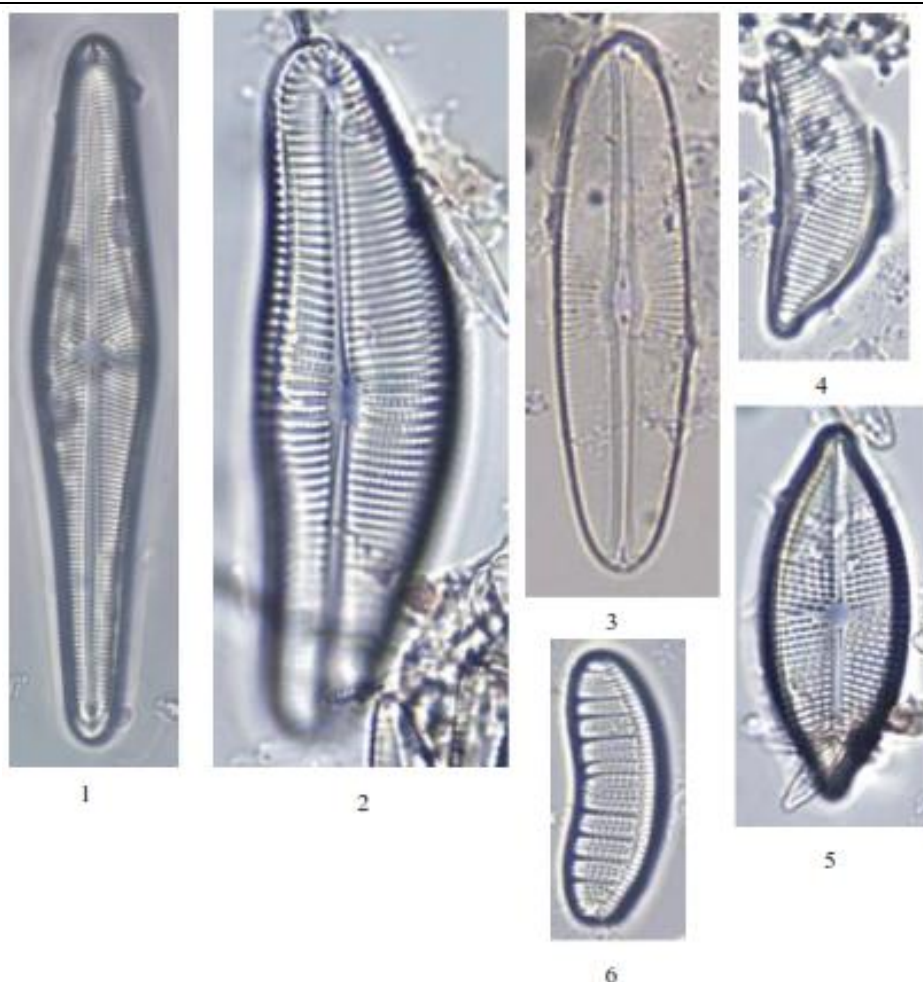


Fig. 1: 1. *Gomphoneis ohridana* Levkov; 2. *Encyonema macedonicum* Levkov, Metzeltin & Krstic; 3. *Sellaphora ohridana* Levkov & Krstic; 4. *Epithemia lunata* Jurilj; 5. *Aneumastus albanicus* Lange-Bertalot & Miho; 6. *Epithemia ohridana* Levkov & Metzeltin. (1500x).

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Comparative analysis of the professional microenvironment between a high-tech company and a service provider

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SAMPLE

The study was conducted among employees at two companies – a high-tech production enterprise and a service provider company. The respondents' mean age is $X=38,88$ ($SD=11,32$), work experience $X=18,67$ years ($SD=11,49$), and work experience at the organization - $X=5,51$ years ($SD=3,12$).

METHOD

The study was carried out by using a questionnaire, including general sample data (7 questions), a modified version of the *Copenhagen's Psychosocial Questionnaire (COPSOQ)* - 74 items. On the basis of the empirical measures, several scales were composed and distributed in several basic modules (the number of items composing a certain scale and the scale reliability – Cronbach's alpha within the studied sample are indicated in brackets).

Module I. „Demands at work”, composed of 4 scales:

- (1) *Quantitative demands at work* (irregular workload, insufficient time to cope with tasks, falling behind with work, etc.)
- (2) *Cognitive demands at work* (concentration and distribution of attention demands, decision-making in difficult situations, memorization demands, etc.)
- (3) *Emotional demands at work* (situations of high tension, “tough nerves” demands, emotional overload).
- (4) *An aggregated Demands at work scale*, composed by the three scales above.
- (5) *Possibilities for influence at work* (choosing with whom and how to work, influence over the quantity of work, etc.).

Module II. „Social relationships at work” includes 5 scales:

- (1) *Role conflicts* (assignment of unnecessary tasks, conflicting guidelines, etc.).
- (2) *Social support* (support by colleagues and by the immediate manager).
- (3) *Possibilities for influence at work*: over the quantity and type of work; whom to work with).
- (4) *Role clarity* (clearly defined expectations, goals, tasks and responsibilities; taking employees' opinions into consideration).
- (5) *Quality of leadership* (providing career opportunities, good planning, conflict management, feedback about employees' work).

Module III. „Mental health” – composed of two components/scales:

- (1) *Positive mood* (feeling happy, the opposite to strenuousness, low spirit, etc.).
- (2) *Vitality* (optimism, vigour, etc.).
- (3) An aggregated „Mental health” scale (composed of (1) and (2)).

Module IV. „Stress” – includes 4 scales for measurement of behavioural, somatic and cognitive manifestations of stress, indicated as follows:

- (1) *Behavioural stress*¹ (irritability, overload of squabbles and conflicts, „drifting with the current”, etc.).
- (2) *Somatic stress* (health concerns: stomachache/other stomach issues, chest pain/squeezing, muscle tension, dizziness).
- (3) *Cognitive stress* (difficulties in concentration, memory and decision-making, confused thoughts).
- (4) An aggregated „Stress” scale (composed of (1), (2) and (3)).

(5) *Demands for hiding emotions and personal opinion*.

This scale has been found to have too low internal consistency for the studied organization and hence, it is not likely to be a reflection of any essential aspects of social relationships and activity.

Module V. „Meaning of work” – comprises 4 scales:

- (1) *Meaning of the work* (the sense of one's job being both important and meaningful).
- (2) *Commitment to the work* (the desire to keep the job until the end of service, great personal importance of the work, the desire to let others know about your job and workplace).
- (3) *An aggregated scale „Meaning and personal commitment to the work”*, composed by the two scales above.
- (4) *Opportunities for development* (the prospects of professional development rather than career prospects, i.e. if the job provides opportunities for expansion of one's knowledge, personal initiative and adequate expression of competencies and skills).
- (5) *Job insecurity* (worries about a potential job loss, about relocation to a undesired workplace, etc.).

Module VI. „Satisfaction with the conditions of work”

– evaluation of the work environment factors (noise, illumination, temperature, dust, etc., including social gains).

Module VII. „Job satisfaction”: with the work in general, with the opportunities for applying one's own competency, with the opportunities for professional development. This scale also includes an overall measure of “Satisfaction with the conditions of work”, as the overall measure of “Satisfaction with the conditions of work” has the lowest coefficient, i.e. a weight lower than the other measures (opportunities for professional development, adequate expression of personal competencies). Consequently, the option to evaluate “Job satisfaction” separately was chosen.

RESULTS

With regard to these two organizations, contiguously presented below are:

- (1) comparative data of the measured constructs by department;
- (2) analysis of the main factors that „determine”: (a) *stress level*; (6) *meaning of the work and commitment to the work*;

1. RESULTS ON THE BASIC SCALES BY DEPARTMENT AT THE HIGH-TECH COMPANY

The illustrative character of data facilitates comprehension of results. Since the bar charts are informative enough only short notes are added to some results. Any further comments and questions can be brought forward a bit later in the discussion section.

All three departments score higher on the scales „Role clarity” (clearly defined expectations, goals, tasks and responsibilities), „Social support” (by colleagues and by the immediate manager) and „Quality of leadership” (providing career opportunities, good planning, conflict management, feedback about the employees' work). Lower are their scores on the scales „Role conflicts” (assignment of unnecessary tasks, conflicting guidelines, involvement on tasks that are welcomed by some colleagues, but unwelcomed by the others) and „Possibilities for influence at work”. The scale „Role conflicts” has the highest value at the Sales Department and similar values at the Administration Department and the Production Department.

¹ As mentioned above, it would be more precise to use the term “behavioural (somatic, cognitive) manifestations of stress”. Still, the term “behavioural (somatic, cognitive) stress” is used herein below for the sake of brevity.

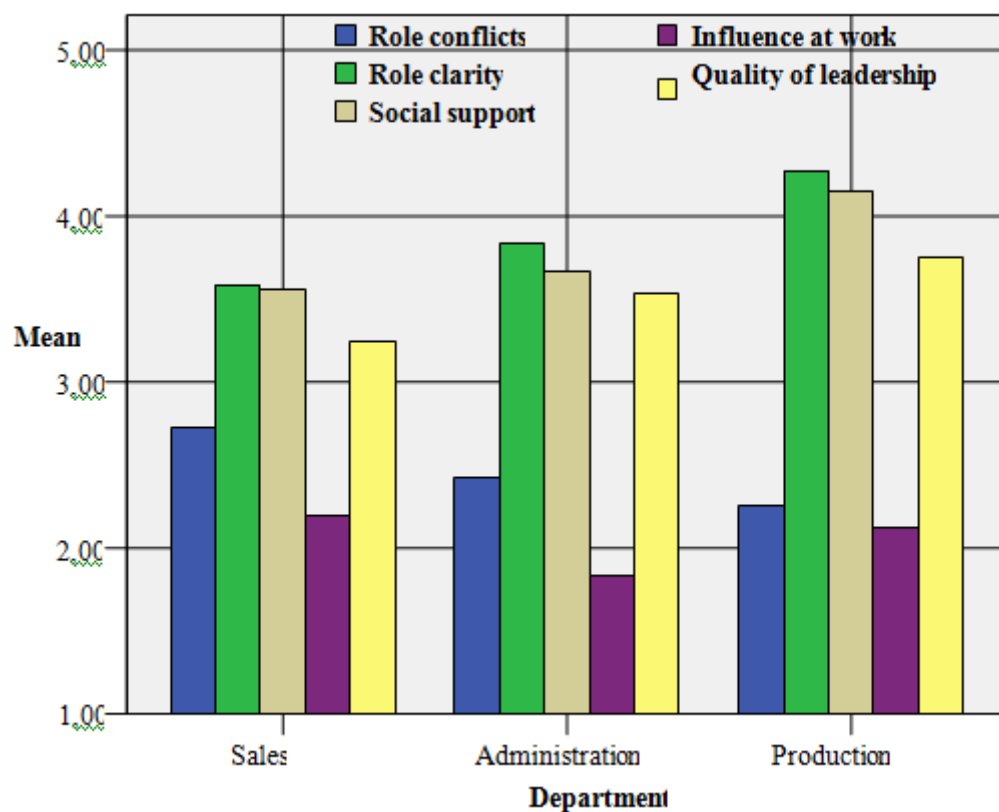


Figure 1. Mean values of the scales included in Module I „Demands at work” by department at the high-tech company

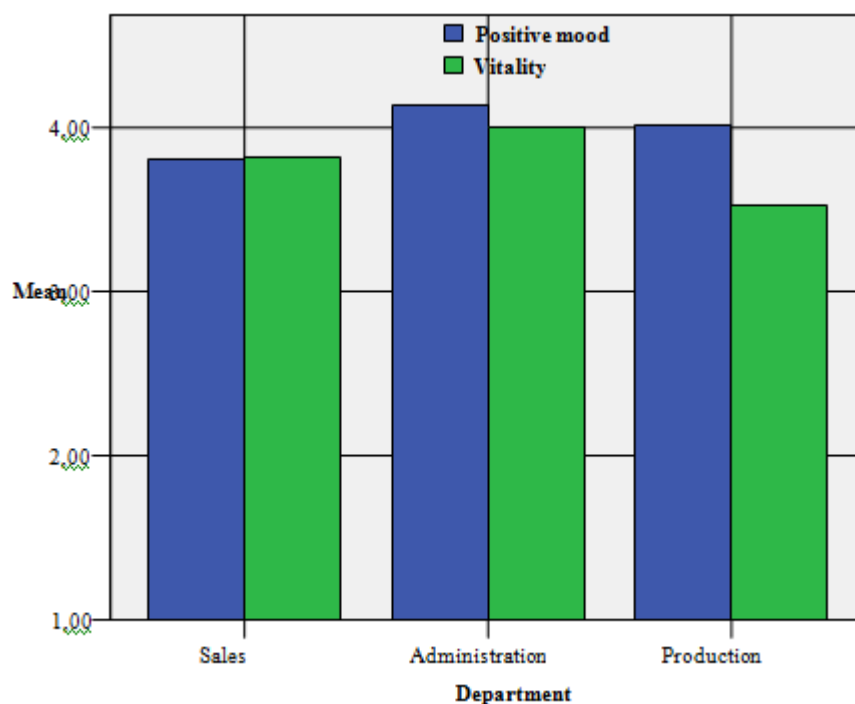


Figure 2. Mean values of the scales included in Module II „Social relationships” by department

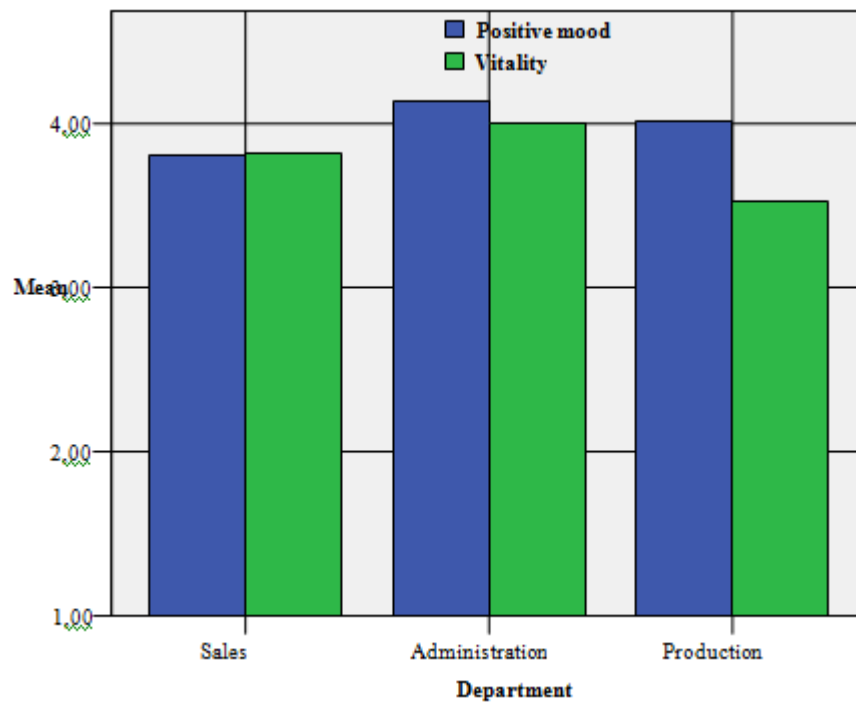


Figure 3. Mean values of the scales included in Module III „Mental health” by department

The levels of „Mental health” are relatively high in the three departments; no significant variation by department.

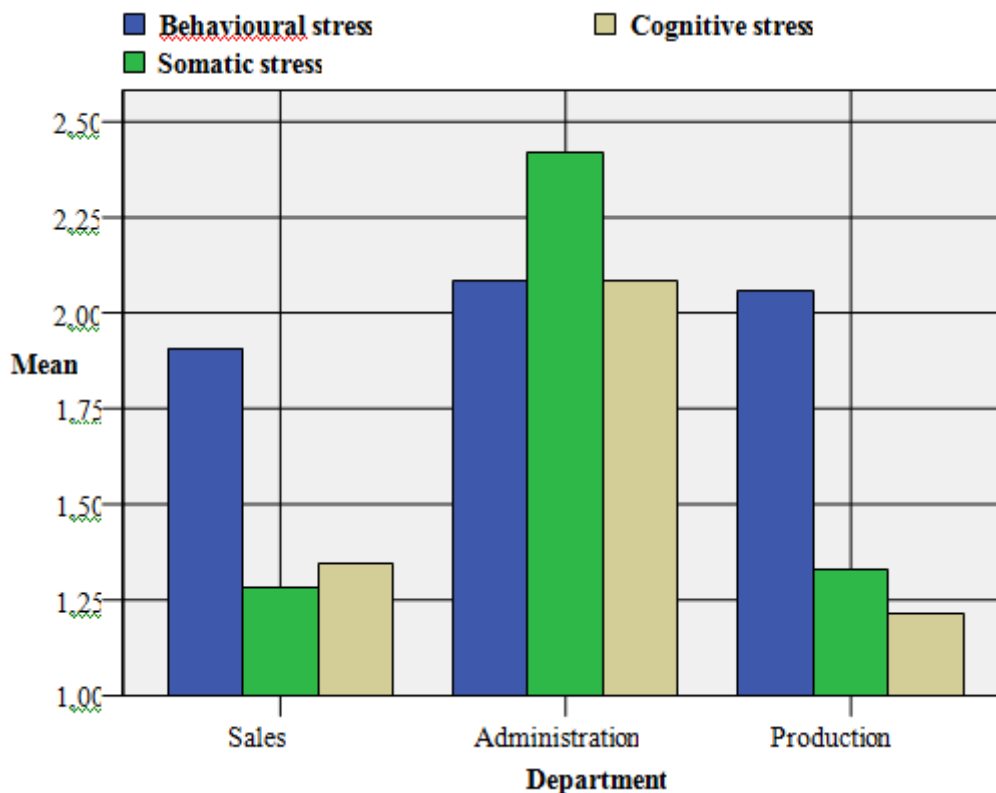


Figure 4. Mean values of the scales included in Module IV „Stress” by department

In the Administration Department, there is a tendency of reporting higher somatic stress („health concerns: stomachache/other stomach issues, chest pain/squeezing, muscle tension, dizziness, etc.) and cognitive stress (difficulties in concentration, memory and decision-making, confused thoughts).

Behavioural stress (irritability, overload of squabbles and conflicts, „drifting with the current”, etc.) was found to attain similar levels in the three departments.

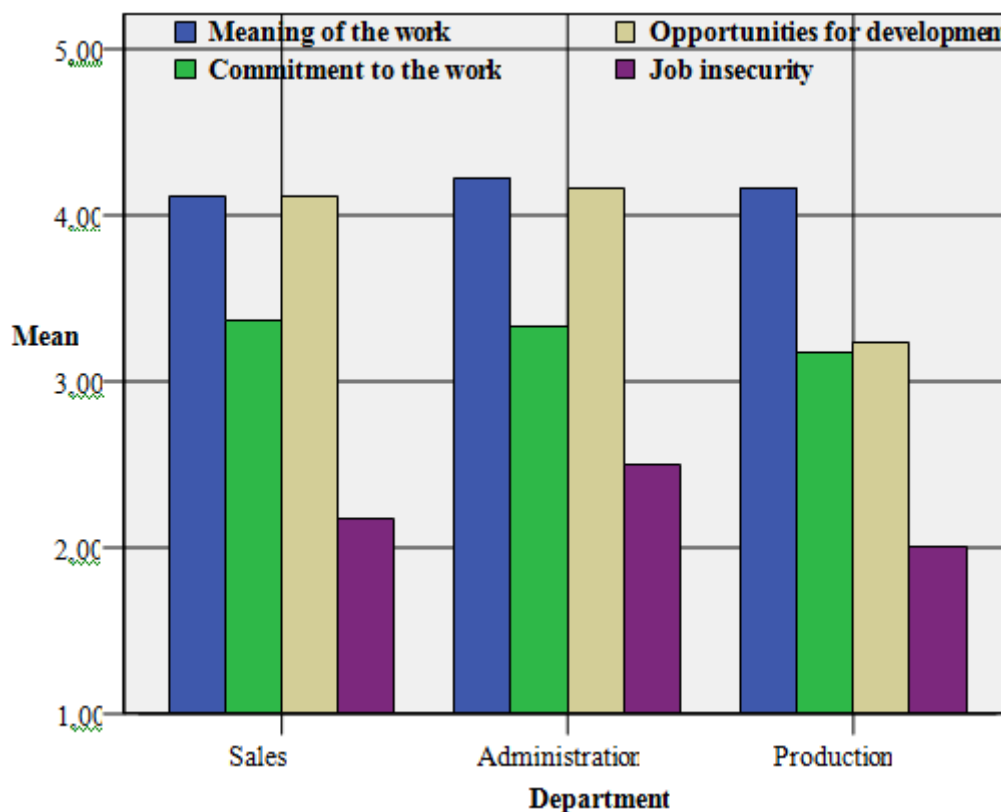


Figure 5. Mean values of the scales included in Module V „Meaning of the work” by department

The scales “Meaning of the work”, “Commitment to the work” and “Opportunities for development” were found to have higher values, and “Job insecurity” was found to have a lower value.

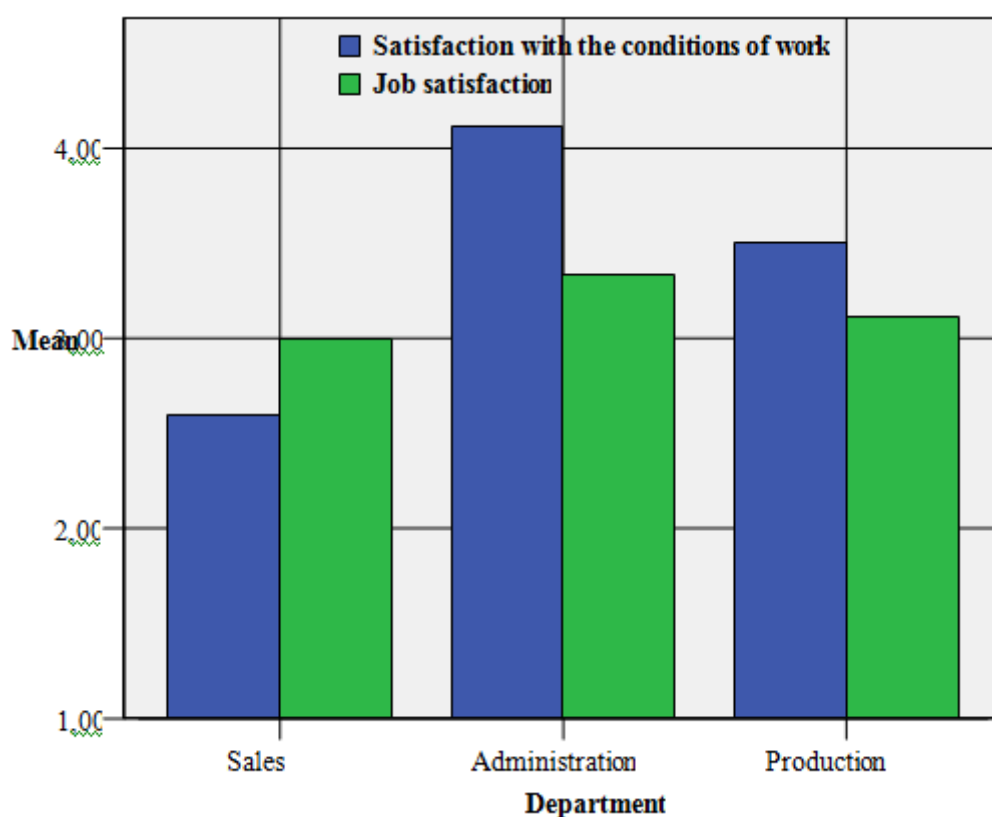


Figure 6. Mean values of the scales included in Module VI „Satisfaction with the conditions of work” and Module VII „Job satisfaction” by department

The measures of job satisfaction (with the work in general, with the opportunities for applying one’s own competency, with the opportunities for professional development) were found to have similar values. Still, there is a salient tendency of keeping a lower level of satisfaction with the conditions of work at the Sales Department.

2. FACTORS ASSOCIATED WITH STRESS AND MEANING/COMMITMENT TO THE WORK

Findings about the factors associated with stress and meaning/commitment to the work are presented below.

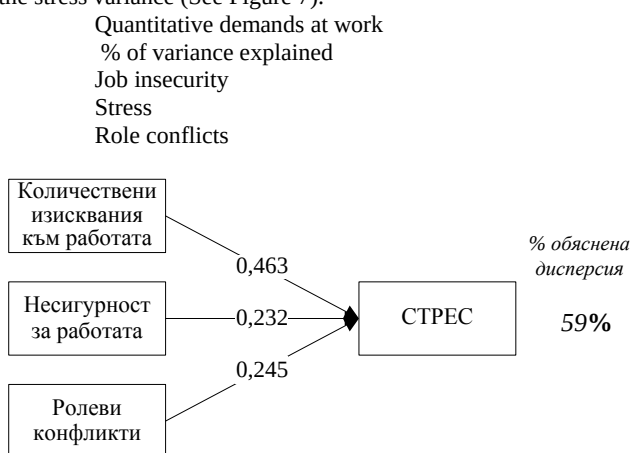
The significant one-way correlations (Pearson's r) with the overall stress level (composed of behavioural, somatic and cognitive manifestations of stress) are given in Table 3.

Table 3. Factors associated with the level of stress

Scale	Pearson's r
Quantitative demands at work	,723(**)
Role conflicts	,689(**)
Job satisfaction	-,572(**)
Hiding emotions/personal opinion	,548(**)
Meaning of the work	-,516(**)
Job insecurity	,508(**)
Role clarity	-,505(**)
Commitment to the work	-,444(**)
Emotional demands to work	,380(*)
Group cohesion	-,336(*)
Opportunities for development	-,284
Satisfaction with the conditions of work	-,208

According to the results, quantitative demands at work (overload of tasks, falling behind with work, insufficient time), role conflicts, job insecurity and emotional demands at work (situations of high tension) raise the level of stress, while job satisfaction, meaning and commitment to the work, role clarity, group cohesion, opportunities for development play a preventive role (i.e. reduce the level of stress)².

The data has also been analysed by means of multiple regression considering the indicated aggregated variables as independent variables that predict the level of stress (positive mood and vitality were not included in the analysis again). However, due to the small sample size, the results have a conditional character. The findings, obtained after the associations between the independent variables have been considered, show that there are three significant predictors – quantitative demands at work, job insecurity and role conflicts that come to explain a considerable percentage (59%) of the stress variance (See Figure 7).



Notice: The standardized regression Beta coefficients are presented above.

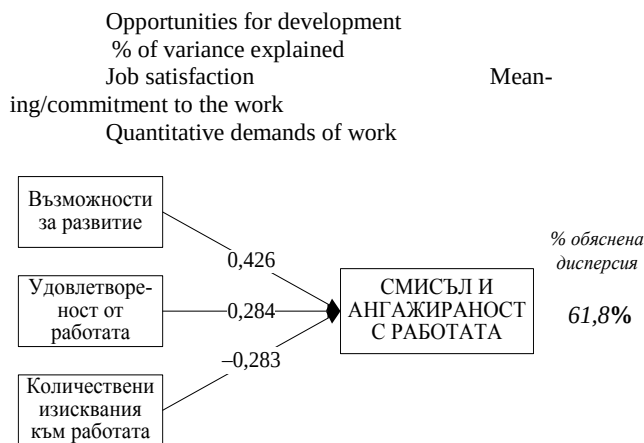
Figure 7. Professional stress factors – multiple regression

Significant one-way correlations (Pearson's r) with the scale „Meaning/commitment to the work” (composed through aggregation of „Meaning of the work” and „Commitment to the work”) are given in Table 4. The results identify both „risk” and „preventive” factors for experience of personal meaning of the work and commitment to it.

Table 4. Factors associated with meaning/commitment to the work

Scale	Pearson's r
Job satisfaction	,722(**)
Opportunities for development	,674(**)
Vitality	,623(**)
Positive mood	,610(**)
Role conflicts	-,593(**)
Role clarity	,527(**)
Quantitative demands at work	-,548(**)
Stress – overall (aggregated)	-,535(**)
Hiding emotions/personal opinion	-,534(**)
Job insecurity	-,411(**)
Group cohesion	,313(*)
Emotional demands at work	-,284
Demands at work – overall (aggregated)	-,302

Similarly, the data was also analysed by using multiple regression, where „Meaning/commitment to the work” was considered a dependent variable, determined by the other constructs (aggregated scales). The findings are conditional (due to the small sample size) and evince three significant predictors – opportunities for development, job satisfaction and quantitative demands at work (with an opposite sign), See Figure 8.



Notice: The standardized regression Beta coefficients are presented above.

Figure 8. Factors for meaning and commitment to the work – multiple regression

RESULTS OBTAINED FOR THE SERVICE PROVIDER:

Scope of activity: nonstop processing of foodstuff and production of food packages is implemented, as both quality and hygiene of production and the workshops are inspected and certified annually. Considering the international contractors of the company, the demands of quality, quantity and sanitation are high.

Module I “Demands at work”:

1) quantitative demands at work (irregular workload, insufficient time to cope with tasks, falling behind with work, etc.) ($\alpha = 0,26$)

² As expected “Positive mood” and “Vitality” are strongly associated with „Stress”, but they are rather concepts of the same order and it would not be accurate to regard them as stress factors.

- 2) cognitive demands at work: concentration and distribution of attention demands, decision-making in difficult situations, memory demands, etc. ($\alpha = 0,74$)
- 3) Emotional demands at work: situations of high tension, "tough nerves" demands, emotional overload ($\alpha = 0,76$)
- * Aggregated scale / overall *Demands at work* ($\alpha = 0,79$)
- 4) Possibilities for influence at work (choosing with whom and how to work, influence over the quantity of work, etc.) ($\alpha = 0,43$)

In Module I "**Demands at work**" the following results have been obtained: The highest quantitative demands at work by department were found for the Operations Department ($x=7$, $N=12$), and the lowest – for the Sanitation Department ($x=5,5$, $N=4$). The highest emotional demands at work were found for the Café Department ($x=9,71$, $N=7$), and the lowest – for the Sanitation Department ($x=4$, $N=4$). The highest cognitive demands were found for the Accounting and Administration Department ($x=14,85$, $N=7$), and the lowest - for "Café" and "Sanitation" ($x=10$). Those working at the Sanitation Department ($x=9,75$, $N=4$) and at the Operations Department ($x=9,58$, $N=12$) have possibilities to exert influence at work. The highest overall demands at work were found for the Accounting and Administration Department ($x=30,85$), Operations and Production Department.

Module II "Social relationships":

- 5) role conflicts (assignment of unnecessary tasks, conflicting guidelines, etc.) ($\alpha = 0,59$)
- 6) social support (support by colleagues and by the immediate manager) ($\alpha = 0,68$)
- 7) social relationships (opportunities for keeping communication lines open at work) ($\alpha = 0,40$)
- 8) role clarity (clearly defined expectations, goals, tasks and responsibilities; taking into consideration the employees' opinions) ($\alpha = 0,72$)
- 9) quality of leadership (providing career opportunities, good planning, conflict management, feedback about the employees' work) ($\alpha = 0,83$)

In a social-psychological perspective the strongest role conflicts have been found at the Accounting and Administration Department ($x=10,14$, $N=7$), and the weakest – at the Café Department ($x=8,57$, $N=7$). The strongest social support was found for the Production Department ($x=8,08$, $N=12$), and the weakest – for the Accounting and Administration Department ($x=6,42$, $N=7$). The most clearly defined roles were found at the Operations Department ($x=16,46$, $N=13$). The quality of leadership of the head of the Sanitation Department were the most highly evaluated ($x=22$, $N=3$).

Module III "Health":

- 10) mental health (includes measures of low spirit, happiness, discouragement, nervousness) ($\alpha = 0,82$)
- 11) vitality (exhaustion, optimism, vigour, inspiration) ($\alpha = 0,64$)

Module IV "Stress":

- 12) behavioural stress (includes troubles with other people, high sensitivity and irritability, lack of motivation to act) ($\alpha = 0,50$)
- 13) somatic stress (health concerns) ($\alpha = 0,71$)
- 14) cognitive stress (difficulties in concentration, memory and decision-making) ($\alpha = 0,63$)

* Aggregated scale / overall *Stress* ($\alpha = 0,77$)

- 15) Demands of hiding emotions/personal opinion ($\alpha = 0,18$)

Those from the Sanitation Department report the highest values of vitality and mental health ($x=22$ и $x=16,25$, $N=4$) and at the same time the highest levels of behavioural, somatic, cognitive and overall stress. The lowest values of vitality and mental health were found for the Café Department ($x=13,12$ и $17,28$).

Module V "Meaning of the work":

- 17) meaning of the work (the sense of one's job being meaningful, internal motivation) ($\alpha = 0,84$)
- 18) commitment to the work (a pleasant feeling for what is done at work, the desire to keep the job until the end of service, great personal significance of the work) ($\alpha = 0,71$)

* Aggregated scale / overall *Meaning and personal commitment to the work* ($\alpha = 0,83$)

- 19) opportunities for development (utilization of personal skills) ($\alpha = 0,80$)

- 20) job insecurity (worries about a potential job loss, about relocation to a undesired workplace, etc.) ($\alpha = 0,65$)

The highest values of meaning of the work ($x= 13,16$), commitment to the work ($x= 11,75$), opportunities for development ($x= 10,27$) and also of worries about a potential job loss ($x=10,5$) were reported at the Production Department ($N=11$).

Module VI "Job satisfaction": with the work in general, with the opportunities of applying one's own competencies, with the opportunities for professional development, with the conditions of work" (an aggregated mean value is calculated) ($\alpha = 0,78$)

Module VII „Satisfaction with the conditions of work", where work environment factors (noise, illumination, temperature, dust, etc.) were evaluated ($\alpha = 0,77$)

The lowest satisfaction with the conditions of work and with the work in general is reported at the Accounting and Administration Department ($x=18,85$ and $x=11,42$, $N=7$), and the highest satisfaction – at the Sanitation Department ($x=27,4$ and $x=16,11$, $N=5$).

An independent samples T-test was used to compare data of regular (standard) vs. irregular shift work.

Regarding the "Shift work" measure, **regular shift** employees were found to have lower values of: role conflicts (8,26), proportion of positive and negative attitudes (0,44), meaning of the work (11,66), satisfaction with the conditions of work (20,27) and quality of leadership (15,36).

Irregular shift employees were found to have higher values of: quantitative demands at work (8,30), overall demands at work (32,30), cognitive demands at work (14,90), role conflicts (9,90), worries about a potential job loss (8,60), satisfaction with the conditions of work (23,48), group cohesion (17,48), quality of leadership (18,19), meaning of the work (13,18).

The analysis of **correlations** shows significant associations ($p < 0,01$) between:

- emotional demands at work and behavioural stress ($r=0,395$)
- emotional demands at work and overall stress ($r=0,375$)
- overall demands at work and cognitive stress ($r=0,408$)
- overall demands at work and overall stress ($r=0,394$)
- role conflicts and behavioural stress ($r=0,408$)
- role conflicts and cognitive stress ($r=0,498$)
- role conflicts and overall stress ($r=0,526$)
- social support and behavioural stress ($r=-0,492$)
- role conflicts and overall stress ($r=-0,330$)
- worries about a potential job loss and somatic stress ($r=0,313$)

Regression. The one-way correlations mentioned above do not show associations between the studied variables, associated with the level of stress. The data was processed further by means of multiple regression, where the level of stress was defined as a dependent variable and regressed on the other variables (entered as independent variables). While entering the independent variables in the regression equation, the stepwise method was employed and the error probability was set to 0,10. However, the regression results should be conditionally interpreted due to the small sample size.

The findings show that the independent variables as per the tested model come to explain a large percentage (68,9%) of the variance of stress (adjusted $R^2 = 0,689$). The data identifies four significant predictors: "Quality of leadership" (with a standardized Beta coefficient = $-0,370$), "Proportion of positive and negative attitudes towards colleagues" (Beta= $-0,420$), "Opportunities for development" (Beta= $-0,343$) and "Emotional demands at work" (Beta= $0,396$). Hence, low quality of leadership, prevalence of negative attitudes towards colleagues, limited opportunities for development, and increased emotional demands at work significantly predict a high level of stress, as these effects are relatively balanced and together these predictors come to explain a large portion of stress. The findings also suggest that it is not only the system of professional relationships at work (incl., quality of leadership, op-

portunities for development and emotional demands at work), which is crucial for the stress level, but also the system of interpersonal relationships: prevalent positive/negative attitudes towards colleagues (sympathy/antipathy) in the professional microenvironment. Hence, positive interpersonal relationships can play a crucial preventive role (as a buffer) of the stress levels.

CONCLUSION

It is the system of professional relationships at work (incl., quality of leadership, opportunities for development and emotional demands at work) that is crucial for the level of stress.

Sixty seven percent of the employees have positive attitudes and sixteen percent - negative attitudes towards their professional community.

Positive interpersonal relationships can play a crucial preventive role (as a buffer) of the stress levels.

Irregular shift employees feel more worried about a potential job loss, more satisfied with the conditions of work; they experience higher cohesion within the group, but also stronger role conflicts compared to the regular shift employees.