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Foreword

Techno-economic sciences, intelligent industrial management and interdisciplinarity in research play a key role in developing innovation, in creating methodological support and in securing the strategic objectives of sustainable socio-economic development. Several analyses of the course and remarkable nature of development to date, for example over the last 250 years, point to alternating phases of intense growth and recession, decline and crises, and can be schematically illustrated in the form of an irregular sinusoid. Cycles of about 50 years can be defined, with beginnings and ends marked by major changes, new solutions, discoveries, technological patterns, economic strategies and "industrial revolutions". This is based on the recognition that it usually takes a longer period of time, 20-30 years, for any new technique, technology or management strategy to become fully economically viable, as well as on the fact that new solutions are mainly created in response to current problems or critical socio-economic situations. Each new forecast cycle, e.g. even up to 2050, must of course be further examined, refined and possibly revised.

The new phase of socio-economic development that has begun since 2000 is strongly marked by the intensification of automation and robotisation processes, digitalisation processes, environmentalisation and the search for synergies between machines and humans in improving the quality of life in society, with a focus on sustainable production in a global market economy. Technical sciences and production management as we perceive them also within our "**engineering sciences and production management - ESPM**" science brand (2015, 2017, 2019, 2022) are today inevitably confronted with the application of interdisciplinary technical-economic-social and environmental approaches. To solve scientific problems and to integrate the knowledge and techniques acquired, fulfilling the objectives of key development strategies. Emphasis today needs to be placed in particular on 4th and 5th generation smart industry, the circular economy, the greening of the economy and its sustainability and balanced development of the various pillars - economic, social, environmental and institutional.

The role and mission of the **ESPM 2022 International Scientific Workshop** is to advance knowledge in the above-mentioned areas and to transfer the results of scientific research into European economic practice in the form of scientific publications (articles and foreign monographs) by the authors of the participating universities and industrial practice.

Whether and how the quality of life in a globalised society will improve in 20-30 years' time is influenced today by the focus and quality of our research, the intensification of innovation processes both in the socio-economic, environmental and institutional spheres as well as in the intrinsically related technological, material and energy pillars of sustainable development.

Thank you all for your goodwill and support. I believe that **ESPM 2022** will fulfill its goals as well as your expectations, that it will enrich us and inspire us to further creative scientific collaboration in pursuit of the ambitious goals of the concept of sustainable socio-economic development.

Milan Majerník, prof. h. c., prof. Ing. PhD.
chairman of the scientific committee of ESPM 2022
and the founder of Pro Enviro n.g.o.

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DETERMINING THE FOCUS OF REHABILITATION IN VIRTUAL REALITY FOR INDUSTRIAL WORKERS

Tea Bajičová [1] – Marek Bureš [2] – Ilona Kačerová [3] – Pavel Kopeček [4]

Abstract: *This paper focuses on the description of methodology used to identify hazardous areas of work activities and to establish a desirable focus of virtual reality rehabilitation for employees of industrial companies. The aim is to identify problem areas in terms of physical and psychological stress. Described methodology is validated in a chosen industrial company on a sample of 49 participants. The chosen participants were employed in three different positions - warehouseman, furnace operator and manufacturing operator. The results for the most demanding of the chosen positions are described in the paper.*

Keywords: rehabilitation, virtual reality, methodology, production, prevention

1 INTRODUCTION

In recent years, there has been a growing emphasis on looking after the health of employees and creating suitable conditions in the workplace. Several factors can motivate employers to take an interest in this issue. In today's highly competitive environment, it may relate to the desire to keep their employees happy and to preserve the reputation of the company. However, the need to comply with legislative regulations relating to ergonomics or the effort to maintain employee performance and avoid the costs linked to the occurrence of occupational illness also play a role.

The rapid advances in technology have not, however, bypassed sectors related to human health care, and new methods for preventing health problems are emerging. One modern technology that is constantly expanding its use is virtual reality. One of the spheres where it is also used is for rehabilitation. Currently, it is being used on a relatively small scale. However, due to its extensive possibilities, this use has great potential for application in industrial enterprises.

Among the benefits of virtual reality rehabilitation are the following:

- Gamification - it is a fun form of exercise that motivates employees to perform exercises on a regular basis. Rehabilitation does not have to be perceived as a mere obligation.
- Easier organisation - virtual reality rehabilitation sessions are available at any time, which can be an advantage especially in multi-shift arrangements (no need for a health professional to be present at all times). If a sufficient number of VR headsets are provided, rehabilitation can be performed by several employees at the same time.
- The possibility of gradually introducing more difficult exercises - based on the evaluation of the results achieved and the progress of the participant, it is possible to set a gradual adjustment of the difficulty of the applications.
- Changing the environment - in virtual reality there are almost unlimited possibilities of creating the environment. Thus, rehabilitation can be placed in an environment that will offer the worker a more pleasant experience compared to the daily work routine
- Financial savings - compared to providing the services of an in-house physiotherapist, VR rehabilitation represents a one-time investment in hardware and software [1].

However, to enable the introduction of VR rehabilitation into industrial companies, there is lack of a standard procedure to identify problem areas that need to be targeted through rehabilitation exercises. For this reason, this paper focuses on proposing a methodology for determining the focus of a rehabilitation plan. Subsequently, this methodology is applied in a selected industrial company and the outcomes for the selected position are described.

2 PROPOSED METHODOLOGY

For the possibility of implementing rehabilitation in VR, an important entry point is the identification of risk factors that can negatively affect the health of employees. The aim of the methodology is to identify problem areas within the performed work activities, on the basis of which a rehabilitation plan for the selected worker can be quickly established. Appropriate selection of the focus of rehabilitation is essential to ensure optimal benefit from rehabilitation - it is essential that the worker performs rehabilitation exercises that are appropriate to their pre-existing or impending health problems. The focus of the proposed rehabilitation plans is divided into two parts:

- The joint part of the rehabilitation plan – it focuses on the problems associated with a specific work role
- The individual part of the rehabilitation plan - the exercises in this part are an addition to the joint part in relation to the individual needs of the worker [1].

The focus of the rehabilitation plan is based on a three-part methodology:

- physical load assessment,
- a questionnaire survey,
- employee analysis [1].

The following subsections contain a more detailed description of each part of the methodology.

Physical load assessment

The first area that is important for identifying risk factors is the physical strain that a worker is subjected to in the course of their work activity. This part of the methodology focuses on the objective assessment of the overloaded parts of the musculoskeletal system and is linked to the job role. It is therefore used to determine the health risks that are common to the group of workers working in the selected role. These are the risks that need to be addressed in the prevention of occupational diseases. The output of this section is the focus of the joint part of the rehabilitation plan [1].

For the assessment of physical strain, an approach corresponding with Government Regulation No. 68/2010 Coll. has been chosen. According to this regulation, physical strain can be assessed on the basis of the following parameters:

- Total physical load, or the load resulting from dynamic physical work performed by large muscle groups, when more than 50% of the muscle mass is loaded.
- Local muscular load, or the load on small muscle groups when work is performed with the upper limbs.
- The working positions that a worker assumes in the performance of a given work activity.

Act No. 205/2020 establishes the necessity of conducting a minimum professional assessment of the risk factors of physical strain in the workplace. Due to the different degree of difficulty of the assessment for professional evaluation or authorized measurement, the exact procedure is chosen on the basis of the historical evaluation of the work position. The physical strain assessment is chosen as the first step of the methodology, as it also allows to define the most problematic workplaces or job roles from its outputs [1].

Questionnaire survey

This part of the methodology aims at obtaining information on the subjective feelings of workers about their work overload. If the problem is identified repeatedly for workers, its prevention can be included in the joint part of the rehabilitation plan. If the problem is reported sporadically, exercises for its prevention can be included in the individual part of the plan for the particular worker [1].

The Nordic Questionnaire, a standardised questionnaire, is aimed at identifying the manifestations of physical overload. It is a simple, internationally recognised questionnaire that identifies symptoms of musculoskeletal disorders in the neck, back, shoulders and upper and lower limbs [2]. The modified version of the Nordic Questionnaire used for this methodology can be divided into three parts:

- Basic information about the respondent - i.e. physical characterization or information about the job position and length of time in the role.
- Identifying areas of the body where the worker has experienced pain or stiffness in the last 12 months. This query covers a total of 9 body areas (neck, upper back, lower back and sacrum, shoulders, elbows, hands and wrists, hips and thighs, knees, ankles and feet). If the worker answers in the affirmative, he/she is then asked whether he/she has sought professional help from a doctor or physiotherapist in the last 12 months.
- An assessment of 15 factors that may influence the development of a musculoskeletal disorder. Each factor is rated on a scale of 0 to 10, where 0 represents no burden and 10 represents a high burden [3].

Meanwhile, the Meister questionnaire - a standardized questionnaire oriented to the assessment of the effects of the work activity on the psyche of the worker - is focused on the perception of psychological stress. The questionnaire was compiled in 1975 by W. Meister from the Zentralinstitut für Arbeitsmedizin in Berlin. It was validated by the Hygiene Service in the following years 1976-1984 and became one of the most widely used instruments for assessing the effects of workload on the psyche [4, 5].

The questionnaire contains 10 questions, which are grouped into the following factors - overload, monotony, non-specific factor and occupational load. To enable evaluation, the critical values of the item medians and the mean values of the factors are determined. Reaching or exceeding them is indicative of excessive workload in the particular area. The resulting mental burden is classified into three degrees:

1. Mental strain that is unlikely to affect health, subjective state and performance (taking into account random fluctuations during the work shift).
2. Mental strain that may routinely cause temporary effects on subjective state or performance.
3. Mental strain for which health risks cannot be ruled out [6].

The above mentioned questionnaires are also supplemented with questions focused on the worker's medical history to assess the health status and possible complications [1].

Employee analysis

The third part of the proposed methodology is a worker analysis designed to identify physical symptoms of developing or pre-existing musculoskeletal disorders of the upper limbs (based on the most common occupational diseases in the Czech Republic). For this purpose, the Phalen's test and the measurement of maximal grip strength using a force gauge are chosen. Depending on the frequency of results indicating existing difficulties, exercises focusing on the upper limbs can be included in the joint or individual part of the rehabilitation plan [1].

Phalen´s test (also called the Phalen´s manoeuvre) is a diagnostic test introduced in 1957 by George S. Phalen. It is a so-called provocation test used to identify

carpal tunnel syndrome, which works on the principle of narrowing the space for the nerve. Nerve compression is caused by wrist flexion. The subject performs maximal flexion of both wrists by resting the backs of the hands against each other (see *Figure 1*). The test is considered positive if there is paresthesia (i.e., tingling, tingling, etc.) or numbness in the thumb, index finger, middle finger, or lateral half of the ring finger within 1 minute in this position. This test is included in the methodology due to the fact that carpal tunnel syndrome of the right and left hand due to overexertion of the limbs or exposure to vibration has long been the most frequently occurring occupational disease in the Czech Republic [7, 8, 9].

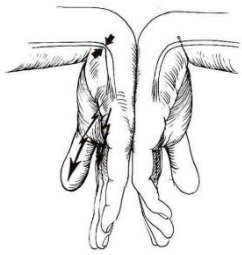

Figure 1 Phalen´s test [14].

The last point of the analysis is to measure the maximum grip strength of the worker using a digital force gauge. The measurement is performed as follows:

- The worker stands upright.
- The force gauge is held with a palm grip.
- The worker's arm is bent in a right angle at the elbow.
- The squeeze lasts 2-3 seconds [10].

The measured values are then compared with a table that indicates the corresponding grip strength in relation to the age and sex of the participant. If the measured value is lower than the table value, this may indicate the existence of an upper limb disorder - for example, the previously mentioned carpal tunnel syndrome. Part of the table is shown below (see Table 1) [1].

Table 1 Recommended maximum grip strengths [11]

Age	Arm	Male (lbs)	Male (kg)	Female (lbs)	Female (kg)
6 – 7	R	32,5	14,74175	28,6	12,97274
	L	30,7	13,92529	27,1	12,29235
8 – 9	R	41,9	19,00552	35,3	16,01181
	L	39	17,6901	33	14,96855
10 – 11	R	53,9	24,44863	49,7	22,54354
	L	48,4	21,95387	45,2	20,50238
12 – 13	R	58,7	26,62587	56,8	25,76405
	L	55,4	25,12902	50,9	23,08785
14 – 15	R	77,3	35,06269	58,1	26,35372
	L	64,4	29,21135	49,3	22,3621

3 VALIDATING THE METHODOLOGY IN THE PRODUCTION DEPARTMENT

To validate the methodology, a company from the automotive sector was chosen. The selected factory is a supplier of rubber parts for the automotive industry. A total of 49 employees working in 3 types of positions were selected for testing:

- Warehouseman (11 employees),
- furnace operator (18 employees),
- production operator (20 employees).

The validation of the methodology and its results will be further described for the position of furnace operators. Workers holding this role are responsible for inserting the hoses in their raw state into the preheating furnaces, removing them from the furnaces and then placing them on the mandrels. Once the hoses are placed on the mandrels, the mandrel trolley must be wheeled into the baking oven and the cycle is started. Once the furnace cycle is complete, the cart is wheeled out by workers and the hoses are removed from the mandrels. The hoses are placed in a basket and taken to the washing machine. The workers also take care of removing the hoses from the washing machine and placing them in the pre-prepared baskets. There were 18 workers from this position who participated in the testing. These were 18 men ranging in age from 25 to 49 years. The average proband in this group is 37 years old, 183 cm tall, weighs 93 kg and has been working as a furnace operator for 13 years [1].

Physical load assessment for the selected position

Due to the obvious high physical demands of the activities performed, local muscle strain was measured for this position to assess the physical strain in addition to the professional assessment. The shift time-weighted average % Fmax is within the limit during an 8-hour work shift. However, the measurements exceeded the all-shift count of large muscle forces (55 - 70 % Fmax) in the flexor group of the right and left upper limb. All groups monitored (especially the flexor group of the right and left hand and forearm) exhibited above-limit muscle forces (i.e. above 70 % Fmax). According to the connection of the recorded video of the work process with the EMG curves, it was evaluated that this was a regular part of the work - more specifically, putting the hoses on the mandrel. The total number of unilateral hand and forearm movements was not exceeded for any of the groups observed [1].

Based on the physical load assessment, the most problematic areas were:

- one-sided strain on the upper limbs,
- the number of movements for the right upper limb,
- head position (extension),
- working positions of the upper limb (shoulder),
- monotony of the performed activity,
- microclimate [1].

Questionnaire survey for the selected position

This section describes the findings obtained by completing the questionnaires. Of the 18 respondents, 16 indicated 'standing' as the predominant work position, with the remaining two workers in this position selecting the 'sitting and standing' option. The group surveyed is predominantly made up of individuals with right laterality - they make up almost 95% of the respondents (i.e. 18 out of 19 probands).

The following findings emerged from the second part of the Nordic Questionnaire:

- More than 50% of the probands reported experiencing pain or stiffness in the shoulder area (11 probands) or in the hand and wrist area (10 probands) during the last 12 months. However, only 2 probands reported that they had decided to consult a health professional as a result of these problems.
- Exactly half of the probands, i.e. 9, also reported difficulties in the lower back or sacrum - 2 of them sought the help of a health specialist.
- Another problematic area was the neck - 8 probands reported pain or stiffness in this area. However, none of the probands decided to consult a health specialist.
- Sixteen of the 18 respondents had experienced pain or stiffness in at least one of these body areas in the last 12 months. On average, probands reported experiencing difficulties in 3 areas.
- However, only 4 probands reported seeking the services of a health specialist [1].

The nine body areas of interest, together with information on the number of probands who reported difficulties in that area, are shown below (see Figure 2).

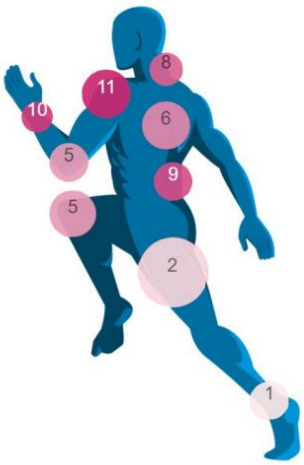

Figure 2 Nordic Questionnaire results [1]

In the third part of the Nordic Questionnaire, the following situations were identified as the most burdensome:

- too hot / cold / humidity / noise / draughts,
- performing the same tasks repeatedly,
- working at the limits of physical capabilities,
- rushing through some work operations,
- working in the same working position for long periods of time

Based on the group evaluation, the position of furnace operator is classified as second degree of mental burden. This means that the psychological stress can be expected to have a negative effect on the performance of workers in this role. The table below shows the scores of individuals in which more than half of the probands reached or exceeded the critical values specified for each factor or gross score (these values are highlighted in red in the table) [1].

Table 2 Meister questionnaire results (Bajičová, 2022)

Category	I - Overload		II - Monotony		III - Non-specific		IV - Occupational load	
Respondent number	Answer	Critical value	Answer	Critical value	Answer	Critical value	Answer	Critical value
5	6	12	6	8	9	12	21	26
6	9	12	10	8	12	12	31	26
8	6	12	9	8	7	12	22	26
9	14	12	8	8	12	12	34	26
11	3	12	5	8	4	12	12	26
12	11	12	13	8	12	12	36	26
15	9	12	8	8	13	12	30	26
18	12	12	13	8	17	12	42	26
19	6	12	6	8	12	12	24	26
20	7	12	7	8	13	12	27	26
21	6	12	8	8	12	12	26	26
27	7	12	7	8	9	12	23	26
28	8	12	8	8	10	12	26	26
29	9	12	8	8	12	12	29	26
31	6	12	8	8	12	12	26	26
34	9	12	8	8	13	12	30	26
35	7	12	4	8	10	12	21	26
43	10	12	6	8	13	12	29	26

Employee analysis for the selected position

The last part of the methodology, i.e. the employee analysis, involved conducting the Phalen´s test. Tingling or numbness in the thumb, index finger, middle finger or lateral half of the ring finger was experienced by two of the probands. This highlights the risk of evolving carpal tunnel syndrome.

Then, during the measurement of maximum grip strength, a lower value than that appropriate for the proband's sex and age was measured for one or both upper limbs in 10 subjects - i.e. in more than half of the workers examined in the position. The measured values for the right and left upper limb are shown in the table below [1].

Table 3 Grip strength measurement [1]

Respondent number	Strength RUE	Strength LUE
5	30	39
6	61	69
8	47	43
9	65	69
11	62	45
12	59	61
15	40	24
18	40	55
19	55	52
20	57	52
21	68	59
27	50	49
28	60	60
29	51	52
31	51	52
34	37	42
35	71	69
43	36	34

Results for the furnace operator position

The results of the individual parts of the proposed methodology show the following risk areas for the job position of furnace operator, which need to be addressed in the rehabilitation plan:

- Upper limbs - the physical load assessment shows an excessive load for the upper limb area. Both inappropriate working postures and regular occurrences of high and excessive muscle forces are identified. This is also reflected in the results of the questionnaire survey, in which more than half of the probands reported that they had experienced pain or stiffness in the shoulder area or in the hands and wrists during work in the last 12 months. Furthermore, the physical load assessment revealed a higher load on the right upper limb due to the number of movements per shift. During the individual worker analysis and the measurement of maximum grip strength, the more heavily loaded right upper limb was more likely to be measured below the appropriate grip strength. The lower measured squeeze forces and positive Phalen's test results suggest the possibility of pre-existing health problems. Thus, especially in these probands, it is desirable to place increased emphasis on the wrist area and provide exercises for the prevention/treatment of carpal tunnel syndrome. Based on the above findings, the upper extremities (especially the shoulders and wrists) can be considered the most overloaded and at risk area for this job.
- Neck - during the performance of work activities, both head flexion and extension (i.e. conditionally acceptable head positions) occur. Almost half of the Nordic Questionnaire respondents reported feeling pain or stiffness in the neck area. For these reasons, it is recommended to include preventive exercises targeting this area in the rehabilitation plan.
- Lower back - this area is classified as a problem area based on the questionnaire part of the methodology, where stiffness or pain in the lower back or sacrum was reported repeatedly by respondents.
- Stress - based on the results of the Meister questionnaire, it can be assumed that workers are exposed to higher levels of stress. It is therefore advisable to include relaxation exercises in rehabilitation.

The exercises can then be further adapted and supplemented based on the perceived difficulties of the individuals (Bajičová, 2022).

Summary of results for the remaining studied positions

The results for the other two examined positions – warehouseman and production operator – showed a lower level of both physical and mental load. However, the most at risk areas remained quite similar to the position of furnace operator.

Based on the results of the used methodology, the most strained areas for the position of warehouseman are:

- upper limbs,
- neck,
- lower back,
- ankles.

For the position of production operator, the overloaded areas are as follows:

- upper limbs,
- neck,
- lower back,
- knees.

According to the Meister Questionnaire, both of these positions fall into the first degree of mental strain, meaning that the stress the workers endure at work is not likely to affect their health or performance [1].

4 CONCLUSION

Based on an evaluation of 49 participants using the proposed methodology, three areas emerged as crucial, namely the upper limbs, neck and lower back. The determination of recurring upper limb issues corresponds with the most frequently occurring occupational diseases in the Czech Republic. Thus, similar results can be expected in other industrial companies as well. In the case of lower back, the extension of the list of occupational diseases to include chronic lumbar spine disease will only be effective from 2023. Therefore, no data are currently available for comparison with developing occupational diseases in the Czech Republic.

Two out of the three crucial areas (upper limbs and neck) are categorised as areas that can be addressed with virtual reality rehabilitation. For both of these areas, the available hardware (VR headsets) can be used to easily monitor their position and thus control the correctness of the exercises (without the need for additional

sensors). For the lower back area, it is currently not possible to provide motion tracking without the use of additional hardware (which is inconvenient for the person exercising), and therefore it is recommended that prevention for difficulties in this area is addressed in other ways.

To further confirm the results of the methodology, it is desirable to investigate a larger sample of industrial workers and monitor their progress during the course of the virtual reality rehabilitation.

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REFERENCES

[1] Bajičová, T. (2022). Návrh implementace rehabilitací ve virtuální realitě v průmyslovém podniku [Master's thesis]. Západočeská univerzita v Plzni.

[2] De Barros, E. N., & Alexandre, N. M. (2003). Cross-cultural adaptation of the Nordic Musculoskeletal Questionnaire. International Nursing Review, 50(2), 101-108.

[3] Hatiar, K., Kobetičová, L., & Hájnik, B. (2004). Ergonómia a preventívne ergonomické programy (4) : Ergonomická analýza pomocou modifikovaného dotazníka "NORDIC QUESTIONNAIRE". Bezpečná práca, 35(4), 20-28.

[4] Hladký, A., & Židková, Z. (1999). Metody hodnocení psychosociální pracovní zátěže: metodická příručka. Praha. Karolinum.

[5] Židková, Z. (2003). Faktor sociální interakce v kategorizaci prací. Psychologie v ekonomické praxi, 38(3-4), 111-120.

[6] Židková, Z. (2016). Evaluation of psychological stress at work. Retrieved from: http://zdenka-zidkova-psvz.webnode.cz/metody/ [accessed: 5 October 2022].

[7] Phalen, G. S. (1957). Compression neuropathy of the median nerve in the carpal tunnel. Journal of the American Medical Association, 164(5), 524.

[8] Minks, E., Minksová, A., & BRHEL, P. (2014). Profesionální syndrom karpálního tunelu. Neurologie pro praxi, 15(5), 234–239.

[9] Katirji, B., Kaminski, H. J., & Ruff, R. L. (2014). Neuromuscular disorders in clinical practice (2nd ed.). New York. Springer.

[10] Kába, M. (2020). Vliv pracovní polohy na lokální svalové zatížení předloktí u stárnoucí populace v průmyslové výrobě [Doctoral dissertation]. Západočeská univerzita v Plzni.

[11] Firrell, J. C., & Crain, G. M. (1996). Which setting of the dynamometer provides maximal grip strength? The Journal of Hand Surgery, 21(3), 397-401.

[12] Nařízení vlády č. 68/2010 Sb. ze dne 22. února 2010, kterým se mění nařízení vlády č. 361/2007 Sb., kterým se stanoví podmínky ochrany zdraví při práci (2010).

[13] Zákon č. 205/2020 Sb. ze dne 21. dubna 2020, kterým se mění zákon č. 258/2000 Sb., o ochraně veřejného zdraví a o změně některých souvisejících zákonů, ve znění pozdějších předpisů, a další související zákony (2020).

[14] Anatomy note (2018). Phalen's test diagram. Retrieved from: https://www.anatomynote.com/disease-anatomy/test-and-maneuver/phalens-testdiagram/ [accessed: 11 September 2022].

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PRODUCTION PROCESSES AS PART OF STRATEGIC PRODUCTION MANAGEMENT

Barbara Barilová [1] – Naqib Daneshjo [2] – Dominika Popovičová [3]

Abstract: *Modern manufacturing is at the core of industrial production from base materials to semi-finished goods and final products. Over the last decade, a variety of innovative methods have been developed that allow for manufacturing processes that are more versatile, less energy-consuming, and more environmentally friendly. The basic prerequisite for the economic use of production factors tied to the company is their use to the highest possible extent. The rate of utilization of all production factors is the utilization of the company's production capacity. The goal of business management is to achieve the best possible economic results. The tool is the observance of maximum economy in every section of production activity. Historical evidence points to a link between manufacturing and economic growth. Companies should try to produce efficiently and environmentally friendly.*

Keywords: manufacturing process, production, strategic management, environmental environment.

1 INTRODUCTION

Strategic production management represents the management of resources that are necessary for the production of specific products. It is about designing and optimizing processes and harmonizing the relationships of these processes and their basic factors in time and space. The task of production management is to comprehensively formulate production tasks, that is, to process orders and submit results to the marketing department. It also focuses on capacity and term planning, overall process management, monitoring and regulation of production processes, recording of process progress and process improvement. Production management is responsible for analyzing and analyzing the market, creating a production perspective, creating incentives for innovative changes in processes, making production including various service processes in production, performing output control up to production service [3].

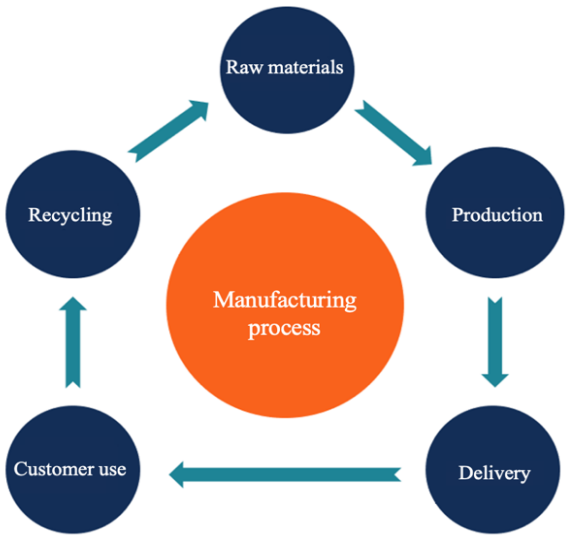

Figure 1 Manufacturing process

The production process is a way of producing goods by combining supplies, ingredients or raw materials according to a specific procedure or recipe. We can observe it in industries that produce large volumes of goods, such as food, beverages, refined oil, gasoline, pharmaceuticals, chemicals, and plastics. The type of production is influenced by numerous factors, such as:
• Demand for the product in the market,
• State of raw materials, components and chemicals with which the company works
• Availability of resources and state of the factory Each production technique is different and, when used correctly, each of them offers different advantages. For example, a batch manufacturing process operates in large continuous batches or in smaller batches to meet demand and minimize waste. Regardless of the implementation, the process types remain largely the same [8].

Strategic production management should focus on the requirements:
• Explicit expression of related functional business strategies, definition of production management goals and their principles and evaluation criteria
• Arrangement of the production process in terms of fluidity of material flows and time for all input factors
• Provision of necessary production capacities for depositions
• Defining the investment intention and technical development in the area related to the production system
• Using the concept of production process management and its planning (JIT, OTP, KANBAN)
• Adapting production volume management to cost management in relation to the quantity produced
• Eliminating risks based on stabilization factors such as are reserve capacities or replacement deliveries
• Cooperation on quality management in the area of the production process
• Ensuring the workforce, employee motivation in the area of the production process, defining and observing the corporate culture

• Using the principle of economic management of the production process and its outputs
• Ident ification of problematic areas of the production process and determination of specific tasks that will ensure the improvement of the situation [2].

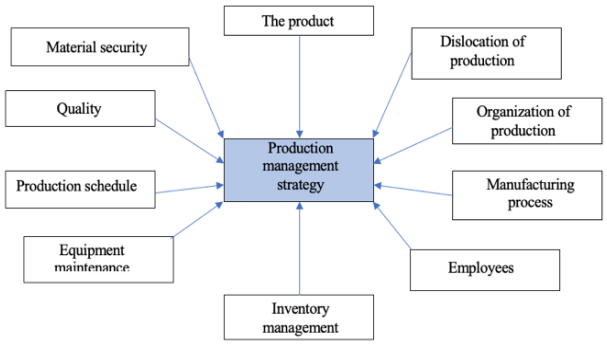

Figure 2. Components of strategic production management

Each new product or product must have clearly specified target technical and economic parameters. Based on them, the entire production program is continuously updated. In order for the product to meet the expectations and needs of the customer, rigorous pre-production preparation must be ensured. This requires the combination of knowledge and know-how of creative people, whose cooperation will ensure the high quality of the resulting products. The whole process has to be done quickly so that the product is on the market at the right time. Due to the shortening of the moral life of products and the increase in demands for development, it is necessary for the production strategy to focus on high-quality products, continuous improvement and innovation in the form of introducing new products or modifying old ones [4].

2 DIVISION OF THE PRODUCTION PROCESS AND ORGANIZATIONAL STRUCTURE

Based on the relationship with customers, it is possible to express the division and organizational structure of the production process. If the customer directly specifies the production product, the organizational form is custom production. If the company does not produce directly for a specific customer but for markets in general, the arrangement system is production to stock [2].

The production process can be divided according to different points of view.

According to the degree of fluidity of the technological process:

- *Continuous production* - in this type of production, the production process is never interrupted, even during work breaks. The entire production process takes place in equipment that is interconnected by pipelines, storage and between storage devices. In this type of production, it is mostly mass production, in which ideal conditions for automation are created. Continuity of production is given by a high degree of automation. Stopping and restarting production is associated with significant costs [2].
- *Interrupted production* – a number of non-technological processes, such as material transport or tool change interrupts the technological process. In this type of production, production can be stopped and restarted at any time without much cost. Because of the variety of operations and the large number of products produced at the same time, batch production is more complex than continuous production. In intermittent production, automation is much more difficult to apply and also creates pressure to increase the fluidity of discontinuous production [2].

According to the nature of the technology:

- *Mechanical production* – the properties of the substance of processed materials and semi-finished products do not change, but the material or semi-finished product changes its shape and quality (e.g. engineering production, construction production, etc.).
- *Chemical production* – the properties of the substance of the substance change.
- *Biological and biochemical production* – substance processes are changed by using natural processes [4].

According to the type of production**:**

- *Piece production* – is characterized by the production of a large number of different types of products in small quantities.
- *Serial production* – the same type of product is produced repeatedly in series, which are referred to as small-, medium- and large-scale production according to the size.
- Mass production – a large amount of one or a small number of product types is produced [4].

Table 1. Comparison of production process types

Type of production process	**Characteristic**	**Example**
Custom production	Individual orders or pieces	Electron microscope
Serial production	Multiple units of diverse products on different devices	Electrical appliances for households
Mass production	Unlimited units of one product on the same devices	Electrotechnical components

According to the form of organization of the production process (an important role is played by the equipment and organization of the production process and thus also the management of the material flow):

1. *Line production* – one or a couple of related products are produced without the individual production they uncoupled the phases with the help of intermediate stocks. It takes a lot of time and capital to create a design for jet production. The layout of the plant is completely adapted to the products. This is the exclusion of inter-operational stocks, short lead times, extensive division of labor, transparent spatial situation and production scheduling only for the line as a whole. Automation of the production process will ensure that the operator can only supervise the processes. Individual operations in the production process must be controlled so that combinations of operations can take place at the same time. The main elements that are important to think about during the coordination process are determining the best sequence of operations for a specific technology, determining and defining the production speed of the line and mutual time coordination of individual workplaces. The goal is to minimize downtime of the flow line system [2].

Table 2 Advantages and disadvantages of line production

The form of organization of the production process	**Advantages**	**Disadvantages**
Current production	- Short transport route - Short production time - Low commitment of working capital - Saving of production costs	- Low adaptability to changes and flexibility - Sensitivity to machine failure and the occurrence of failures - Monotonous work

2. *Group production* - it involves the production of several products, the consumption of which is relatively stable. Each of these products goes through a fixed route and is produced on the same equipment. In this type of production, the production stages can be decoupled using intermediate stocks. This is why batch production takes longer than mass production. Spatial distribution of the equipment is controlled according to the group of products and must be flexible enough to be able to adapt to the production of a larger number of products. Provided that certain conditions are met, it is possible to arrange selected parts of the production process as in flow production. However, this production is less economical than jet production. Spatial layout cannot be solved once and for all, because different requirements are placed before each production process, which means rescheduling again and again. Coordination of individual operations is influenced by factors such as the number of production stages, the total number of products to be produced, the number of products processed at the same time, the flexibility of the workplace and production facilities, and the degree of interconnectedness of the production process with interoperational stocks. The solution is to draw up a production schedule, which prescribes how much, from what, when and where it must be produced. It is about defining the needs (material) and order (operations and orders) for the required volume. For the purposes of determining needs, it is possible to use the MRP (Material Requirement Planning) technique or some method from the SIC (Statistical Inventory Control) stock management system) [2].

Table 3 Advantages and disadvantages of group production

The form of organization of the production process	**Advantages**	**Disadvantages**
Group production	- Production of a larger number of products - Products are processed simultaneously	- Longer average production time compared to jet production - Less economical than jet production - Complexity of scheduling before each production process

3) *Phased production (job shop)* – a whole range of products is produced from each type in small quantities. Products of various nature are produced, either standard or specific for a particular customer. The products pass through the workshop along different routes for each product, which means that the routes are diverse and also differ in the length of the processing time. The average length of production is much longer than in jet production. Production facilities are less efficient because they are not specialized. They are organized into functional groups, so it is a so-called technological arrangement of production. The orders are determined by the machine based on the order so that the optimization criterion is met. Custom manufacturing is dynamic, which means that the tasks that will need to be performed are not known in advance. Therefore, it is not possible to schedule work orders precisely because the tasks arrive in

time. A very effective method in this type of production is SPT (Shortest Processing Time). From the point of view of lead time control, the performance of custom production is strongly dependent on the load factor, because the factor determines the waiting time. The critical limit that the utilization coefficient must not exceed is 90% [2].

Table 4 Advantages and disadvantages of phased production

The form of organization of the production process	**Advantages**	**Disadvantages**
Phase production	- High degree of flexibility and adaptability to changes - Low sensitivity to machine failures - Low sensitivity to failure	- -Length and complexity of transport routes - Long production lead time - High demands on production areas - Limited overview in production - High level of inventories of work in progress

An effective logistics and production strategy and planning provides the company with control over incoming material, maintains stocks at optimal levels, organizes the reverse flow of goods and ensures the transfer of cargo by the most suitable mode of transport, which significantly helps to reduce costs. If the company does not provide services quickly, qualitatively and flawlessly, it has no chance to succeed. An appropriate management strategy can optimize transport processes and eliminate possible breakdowns, which means that it also has a direct impact on customers. Quality services build a solid reputation for the company and thus ensure further orders.

During 2021 and 2022, we see a significant increase in energy prices due to a combination of a sharp increase in global energy demand (due to the reactivation of the economic cycle) and weak supply (due to geopolitical issues and a shift in the energy model towards non-fossil fuels), leading to a global energy shock. In 2022, the geopolitical context puts additional pressure on international gas and oil prices, which could exacerbate the already significant impact of rising energy bills. High energy prices represent the biggest problem for companies with a high degree of electrification in heavy industry. Some factories had to significantly reduce their production in order to avoid next year's losses amounting to tens of millions of euros [5].

This fact, related to the increase in the prices of energy and commodities, negatively affected suppliers, customers, but also operators of systems and networks. Electricity and gas prices were most significantly affected, as a result of two significant events, which are the Covid-19 pandemic and the war in Ukraine, which began on February 24, 2021. At the beginning of 2022, the situation was expected to stabilize, and thus wholesale energy prices would fall. However, current forecasts say that a significant drop in prices will not occur even until 2024 [6].

Economic changes in the form of alternating periods of crisis (economic, social, economic and moral) and periods of well-being, representing the rapid development of industry, companies and technologies, push businesses to constantly improve the quality and efficiency of production, optimize distribution, optimize costs and profit and offer customers high quality services. It is very important that the company pays attention to the search for possible savings, because they can ensure their survival in difficult times, or even a competitive advantage. If a company wants to maintain and strengthen its position on the market, it must implement an innovative policy that will ensure a better position than its competition. Companies must therefore focus on increasing resource efficiency through a more systematic approach. A manufacturer's measures to increase cost efficiency concern either the production process or the personnel it employs. A manufacturer that focuses only on these two aspects significantly limits its ability to reduce the overall costs of its company. This is why material flow analysis is beneficial to the overall profitability, longevity and efficiency of a business. Material flow analysis is an important part of industrial production, especially in terms of efficiency and costs. A manufacturer relies on a lean manufacturing process to ensure profitability, but if there is too much waste in the manufacturing process, the company loses money in the long run. Such business also has an adverse effect on the environment. By working with lean consulting firms and committing to MFA and material flow restructuring when needed, the manufacturer saves money and optimizes performance, leading to improved fiscal performance of the business The need for increased efficiency in the management of non-renewable resources is increasingly important, because air pollution has real and far-reaching consequences [7, 8].

Due to the rapid growth of the number of companies and thus the rapidly growing competition, the period of globalization is very important for companies to constantly increase their competitive advantage in the market. The European Union has gone through various changes in the economy caused by a change in the political environment. This fact caused the need to change the management and guidance of operational economic processes. We can observe big changes especially in the material circulation process. Circulation does not mean only a material connection between production and consumption, but also a material connection in one's own production. Differentiation from the competition is therefore the

most important goal of manufacturing companies. Differentiation can lie in better products, technologies or innovations, but also in the way the company handles waste. It is very important to pay attention to the effective management and improvement of processes in the material flow. The way manufacturing companies handle waste can significantly affect their impact on the environment. A company can prevent harmful effects by influencing its activities related to the extraction of primary raw materials and also the transformation of primary raw materials in production processes [9].

The European waste management policy has set itself the goal of preventing waste generation. Waste production in manufacturing sectors in the EEA 18 countries currently appears to be stable. However, acceding countries saw a significant increase in production from the basic metal industry and also from food production. The amount of construction and demolition waste is still growing. We can conclude that this growth is closely related to economic growth. Recently, waste streams have also begun to appear, which are created as a result of the implementation of measures to improve the environment in other areas, such as residues from flue gas cleaning and sewage sludge from waste water treatment plants. One of the other very important goals of the European Union in within the framework of the waste policy is to obtain high-quality resources from waste in the greatest possible quantity and thereby contribute to the circular economy. The European Green Deal was created to protect human health and the planet. The reason for its creation is the effort to create a healthier, more efficient, more modern and especially more competitive policy. This strategy has set a very ambitious and bold goal of zero environmental pollution. The European Union developed the Waste Directive, which represents the EU's legal framework for waste management. A 'waste hierarchy' has been introduced, meaning the introduction of an order of preference for waste management, which helps to categorize waste based on the need for different specific treatment approaches. For these purposes, the EU has created a number of laws that deal with those types of waste [9].

3 CONCLUSION

The type of production is given by the complex characteristics of the technical, organizational and economic characteristics of production, with regard to the width of the assortment, regularity, stability and volume of production. The main indicator characterizing the type of production is the coefficient of consolidation of operations Kz. The coefficient of consolidation of operations for a group of works is defined as the ratio of the number of all different technological operations performed or carried out during the month to the number of works [4].

Nowadays, production management is a decisive factor in the success of the company. Without production management, the company cannot fulfill the obligations or goals it has set. Good governance brings many benefits to any business, regardless of its size. These advantages consist in better quality, lower operating costs and also in the reliability of the production system. Better quality – A well-maintained facility can produce higher quality products. It also ensures high awareness of managers, supervisors, operators and technicians who can catch errors before they occur [1]. A systematized program will create standard operating procedures, standard work documentation and built-in audit procedures. Effective management ensures the development and deployment of procedures that reduce waste to the lowest possible level. Without its introduction, the quality of products is reduced, or defects occur, scrap and over-processing will increase production costs and reduce profitability. Waste does not have to be physical. Waste can also include excessive or unnecessary movement of operators and repeated transport. Production management relies on principles that also reduce these types of waste. Lower operating costs - Managers use different costing methods to reduce costs. Effective production management techniques and systems reduce these costs by providing mechanisms and methodologies to identify, analyze and change processes to achieve the most efficient production method. Applying these techniques to all variables cumulatively reduces costs in all areas. Reliable production management system - means using data to help managers evaluate plant progress. This includes operator output, equipment performance and efficiency, quality monitoring methods, and more. Using these tools, managers can identify variances that could affect quality, production time, and errors, and use this information to proactively address them.

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REFERENCES

[1] Abel, C. A., Edwards, K. L., & Ashby, M. F. (1994). Materials, processing and the environment in engineering design: the issues. *Materials & Design*, *15*(4), 179-193.

[2] Denno, P., Dickerson, C., & Harding, J. A. (2018). Dynamic production system identification for smart manufacturing systems. *Journal of manufacturing systems*, *48*, 192-203.

[3] Harris, R., Harris, C., & Wilson, E. (2003). *Making materials flow: a lean material-handling guide for operations, production-control, and engineering professionals*. Lean Enterprise Institute.

[4] Marie, J. (2016). *Výrobní a logistické procesy v podnikání*. Grada Publishing as.

[5] Košturiak, J., & Chaľ, J. (2008). *Inovace: vaše konkurenční výhoda!*. Computer press.

[6] Sixta, J., & Žižka, M. (2009). *Logistika: metody používané pro řešení logistických projektů*. Computer Press.
[7] Pauliková, A., Chovancová, J., & Blahová, J. (2022). Cluster modeling of environmental and occupational health and safety management systems for integration support. *International journal of environmental research and public health*, *19*(11), 6588.
[8] TREND. (2022). Energetická búrka spacifikovala firmy, od hrôzy. Žijú v zlých časoch, dražoba im nedá spávať. Retrieved from: https://www.trend.sk/ekonomika/energeticka-burka-spacifikovala-firmy-hrozy-ziju-zlych-casoch-drazoba-im-neda-spavat [accessed: 11 August 2022].
[9] URSO.GOV.SK. (2022). Vysoké ceny energií. Retrieved from: https://www.urso.gov.sk/vysoke-ceny-energii-vy-sa-pytate-urso-odpoveda/ [accessed: 12 August 2022].

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COMPARISON OF AGILE AND TRADITIONAL PROJECT MANAGEMENT APPROACHES WITH RESPECT TO THE PROJECT LIFE CYCLE

Michal Brutovský [1] – Katarína Buganová [2]

Abstract: *Project management is currently one of the most frequently used tools for implementing change, innovation and optimization of business activities and processes. There are several methodologies and approaches based on which it can be implemented, and a great emphasis is also placed on risk management. The aim of this article is to highlight the specificities of traditional and agile approaches in project management with respect to the project life cycle.*

Keywords: project, traditional approach, agile approach, life cycle, comparison.

1 INTRODUCTION

Project management is essential in today's business environment because it promotes the implementation of change and continuous improvement through various types of projects, thus improving business performance. Craddock (2013) proved that the success and sustainability of projects are directly related to business excellence [1].

Adopting a project management culture helps organizations understand and adapt their core activities to different norms, regulations, and behaviours. In addition, it influences employee expertise and engagement, project management processes and their application through various methods and tools such as requirements analysis, timeframes, agile methods, specific software to support project management, etc. [2], [3].

It is increasingly emphasized that project success in modern thinking should take into account not only the dimension of efficiency and business impact on the organization and the customer (benefits). Also important are new perspectives for all stakeholder groups, directly related to the appropriate achievement of their desired level of satisfaction in terms of organizational, personnel and technical implementation of the project [4], [5], [6].

As such, project management deals with the creation of a new organizational state, e.g., through the creation of a new or adapted product, service, or process. Project management ensures that the creation of this new organizational state happens within the prior defined time and costs, i.e., that the project is completed on time, within budget, and in scope. Sustainable project management extends this perspective and includes sustainability targets [7].

Risk is an inherent property of every project. In many cases, project management and risk management are applied quite independently. On the one hand, the traditional tools of project management do not include the notion of risk. On the other hand, the tools of risk management focus on the representation of risks without explicitly representing the project, which leads to implement the risk management process independently of the project management process. Methods and tools are needed to manage and represent risk project. The absence of such techniques is a concern because there is no risk without project and no risk-free project [8].

Risk management is implemented in the project management of the enterprise by implementing the risk management process at both the strategic and operational levels of the enterprise, as part of the implementation of business and project processes and guidelines. In order to achieve high efficiency of the risk management process, the established principles of risk management at the strategic and operational level of the organisation must be followed, whereas the traditional or agile method of project management can be used.

2 SPECIFICS OF TRADITIONAL AND AGILE APPROACHES IN PROJECT MANAGEMENT

The unprecedented rate of change in business and technology has made it increasingly difficult for project teams to determine stakeholder requirements and be responsive. The rapid changes to requirements necessitate agile project management practices [9], [10].

Generic definition of project agility offered by Conforto et al. (2016) is the project's team ability to quickly change the project plan as a response to customer or stakeholders' needs, market, or technology demands to achieve better project performance in an innovative and dynamic environment [11].

Project management methodology is usually defined as a set of methods, techniques, procedures, rules, templates, and best practices used on a project. It is commonly based on a specific project management approach, that defines a set of principles and guidelines which define the way a project is managed. With the

growing trend of usage of agile project management on different projects, it is clear that two opposite sides exist - traditional and agile project management approach, and that there exists a need to combine both approaches [12].

If the level of these deficiencies can be eliminated or reduced, it will increase the chances of project success. Businesses can then manage projects in the right way, considering their organisation and the challenges they face. UK project management company Wellingtone PPM created a survey in 2017 to review project management across all industries. It found that only 59% of respondents base their project on planned project scope, 48% mostly or always follow their project schedules, and 62% are always or mostly involved in risk management [13].

Recent results from the Standish Group study in Figure 15 show that agile projects are statistically 2 times more likely to succeed and 1/3 less likely to fail than traditional (waterfall) projects [14].

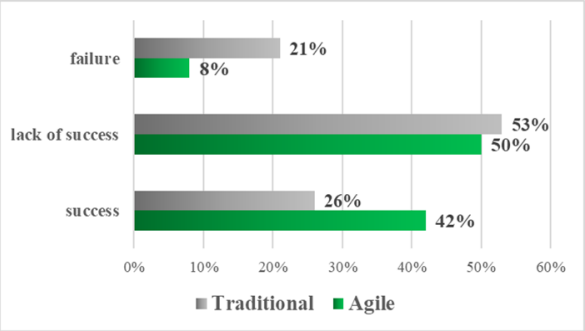

Figure 1. Success of project approaches (Source: adapted from [14])

Standish Group's 2018 survey findings show the success rate of technology projects at 36%, with agile projects succeeding more often [14]. Agile approaches in large enterprises often encounter complications such as management's reluctance to change established stereotypes and embrace a change in corporate culture, or the involvement of the responsible project manager in product development.

According to the latest industry survey, "15th State of Agile Report" (2021), agile project management practices have been extensively used in IT projects. However, professionals have started applying these practices to non-IT projects like business process change, financial services, manufacturing, innovative engineering, and healthcare projects [15].

In the traditional approach, complications are most often associated with over-complexity, well-defined processes, and customers may not always understand delivering a product that. The traditional approach is based on the need to meet the specifics of the requirements. Requirements are fixed as functionality, and time and resources act as variables. In the event that there is a threat to the fixed functionality, changes are also set in these variables. Often budget or human resources need to be increased, which may not be desirable.

The agile approach, on the other hand, considers time and resources as fixed, which are defined by the client at the beginning of the project activities, and the functionality (functional requirements) changes continuously.

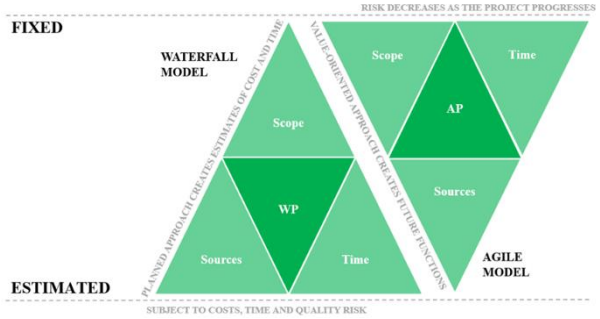

Figure 2. Traditional and agile triple-imperative (Source: modified according [16])

Agile methods remove the need to create descriptions of the task elements to be implemented, prioritizing functionality and a properly functioning system or component that is ready to be handed over to the customer. The basis of agile methods is teamwork, self-organization of team members, proper communication, and creativity. The agile approach to project management largely boils down to the human factor, with particular emphasis on communication, commitment, collaboration and proactivity of stakeholders [17], [18], [19].

3 COMPARISON OF TRADITIONAL AND AGILE APPROACHES IN PROJECT MANAGEMENT

Both the traditional approach and the agile approach have their specifics, which may suit certain types of organizations. It is also necessary to consider the nature of the project. The procedure is different for projects aimed at expanding services, construction projects, innovation projects, educational projects, IT projects, etc. Each project team should consider choosing a traditional and agile approach (or a combination) even before starting the project solution, already during the creation of the feasibility study.

A comparison of the two approaches is shown in Figure 3. It claims that the full assignment must not be created entirely at the outset (at the time of greatest uncertainty) but must be continuously changed and all estimates continuously refined. Moreover, a close connection with the customer creates a better environment and relationship.

In today's dynamic times, it is an advantage to release a product as quickly as possible and then work

on it based on feedback [20].

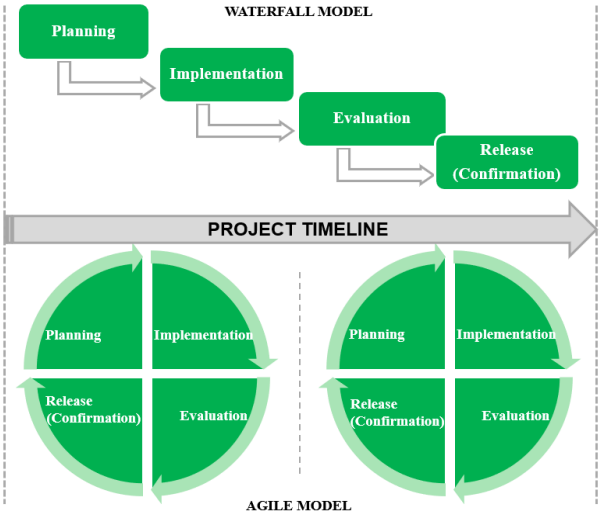

Figure 3. Traditional versus agile approach (Source: prepared by authors, modified according [16])

A comparison is then drawn in Table 1, which shows that these are two different approaches to managing the process and the project life cycle process. Agile as more flexible, collaborative, embracing change and often suitable for smaller projects where a minimum viable product is critical.

Table 1. Comparison of project management models (Source: prepared by authors)

THE SPECIFICS OF BOTH MODELS	
WATERFALL MODEL	**AGILE MODEL**
gradual/linear phases	continuous cycles
preliminary planning and in-depth documentation	small, high-functioning, collaborative teams
contractual negotiations	multiple methodologies
simple and anchored projects	flexible/continuous development
close involvement of the project manager	customer participation

Agile values and principles focus on iterations, increments, self-organization, and closer interaction and collaboration with customers as a new way of project management [21].

Traditional, on the other hand, as more controlled and rigorous, with progress measured by clearly defined incremental milestones and targets. Both approaches are proven to work and fail on different types of projects.

Tables 2 and 3 describe and compare selected criteria of traditional and agile project management approaches.

Table 2. Comparing the focus of the traditional project management approach (Source: prepared by authors)

TRADITIONAL (WATERFALL) APPROACH	
FOCUS	**DESCRIPTION**
Pressure	Tasks are assigned to managers and team leaders.
Priorities	Tasks have priorities. Multiple tasks can have the same priority.
ASAP	As soon as possible. Typically, high pressure on tasks, working on multiple tasks at the same time.
Large teams of specialists	Team oriented to a particular specialisation.
Irregular deliveries with frequent corrections	Delivery of the result takes a long time and is delivered to the client after a longer period.
90% of things 90% done	The product is constantly in a state of development. We have to wait a long time for the final.
Limited visibility	Only selected persons have an overview of the status of the project. Team members often don't know where they are and where they are going. Non-transparency puts a lot of pressure on processes and control mechanisms.
Post Mortem	At the end of the project, the project manager will focus on developing a post mortem, or lessons learned, so that subsequent projects do not repeat the mistakes that have been identified.
Acceptance testing at the end	The project is tested only at the end after handover.
Waterfall	The project is divided into analysis, design, implementation and testing phases. Each change takes the team back to the previous phases in a complicated way.

Table 3 describes the criteria in the same sequence that are characteristic of the agile approach.

A project is an activity that directly involves risk and uncertainty. The key to the success of any enterprise implementing projects of various types is the effective implementation of risk management elements in project management from the inception of the project idea and its intention, through implementation and subsequent control and sustainable status.

Table 3. Comparing the focus of the agile project management approach
(Source: prepared by authors)

AGILE (ACTIVE) APPROACH	
FOCUS	**DESCRIPTION**
Pull	Tasks are taken by each member of the team independently, according to his/her competences.
Sequence	Tasks have a unique sequence number. The team tries to complete tasks according to the order typically set by the client, or the area according to value and importance.
ALAP	As late as possible. Do not waste time detailing features you may not need. Details are added only before implementation.
Small and multifunctional teams	Effective communication and small teams of up to 10 people. All roles are required to deliver results.
Regular deliveries	The product can be delivered continuously at regular intervals.
Getting Things Done	In each iteration, the completed and functional part of the product.
Transparency	The entire team, including the client and management, transparently sees the status of tasks, plans and issues. Transparency is the foundation of trust.
Continuous improvement	The team is focused on continuous improvement of work organization, team functioning, quality of inputs and outputs. They strive to identify and eliminate redundancies.
Continuous acceptance	The results of each iteration are accepted and presented continuously at the end of each iteration.
Iterations and increments	The project is divided into iterations of equal length, during which the team analyses, implements and delivers the next part that the client needs the most.

Significant risks can arise already when moving to an agile project management approach. The following risks may arise when an organisation moves to an agile approach to project management:

- Excessive number of project team members – a frequent risk of projects is the inability of individuals to do a good job, in a smaller project a smaller number of people are needed, where a more rigorous selection of qualified staff is taken care of, which is not always feasible in a project with many people,
- Lack of synchronization of project teams – when a small team is working it is possible to observe the result of the team, it is essential to ensure close cooperation of teams working on common functionality,
- Lack of transformation in the mindset of employees during the transition - managers and executive leaders must rigorously oversee the maintenance of practices according to the new (agile) methods in order not to revert to previous approaches, the risk is rooted in insufficient breaking of employees' ties to the past [22], [23].

In agile methodologies, several project planning, execution, monitoring, control and closure processes are performed in each iteration. In general, agile methods are lightweight processes that [24], [25]:

- Employ short iterative cycles,
- Actively involve users to establish, prioritize, and verify requirements, and
- Rely on a team's tacit knowledge as opposed to documentation.

Agile methodologies, along with the corresponding tools and practices, are claimed to facilitate teams in managing their work more effectively and conducting their work more efficiently while fostering the highest quality product within the constraints of the budget [26].

Support is needed to develop new strategies for the development and implementation of risk management as part of project management to realise the potential. Risk management is a priority process within project management, whether agile or not.

A risk is an unpredictable event or scenario that, if it occurs, has a positive or negative impact on one or more objectives. Negative risks are perceived as threats and positive risks are perceived as opportunities. Risk management procedures include risk assessment, risk identification, risk analysis, risk response planning, response implementation and risk monitoring. The objective of project risk management is to reduce the likelihood and/or impact of negative risks while increasing the likelihood and/or impact of positive risks to optimise the possibility of project success [27].

While project risk management is essential for all projects, it is more important for agile projects because of the risk factors involved in the agile project prioritization process. According to several authors, a great deal of explicit risk management becomes unnecessary if a project uses an agile approach. With short iterations, a concentrated focus on project output,

a heavy emphasis on automated testing, and frequent deliveries to customers, teams help avoid the biggest risk that most projects face - not delivering anything in the end. Many agile projects reject any form of explicit risk management. Risk management is about identifying, addressing and eliminating sources of risk before they become a threat to the company. There is a common agile way of managing risk. Risk management in agile project management adopts a cycle of four processes. These four risk control steps associated with agile project management mean that risks are identified, assessments are made, responses are considered and reviews are analysed [28], [29].

The most common weaknesses associated with project failure are:

- poorly defined project scope,
- insufficient risk management,
- key prerequisites are not identified,
- project managers who lack experience and training,
- no use of formal methods and strategies,
- lack of effective communication at all levels,
- key personnel leaving the project and/or the company,
- poor management of expectations,
- ineffective leadership,
- lack of detailed documentation,
- failure to follow requirements,
- failure to follow procedure,
- lack of detail in project plans,
- inaccurate estimates of time and effort,
- cultural differences in global projects.

It is necessary to prepare for the maximum use that the agile project and risk management model offers. Most important for the correct and successful implementation of projects is a competently implemented project management with implemented risk management. These are basic aspects of project management, but a large proportion of respondents consider them optional. There is a relationship between them, and we find that effective risk management is critical to managing scope and controlling schedules, especially for complex projects with challenging and frequently changing requirements. Risk management is one of the most important success factors for projects.

4. CONCLUSION

To be successful, an industrial enterprise needs to start with optimising its project management processes. It is necessary to make process changes and activities aimed at process innovation and project management optimisation and to apply risk management suitable for this type of activities, which will take into account the conditions of process-type project management. It must be aimed at improving the skills of managers and focus on gradual adaptation using the potential of employees.

What is being forgotten is the European Union Council Directive 89/391/EEC itself, which states that the employer must be able to identify and assess the risks to safety and health, and to determine and take the necessary protective measures.

When planning risk prevention in enterprises, it is necessary to take into account the impact of technology, work organisation, working conditions, social relations and the impact of the environment on the workplace. These are all aspects and an integral part of the success of project management of the enterprise, which is insufficiently applied in practice today.

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REFERENCES

[1] Craddock, W. (2013). How Business Excellence Models Contribute to Project Sustainability and Project Success. In *Sustainability Integration for Effective Project Management*; IGI Global: Hershey, PA, USA, 2013; pp. 1–19.

[2] Turner, R.; Ledwith, A.; Kelly, J. (2012). *Project management in small to medium-sized enterprises*: Tailoring the practices to the size of company. Manag. Decis. 2012, 50, 942–957.

[3] Trzeciak, M. (2021) *Sustainable risk management in it enterprises.* Risks 2021, 9, 135.

[4] Tam, C.; Moura, E.J.D.C.; Oliveira, T.; Varajão, J. (2020). *The factors influencing the success of on-going agile software development projects*. Int. J. Proj. Manage. 2020, 38, 165–176.

[5] Bergmann, T.; Karwowski, W. Agile Project Dhir, S.; Kumar, D.; Singh, V.B. (2019). *Success and Failure Factors that Impact on Project Implementation Using Agile Software Development Methodology.* In Software Engineering; Hoda, M., Chauhan, N., Quadri, S., Srivastava, P., Eds.; Advances in Intelligent Systems and Computing; Springer: Krems, Austria, 2019; pp. 647–654.

[6] Mishra, A.; Abdalhamid, S.; Mishra, D.; Ostrovska, S. (2021). *Organizational issues in embracing Agile methods: An empirical assessment*. Int. J. Syst. Assur. Eng. Manag. 2021, 12, 1420–1433.

[7] Silvius, G. (2012). *Change the Game: Sustainability in Projects and Project Management.* In Green Business Process Management; Vom Brocke, J., Seidel, S., Recker, J., Eds.; Springer: Berlin/Heidelberg, Germany, 2012; pp. 161–177.

[8] Rodney, E; Ledoux, Y; Ducq, Y; Breysse, D Rodney, E; Ledoux, Y; Ducq, Y; Breysse, D. (2014). *Integrating Risks in Project Management* 16th International Dependency and Structure

Modelling Conference (DSM) 2014 | Risk And Change Management In Complex Systems, pp.369-377.
[9] Sweetman, R., Conboy, K. (2018) *Portfolios of agile projects*. Project Management Journal, 49 (6) (2018), pp. 18-38.
[10] Schwalbe. K. (2018) *IT project management.* (9th ed.), Cengage Learning Press, Boston, MA.
[11] Conforto, E.C., Amaral, D.C., Da Silva, S.L., Felippo, A.D., Kamikawchi D.S.L. (2016) *The agility construct on project management theory*. International Journal of Project Management, 34 (4) (2016), pp. 660-674.
[12] Spundak, M. (2014) *Mixed agile/traditional project management methodology - reality or illusion?* 27th World Congress of the International-Project-Management-Association (IPMA). 2014. Selected papers from the 27TH IPMA 119 , pp.939-948
[13] Wellingtone PPM, 2018. *The State of Project Management Annual Survey* [online]. Retrieved from: https://www.wellingtone.co.uk/wp-content/uploads/2018/05/The-State-of-Project-Management-Survey-2018-FINAL.pdf [accessed: 2022-01-27].
[14] Standish Group, 2018. *Chaos Study results show Waterfall and Agile project success and failure rates* [online]. Retrieved from: https://www.standishgroup.com/sample_ research_files/CHAOSReport2015-Final.pdf [accessed: 2022-01-27]
[15] State of Agile Report. 2021. Version one inc 14th ed.. Retrieved from: https://stateofagile.com/#ufh-i-615706098-14th-annual-state-of-agile-report/7027494 [accessed: 2022-01-27].
[16] Svozilová, A. (2016). Project management - Systemic approach to project management. Prague: Grada Publishing.
[17] Bogdanova, M.; Parashkevova, E.; Stoyanova, M. (2020). *Agile project management in governmental organizations–methodological issues.* IJASOS 2020, 6, 262–275.
[18] Tam, C.; Moura, E.J.D.C.; Oliveira, T.; Varajão, J. (2020). *The factors influencing the success of on-going agile software development projects.* Int. J. Proj. Manage. 2020, 38, 165–176.
[19] Bergmann, T.; Karwowski, W. (2019). *Agile Project Management and Project Success*: A Literature Review. In Advances in Human Factors, Business Management and Society; Kantola, J.I., Nazir, S., Barath, T., Eds.; Advances in Intelligent Systems and Computing; Springer: Cham, Switzerland, 2019; pp. 405–414.
[20] Ošlejšek, R. (2016). *Object-oriented methods of information systems design.* [online]. Retrieved from:https://is.muni.cz/el/fi/jaro2016/PA103/um/?lang=cs;zoomy_ is=1 [accessed: 2022-01-27].
[21] Petrillo, A.; Di Bona, G.; Forcina, A.; Silvestri, A. (2019). *Building excellence through the Agile Reengineering Performance Model* (ARPM). Bus. Process Manag. J. 2018, 24, 128–157.
[22] Ujhelyi, M. (2012). Can large companies develop agile despite the risks? [online]. Bratislava: STU, Retrieved from: http://www2.fiit.stuba.sk/~bielik/courses/msislov/kniha/2013/Essayse0ef.html?keyword=40&lang=sk [accessed: 2022-01-27].
[23] Buganová, K., Šimíčková, J. (2019). *Risk management in traditional and agile project management*. In: TRANSCOM 2019 [electronic] : conference proceedings. - ISSN 2352-1465. - 1. vyd. - Amsterdam: Elsevier Science, 2019. - s. 986-993 [online].
[24] Wysocki, R.K. (2014). *Effective Project Management: Traditional, Agile, Extreme*. 7th ed.; John Wiley & Sons: Hoboken, NJ, USA, 2014.
[25] Fowler, M.; Highsmith, J. (2001). *The agile manifesto.* Softw. Dev. 2001, 9, 28–35.
[26] Weichbroth P. A. (2022). Case Study on Implementing Agile Techniques and Practices: Rationale, Benefits, Barriers and Business Implications for Hardware Development. Applied Sciences. 2022; 12(17):8457.
[27] Project Management Institute. (2019) *The Standard for Risk Management in Portfolios, Programs, and Projects;* PMI Global Standard; Project Management Institute: Newtown Square, PA, USA, 2019; ISBN 9781628255652.
[28] Šimíčková, J., Buganová, K., Mošková, E. (2021) *Specifics of the agile approach and methods in project management and its use in transport.* In: 14th International scientific conference on sustainable, modern and safe transport [electronic]. - ISSN 2352-1465 (online). - 1. vyd. - Amsterdam: Elsevier, 2021. - s. 1436-1443 [online].
[29] Muhsinzoda, M. (2015). *Brief Kanban risk management.* [online]. PublicaTIC. Retrieved from: https://blogs.deusto.es/master-informatica/brief-kanban-risk-management/ [accessed: 2022-01-27]

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MANAGERIAL APPROACHES FOR MEASURING SECURITY RISKS IN THE CONDITIONS OF TERRITORIAL SELV-GOVERNMENT UNITS IN SLOVAK REPUBLIC

Ľuboš Cibák [1] – Monika Hudáková [2] – Marián Kováč [3]

Abstract: The objective of the article is to analyse the current situation of risk management applicability on municipal level of public adminsitration in Slovakia and to propose a specific methodology for risk assessment of security services on this level of public administration. The article beside proposing the method also evaluates applicability of the proposed methodology in practice. The article refers to a wider research in the risk management applicability in public administration and entrepreneurial environment and its connectedness to the citizens´ security level and life quality in regions.

Keywords: risk management, managerial approaches, security risks, citizens´ security, territorial self-government

1 INTRODUCTION

At the municipal level, public policies are planned and implemented as tasks within its own competence (original) and tasks in the devolved competence (transferred). Many of these competencies carry a risk flag, especially for those tasks that are directly linked to financial planning or where the decision-making process takes place.

For a long time, security was considered a purely military matter, but the new framework for security analysis provides a different, more comprehensive view of security. This new framework is primarily based on the collapse of the bipolar world and the subsequent gradual increase in social and industrial risks. Representatives of this direction are authors such as Barry Buzan and Ole Waever, or Jaap de Wilde. [5]

According to the authors Balážová, Papcunová: "When assessing any public service, the management can evaluate the achieved results according to the following criteria:[1]

• Quality of service for the customer, including availability (for example, time);

• Public service performance;

• Costs incurred for this service;

• Customer satisfaction and employee satisfaction."

The Center for International Statistics at the Canadian Council for Social Development, in cooperation with the Canadian Insurance Board, proposed a model for determining the so-called Index of Civil Security. [2] By the civil security index, they understood the combination of economic security and physical security, which were later enriched with health security. The research was based on the principle of realizing that security is a subjective state (feeling) of people, depending on the ability to respond and manage a specific situation.

The municipality, as the basic unit of territorial self-government, has a specific place and tasks in relation to the security of citizens. The self-government of cities and municipalities has an important role in promoting sustainable socio-economic development, primarily through the creation and implementation of planning documents of fundamental importance for the given territory.

In this context, the security of citizens also comes to the fore, as one of the decisive factors in the quality of life of the inhabitants, which the municipality ensures to its citizens as the closest link of public administration.

We believe that measurable indicators for the security of citizens within the municipality should be part of a wider, interconnected process, with a clear strategic goal and a procedure for achieving it. Measuring the value of monitored indicators of citizens' security, their combination or mutual comparison represent a necessary connecting link for the application of managerial approaches at the level of self-government management, risk management and crisis management.

The mission of the municipality's self-government is also to satisfy the needs of citizens in the area of their security, as long as it is within the power of the municipality's self-government apparatus to solve the given situation.

With regard to the above, we can conclude that: "The mission of the municipality as a local self-government body in the area of citizen security is the provision of public services that lead to the protection of life, health, property and the environment of citizens, as well as to the development of the security environment of the given municipality."

2 METHODOLOGY PROPOSAL FOR MEASUREMENT OF SECURITY RISKS ON SELF-GOVERNMENT LEVEL OF PUBLIC ADMINISTRATION IN SLOVAKIA

When creating the proposed method of measuring the security of citizens, we based ourselves on well-

known methods of measuring differences. In particular, it was a SERVQUAL method based on the GAP method. It originally served to measure the quality of service based on the paradigm of the contradiction between the idea of a service and its actual provision. Based on qualitative research, the authors of the method, A. Parasuraman, V.A. Zeithaml and L. L. Berry, have identified 5 gaps, which we now present in a transformed form to the needs of the issue addressed. [3]

The first gap is the difference between what the citizen expects and what the municipality thinks he expects. In order to reduce this gap, it is necessary to conduct surveys of citizens' perceptions of the issue and also to create opportunities for their expressions, to be close to citizens so that their needs can be known.

The second gap is the difference between the real characteristics of the service and the expectations of citizens.

The third gap is the difference between the real system of service provision (in relation to human resources, technologies, etc.) is not in line with the standards that the municipality declares in relation to services for citizens.

The fourth gap is between the proclamation of the provision of a service by the municipality and the service actually provided.

The last, *fifth* space is the space, as the resulting difference given by adding up the previous differences.

Inputs used by the method

Under the proposal, the quality of such services is assessed on the basis of three dimensions of input data,

- ✓ Objective data indicators given by quantitative features of the competences and tasks of the municipality in the field of security.
- ✓ Subjective indicators given by the opinion of representatives of the municipality on the quality of support from the state for the provision of services in the field of security of citizens. They are given by the semi-quantitative expression of the qualitative features of the competences and tasks of the municipality in the field of security.
- ✓ Subjective indicators given by the opinion of the representatives of the municipality on the existence and extent of the difference between the service provided and the expected service on the part of citizens. Also expressed in semi-quantitative form.

In this context, we formulate the following logical statement: "A citizen can feel safe in the territorial unit of a municipality if the requirements that the municipality is to fulfill in the field of security in accordance with the law are fully met. At the same time, the municipality or representatives of the municipality's self-government can perceive their abilities to provide specified services if they are in accordance with the needs and expectations of citizens."

The leitmotive of the proposed method is relation to the identified pillars of the risk management approaches in public sector innovations published in OECD survey. There are identified three pillars of successful risk management as to set up the preconditions; identification of processes for mitigation of uncertainty, and the orientation that ensures that one innovation does not have consequences in other areas. [4]

If we want to measure the quality of security services, we must base ourselves on a coherent, definitive set of services under the above scheme. Thus, a certain set of services i <1;n> , will be determined by the number of security services that the municipality should provide to its citizens.

In relation to the above decisions, the security of a citizen of the relevant territorial unit "a" will be defined as a combination of indicators of an objective and subjective nature.

I"b" a=√(2&[(√(n&(P"1 … Pn")))(√(n&(X"1" … X"n")))])

We express the security of citizens of the territorial unit "a" as an index that is equal to the square root of the product of the sub-index of objective security and the sub-index of subjective security.

The subjective security sub-index expresses the sum of qualitative security indicators. We express it as the square root of the product of the semi-quantitatively expressed qualitative indicators of services "i" for i <1;n>.

The objective security sub-index expresses the sum of quantitative security indicators and is expressed as the square root of the product of the service data indicators "i" for i <1;n>.

The cross-connection of subjective and objective sub-indexes reliable for citizens´ security measurement refers to a similar proposal identified in the research of Maatreva, Solodukha and Sunaeva who identified the principles for assessment of the public services quality by using the perception indicators and also adapted the SERVQUAL methodology for the assessment of satisfaction with public services. [6]

The application of the proposed procedure for measuring the security of citizens is tied to:

- ✓ A certain set of "n" security services that a municipality should provide to citizens.
- ✓ Determination of the unit of measurement, resp. the method of adding up components with different dimensions.
- ✓ Selection of the appropriate scale for evaluating the measurement results.

1) In order to identify all "n" services that determine the security of the citizen in the conditions of the municipality, we used the results of the performed critical analysis of the competencies and tasks of the municipality defined in the legal norms with regard to two criteria: [7]

(A) obligations relating to the municipality;
and at the same time
(B) obligations relating to the security of citizens as defined by choice.

These are such services that the municipality provides for its citizens, failure to comply with which

would directly endanger the life, health, property or life quality of the citizen.

The resulting set of obligations of the municipality in the field of citizen security is the basis for formulating the services that the municipality should provide in order to achieve the ideal security of citizens.

2) Since the individual security indicators are expressed in different scales and different units of measurement, we consider it as necessary to introduce a transformation method for the formation of scores.

The perceived service to citizens and the municipality will be measured by surveying the opinions of respondents on the chosen scale, thus achieving a semi-quantitative expression of the qualitative features of security. The survey of the perceived quality of service will consist of closed questions with a possible answer on the range {1; 2; 3; 4; 5}, with answers 1 and 5 indicating a verbal meaning with a mutually opposite effect on the security of the citizen. Answer 1 will represent an exclusively negative impact, answer 5 will have a significant positive impact on the quality of service. Answers 2, 3, 4 will represent intermediate steps between specified boundary descriptions.

Let Xi be the value reached by the i-th municipality, then the transformation of the indicator Xi into the form X'i will be provided by the formula below:

$$X'i=((Xi-Min(x)))/((Max(x)-Min(x)))$$

Rating scale used by the method

In order to allow not only comparison, but also direct evaluation of the obtained index, we consider it necessary to classify the individual values of the index into intervals. To do this, we will use the formula for determining the width of the class, while we already know the number of classes, it was fixed at 5.

$$h = (Xmax – Xmin) / k$$

By substituting the appropriate variables, we get the class width, which will depend on the specific value of the variables. Thus, we obtain the intervals in which we can evaluate the resulting index through the appropriate range of subjective indicators in the sense of verbally expressed extremes.

Final assessment of the proposed method

In the current sense, we can only assess the proposed method from a theoretical point of view and from a subjective point of view of its practical applicability. However, we consider that the method includes all the characteristics that are the subject of the evaluation of the individual methods identified. First of all, it is an effort to objectify the selection of input indicators forming the basis for the creation of the output values of the index. Furthermore, it is also a specific orientation to the object of investigation – the security of citizens in the conditions of self-governing territorial units of towns and villages of Slovakia. We have tried to create the algorithm of the method in full accordance with the possibility of its future use, based on such procedures as are applicable to any research subject in relation to the availability of the indicators in question. Last but not least, the rating scale reflects the objective distribution of individual intervals through the application of a formula for the formation of intervals in terms of their width. The number of intervals is determined by the number of individual possible evaluations.

Verification of the proposed method in practice

We decided to verify the validity and applicability of the proposed method of measuring the level of security of citizens in the conditions of territorial units of the Slovak Republic through a case study. The overall range of identified indicators of the security of citizens at the municipal level is considerable. We therefore consider it appropriate to confine ourselves when verifying the proposed method to one of the identified areas of security for citizens. Taking into account the results of the survey of citizens' perceptions of individual areas of security, we decided to focus more losely on the area of Public Order and crime prevention. The reason for this is the identified inconsistency in the perception of the service by citizens, but also its overall lower qualitative perception by citizens. By applying the proposed method, we verify the objectivity of the conclusions resulting from the evaluation.

To verify the proposed method of measuring the level of securityy of citizens, the following restrictions apply:

- ✓ The case study is aimed exclusively at verifying the proposed method of measuring the level of security of citizens in the conditions of territorial units of the Slovak Republic.
- ✓ Its intention is not to create generalizing conclusions generally valid for all municipalities of the Slovak Republic.
- ✓ The selected set of municipalities examined (the scope of the sample) was not established with the priority aim of creating a representative sample.

Similar viewpoint can be seen in study of Haustein and Lorson, who identify citizens into a decisive role in the risk identification and risk management, who can help to handle system risks by fostering acceptance and loyalty. [8]

Protection of public order and crime prevention at the level of municipalities of the Slovak Republic

In accordance with the Act of the SNR No. 564/1991 Coll. on municipal police, the municipal police has clearly defined tasks and competencies in the field of security. It thus fulfils an irreplaceable role, which also has its historical context. At present, the municipal police have a specific status within the security system of the Slovak Republic given by the relevant legislation.

One of the programmes that municipalities have earmarked as part of the programme budgeting is Security and Order, usually referred to as Programme 5. Some municipalities subdivide the Security and Order Programme into Sub-programmes such as Public Order; Protection against fires; Civil protection; or Flood protection.

Case study methodology

The subject of the survey within the framework of the case study is a municipality with an established municipal police. Between the municipalities of Slovakia, the differences are due not only to the size structure, but also to social and economic cha/racteristics. These differences do not allow for the establishment of municipal police units in all municipalities. We therefore consider that, in order to achieve the optimal set for verifying the proposed method, it will be most appropriate to select only those municipalities that have a common characteristic, namely the status of the city. In relation to the issue, we therefore focus on those municipalities that have the status of a city and have a municipal police force. Indicators of the security of citizens within a city with an established municipal police directly derive from the identified competencies and tasks of city self-government.

In relation to the effective solution of the case study, we consider it necessary to identify the different actors of such a security analysis [5]:

- ✓ Reference object – citizens of a given city who may be at risk and can legitimately claim the right to receive services in the field of Public Order and Crime Prevention in the municipality.
- ✓ The actor of securitization is the self-government of the city. If necessary, they declare the reference objects at risk and, as the founder of the city police, he is the mover of the securitization process in the city.
- ✓ Functional actors – act on the dynamics of security relations in the sector. These are the members of the municipal police themselves, but also business entities and significant individuals. On the other hand, there are potential intruders of public order or perpetrators of crimes.

We consider subjective and objective indicators, forming individual sub-indices, as indicators of the security of citizens within the meaning of the proposed method. The structure of indicators of the security of citizens in the city is presented in Table 1. This is based on a critical analysis of the competences and tasks of local self-government.

In addition to the direct application of the proposed method, the case study also includes obtaining an overview of selected statistical features and their interrelationships within the issue.

Methodology for the statistical survey of the case study

Statistical problem: Security of citizens in the conditions of a municipality with the status of a city in the field of crime prevention and protection of public order.

Statistical unit: A municipality with city status.

Statistical characteristics: The statistical characteristics have been defined solely on the basis of critical analysis. We can divide them by nature into qualitative and quantitative.

Qualitative statistical features:

- ✓ The quality of the services provided in the field of crime prevention and ensuring public order in the city.
- ✓ The sufficiency of external resources provided to the city to ensure crime prevention and public order within the city.

Quantitative features:

- ✓ The number of inhabitants of the city;
- ✓ The area of the territory of the city;
- ✓ The budget of the city allocated to ensure the functioning and fulfillment of the tasks of the MsP carried out by the city pursuant to par. 4 of Law 583/2008;
- ✓ Number of members of the city police;
- ✓ Number of preventive measures carried out by the city police;
- ✓ Number of offences registered by the municipal police within the meaning of Sections 52 and 86 of Law 372/1990;
- ✓ Number of block fines imposed by the city police;
- ✓ The total amount of fines for offenses issued by the city police;
- ✓ The number of existing cameras to track wrongdoing in the city.

Statistical questions

The statistical questions are formulated again with reference to the results of the aforementioned critical analysis. Another factor controlling the content of the statistical questions is the nature of the proposed method. Thus, a comparison of objective and subjective security, based on the procedures of the GAP analysis method. Statistical questions:

- ✓ What are the characteristics of the level and variability of each defined quantitative trait of the observed sites?
- ✓ What is the most frequent interval of each defined quantitative sign in municipalities with city status?
- ✓ Is there a dependence, and if so, what is the dependence between any qualitative and any quantitative trait?

The questionnaire survey questions reflecting the indicators observed were compiled strictly in accordance with the methodology of the statistical survey. Thus, in addition to the questionnaire survey, the data kept in the documents of each relevant municipality became the source of the data in the survey. This was the Report on the Activities of the City Police; The budget of the municipality for the calendar year; The final account of the municipality for the year in question.

Additional data, the number of inhabitants was obtained directly from the questionnaire from the city examined, respectively from the Database of Local and Municipal Statistics of the Statistical Office of the Slovak Republic. The area of the territory was obtained from the Database of Local and Municipal Statistics. The number of municipal police officers was obtained from the Report on the Activities of municipal police, source Ministry of Interior of the Slovak Republic,

Department for Supervision of the Activities of Municipal Police.

Description of the content of each indicator

The indicator "municipal police budget" (MPB) represents the amount of funds expressed in Euros that were actually spent by the city yearly for the services of the city police, including wage costs and possible capital expenditure.

The indicator "Number of preventions" (NP) represents a number of discussions, lectures, demonstrations that the municipal police conducted in order to prevent anti-social and other undesirable activities.

"Number of cameras" (NC) means an indication of the current state of both rotating and stationary cameras. In this context, the possibility of expressing the percentage coverage of the city's territory was considered. However, due to the impossibility of comparing the total area of the city with the territory that would require a camera check, such an intention was abandoned.

"Number of members of the municipal police" (NMPM) – the data represents the human resources involved in the performance of the tasks of the city police, while the representative number does not include the auxiliary staff or the staff of the camera system operator.

We consider the "number of infringements" (NI) to be an important output-oriented indicator. Its specific expression must be understood in the opposite way. That is, the lower the number of offenses, the safer the city is.

A set of inter-subjective indicators was structured with a view to examining the quality of service in the field of crime prevention and protection of public order in the city.

"Quality of service in relation to meeting the needs of citizens" (SQ) was marveled at through the statement of experts from the city police about whether and how well the city meets the needs of citizens and their expectations through municipal police services. The supplementary question followed the forms of mutual communication between the city and citizens. In case of perceptive indicators the scale is set on the range from 1 to 5, where 1 means the lowest quality of service rating and 5 the highest rating.

"Quality of support from external sources for the provision of the service" (QS)– the indicator monitors whether the city police is sufficiently supported from external sources, taking into account their status and tasks. The basis for the investigation was mainly the fact of real cooperation and use of the services of the municipal police and the Police Force of the Slovak Republic, or the use of the camera monitoring system in the wider context in criminal investigations. Again, the form of responses scale range is from 1 to 5.

In relation to allowing mutual comparison and further work with the data obtained, we consider it necessary to express them in the form of a converted number per unit. For this we set 1000 inhabitants of the city, or 1 km^2. We decided to list almost all indicators in relation to the respective population. The only indicator of the number of cameras for monitoring anti-social activity is expressed in relation to the area of the city. We consider such a statement to be appropriate in view of the possibility of formulating measurable objectives in relation to planned future values within the city documentation (Program Budgeting).

The perceived sub-index is formed by two inter-subjective indicators. On the one hand, it is perceived support from external sources to ensure the functionality of the services in question. The second is the evaluation of the provision of the service in relation to the quality of meeting the needs of citizens. It is in this indicator that the attempt to blur the distinction between the service actually provided and the expectations of citizens is reflected.

Furthermore, there is a need to transform the obtained data into a prepared scale, in order to allow their mutual expression to each other, in the form of scores on a scale of 1-5, where 1 is the lowest possible value and 5 the highest possible value. This scale was chosen in relation to allowing comparison with intersubjective indicators, but also the calculation of the index itself from individual sub-indices.

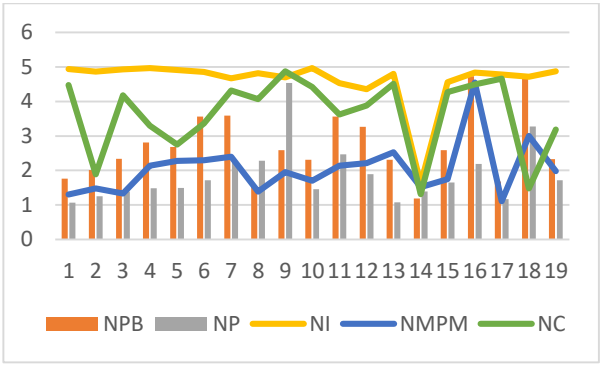

Figure 1. Post-transformation indicators
(Source: Authors)

Subsequently, it is necessary to summarize the individual indicators into an overall index of the security of citizens in the conditions of cities in relation to the protection of public order and crime prevention (city police services).

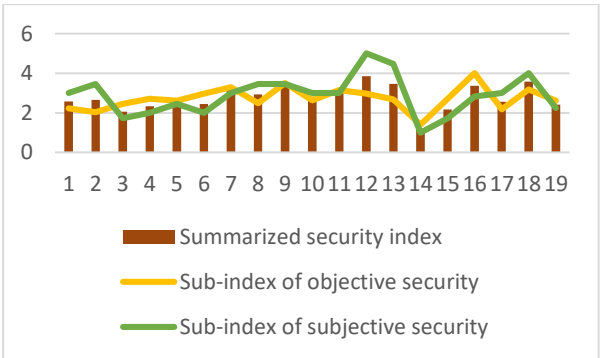

Figure 2 Public order Municipal security index
(Source: Authors)

According to the above graph, one city ranked at the level of the lowest rating with its Public Order Index, when the city's services in the field of public order and crime prevention are provided at an insufficient level.

For up to 8 cities, the rating was at the level – low quality of service. For 6 places at the level of average quality of service and 4 achieve a satisfactory quality of service. None of the cities surveyed achieved the highest possible rating.

Index value interval A verbal description of an index rating

<1;1,8> The service is poorly provided and the existing measures do not meet the needs of citizens.

(1,8;2,6> The service is provided at a low level and existing measures meet the needs of citizens to a limited extent.

(2,6;3,4> The service is provided at an average level and the existing measures meet most of the needs of citizens.

(3,4;4,2> The service is very well provided and the existing measures meet the needs of citizens.

(4,2;5> The service is well provided and the existing measures fully meet the needs of citizens.

The obtained index of the security of citizens in the field of public order and crime prevention in the territorial unit of the city informs us about the quality of services in the specified area for citizens. It combines both perceived – subjective indicators and indicators of an objective nature. It provides an essential tool for assessing the quality of given services and comparing them. We consider it extremely important to be able to use the index also as a means of effectively improving the quality of such services.

Summarization of the results of the public order index

The presented case allows the application of the proposed method in specific conditions and prove its full practical functionality. The procedure for applying the proposed method in practice consisted of several points. First of all, it was necessary to specify particular conditions, both by choosing a specific subject and an object of investigation. At first, the subject of the survey nedds to be justified as the area of protection of public order and crime prevention as a service of the municipal police. The reason stemmed from the results of a survey of citizens' opinions on security in the territorial units of municipalities. The area in question was perceived inconsistently by respondents, with prejudice and subjectivisation caused by negative experiences of citizens with repressive measures of the municipal police being cited as the reason. Thus, by choosing an area of interest, the case study also set itself the task of examining the described opinion from the objective point of view of measuring the security of citizens. Municipalities with the status of a city with an established municipal police became the object of the survey. Subsequently, the selection of specific inputs into the process of creating the resulting index was made.

These were created taking into account the results of the critical analysis of security services. The individual identified features of the municipality's services within the General Internal Administration area served as a starting point for deriving qualitative and quantitative indicators of the security of citizens in given specific conditions. In the next step, specific data was obtained in the form of a basic set of monitored data.

Data collection was carried out through a questionnaire survey, but also from the documentation of the city: City budget; The final account of the city; Report on the activities of the city police, These were both data quantitatively, expressed directly by a numerical indicator, but also data qualitatively expressed semi-quantitatively through a prepared transfer scale. It was necessary to transform the individual data indicators of the objective sub-index. In this respect, a specific variant procedure had to be used as opposed to the general one that was part of the proposed method. The variation of the situation from the assumed state consisted in the fact that the values of the individual indicators did not represent a finite set of values with an easily identifiable minimum and maximum. These were sample data, and a specific method of deriving their theoretical lows and maxima was chosen for the selection of the minimum and maximum.

The acquisition of the normative values of individual indicators on a scale identical to the scope of the semi-quantitative expression of qualitative variables allowed the formation of sub-indices and the resulting public order index of each city examined. The existence of standard input data as indicators allowed, following the procedure given by the algorithm of the proposed method according to the sub-areas, the creation of sub-indices of objective and subjective security. Their mutual product could have produced the resulting public order index.

The method is fully functional and applicable to other areas of security. Although this does not directly follow from the scope of the sample, we dare to state the possibility of applying the method to any city, but also to the municipality in any area of security according to the created algorithm.

3 CONCLUSION

In connection with the outputs obtained from the implementation of the measurement of the security of citizens in the conditions of self-governing territorial units of cities, we consider it appropriate to formulate results applicable both in theory and in practice. We listed the individual cities of Slovakia that became the object of the survey in relation to the exclusionarea of security not by name, but with an assigned code. Thus, we pursued the intention of minimizing possible subjective influences. The combination of the outputs of measuring the security of citizens and the results of a statistical project allows us to assess the current state of the monitored places in the area of security in question – protection of public order and crime prevention.

A comprehensible and universally applicable measurement of the level of security of citizens enables a better understanding of security factors in a self-governing territorial unit. This knowledge facilitates the application of elements of risk management, primarily the assessment of needs for taking measures to increase civil security, improve protection against threats and reduce the probability of their occurrence and manifestations.

The very knowledge and expression of the structured security index enables effective Benchmarking of cities and municipalities as a form of comparison, which represents an effective form of improvement when knowledge of the real situation affects those involved.

The possibility of change and real improvement through knowledge of the formula of individual indicators and the possibility of influencing specific values represent a significant positive effect.

ACKNOWLEDGEMENTS

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REFERENCES

[1] Balážová, E., Papcunová, V. (2008) Manažment samospráv. Municipalia.
[2] Mackenzie, A., Tsoukalas, S. (2003). The personal security index. Canadian Council on Social Development.
[3] Zeithaml, V., Parasuraman, A. (2004) Service quality. Cambridge, Marketing Science Institute.
[4] OECD (2017). Fostering Innovation in the Public Sector, OECD Publishing.
[5] Buzan, B. et al. 2005. Bezpečnost: Nový rámec pro analýzu. Centrum strategických studií,
[6] Matraeva, L. V., Solodukha, P. V., Sunaeva, Y. V. (2019). Public services quality perception: Assessment model due to different life-cycle stages of state priority. IBM. 3153-3162.
[7] Kováč, M., Hudáková, M. (2015) Možnosti merania bezpečnosti občanov v podmienkach územných celkov SR. Wolters Kluwer.
[8] Haustein, E., Lorson, P.C. (2021) Co-creation and co-production in municipal risk governance—A case study of citizen participation in a German city. Pub. Manag. Rev.
[9] Hajko, J., Klátik, P., Tunega, M. (2011) Competitive regions 21. Business Alliance of Slovakia, 2011. 431 s. ISBN 978-90-89493-04-3.
[10] Hastings, D.A. (2011) The Human Security Index: An Update and New Release
[11] Stiglicz,J.E. (2008) Report by the Commission on the Measurement of Economic Performance and Social Progress

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CORRELATION BETWEEN CAR SALES AND THE GDP IN THE LARGEST CAR MARKETS IN WEST EU COUNTRIES WITH FOCUS ON THE IMPACT OF COVID PANDEMICS

Mátuš Dzuro [1] – Naqib Daneshjo [2] – Lucia Malíčková

Abstract: *The present work focuses on the evaluation of passenger and light utility vehicle sales correlation with the GDP in largest West EU markets: Belgium, France, Germany, Italy, Netherlands, and Spain. Correlation is evaluated over a period of up to 20 years. The correlation is later evaluated over a 10-year scope before the Covid pandemics. In 2020 the Covid pandemics hit EU. The correlation between car sales and GDP is then evaluated including 2020. This paper analyses the influence of a significant negative factor. This factor is external to the economy.*

Keywords: passenger car sales, LCV sales, correlation, Covid-19 pandemics

1 INTRODUCTION

The vehicle market has a major role in the EU economy. During the financial crisis that started in 2008 there was much attention given to the car sector with various incentives. Due to the importance given to the car sales a hypothesis can be raised that there might be a correlation between the car sales and GDP of countries. This paper studies the correlation between these two indicators using the correlation coefficient. The objective is to evaluate if there is a correlation and what was the impact of the Covid 19 pandemics on that correlation in the first year of the pandemics.

2 METHODOLOGY

The present paper is based on data regarding GDP in EU countries and regarding the sales of passenger cars and light commercial vehicles.

The GDP is analysed at the level of market prices. The GDP is the value of all goods and services produced without the value of goods or services used in to create them. Source of data are annual results published by Eurostat. [1]

Countries considered: Belgium, Germany (until 1990 former territory of the FRG), Spain, France, Italy, Netherlands. Data were collected at ec.europa.eu/eurostat/databrowser. As a part of this work, data from other countries were collected as well and were partially analysed.

Regarding the car sales the following source was used: carsalesbase.com. [2] This source provided information on passenger and light utility vehicles sales over a period. The period was not always equal, most frequently starting in 1995. Data on Cyprus, Estonia and Malta are not available in sufficient quality and were not considered for this paper. The mentioned countries are excluded from this study.

The correlation coefficient a value of correlation. It shows a statistical relationship between two groups of values. The correlation coefficient has a value between −1 and +1. The closer the absolute value of correlation approaches to 1 the stronger the correlation. 0 represents the weakest possible correlation or no correlation. Correlation does not imply causation.[3]

The closer the correlation coefficient is closer to +1 or -1, the stronger it presents positive (+1) or negative (-1) correlation between the values analysed. Negative correlation means that if one value decreases the other follow and vice versa. [4]

The definition of the strength of correlation is not exact. Extremes are given: -1, 0 and 1. 0 represents no correlation. We will consider strong correlation over with absolute value over 0,75. A medium correlation will be 0,25 and 0,75. Values bellow 0,25 will mean weak correlation. This will be valid for this paper.

3 RESULTS AND DISCUSSION

The change in cars sales in the first year of pandemics in the EU excluding Cyprus, Estonia and Malta is shown in table 1. Its visible that LCV sales dropped less due to pandemics compared to passenger cars between 2019 and 2020.

Table 1. car sales drop in EU 2019 to 2020 (first year of Covid 19 pandemics in EU)

Year	Passenger Cars	Light Commercial	Total Sales
2019	12 990 239	1 743 145	14 733 384
2020	9 913 698	1 434 561	11 348 259
Change	-24%	-18%	-23%

Germany, France, and Italy as the largest markets. Other countries are smaller and 50% of the countries analysed are less than 2% of the total market analysed.

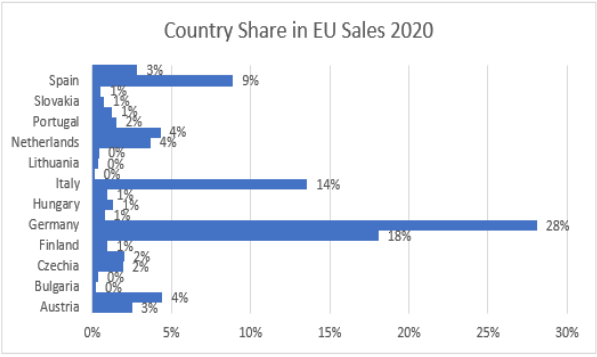

Figure 1. Share of countries in total cars sales in EU in 2020

The following overview shows how the cars sales and the GDP changed between 2019 and 2020.

Table 2. Change of car sales and GDP in selected countries in 2020 compared to 2019

Country	France	Germany	Italy	Netherlands	Spain
Sales	76%	81%	73%	80%	69%
GDP	95%	97%	92%	98%	90%

An in-depth analysis on the above selected countries follows hereafter.

Belgium

The correlation between the GDP and sales of Passenger Cars in Belgium in the pre-pandemic years between 2019 and 2000 can be described as positive with medium strength with a correlation at the level of 0,56.

For the Light Commercial vehicles in the same period the correlation is positive with strong strength and a correlation of 0,77.

The total car sales in Belgium during this period have medium and positive correlation at the level of 0,63.

A more specific analysis of the correlation between the GDP and car sales is done in the period of 10 years prior to the Covid pandemics. During this timeframe Passenger Cars had a positive and medium correlation with value of 0,26.

The Light Commercial vehicles had a positive and strong correlation at the level of 0,91.

The car sales in Belgium had a in general a positive and medium correlation at the level of 0,45.

A third step of the analysis focuses on the correlation between sales and the GDP in a 10-year period while the last year of that period is 2020 i.e., the first year of the Covid 19 pandemics. This adjusted period shows the following results. For Passenger Cars the correlation is weak and positive at the level of 0,09.

Regarding the Light Commercial vehicles, the correlation is positive and strong with value of 0,89.

Total car sales in relationship with the GDP had a positive and medium correlation with a value of 0,25.

Including the first year of Covid pandemics had the following impact on the correlation between car sales and GDP: Passenger Cars changed by -0,17, the Light Commercial vehicle sales by -0,02 and the total sales by -0,19.

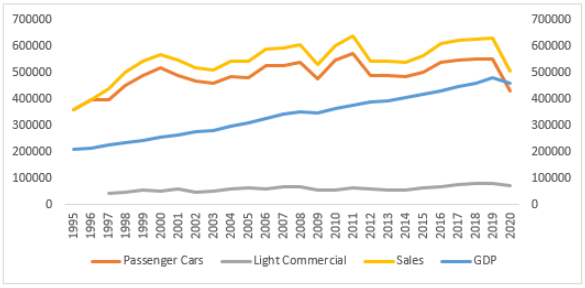

Figure 2. Sales of vehicles and GDP over time in Belgium

France

The correlation between the GDP and sales of Passenger Cars in France in the pre-pandemic years between 2019 and 2000 can be described as negative with weak strength with a correlation at the level of -0,15.

For the Light Commercial vehicles in the same period the correlation is positive with weak strength and a correlation of 0,14.

The total car sales in France during this period have weak and negative correlation at the level of 0,11.

A more specific analysis of the correlation between the GDP and car sales is done in the period of 10 years prior to the Covid pandemics. During this timeframe Passenger Cars had a positive and weak correlation with value of 0,19.

The Light Commercial vehicles had a positive and medium correlation at the level of 0,63.

The car sales in France had a in general a positive and medium correlation at the level of 0,27.

A third step of the analysis focuses on the correlation between sales and the GDP in a 10-year period while the last year of that period is 2020 i.e., the first year of the Covid 19 pandemics. This adjusted period shows the following results. For Passenger Cars the correlation is medium and positive at the level of 0,25.

Regarding the Light Commercial vehicles, the correlation is positive and medium with value of 0,71.

Total car sales in relationship with the GDP had a positive and medium correlation with a value of 0,33.

Including the first year of Covid pandemics had the following impact on the correlation between car sales and GDP: Passenger Cars changed by 0,06, the Light Commercial vehicle sales by 0,09 and the total sales by 0,06.

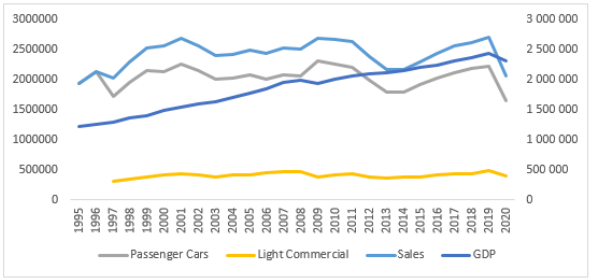

Figure 3. Sales of vehicles and GDP over time in France

Germany

The correlation between the GDP and sales of Passenger Cars in Germany in the pre-pandemic years between 2019 and 2000 can be described as negative with weak strength with a correlation at the level of -0,18.

For the Light Commercial vehicles in the same period the correlation is positive with strong strength and a correlation of 0,92.

The total car sales in Germany during this period have weak and negative correlation at the level of 0,06.

A more specific analysis of the correlation between the GDP and car sales is done in the period of 10 years prior to the Covid pandemics. During this timeframe Passenger Cars had a positive and medium correlation with value of 0,36.

The Light Commercial vehicles had a positive and strong correlation at the level of 0,96.

The car sales in Germany had a in general a positive and medium correlation at the level of 0,44.

A third step of the analysis focuses on the correlation between sales and the GDP in a 10-year period while the last year of that period is 2020 i.e., the first year of the Covid 19 pandemics. This adjusted period shows the following results. For Passenger Cars the correlation is weak and positive at the level of 0,19.

Regarding the Light Commercial vehicles, the correlation is positive and strong with value of 0,93.

Total car sales in relationship with the GDP had a positive and medium correlation with a value of 0,27.

Including the first year of Covid pandemics had the following impact on the correlation between car sales and GDP: Passenger Cars changed by -0,17, the Light Commercial vehicle sales by -0,03 and the total sales by -0,17.

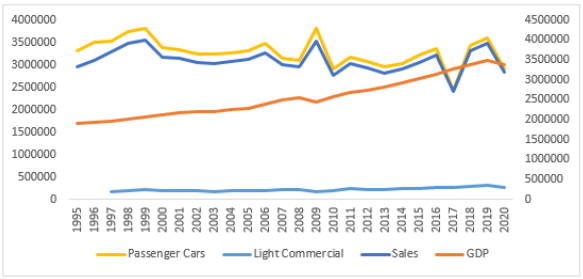

Figure 4. Sales of vehicles and GDP over time in Germany

Italy

The correlation between the GDP and sales of Passenger Cars in Italy in the pre-pandemic years between 2019 and 2000 can be described as negative with medium strength with a correlation at the level of -0,56.

For the Light Commercial vehicles in the same period the correlation is negative with medium strength and a correlation of 0,55.

The total car sales in Italy during this period have medium and negative correlation at the level of 0,59.

A more specific analysis of the correlation between the GDP and car sales is done in the period of 10 years prior to the Covid pandemics. During this timeframe Passenger Cars had a positive and medium correlation with value of 0,65.

The Light Commercial vehicles had a positive and weak correlation at the level of 0.

The car sales in Italy had a in general a positive and medium correlation at the level of 0,6.

A third step of the analysis focuses on the correlation between sales and the GDP in a 10-year period while the last year of that period is 2020 i.e., the first year of the Covid 19 pandemics. This adjusted period shows the following results. For Passenger Cars the correlation is strong and positive at the level of 0,87.

Regarding the Light Commercial vehicles, the correlation is positive and weak with value of 0,07.

Total car sales in relationship with the GDP had a positive and strong correlation with a value of 0,82.

Including the first year of Covid pandemics had the following impact on the correlation between car sales and GDP: Passenger Cars changed by 0,21, the Light Commercial vehicle sales by 0,06 and the total sales by 0,22.

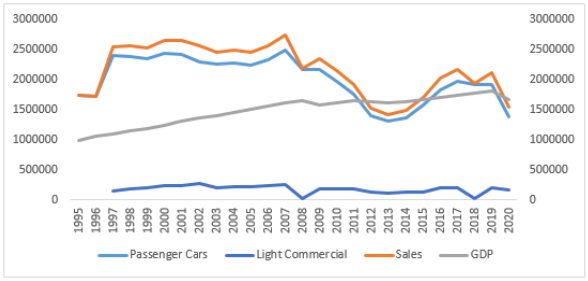

Figure 5. Sales of vehicles and GDP over time in Italy

Netherlands

The correlation between the GDP and sales of Passenger Cars in Netherlands in the pre-pandemic years between 2019 and 2000 can be described as negative with medium strength with a correlation at the level of -0,61.

For the Light Commercial vehicles in the same period the correlation is negative with medium strength and a correlation of 0,36.

The total car sales in Netherlands during this period have medium and negative correlation at the level of 0,61.

A more specific analysis of the correlation between the GDP and car sales is done in the period of 10 years prior to the Covid pandemics. During this timeframe Passenger Cars had a negative and medium correlation with value of -0,33.

The Light Commercial vehicles had a positive and strong correlation at the level of 0,9.

The car sales in Netherlands had a in general a negative and weak correlation at the level of -0,14.

A third step of the analysis focuses on the correlation between sales and the GDP in a 10-year period while the last year of that period is 2020 i.e., the first year of the Covid 19 pandemics. This adjusted period shows the following results. For Passenger Cars the correlation is medium and negative at the level of -0,44.

Regarding the Light Commercial vehicles, the correlation is positive and medium with value of 0,73.

Total car sales in relationship with the GDP had a negative and medium correlation with a value of -0,3. Including the first year of Covid pandemics had the following impact on the correlation between car sales and GDP: Passenger Cars changed by -0,1, the Light Commercial vehicle sales by -0,17 and the total sales by -0,16.

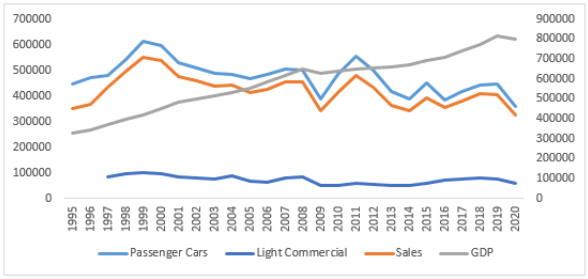

Figure 6. Sales of vehicles and GDP over time in the Netherlands

Spain

The correlation between the GDP and sales of Passenger Cars in Spain in the pre-pandemic years between 2019 and 2000 can be described as negative with medium strength with a correlation at the level of -0,34.

For the Light Commercial vehicles in the same period the correlation is negative with medium strength and a correlation of 0,53.

The total car sales in Spain during this period have medium and negative correlation at the level of 0,39.

A more specific analysis of the correlation between the GDP and car sales is done in the period of 10 years prior to the Covid pandemics. During this timeframe Passenger Cars had a positive and strong correlation with value of 0,92.

The Light Commercial vehicles had a positive and strong correlation at the level of 0,94.

The car sales in Spain had a in general a positive and strong correlation at the level of 0,92.

A third step of the analysis focuses on the correlation between sales and the GDP in a 10-year period while the last year of that period is 2020 i.e., the first year of the Covid 19 pandemics. This adjusted period shows the following results. For Passenger Cars the correlation is strong and positive at the level of 0,88.

Regarding the Light Commercial vehicles, the correlation is positive and strong with value of 0,94.

Total car sales in relationship with the GDP had a positive and strong correlation with a value of 0,9.

Including the first year of Covid pandemics had the following impact on the correlation between car sales and GDP: Passenger Cars changed by -0,03, the Light Commercial vehicle sales by 0 and the total sales by -0,02.

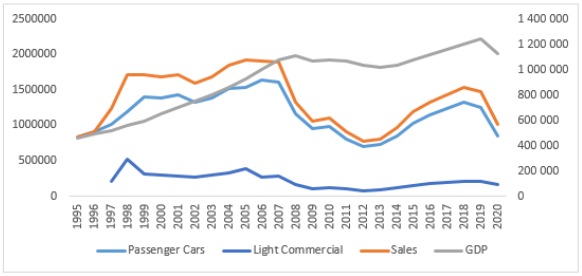

Figure 7. Sales of vehicles and GDP over time in Spain

Table 3 represents the value of the correlation coefficient in selected countries over a period of 20 years prior to the start of pandemics.

Table 3. Correlation of GDP and vehicle sales 20 years before the Covid-19 pandemics

Country	Passenger Cars	LCV	Total Sales
Belgium	0,56	0,77	0,63
France	-0,15	0,14	-0,11
Germany	-0,18	0,92	-0,06
Italy	-0,56	-0,55	-0,59
Netherlands	-0,61	-0,36	-0,61
Spain	-0,34	-0,53	-0,39

During a 10 years period before the Covid the correlations evolve. They become more positive compared to the previous measurement.

Table 4. Correlation of GDP and vehicle sales over 10 years before the Covid-19 pandemics

Country	Passenger Cars	LCV	Total Sales
Belgium	0,26	0,91	0,45
France	0,19	0,63	0,27
Germany	0,36	0,96	0,44
Italy	0,65	0,00	0,60
Netherlands	-0,33	0,90	-0,14
Spain	0,92	0,94	0,92

The impact of the Covid pandemics can be seen when the first year of that impact is taken into account as shown in Table 5.

Table 5. Correlation of GDP and vehicle sales over 10 years including the first year of the Covid pandemics

Country	Passenger Cars	LCV	Total Sales
Belgium	0,09	0,89	0,25
France	0,25	0,71	0,33
Germany	0,19	0,93	0,27
Italy	0,87	0,07	0,82
Netherlands	-0,44	0,73	-0,30
Spain	0,88	0,94	0,90

To better clarify the change of correlation coefficients before and including the pandemics, the differences are calculated in Table 6.

Table 6. Comparison of a 10-years correlation before the pandemics and including its first year

Country	Passenger Cars	LCV	Total Sales
Belgium	-0,17	-0,02	-0,19
France	0,06	0,09	0,06
Germany	-0,17	-0,03	-0,17
Italy	0,21	0,06	0,22
Netherlands	-0,10	-0,17	-0,16
Spain	-0,03	0,00	-0,02

When the pandemics are considered, the correlation coefficient decreases in Belgium, Netherlands, Germany, and Spain. Only France and mainly Italy have an increased correlation coefficient compared to the pre-pandemics period.

Table 7. Comparison of a 10-year correlation before and including pandemics

Group	Passenger Cars	LCV	Total Sales
Average	-0,03	0,02	-0,03

A particularity is the weighted average of the selected countries based on the number of cars sold oin 2020. It shows that very little change in the correlation coefficients, mainly as an impact of the Italian market which is large and was not moving in the same direction as the remaining countries. The LCVs show a stronger correlation with GDP evolution compared to the passenger cars.

3 CONCLUSION

The objective of this paper was to study the correlation between GDP and car sales selected EU countries. This was done regarding the negative external influence of the Covid-19 pandemics that started in the EU in 2020.

Passenger vehicles have a weaker correlation with GDP when measured with the impact of an external negative influence. The LCV have a stronger correlation in case of an external impact.

This can be due to various reasons. A likely explanation is the continuity of business and the need of LCVs as tools. For passenger cars the consumption can be postponed, and the vehicle can be used longer with might not be possible in the case of a used LCV.

, production management is a decisive

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REFERENCES

[1] Padhan, R., & Prabheesh, K. P. (2021). The economics of COVID-19 pandemic: A survey. *Economic analysis and policy*, *70*, 220-237

[2] Hung, N. T., & Vo, X. V. (2021). Directional spillover effects and time-frequency nexus between oil, gold and stock markets: evidence from pre and during COVID-19 outbreak. *International Review of Financial Analysis*, *76*, 101730.

[3] Butt, A. S. (2021). Strategies to mitigate the impact of COVID-19 on supply chain disruptions: a multiple case analysis of buyers and distributors. *The International Journal of Logistics Management*.

[4] Shaikh, I. (2022). Impact of COVID-19 pandemic on the energy markets. *Economic Change and Restructuring*, *55*(1), 433-484.

[5] Choi, T. M. (2021). Risk analysis in logistics systems: A research agenda during and after the COVID-19 pandemic. *Transportation Research Part E: Logistics and Transportation Review*, *145*, 102190.

[6] Pauliková, A., Chovancová, J., & Blahová, J. (2022). Cluster modeling of environmental and occupational health and safety management systems for integration support. *International journal of environmental research and public health*, *19*(11), 6588.

[7] Nordhagen, S., Igbeka, U., Rowlands, H., Shine, R. S., Heneghan, E., & Tench, J. (2021). COVID-19 and small enterprises in the food supply chain: Early impacts and implications for longer-term food system resilience in low-and middle-income countries. *World Development*, *141*, 105405.

[8] Narayan, P. K., Phan, D. H. B., & Liu, G. (2021). COVID-19 lockdowns, stimulus packages, travel bans, and stock returns. *Finance research letters*, *38*, 101732.

[9] Akhtaruzzaman, M., Boubaker, S., & Sensoy, A. (2021). Financial contagion during COVID–19 crisis. *Finance Research Letters*, *38*, 101604.

[10] Eurostat, ec.europa.eu/eurostat/databrowser, last accessed 2022/09/06.

[11] Carsalesbase, carsalesbase.com, last accessed 2022/09/06.

[12] Wikipedia, https://en.wikipedia.org/wiki/Correlation_coefficient, last accessed 2022/09/06.

[13] Microsoft.com, https://support.microsoft.com/sk-sk/office/correl-funkcia, last accessed 2022/09/06

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RENEWABLE ENERGY SOURCES IN THE SEA/EIA PROCESS IN POLAND AND SLOVAKIA

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Abstract: *The market economy of countries is influenced by the EU's renewable energy commitments, the ever increasing consumption and prices of electricity, the need to replace old installations with new ones and public awareness of environmental protection. In this context, a significant increase in the number of RES investments is expected in EU countries now and in the coming years. In Poland, the share of renewables in gross final energy consumption in 2020 was 16.13%, which means that it exceeded the level of 15% set by the European Union. At the end of 2019, the Polish government adopted the National Energy and Climate Plan for 2021-2030, declaring that by 2030 the share of RES in gross final energy consumption (electricity generation, heating and cooling and transport sectors) will reach 21-23%. Slovakia is also proposed to reach 19.2% RES in 2030, an increase of 5.2 percentage points compared to the target set for 2020. Among the fastest growing RES sectors are photovoltaics, wind and hydropower as well as biomass. However, even the construction of new RES power generation capacity is associated with negative environmental impacts due to permanent and temporary land take, land use change, tree felling, impacts on ecosystems, higher water, fertiliser or material consumption and ultimately the generation of waste, e.g. used solar panels. The aim of this paper is to assess the readiness and effectiveness of the SEA/EIA process in terms of assessing the environmental impacts of RES investments at all stages of the investment, from planning to disposal.*

Keywords: renewable energy sources, environmental impact assessment

1 INTRODUCTION

The most important and already frequently used renewable energy sources (RES) are: water, wind, solar, geothermal, biomass, wave, current and tidal. As civilization progressed and energy demand increased, it became necessary to replace conventional fossil fuel energy sources. At the same time, concern for the state of the environment forced the further development and promotion of RES. In the European Green Deal adopted in 2019, the area of "Providing clean, affordable and secure energy" will be important for Europe's economic transformation [1]. European legislation has made a commitment to cover 20% of energy consumption by 2020 through renewable energy sources (RES). At the same time, Member States have committed themselves to achieving 10% coverage of transport fuel consumption through RES. Progress was published every two years when Member States reported on their progress. One year after the end of the commitments, a change in the RES Directive was proposed. The Commission proposed to increase the share of RES energy coverage to 40% and to promote the use of renewable fuels. The European Commission aims to achieve climate neutrality by 2050 and to deliver clean energy in line with the European Green Deal. This also includes the decarbonisation of selected economic activities [2]. Slovakia has significantly increased its share of RES to 17.35% in 2020. The significant increase not only fulfilled the commitment to the EU, but also broke the Slovak record [3]. RES development can bring significant improvement of the economic situation in Slovakia [4]. Increasing population demands and rapid urbanisation bring new energy challenges that need to be met in today's modern world. The perception of the promotion of RES in Slovakia has often led to misconceptions, as wood has been used as an energy source, leading to the problem of deforestation and emissions into the air. There is great potential in the use of geothermal energy. In terms of natural conditions, we can use the geomorphology of the landscape precisely to the advantage of harnessing this energy. Slovakia is currently facing a problem in terms of the infrastructure for the connection of RES systems. The current grids are outdated and not sufficiently prepared to accommodate the necessary capacity. Another potential problem is the poor public opinion towards the use of RES. On the other hand, Slovakia is one of the countries where the level of bureaucracy associated with the construction of RES is benevolent. Society as a whole cannot be divided into political and natural sides. The mutual integration of systems not only allows but also needs mutual cooperation. In view of the current energy situation caused by political interests, Slovakia is also facing soaring energy demand. The development and promotion of RES can help to address the rising demand and bring benefits in both the economic and social spheres. The Slovak Republic has put forward a call to support the construction of new RES electricity generation facilities, mainly in response to the current situation.

2 LEGAL BASIS – EUROPEAN UNION, POLAND, SLOVAKIA

2.1 Legislation in force

Legislation for the development and use of renewable energy in recent years is closely linked to the adoption of Directive 2009/28/EC of the European Parliament and of the Council of 23 April 2009 (Directive 2009/28/EC of the European Parliament and of the Council of 23 April 2009 on the promotion of the use of energy from renewable sources and amending and subsequently repealing Directives 2001/77/EC and

2003/30/EC) (Table 1). This Directive amended and repealed the previous Directives 2001/77/EC and 2003/30/EC, setting common rules for the use of renewable energy in the EU, as well as for reducing greenhouse gas emissions and promoting greener transport [5]. The implementation of the Directive into the Polish legal system was carried out pursuant to the Act of 20 February 2015 on Renewable Energy Sources, as amended, which specified (Act of 20 February 2015 on Renewable Energy Sources, 2015):

- rules and conditions for the implementation of the production of electricity from renewable energy sources and agricultural biogas - in renewable energy, bioliquids facilities;
- mechanisms and instruments supporting the production of electricity from renewable energy sources, agricultural biogas, heat - in renewable energy installations
- rules for issuing guarantees of origin for electricity produced from renewable energy sources in renewable energy installations;
- the rules for the implementation of the National Renewable Energy Action Plan;
- conditions and procedures for the certification of renewable energy installers and for the accreditation of training providers;
- the principles of international cooperation in the field of renewable energy and joint investment projects.

The investment and construction process of renewable energy installations is additionally regulated by the following laws: in the field of spatial planning (Act of 27 March 2003 on spatial planning and development, 2003), Construction (Construction Act of 7 July 1994) (Construction Act, 1984) and Environmental Impact Assessment (Act of 3 October 2008 on the Provision of Information on the Environment and its Protection, Public Participation in Environmental Protection and Environmental Impact Assessment) , 2008) (EIA Act, 2008). In addition, in Poland, there is an Act of 20 May 2016 on wind power plants (Act of 20 May 2016 on wind power plants, 2016), the so-called Upwind Act or the Act on distances. The Slovak legislation applies in the framework of RES the Act on Support of Renewable Energy Sources and High Efficiency Combined Production and on Amendments and Additions to Certain Acts 309/2009 Coll., the Act on Energy and on Amendments and Additions to Certain Acts 251/2012 Coll. and the Act on Regulation in the Network Industries 250/2012 Coll. In the investment and construction process the Act on Spatial Planning 200/2022 Coll., the Building Act 50/1976 Coll. and the Act on Environmental Impact Assessment 24/2006 Coll. are regulated. . Act No 309/2018 Coll., amending and supplementing Act No 309/2009 Coll. on the promotion of renewable energy sources and high-efficiency combined production and on amending and supplementing certain acts, as amended, and amending and supplementing certain acts.

3 WIND POWER PLANTS

Following the adoption of the Wind Energy Act in 2016, there has been a significant change in the siting of wind farms. Until now, they have been implemented under the same regulations as other RES projects. This law defines the conditions and procedure for the siting and construction of wind power plants, as well as the conditions for the siting of wind power plants near existing or planned residential developments. The Act does not apply to investments made and used in marine areas of the Republic of Poland.

The location of the wind power plant is based solely on the processed master plan of the municipality. The distance at which it can be located and built (RES Act):

- wind power plant - from a residential building or a building with a mixed function that includes a residential function and
- a residential building or a building with a mixed function that includes a residential function - from the wind power plant,

is equal to or greater than ten times the height of the wind turbine measured from ground level to the highest point of the structure, including the technical elements, in particular the rotor and blades (overall height of the wind turbine) (Rule 10H). This distance is not required for the alteration, addition, extension, restoration, installation or conversion of a dwelling house or mixed-use development that includes a residential function.
This distance must also be respected in the case of the siting and construction of a wind park from the forms of nature protection referred to in the Nature Conservation Act of 16 April 2004 and from the promotional forest complexes referred to in the Forestry Act of 28 September 1991, but the establishment of these forms of nature protection and promotional forest complexes does not require this distance to be respected.
A zoning plan that allows the location of a wind farm (RES Act):

- determines the maximum overall height of the wind farm;
- is prepared at least for the area where new residential buildings or buildings with a mixed function, including residential function, cannot be located, the boundaries of which are determined taking into account the maximum overall height of the wind farm indicated in this zoning plan.

The enactment of the Wind Energy (Distance) Act is seen as a constraint on the development of wind energy in Poland. The distance limits were introduced to take into account the interests of the population, but on the other hand they led to 'blocking' areas around wind turbines from possible residential development. In May 2021, a new layer "Exclusion zones around wind turbines" was added to the planning section of the website www.geoportal.gov.pl, which presents areas excluded from residential development due to the

presence of wind turbines. As can be seen, the areas most affected by this regulation are Western Pomerania and the areas of Łódź, Wielkopolska and Kujawsko-Pomorskie Voivodeships (Figure 1).

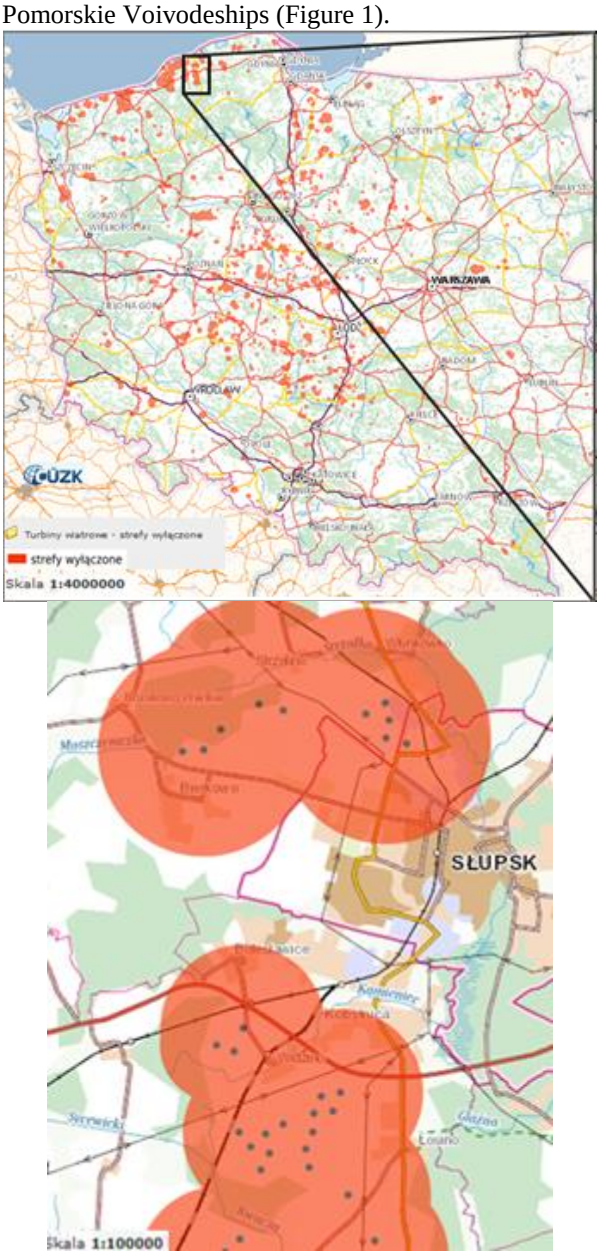

Figure 3. Exclusion zones from possible residential development around wind turbines, based on www.geoportal.gov.pl, 20.09.2022

The amendment of the Wind Power Act is necessary because of the need to resume the construction of wind power plants. The procedures related to the amendment have been going on for almost two years. According to the amendment, the basic principle for the siting of a new wind farm, according to which such a facility can only be built on the basis of a zoning plan (Local Development Plan), will remain unchanged. However, the obligation to prepare or amend a site plan for the purposes of a wind farm project will only apply to the area of potential environmental impact of the wind farm and not to the area designated in accordance with Rule 10H (i.e. for an area within a radius defined by a distance equal to ten times the total height of the proposed residential wind farm). Under the new regulations, a municipality's zoning ordinance will be able to define a distance from a wind farm to a residential building other than that specified by the 10H rule, taking into account the extent of the wind farm's impacts, but with an absolute minimum distance of 500 metres. The basis for determining the distance of the wind farm from residential buildings will be, inter alia, the results of the Strategic Environmental Assessment (SEA) carried out as part of the draft masterplan. The SEA analyses, inter alia, the impact of noise emissions on the environment and the health of the inhabitants. The same absolute minimum safety distance will apply to the location of new residential buildings in relation to an existing or planned wind park. Importantly, the municipal authorities will not be able to opt out of implementing an SEA for a municipal development plan that includes the location of a wind farm. In order to protect the most valuable natural values, the ban on the siting of wind power plants in national parks, nature reserves, protected landscape areas and Natura 2000 sites will continue to apply. The obligation to respect setbacks will therefore remain in the case of national parks (10H) and nature reserves (500 metres). It is expected that the implementation of the proposed solutions will enable the construction of new wind power installations with a total capacity of 6-10 GW, which will contribute to strengthening Poland's energy security. At present, the legislative process can be considered to be well advanced, the law has already undergone inter-ministerial and public consultations and is currently awaiting submission to the Council of Ministers. This is the last important element before the adoption of the document. The amendment to the law should have been approved last year, which would have brought it into force earlier this year. Unfortunately, up to now the law has still not been adopted [6,7].

According to the latest information from Climate and Environment Minister Anna Moskwa, the government's project to change the law on wind farms requires dialogue between the government and parliament due to the "challenging" solutions [8].

It should be noted, however, that although Polish regulations are quite restrictive, those in Germany and Austria are even stricter [9]. Nevertheless, Germany is the undisputed leader in wind power (54 GW installed in 2020) [10].

3.1 Offshore wind power plants

The Act of 17 December 2020 on the promotion of offshore wind power generation introduces a regulation supporting the construction of offshore wind farms in the Baltic Sea and creates a legal framework that will support entities interested in the development of the offshore wind energy sector in Poland. The Polish company PGE (Polska Grupa Energetyczna) Baltica has now (September 2022) commenced environmental research for the purpose of environmental reporting and obtaining an environmental decision for the Baltica 1 project - an offshore wind farm located approximately 80 km off the Baltic Sea coast.

Baltica 1 is one of three projects that PGE is currently implementing in the Baltic Sea. In 2026-2027,

the Baltica 2 and Baltica 3 wind projects, which make up the Baltica Offshore Wind Farm with a total installed capacity of approximately 2.5 GW, will be launched. The first electricity from the Baltica 1 Offshore Wind Farm will flow in early 2030.

The environmental research will enable the precise identification of natural marine resources, including geological and water conditions and the presence of organisms in the study area - plants, seabed dwelling animals, fish, birds and mammals, including bats, in order to minimise the impact on the natural environment both during construction and during the subsequent long-term operation of the offshore wind farm. The survey will cover the area of sea and land on which the offshore wind farm connection infrastructure will be constructed.

Poland's energy policy to 2040 suggests that installed onshore wind capacity will reach 5.9 GW in 2030 and 11 GW in 2040 [11].

4 RES PROJECTS – POLAND, SLOVAKIA

Renewable energy refers to renewable, non-fossil energy sources, including wind energy, solar energy, aerothermal energy, geothermal energy, hydrothermal energy, hydropower, wave, current and tidal energy, energy derived from biomass, biogas, agricultural biogas, bioliquid.

The most popular renewable energy sources in Poland (by installed capacity) are:

- wind energy,
- biomass,
- hydropower,
- biogas,
- solar energy.

The installation of a renewable energy source is also, according to the RES Act, the installation of a thermal waste conversion plant - waste incineration or waste co-incineration plant within the meaning of the Act of 14 December 2012 on waste (Coll. of 2022, items 699 and 1250) in which part of the electricity and heat produced comes from the biodegradable part of industrial or municipal waste, of vegetable or animal origin, including waste from waste treatment plants and waste from water and waste water treatment , in particular sewage sludge, in accordance with the provisions on waste to the extent that the part of the energy obtained from the combustion of waste qualifies (RES Act).

Poland, like Slovakia, has for many years been reducing the share of fossil fuel-based sources in its energy mix (energy mix - the structure of energy production and consumption according to the criteria of energy carriers) and increasing the share of RES. However, it should be noted that in Poland the dominant energy source was fossil fuel combustion and in Slovakia nuclear energy. In recent years, in both countries the growth rate of the share of renewable energy sources in the energy produced has been at the level of 6% per year. Nevertheless, Slovakia boasts a 32% share of renewable energy in the energy mix. Overall, in Poland, RES represent 19.7% of the current energy mix [12].

In Poland in 2004, only 5% of energy was produced from renewable energy sources (mainly hydropower and, to a lesser extent, wind power). Since then, there has been a huge increase in the use of renewable energy from the following sources:

- Geothermal: Only water temperatures below 150°C are used. This means that the energy can be used for heating a house, greenhouse, hydro cultivation (?), recreation or balneotherapy [13]. In 2021, geothermal energy provided only 0.2% of the energy consumed. According to experts, the potential of geothermal energy in Poland is not properly exploited [14]. Slovakia has a significant potential for the use of geothermal energy. So far, this energy is mainly used for recreational purposes. Despite the good accessibility related to the suitable composition of the bedrock, the potential that geothermal energy provides in Slovakia is not fully exploited.
- Photovoltaics: Rapid development occurred after 2015 with accumulation in 2020-2021. Installed capacity in 2021 was 10 times the 2015 capacity value. In 2021, PV provided only 2.9% of the energy consumed. However, it is important to mention the uneven distribution of production. In the summer months the share is 4% and in the winter months the share drops to 1%. Currently, there is a further increase in the number of installations, but it should be added that this source of energy is very dependent on weather conditions. Moreover, the lifetime of the installed panels is 25-30 years [15]. In Slovakia, the use of photovoltaics has already increased in single-family homes. The level of incident solar radiation allows the installation of photovoltaic panels throughout Slovakia. Residents' interest in installation has increased sharply, mainly due to the feed-in tariff of the energy produced [16].
- Hydropower: Water-based power generation in Poland is the longest used source of renewable energy (since 1920). A clear development and increase in hydropower capacity occurred in the 1970s. The power plant commissioned in 2014 at the Świnna Poręba reservoir has a capacity of only 4.4 MW. In recent years, a slight decline in the share of hydropower in power generation has been observed. In 2021, hydropower accounted for only 1.5% of the energy consumed. Currently, there is a programme for the construction of pumped storage power plants, which are much better suited to the structure of daily energy demand. The Żarnowiec power plant in operation has a capacity of 716 MW. Despite water level fluctuations, hydroelectric power plants are much more stable than generation based on solar and wind conditions. Hydropower is the most used renewable energy in Slovakia. The beginning of its use dates back to 1892. At present there are 25 large hydroelectric power plants in Slovakia, but at the time of the

establishment of the Czechoslovak Republic there were as many as 37. The use of hydropower potential is related to the geographical distribution of the country, which is why a significant part of hydropower is dispersed in small hydropower plants. The largest hydropower plant in Slovakia is the Gabcikovo hydroelectric power station with an average annual balance of 2200 GWh.

- Wind power: Wind power generation in Poland has been developing since 1991, when the first installation was built at the Żarnowiec hydroelectric power plant. A clear development and increase in wind power capacity took place in 2008 and continues to this day. The capacity commissioned in 2020-21 exceeded 1.7 GW. In 2021, wind power provided up to 9.4% of the energy consumed. There is currently a project to build a power plant on the shallow shelf of the Baltic Sea, with an estimated potential of 11 GW of capacity. There is a further increase in the number of installations, but it should be added that this energy source is dependent on weather conditions. Moreover, the lifetime of the turbines is 25 years. In Slovakia, wind energy is one of the least exploited RES sources. There are only two wind power plants in operation on our territory. The inland location of the country does not provide a sufficient level of wind speed and intensity to fully exploit RES.
- Biomass: In 2019, Poland has included solid biofuels, i.e. wood, in its renewable energy production. It has thus achieved a leap in the share of RES and met the RES target set by the EU. The share of energy obtained in this way accounts for up to 73% of renewables. This compares with 63% in Slovakia and an EU average of 40%. As for energy from biomass (i.e. plant waste), it accounts for only 1.3% of Poland's energy mix.

5 EIA PROCESS FOR RENEWABLE ENERGY INSTALLATIONS - PROCEDURES IN POLAND AND SLOVAKIA

The implementation of renewable energy installations requires the completion of standard investment and construction procedures and obtaining the necessary administrative decisions based on the laws governing the issue. In most cases, the following decisions must be obtained for the implementation of RES installations. Before starting the process of obtaining an environmental decision, it is necessary to determine whether it is necessary for the planned RES project. An environmental decision is only necessary for projects that may have a significant impact on the environment, which are included in the Regulation of the Minister of the Environment.

Projects that are always likely to have a significant impact on the environment are a group of projects for which it is possible to obtain an environmental decision after an environmental impact assessment has been carried out.

Projects that may potentially have significant environmental impacts are a group of projects for which it will be possible to obtain an environmental decision without carrying out an environmental impact assessment. Whether an environmental impact assessment will be required for a given project depends on the decision of the authority conducting the procedure (screening procedure).

In Poland, projects that always require an EIA procedure include wind farms with a total nominal capacity of at least 100 MW, wind farms located in marine areas of the Republic of Poland and waste treatment plants – incinerators.

Other projects that meet the criteria set out in the relevant regulation are subject to screening.

6 CONCLUSION

Projects that may have a potentially significant effect on the environment include, but are not limited to, projects involving the superstructure, reconstruction or installation of an existing or completed project that may have a significant effect on the environment and does not meet the criteria set out in the relevant regulation.

The differences between EIA process in Slovakia and Poland can already be seen in the fact-finding procedure. If the fact-finding procedure determines that the proposed activity must be assessed in accordance with the EIA Act, it proceeds to scoping. The verifiers of the information are equally different, for PL the verification by the regional director of environmental protection and the state sanitary inspector applies, in Slovakia the information is verified by an authorized person. The same procedure applies for public comments and assessment of the investor's application. In Poland the decision is binding, whereas in Slovakia it is advisory. There is also a difference of one year in the time of the decision.

A decision to refuse to issue an environmental decision may only be issued in the following cases specified in the EIA Act:

- non-compliance of the location of the RES installation project with the zoning plan,
- refusal of the cooperating authority to agree to the conditions for the RES project,
- the applicant's disagreement with the implementation of the RES installation project in another variant,
- demonstration of a significant negative impact on a Natura 2000 area,
- demonstration, after an environmental impact assessment, that the RES project negatively affects the possibility of achieving the environmental objectives set out in the Water Act.

The result of the impact assessment of the proposed activity or its modification is the final opinion. The final opinion is a decision which is binding for the further permitting procedure. A decision issued in the permit

procedure is a permit or a decision of the permitting authority refusing to grant a permit or terminating the permit procedure.

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REFERENCES

[1] COM. (2019). Communication from the commission to the european parliament, the european council, the council, the european economic and social committee and the committee of the regions.
[2] Europarl. (2021). Renewable sources energy. Retreived from: https://www.europarl.europa.eu/factsheets/sk/sheet/70/renewable-energy [accessed: 3 October 2022].
[3] Eurostat. (2022). Retreived from: https://ec.europa.eu/eurostat/en/web/products-statistical-books/-/ks-ei-20-001 [accesed: 3 October 2022].
[4] Katanikova, R., Svikruhova, P., & Grman, P. (2021). Biomass as an alternative energy source and an innovative tool for regional development. *Agricultural economics, XXVI(2).*
[5] Siwkowska, A. (2019). Investment and construction process for RES installations. *Wydawnictwo CH Beck.*
[6] Globenergia. (2022). Retreived from: https://globenergia.pl/ustawa-antywiatrakowa-jak-miecz-obosieczny-kiedy-nowelizacja-odblokuje-budownictwo-mieszkalne/ [accessed: 17 February 2022].
[7] Ministry of Climate and Environment. (2022). Retreived from: https://www.gov.pl/web/klimat/nowelizacja-tzw-ustawy-10h-przyjeta-przez-rzad [accessed: 5 July 2022].
[8] Interia Zielona. (2022). Retreived from: https://zielona.interia.pl/eko-technologie/energetyka/news-ustawa-odlegloscIowa-zalicza-kolejny-przestoj-potrzeba-rozmo,nId,6290006#utm_source=paste&utm_medium=paste&utm_campaign=firefox [accessed: 9 September 2022].
[9] Global Compact. (2021). Retreived from: https://ungc.org.pl/ [accessed: 9 September 2022].
[10] BMWK. (2022]. Retreived from: BMWK - Bundesministerium für Wirtschaft und Klimaschutz [accessed: 9 September 2022].
[11] Globernergia. (2022). Retreived from: https://globenergia.pl/coraz-blizej-polskich-projektow-offshore-wind-kolejne-badania-srodowiskowe-w-toku/ [accessed: 20 September 2022].
[12] GUS. (2021). Renewable energy in 2020.
[13] Sowiżdżał, A. (2018). Geothermal energy resources in Poland – Overview of the current state of knowledge. *Renewable and Sustainable Energy Reviews, 82(3),* 4020-4027.
[14] Hajto, M. (2021). Status of geothermal energy use in Europe and the world in 2020. *Geological Review, 69(9),* 566-577.
[15] Tora, M., Karbowniczek, M., & Rora, B. (2020). Photovoltaics in Poland. Current status and prospects. Issues of energy resources and energy in the national economy. Domestic energy and the European Green Deal. *Scientific Journals of the Institute of Mineral and Energy Economy of the Polish Academy of Sciences, 1(110),* 111-118.
[16] Jobbágy, J., & Daubner, M. "HODNOTENIE VYUŽITIA SOLÁRNEJ ENERGIE." TECHNOFORUM 2020 (2020): 67.

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PERCEPTION OF CONSUMERS IN THE CONTEXT OF DOMESTIC PRODUCTION BY YOUNG SLOVAKS BASED ON CONSUMER ETHNOCENTRISM

Kristína Korytinová[1]

Abstract: *The publication points to the issue of consumer ethnocentrism in connection with the perception of domestic food. The aim of the article is to focus on consumer ethnocentrism in relation to domestic products. The article presents primary research. It was conducted on 100 Slovak respondents under the age of 27. In the methodology part, we use several methods. Mathematical-philosophical methods include analysis, synthesis, scientific abstraction, and mathematical-statistical methods include descriptive and inductive statistics. The CETSCALE tool is used in the work to measure consumer ethnocentrism. Cronbach's alpha coefficient helped verify the reliability of the tool. The results indicate that young Slovaks represent a low level of consumer ethnocentrism. Globally, domestic products are perceived positively. The overall results can be used in further research as well as in practice in the investigated area.*

Keywords: consumer ethnocentrism, domestic products, Slovakia, CETSCALE

1 INTRODUCTION

The era of globalization encourages us to focus on the idea of ethnocentrism. It is necessary to point out the global tendency towards the economic, political and cultural unity of humanity, which can bring positive and negative impacts in various directions. In Slovakia, this topic remains less researched and that is why we want to focus on it. "Ethnocentrism is defined as viewing the whole world only through one's own eyes with one's beliefs, values, and attitudes and not acknowledging that others may not see the world in the same way." (Samovar et al., 1981).

The main aim of this article is to focus on consumer ethnocentrism in relation to domestic products. There are more reasons why we chose this particular area. Globalization brings with it an increase in competition on the domestic and international markets. This contributes to the number of foreign products on the domestic market. As a result, a chain reaction is triggered and the domestic economy declines due to various factors. It should be mentioned that we are becoming less able to compete with foreign products, which causes an increase in unemployment in the country and other negative effects (Lutz et al., 2014).

Only a few authors dealt with the level of ethnocentrism in Slovakia. The author Sedláková (2007) examined perhaps the topic closest to us, focused on the degree of ethnocentrism of Slovak consumers in the food industry. The result was strong ethnocentrism (67.47 was the average CETSCALE value). Another well-known author Kleinová (2009) investigated the synthesis of ethnocentrism and the food industry, while her research consisted of a 6-point Likert scale (she achieved a result of 68.49). We list many other authors who address the topic of ethnocentrism in relation to food products (see Čvirik, 2018a, 2018b, 2018c; Lesáková, 2016; Lieskovská et al., 2013).

The origins of ethnocentrism go to America, when in 1906, psychologist William Graham Sumner published a work called Folkways: A Study of the Sociological Importance of Usages, Manners, Customs, Mores and Morals. Ethnocentrism touched on both sociology and psychology and looked at things through two groups. "By internal group, the author means a social group united by the same thinking, culture and behavior, which is based on folklore (human customs)." (Čvirik, 2021) The evaluation factor is the in-group. Its task is to look for differences with other out-groups, where it is necessary to take into account positively evaluated common features and negatively evaluated differences.

The most popular authors associated with consumer ethnocentrism are Shimp and Sharma (1987, p. 280). They are the creators of Theoretical analysis of Consumer Ethnocentrism. They captured the essence with a general definition, even if it is oriented towards the American consumer market "from the perspective of ethnocentric consumers, buying imported products is wrong, in their minds it is it hurts the domestic economy, it also causes job losses and is unpatriotic towards the nation." (Shimp and Sharma, 1987) The authors also try to find a deeper reason why ethnocentric consumers perceive the purchase of foreign products as wrong. Above all, it is the inner conviction of the ethnocentric consumer. Here it is possible to see a clear difference between in-group and out-group groups and the rejection of everything from another group, in our case it is food. Another leading author states that: "consumer ethnocentrism is belief in superior domestic products to foreigners." (Solomon, 1992) He gradually shaped and adjusted his definition with the experience he gained. He talks about the definition of consumer ethnocentrism as "a tendency to prefer products of his own culture, to products of other cultures. Ethnocentric consumers are likely to feel it is wrong to buy products from other countries mainly because of the negative impact on the domestic economy." (Solomon et al., 2006).

Several researches deal with the connection between preference for domestic products and consumer ethnocentrism. "The phenomenon of consumer preference for domestic products, or prejudice against

imports, has been termed economic nationalism, cultural bias against imports, or consumer ethnocentrism". (Sharma et al., 1995, p. 26) More authors agreed that the most important criteria for evaluating domestic products are price and quality in the context of consumer ethnocentrism (Balabanis & Siamagka, 2017; Ding, 2017; Ismail et al., 2012; Liu et al., 2006; Wang & Chen, 2004). The purchase intention is absent in several marketing studies (Khalid et al., 2018). According to the authors Eagly and Chaiken (1993) the definition of purchase intention reads: "the person's motivation in the sense of his or her conscious plan to exert effort to carry out a behaviour." (Eagly & Chaiken, 1993) It follows from the above that it is not enough to focus only on price and quality, but also the purchase intention must be taken into account as a factor when evaluating the preference for domestic products.

It is necessary to realize that if we do not support the domestic market in global, we will all pay for it as individuals in various areas. It is also true that homemade products are the most natural for our health. We should rely on what we can grow and then process in our country. The era of globalization is on the rise, which also causes the suppression of domestic products in the food industry. Consumer behavior goes hand in hand with ethnocentrism.

2 METHODOLOGY

Aim and sample

The aim of this article is to investigate the degree of consumer ethnocentrism among young Slovaks (age up to 27 years) and to investigate the preference of domestic or foreign products in selected product categories.

Primary research is used in the publication. The characteristics of young Slovaks are specified in the article in connection with the measurement of consumer ethnocentrism, which is oriented towards one nation. The second feature, the age limit was set on the basis of European and Slovak recommendations within the age definition of the youth segment (Ministry of Education of the Slovak Republic. 2005).

The sample consisted of 100 respondents. Due to the size of the sample, a sampling error of about 10% can be stated. 43% of men and 57% of women took part in the survey, which almost corresponds to the population quotas in this age segment. At the same time, it is necessary to note that from the point of view of residence and entropy within Slovakia, each region had its own representation in the sample.

Research tools

An online questionnaire was the main instrument of the primary research. It contained 3 sections - filter questions, 17 questions focused on the purchase of domestic/foreign food and 4 questions to determine consumer ethnocentrism.

The CETSCALE tool (Shimp - Sharma, 1987) was used in the research to measure the level of consumer ethnocentrism using a Likert scale. It specifically contains five levels (1-strong disagreement, 5-strong agreement) and 17 statements to which we obtained answers thanks to the respondents. Given that it is a relatively new tool in the field of science, it was necessary to verify its reliability.

Table 1 Frequentist Scale Reliability Statistics.

Estimate	Cronbach's α
Point estimate	0.897
95% CI lower bound	0.864
95% CI upper bound	0.923

Notes: * Reverse encoding; ** Overal Cronbach´s α = 0.820; CI = <0.782 – 0.853>.
Source: Own calculations.

As can be seen from Tab. 1, the reliability estimate was the demonstration of the reliability estimate coefficient - Cronbach's α. The results of reliability verification reach high values. Therefore, the CETSCALE tool can be considered reliable.

3 RESULTS

The results of the measure of consumer ethnocentrism are shown in Tab. 2 in the form of average value and standard deviations for individual statements.

Table 2 CETSCALE -Mean values and standard deviation.

CETSCALE items*	Mean	St. dev.
1. Slovak people should always buy Slovak-made products instead of imports.	2,940	1,162
2. Only those products that are unavailable in the Slovak Republic should be imported.	3,230	1,205
3. Buy Slovak-made products, keep Slovak Republic working.	3,890	0,875
4. Slovak products, first, last, and foremost.	3,120	1,113
5. Purchasing foreign-made products is un-Slovakian.	1,910	1,138
6. It is not right to purchase foreign products, because it puts Slovaks out of jobs.	2,220	1,142
7. A real Slovak should always buy Slovak - made products.	2,020	1,137
8. We should purchase products manufactured	3,170	1,111

in Slovak Republic instead of letting other countries get rich off us.		
9. It is always best to purchase Slovaks products.	3,040	1,100
10. There should be very little trading or purchasing of goods from other countries unless out of necessity.	2,640	1,115
11. Slovaks should not buy foreign products, because this hurts Slovaks business and causes unemployment.	2,240	0,976
12. Curbs should be put on all imports.	2,240	1,074
13. It may cost me in the long-run but I prefer to support Slovak products.	3,030	1,087
14. Foreigners should not be allowed to put their products on our markets.	1,760	1,016
15. Foreign products should be taxed heavily to reduce their entry into the Slovak Republic.	2,240	1,156
16. We should buy from foreign countries only those products that we cannot obtain within our own country.	2,830	1,264
17. Slovak consumers who purchase products made in other countries are responsible for putting their fellow Slovaks out of work.	2,210	1,066
Overall level of consumer ethnocentrism.	44,730	11,542

*Note: * Based on Shimp and Sharma (1987).*
Source: Own calculations.

The largest recorded average value was the statement 3. Buy Slovak-made products, keep Slovak Republic working. On the contrary, the lowest average value was the statement number 14. Foreigners should not be allowed to put their products on our markets.

As for the overall assessment of consumer ethnocentrism, there were 17 statements to which respondents responded from 1 (completely disagree) to 5 (completely agree). It follows from the above that the measured values will be from 17 (the lowest possible value) to 85 (the highest possible value). The results indicate that the average value of young consumers in Slovakia is around 44.7 points, which represents a below-average value.

From the point of view of preference for domestic and foreign products, we examined selected product lines.

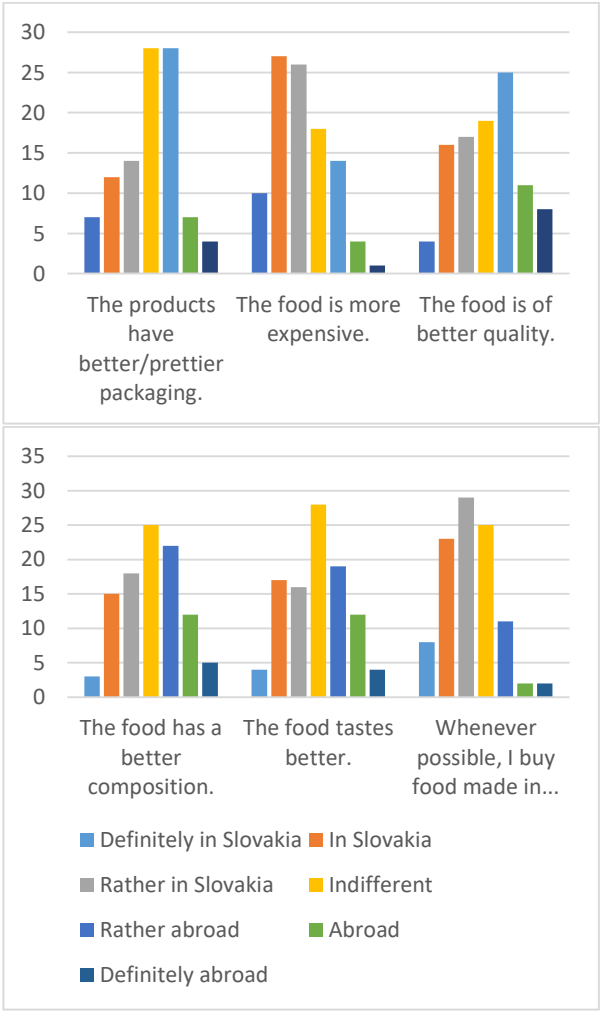

Chart 1 Comparison of domestic and foreign products.
Source: Own processing.

Respondents marked real foreign products as the most beautiful packaging of goods. Paradoxically, respondents perceive foreign products as higher quality, while rating domestic products as more expensive. Within the category of composition and taste, the respondents were neutral. Overall, it follows from the above that the majority of respondents prefer to buy domestic products.

In chart 2, we can see the influence of individual factors in the context of importance.

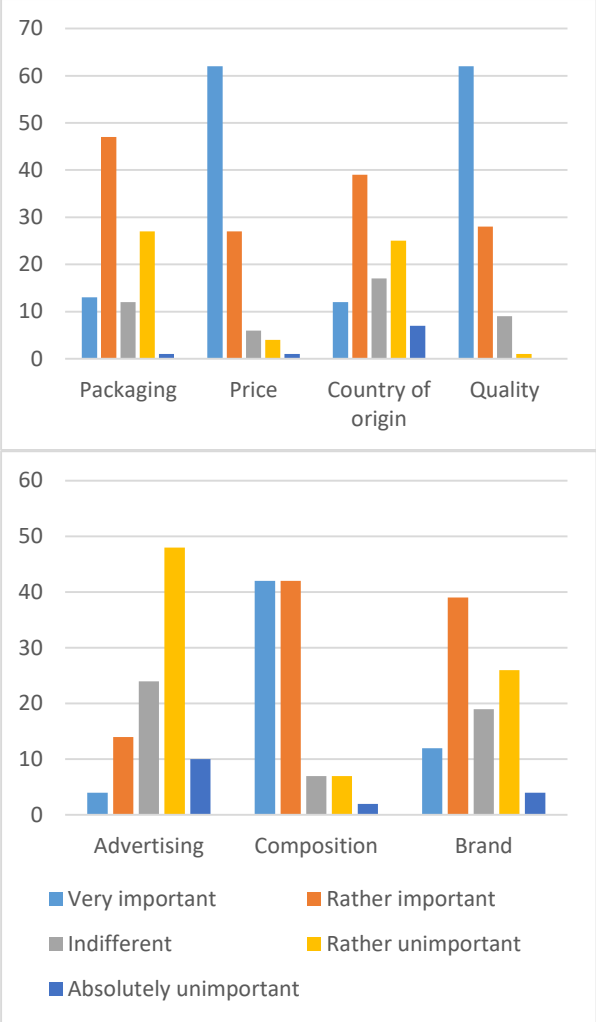

Chart 2 Factors affecting the purchase of food. Source: Own processing.

The above graph shows that consumers consider quality and price to be the most important when buying food, on the same level. On the contrary, they identified advertising as the least important, followed closely by the country of origin.

4 DISCUSSION

The article studies the influence of consumer ethnocentrism on the perception of domestic foods. The CETSCALE tool was used to measure consumer ethnocentrism, we verified its reliability.

The survey revealed a low level of consumer ethnocentrism in Slovakia. We have registered several publications in Slovakia in this field (Čvirik 2018a, 2018b, 2018c). The results showed unequivocally that consumers, whenever they have a choice, choose to buy a domestic product, despite the fact that not all individual product categories were perceived positively in favor of domestic products. At the same time, the factors that most influence their decision making during the purchase include price and quality. It should be taken into account that the survey has a certain margin of error. Therefore, we consider the results to be a pilot study.

5 CONCLUSION

The aim of this publication was to focus on consumer ethnocentrism in relation to domestic products. Findings resulting from primary research show that young Slovaks under the age of 27 respond positively to domestic products. When choosing food, they therefore reach for domestic products compared to foreign ones. The consumer ethnocentrism factor is on average less significant, its level is below average. Based on the mentioned facts, it follows that the relationship between consumer ethnocentrism and the perception of domestic products does not exist. The application of the achieved results is possible both in theory and in practice. Their future use is possible in the field of marketing and business, as well as in psychology and sociology. The established facts offer wide possibilities of use and can be adapted, for example, within the profile of a standard customer. The publication shows us possible incentives for the field of marketing communication.

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REFERENCES

[1] Balabanis, G., & Siamagka, N.-T. (2017). Inconsistencies in the behavioural effects of consumer ethnocentrism: The role of brand, product category and country of origin. *International Marketing Review*, 34(2), 166-182. https://doi.org/10.1108/IMR-03-2015-0057

[2] Čvirik, M. (2018a). Spotrebiteľský etnocentrizmus v generačnom kontexte. *Studia Commercialia Bratislavensia*, *11*(39).

[3] Čvirik, M. (2018b). Spotrebiteľský etnocentrizmus na Slovensku. *Vedecké state Obchodnej fakulty*, *1*(1), 5-13.

[4] Čvirik, M. (2018c). Spotrebiteľský etnocentrizmus–skúmanie diferencií na základe deskriptívnych charakteristík spotrebiteľa. *Ekonomický výzkum–prezentace výsledků doktorandů*, 29-39.

[5] Čvirik, M. (2021). The impact of consumer ethnocentrism and the patriotism on judgement for selected domestic products: The case of Slovakia. *Central European Business Review*, *10*(3), 1.

[6] Ding, Q. S. (2017). Chinese products for Chinese people? Consumer ethnocentrism in China. *International Journal of Retail & Distribution Management*. https://doi.org/10.1108/IJRDM-11-2016-0212

[7] Eagly, A. H., & Chaiken, S. (1993). *The psychology of attitudes*. Harcourt brace Jovanovich college publishers.

[8] Ismail, Z., Masood, S., & Tawab, Z. M. (2012). Factors affecting consumer preference of international brands over local brands. In *2nd international conference on social science and humanity* (Vol. 31, No. 12, pp. 54-59).

[9] Khalid, N. R., Wel, C. A. C., Mokhtaruddin, S. A., & Alam, S. S. (2018). The influence of self-congruity on purchase intention for cosmetic merchandises. *International Journal of Academic Research in Business and Social Sciences*, *8*(4), 933-945. https://doi.org/10.6007/ijarbss/v8-i4/4122

[10] Kleinová, K. (2009). Analýza spotrebiteľských preferencií a imidž slovenských a zahraničných potravín na trhu SR. *Dizertačná práca. Nitra: SPU*.

[11] Lesáková, D. (2016). Ethnocentric behaviour in the Slovak population: do Slovaks purchase Slovak dairy products?. *Ekonomický časopis*, *64*(08), 795-807.

[12] Lieskovská, V., Megyesiová, S., & Bilohuščinová, D. E. N. I. S. A. (2013). Akceptácia podpory predaja domácich produktov spotrebiteľmi v maloobchode SR. *Marketing Science & Inspirations*, *8*(2).

[13] Liu, F., Murphy, J., Li, J., & Liu, X. (2006). English and Chinese? The role of consumer ethnocentrism and country of origin in Chinese attitudes towards store signs. *Australasian Marketing Journal*, *14*(2), 5-16. https://doi.org/10.1016/S1441-3582(06)70057-X

[14] Lutz, S., Talavera, O., & Park, S. M. (2014*). Effect of foreign presence in a transition economy, regional and industry wide investment and firm – Level exports in Ukrainian manufacturing. Emerging Markets Finance and Trade,* 44(5), 82-98.https://doi.org/10.2753/REE1540-496X440506.

[15] Samovar, L. A., Porter, R. E., & Jain, N. C. (1981). *Understanding intercultural communication*. Wadsworth Publishing Company.

[16] SedlakovA, J., Schade, G., Vogler, W., & Kretter, A. (2007). Spotrebitel'ske spravanie sa mladych slovenskych konzumentov-vplyv etnocentrizmu a povdu potravin. *Acta oeconomica et informatica*, *10*(394-2018-1000), 45-48.

[17] Sharma, S., Shimp, T. A., & Shin, J. (1994). Consumer ethnocentrism: A test of antecedents and moderators. *Journal of the academy of marketing science*, *23*(1), 26-37. https://doi.org/10.2307/3151638.

[18] Shimp, T. A., & Sharma, S. (1987). Consumer ethnocentrism: Construction and validation of the CETSCALE. *Journal of marketing research*, *24*(3), 280-289.

[19] Solomon, M. R. 1992. *Consumer Behavior. USA: Allyn and Bacon*.

[20] Solomon, M. R. et al. (2006). Consumer Behaviour: A European Perspective. 3rd Edition. Harlow: Prentice Hall.Hennessy, J. L., & Patterson, D. A. (2012). *Computer architecture: a quantitative approach*. Elsevier.

[21] Wang, C. L., & Chen, Z. X. (2004). Consumer ethnocentrism and willingness to buy domestic products in a developing country setting: Testing moderating effects. *Journal of Consumer Marketing*, 21(6), 391-400. https://doi.org/10.1108/07363760410558663.

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SOLVING THE SPATIAL RELATIONSHIPS IN MANUFACTURING SYSTEMS

Juraj Kováč [1] – Vladimír Rudy [2] – Peter Malega [3]

Abstract: *To achieve effective results work activities a person must have created optimal working conditions. Part of these conditions, the spatial arrangement is also suitable workplaces. The paper describes the procedure of the spatial solutions of the selected workplace by means of research relations between individual workplaces.*

Keywords: manufacturing1, production systems 2, technological processes 3, zone 4.

1 INTRODUCTION

Staying in the market and preserving the competitiveness of the company is linked to new progressive technologies and greater use creative scientific and technical potential. Deal especially in today's period, during the engineering recession production of medium and large companies as a result economic crisis. It is necessary to apply such development strategies that will make it possible to produce products and provide services with high added value and to introduce production innovations that will ensure high competitiveness and adaptability production to market conditions. They are for designing production systems long-term developed adequate methodological procedures, algorithms and tools that in individual stages of the project process will ensure a higher efficiency of solutions. The creative nature of the project activities creates pressure for interactive generation variants of solutions, their evaluation, optimal choice and detailed elaboration. If the goal is high qualitative level of project solution, is it is necessary to think with high variability. This results from the real nature of engineering production processes, typology, structural arrangement, localization of production systems in space, time, their economic efficiency and Come.

2 ZONAL AND SPATIAL ASPECTS OF DESIGNING PRODUCTION SYSTEMS

Creation of production systems is based on solving the functional and spatial relations of production technology. This is done by drafting the layout, or the spatial solution.

Functional and spatial workplace zones in production systems: When examining the functional and spatial layout of production systems, it is effective to divide space into zones and sub-zones.

In terms of the zone hierarchy, ensuring complex technological processing requires that initial, main and finishing technological operations are usually carried out at the workplace. Due to differences in technological methods and structures used in the initial, main and finishing technological processing, the functional structure of the complex workplace can be divided into its respective parts. Significant is the division into three parts:

1. The Preliminary Technological Processing Workplace part, where the manufacturing and handling bases for follow-up operations are generally prepared and the damaged layer of material is removed in the process of producing the semi-finished products.
2. The Main Technological Process Workplace part, where most technological operations are carried out. It usually consists of several technological workstations with different functional structures.
3. The Special Technological Processes Workplace part, where qualitative offset types of technological operations, required to complete the production (e.g. induction hardening, product cleaning, labelling, etc.), are performed.

On closer examination, it seems useful to analyze technological workstations as functional and spatial zones (Fig. 1):

- The technological zone is the area in which technological operations on the products are carried out.
- The handling zone is the area in which handling (operational and inter-operational) of products, tools and waste, is done
- The control zone is the area in which the control operations are carried out,
- The operating zone is the area where adjustment, maintenance, repairs, etc. are done. [1]

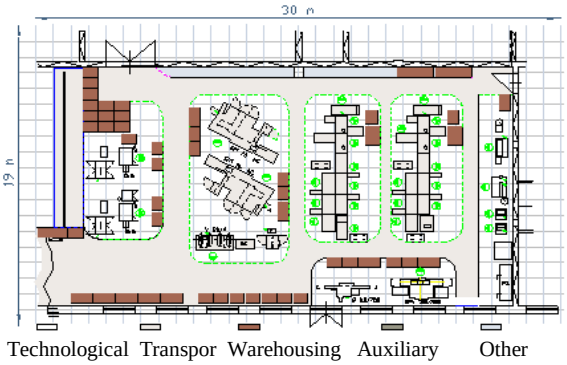


Figure 1 Definition of production system zones [1]

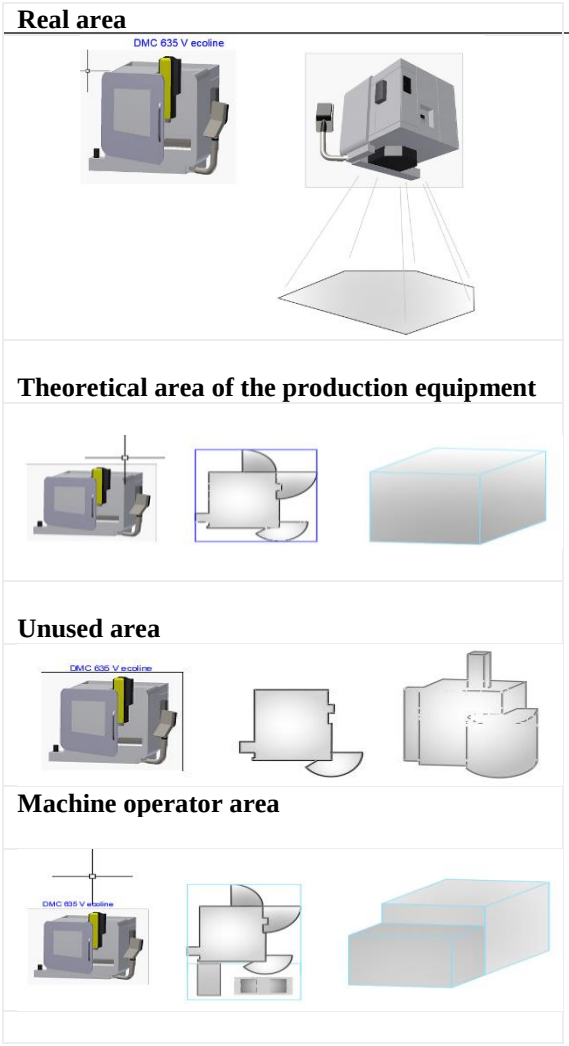


Figure 2 Individual building elements of the construction system [1]

The nature of control operations is such that the control zone essentially coincides with the area occupied by the control elements of the workplace and studying it is relevant when the workplace element .

A more detailed analysis should focus on the issues of the technology and handling zones of the workplace. For the purpose of designing, it is especially important to identify the quantitative parameters of the zones. Basic functional zone identifiers are:

- The shape of a zone, derived from the functional elements of the workplace, especially from the kinematic relations of the working mechanisms and units.
- The dimensions of the zone derived from the size of the functional elements and from the kinematics.
- Zone orientation referenced to the set base of workplace elements,
- Elemental zone structure expressed through the composition of partial zones.

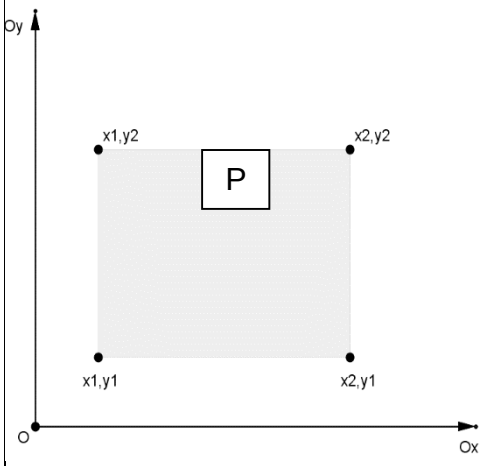
For zone synthesis in workstations, it is especially important to optimize the relations of technological and handling zones for components that are functionally linked to the manufacturing process. The following is required:

- High degree of overlap of technological and handling zones. This condition minimizes work space.
- Elimination of "dead zones", that is, those parts of the technological zone that are not functionally available to the handling device. This condition increases the degree of workplace automation.
- Ergonomics of man-operated zones.
- Compliant alignment of the shape, dimension and orientation properties of handling and technological equipment zones

After the individual building elements of the construction system have been analyzed in designing, the following step is the zone synthesis. The handling and technological zone synthesis is important in terms of efficient functional activities of the production system building elements. Consistency must be first achieved between operational activities of handling and technological elements. The individual zone synthesis does not lie only in determining the size of their overlaps but also in the degree of their utilization. It is necessary to maximize the use of the zones with the minimized area occupied by the production system. The synthesis of individual zones is preferably solved graphically, indicating the availability and the overlap of the elemental zones. Synthesis results are used in the processing of technological layout, which uniquely determines all elements and their spatial arrangement.

Quantitative and qualitative assessment of zone synthesis of individual production system building components can be accomplished in several ways. In addressing zonal problems, it is necessary to minimize mounting surfaces, transport costs, to eliminate dead zones as well as a high degree of the technological and handling zone overlap. It is also necessary to maintain safe distances and ergonomics of human-operated zones. [2]

Elemental area "A"



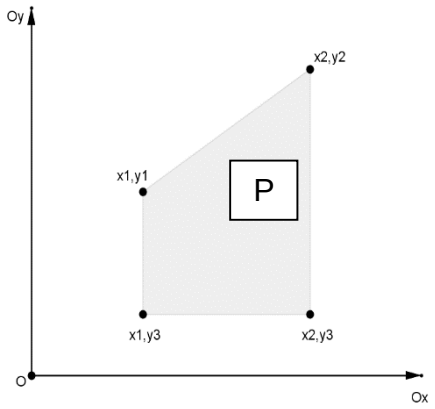
- delimited by lines parallel to "O_x - oy "
- the following holds for the elemental area:

$$y_1 \le y \le y_2 \qquad x_1 \le x \le x_2$$

- area size

$$P = \iint_{y} dx\,dy = \int_{x_1}^{x_2}\int_{y_1}^{y_2} dy\,dx = (x_2 - x_1)(y_2 - y_1)$$

Elemental area "B"



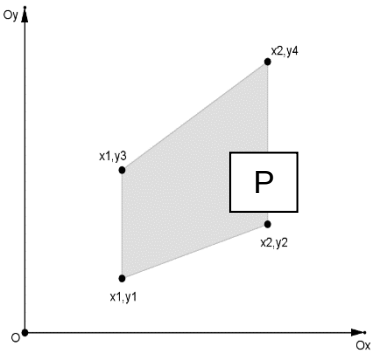
delimited by lines parallel to "- oy " o_x
the following holds for the elemental area:
$x_1 \le x \le x_2 \quad y_3 \le y \le f(x_j)$,
(or $f(x_j) \le y \le y_3$), where:

$$f(x_j) = \frac{y_2 - y_1}{x_2 - x_1} x + \frac{x_2 y_1 - x_1 y_2}{x_2 - x_1}$$

- area size

$$P = \left| \iint_Z dx\,dy \right| = \left| \int_{x_1}^{x_2} \int_{y_3}^{\frac{y_2 - y_1}{x_2 - x_1} x + \frac{x_2 y_1 - x_1 y_2}{x_2 - x_1}} dy\,dx \right| = \left| \frac{(x_2 - x_1)(y_1 + y_2)}{2} - y_3 (x_2 - x_1) \right|$$

Elemental area "C"



delimited by lines - independent of o_x
the following holds for the elemental area:
$x_1 \le x \le x_2 \quad f(x_i) \le y \le f(x_j)$, where

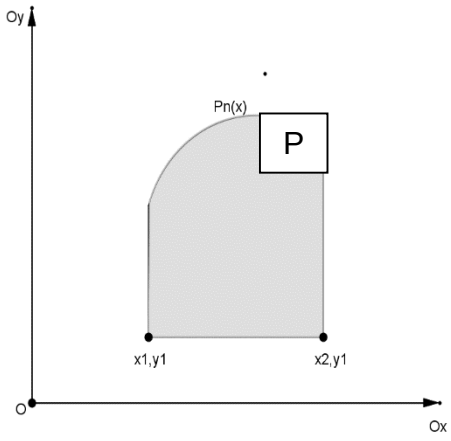
$$f(x_i) = \frac{y_2 - y_1}{x_2 - x_1} x + \frac{x_2 y_1 - x_1 y_2}{x_2 - x_1},$$

$$f(x_j) = \frac{y_4 - y_3}{x_2 - x_1} x + \frac{x_2 y_3 - x_1 y_4}{x_2 - x_1}.$$

- area size

$$P = \iint_Z dx\,dy = \int_{x_1}^{x_2} \int_{\frac{y_2 - y_1}{x_2 - x_1} x + \frac{x_2 y_1 - x_1 y_2}{x_2 - x_1}}^{\frac{y_4 - y_3}{x_2 - x_1} x + \frac{x_2 y_3 - x_1 y_4}{x_2 - x_1}} dy\,dx = \frac{(x_2 - x_1)(y_4 + y_3 - y_2 - y_1)}{2}$$

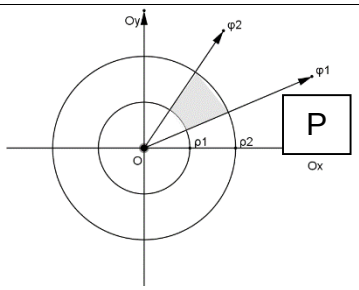
Elemental area "D"



delimited by a line parallel to the and the polynomial o_x
n-th power (e.g., second order polynomial)
- the following holds for the elemental area:
$x_1 \le x \le x_2 \quad y_1 \le y \le a_2 x^2 + a_1 x + a_0$
,- area size

$$P = \iint_Z dx\,dy = \int_{x_1}^{x_2} \int_{y_1}^{a_2 x^2 + a_1 x + a_0} dy\,dx = \frac{a_2}{3}\left(x_2^{\,3} - x_1^{\,3}\right) + \frac{a_1}{3}\left(x_2^{\,2} - x_1^{\,2}\right) + (a_0 - y_1)(x_2 - x$$

Elemental area "E"



delimited *by a circle or part of a circle.* For elements working in other than a rectangular coordinate system, transformation into polar coordinates may be applied: $\rho, \varphi, \left(0 \le \rho \le \infty, 0 \le \varphi \le 2\pi \right)$.
- the following holds for the elemental area:
$\rho_1 \le \rho \le \rho_2 \qquad \varphi_1 \le \varphi \le \varphi_2$

,- area size

$$P = \iint_Z \rho\,d\rho\,d\varphi = \int_{\varphi_1}^{\varphi_2} \int_{\rho_1}^{\rho_2} \rho\,d\rho\,d\varphi = \frac{\left(\rho_2^{\,2} - \rho_1^{\,2}\right)(\varphi_2 - \varphi_1)}{2}$$

To determine spatial characteristics of each type of the area built up by the production equipment, the following also holds (Tab.1):

Table 1 Mathematical description of the calculation of space requirements of the projected production equipment

Area type	Type of premises	Area size
Real space	type A - C	$P = P_A + P_C = \iint_{Z_A} dx\,dy + \iint_{Z_C} dx\,dy$
Theoretical space	type A - D - E	$P = P_{A1} + P_{A2} + P_{A3} + P_D + P_{E1} + P_{E2} + P_{E3} + P_{E4}$ $P = \iint_{Z_{A1}} dx\,dy + \iint_{Z_{A2}} dx\,dy + \iint_{Z_{A3}} dx\,dy + \iint_{Z_D} dx\,dy + + \iint_{Z_{E1}} \rho\,d\rho\,d\varphi + \iint_{Z_{E2}} \rho\,d\rho\,d\varphi + \iint_{Z_{E3}} \rho\,d\rho\,d\varphi + \iint_{Z_{E4}} \rho\,d\rho\,d\varphi$
Nonusable space	type A - D - E	$P = P_{A1} + P_{A2} + P_{A3} + P_{A4} + P_{A5} + P_D + P_{E1} + P_{E2} =$ $P = \iint_{Z_{A1}} dx\,dy + \iint_{Z_{A2}} dx\,dy + \iint_{Z_{A3}} dx\,dy + + \iint_{Z_{A4}} dx\,dy + \iint_{Z_{A5}} dx\,dy + + \iint_{Z_D} dx\,dy + + \iint_{Z_{E1}} \rho\,d\rho\,d\varphi + \iint_{Z_{E2}} \rho\,d\rho\,d\varphi$
Operator space	type A - B- D - E	$P = P_{A1} + P_{A2} + P_{A3} + P_{A4} + P_B + P_D + P_{E1} + P_{E2} =$ $P = \iint_{Z_{A1}} dx\,dy + \iint_{Z_{A2}} dx\,dy + \iint_{Z_{A3}} dx\,dy + + \iint_{Z_{A4}} dx\,dy + \iint_{Z_B} dx\,dy + + \iint_{Z_D} dx\,dy + + \iint_{Z_{E1}} \rho\,d\rho\,d\varphi + \iint_{Z_{E2}} \rho\,d\rho\,d\varphi$

PRODUCTION SYSTEMS LAYOUT

Designing activity output is processing of the technological layout of workstations and production systems in such a way that uniquely determines the constituents of production and their spatial arrangement. Basic tasks in solving the layout of production equipment include determining spatial relations between the means of production, the products and the human operator. It is necessary to determine which of these elements have a fixed place and how this place is determined. Based on the combination, the basic variants of the workspace arrangement are created:

- The means of production and the operator have a fixed place. This case is typical for most of the workstations in engineering production.
- All workplace elements are fixed. This is the case when all operations are performed on one machine. Examples of this arrangement are workstations with NC-machining centers and automatic machines.
- Only the production equipment has a fixed place (workstations with multi-tool operation).
- The production equipment and products have a fixed place (multi-tool operation of NC-machining centers and automatic machines).
- Only the worker has a fixed place (a unique case of machine carousels, where several machines are rotating on a rotating plate).
- Only the product has a fixed place (production of heavy, large-sized objects).
- The product and the operator(s) have a fixed place.
- All workplace elements are mobile.

Among the basic variants of the technological workplace layouts, variants 1 (single-operator operation) and variant 3 (multi-tool operation) are the most common in the machine-building industry. The spatial arrangement of production equipment at the workplace is influenced by several factors. The most important of these are:

- Minimal transport routes.
- Minimal storage and auxiliary areas.
- Convenient handling operations.
- Respecting the basic conditions of the structure (power lines, lighting, floor load capacity, etc.).

Commonly used arrangements are as follows: Arrangement in the line. This variant is advantageous in terms of simpler solution of the traffic roads and power distribution, and it is most often used in practice.
Arrangement into a polygon (circle): This way, the handling flow and the work area are reduced in direct continuity of the production on individual machines. The disadvantage is a more complicated solution for installation and access to the workplace during setup and maintenance.
Combination of linear and polygon layout: In this case, special methods are used for the solution. The essence of these methods is compiling the layout variants and optimal variant selection according to the selected criteria.
When designing dispositive production arrangement, it is necessary to keep certain minimal distances between individual production facilities and fixed elements of building constructions (e.g. columns, walls, etc.). The minimal distances depend in particular on:

- Type and function of manufacturing equipment,
- Dimensions of the materials being handled
- Mutual position of devices and the organization of handling,
- Energy and safety factors of devices.

Various special methods have been developed to solve deployment problems. The essence of these methods is compiling the layout variants and optimal variant selection according to the selected criteria. Raster network types as auxiliary graphical tools play a major role in designing manufacturing system layouts.

Especially in relation to design of production activity, it is advantageous to use industrial rasters. These are planar or spatial lattices formed by parallel perpendicularly intersected straight lines (raster lines), the mutual spacing of which is standardized. Industrial rasters make it possible to create direct dimensional relations between the given space and the elements of production system placed therein. Part of these can be single modules of industrial buildings standardized halls.

In addition to industrial raster with its perpendicularly intersected straight lines, other types of rasterization are also used in design. For example, a triangular raster. Basic or preselected dimensions of the space are the starting point for determining the industrial raster. They are based on the modules as basic units of a particular dimensional system. The dimension of raster, which is to be the basis for the reference space and, at the same time, for the design of the system, is a multiple or share of the M 100 mm module used in practice.

It is also advantageous to use the industrial raster for making a layout of an industrial area or an industrial complex (Fig. 25). It is the basic graphic tool to divide the given space (territory). It creates the prerequisite for an optimal assembly halls integration with the area available. [5]

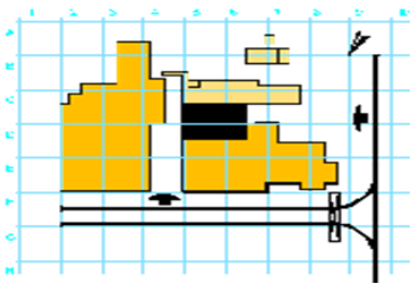


Figure 3 Gross raster of the production area [5]

In new designs, defining the position of the boundary lines, columns, etc. is hel pful in facilitating the arrangement of the means of production. According to the raster network, it is possible to distribute not only technical equipment but also its installation. To optimize the layout of the construction elements of the production system, the spatial relations between the technical and handling zones are particularly important.

Further characterized methodical procedure of layout creation is based on the use of models of standardized relations of building elements of the production sites and the systems structures. The procedure is as follows:

1. A raster network model is assigned to the reference space where the production system is to be situated and whose dimensions are calculated according to the capacity of the required areas, or the volumes, and by the means of production.
2. According to production (functional) activity that should be carried out in the reference space, the working zones, or sub-zones of the production process, are entered in the raster.
3. The individual zones are provided with the models of topological relations of construction elements of production system structure (production machinery, handling and auxiliary equipment, etc.).
4. The topological relations are resolved in a computationally interactive way based on the use of simplified 2-D models or 3-D models of the production system building elements.
5. Specific 2-D or 3-D models of the respective building elements are chosen from the graphic database and inserted into the calculated reference points of their location.
6. Based on the interactive decision-making procedures and visualization of the solution, the optimal variant of the structure of the production system is chosen. [5]

3 CONCLUSION

The size of workplaces, their shape and arrangement they are very diverse, it depends on the specific production process and from the nature of the performed activities. The workspace should be clear, comfortable and safe for the worker to feel in it all right. The workplace should be spacious and dimensional expediently arranged so that the worker ensured good working well-being with the possibility of optimal work performance at little physical effort. Working dimensions premises must be subject to the assumed production capacity, type of production, planned number of workers and also internal equipment operations. As a result of optimal spatial workplace solutions are more flexible and productivity of the entire system.

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REFERENCES

[1] Kovač J., Rudy V., Kováč J.: Methods for the design of production processes. Specifics of designing production systems. Edition of professional and scientific literature. TU UK Košice. 2017.326 p. ISBN 978-80-553-2874-4.
[2] Kováč, J., Rudy, V., Kováč, Juraj: Automation of production. Edition of scientific and professional literature. SjF TU in Košice. 2016. ISBN 978-80-553-2311-4
[3] Mareš, A .: Techniques for shortening the time of design of assembly processes and systems. Diz. work. SjF TU in Košice, 2006.
[4] Modrák, V .: Contribution to Designing Structural Changes in Manufacturing Processes. Hab. work, FTT TU in Košice, 2001
[5] Naqib Daneshjo, Vladimír Rudy, Katarína Repková Štofková Albert Mareš, Juraj Kováč, Andrej Jahnátek Jana Krivosudská, Norbert Šmajda, Ján

Rusnák.: Intelligent industrial engineering innovation potential. San Antonio : FedEx Print & Ship Center - 2018. - 297 s. [print]. - ISBN 978-0-578-40289-5.

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CONSUMER PURCHASING BEHAVIOUR AT THE ORGANIC FOOD MARKET

Matej Krejnus [1] – Katarína Repková Štofková [2] – Jana Štofková [3]

Abstract: *The main objective of the paper is to analyze the purchasing behavior of consumers in the organic food market. The first part focuses on the theoretical perspective, defines the concepts of consumer, customer, consumer behavior models, which are divided into traditional and modern, bio-products and bio-foods. Subsequently, the institutions or companies dealing with the certification of organic food on the Slovak market are identified. The organic food is labelled with the appropriate graphic design. In the article 3 organic labels that can be found on the products are shown. At the end of the theoretical part, factors influencing the purchase of organic food are identified, which include for example: health and safety, environmentally friendly, nutritional value, product price, product certification, availability of products. Subsequently, to complement the theoretical knowledge, the inquiry method was chosen. 328 respondents between the ages of 18 and 70 years participated in the electronic survey. The partial results showed, that the respondents obtained information about organic food via the internet. Some respondents do not have enough information about organic products. Besides, the respondents mainly appreciated the reduced price of organic products. The results of the research showed us that, the categorization of the data found that most of the people who buy organic food are employed women who live in the Žilina region, are between 26 and 40 years old, have a secondary or higher education and have an income of 500-900€.*

Keywords: consumer. consumer behavior. models of consumer behavior. customer. organic farming. conventional farming.

1 INTRODUCTION

Organic farming, organic products and organic food, we are beginning to encounter these terms much more often than in the past. There may be a number of reasons for this, such as increased attention to environmental protection, the increasing morbidity of both animals and the world population, the trend towards healthy lifestyles, or the ongoing situation with the COVID-19 pandemic, which has forced people to spend more time worrying about what they are consuming. A consumer is a natural person who, when concluding and performing a consumer contract, is not acting within the scope of his or her business, occupation or profession. Organic food and organic farming are among the hot topics, but most consumers in Slovakia still lack information that may cause low demand for these foods. It is for this reason that this article addresses this issue. A customer can be characterized as a person who buys goods or services and pays the price, but the final consumption may not be his priority. It is an individual or economic entity that purchases a product or service from a seller on a regular basis. Customers are mostly those who purchase goods for the purpose of adding value and resale (Surbhi, 2017)[1]. "A customer and a consumer can be identified if the person who buys the products or services also consumes them." (Vysekalova, 2004). [2]

MODELS OF CONSUMER BEHAVIOUR

Consumer behaviour models help to understand and retain the consumer base. There are six of these models and they are divided into two groups, traditional and modern models of consumer buying behavior [3].

Traditional behavioural models have been developed by economists in the hope of understanding what customers buy based on their wants and needs. These models focus on emotion-driven buying behaviour. These include [3].

Model of learning: This model is defined that buyer behavior responds to the desire to satisfy basic survival needs, such as food, and learned needs that result from lived experiences, such as fear or guilt.

The psychoanalytic model: The psychoanalytic model draws on the theories of Sigmund Freud and says that individual consumers have deep-seated motives, both conscious and unconscious, that lead them to make purchases.

Sociological model: The sociological model of consumer behavior suggests that purchases are influenced by an individual's place within various social groups, family, friends and work groups, as well as less defined groups such as consumers who engage in healthy lifestyles.

Modern models. Current models of consumer behaviour focus on rational and deliberate decision-making rather than emotions or unconscious desires. One of these models is:

Model Engel-Kollat-Blackwell (EKB) - The Engel-Kollat-Blackwell model of consumer behaviour outlines a five-stage decision-making process that consumers go through before purchasing a product or service. [3]

Black cabinet model- In this model, consumers are treated as individual thinkers who process internal and external stimuli in making purchase decisions. The stimuli come from the marketing mix, (product, price, distribution, communication), and others that influence consumer buying behaviour and enter the 'black box' where they are translated into a set of observable responses. (Kotler - Armstrong , 2004) [4,5]

Impulse Purchase Hawkins Stern - characterised as consumers who make unplanned purchasing decisions. (Stern, 1962)[6]

2.1 BIOPRODUCTS AND ORGANIC FOOD

Bioproducts come from organic farming and can be of plant or animal origin. Simply put, bioproducts are raw materials from which, by further processing, organic food, biodigesters and biobased products are produced. (TradeBIO)[7]

Organic food is produced only from organic products and using only authorised ingredients, additives and technological processes as laid down by the applicable laws. They shall be processed differently from conventional food. These foods are produced by farmers who place great emphasis on the use of renewable resources and the conservation of soil and water in order to improve the quality of the environment for future generations. It implies that organic food is produced without the use of most conventional pesticides, such as fertilisers made from synthetic ingredients. The products are non-ionising and contain fewer food additives than conventional foods. (Davis, 2020)[8]

Bioconsumer

An organic consumer is a person who buys organic food for their own use or to meet the needs of their loved ones. There are many different types of organic consumers, ranging from hard-core advocates to skeptical consumers. [9]

A 2009 study by the Hartman Group found that there are three key divisions of organic consumers (Chait, 2019). Table 1 shows the three main divisions of consumers of organic products.

Table 1. Three key divisions of organic consumers

Type	Definition
First	People who are starting to lean towards organic food but are not making any significant behavioural changes, which means they are not buying organic products;
Second	organic consumers who not only change their attitudes but also change their habits and buy organic products;
Third	the smallest group are the so-called 'key consumers' - this includes people who invest in organic food and buy it frequently.

In addition to these basic divisions, there are other types of organic consumers, such as parents and parents-to-be, who also often buy organic food. They are aware of the reasons why it is better and healthier to avoid toxic and persistent pesticides and fertilisers. They are trying to reduce the family's exposure to GMOs and growth hormones. [9]

2.2 BIOPRODUCTS AND ORGANIC FOOD

The production and sale of organic food in markets is subject to strict conditions. Before a product is labelled 'organic' or 'bio', a government-approved certification body inspects the place where the food is grown to make sure it meets organic standards.

The control in the organic farming system in Slovakia is according to the Act on Organic Agriculture and Production of Organic Food No. 224/1998 Coll. ÚKSÚP is responsible for the control of organic production in the organic sector under the Organic Production Code of the Organic Farming System of the Slovak Republic. Three inspection organisations carry out direct inspection of producers and processors registered in the EP system in Slovakia [10]:

Naturalis SK, s. r. o. - Inspection organization code: SK-BIO-002;

Biokont CZ, s. r. o. - Inspection organisation code: SK-BIO-003;

EKO-CONTROL, s. r. o. - Inspection organisation code: SK-BIO-004.

These institutions control compliance with all legal rules for the production, processing, packaging, storage, labelling and sale of organic produce, including the keeping of accurate documentation of all operations carried out and accounting. It follows that as long as the food or product is certified organic, we can trust it, because the assessment process for organic food is very strict. [10]

Labelling of organic food in the EU. Labelling of organic products or organic food can be done on the basis of a certificate issued by a certification body by means of the written abbreviation "bio" or "eco", a graphic symbol, the words "produced in organic farming" and the numerical code of the certification body. [11]

Table 2. The labels of organic products or organic foodstuffs are given in panel two

Type	Definition
Grafický znak	
CZ znak	
Eurolist	

Products of Slovak organic farming

Slovak organic agriculture produces organic cereals of all kinds, legumes, vegetables, fruits and also organic wine. Furthermore, medicinal plants and plants for cosmetic purposes are grown. Animal husbandry on organic farms is quite strongly represented. Most of the animals reared are ruminants (cattle, sheep and goats). However, Slovakia has large reserves in pig and poultry

farming, and consumer demand is high, especially for eggs, pork and organic poultry.[11]

Organic food can be purchased in Slovakia:

- on farms of organic farmers - relatively good prices;
- in health food retail outlets - wider range, slightly higher prices

prices, advice from staff;

- hypermarkets - limited range, uninformed staff;
- at markets, fairs, exhibitions - good prices, buying from producers;
- in clubs of friends of organic farming - exchange of experience, support for producers;
- e-shops - time saving, convenience, delivery fee.

The buying preferences of Slovaks have changed rapidly in recent years. Food is more affordable and physically accessible. Slovak consumers are increasingly buying mainly organic and healthy food. Demand for fruit and vegetables has also increased. Consumers want good quality food at good prices, they are also more interested in the origin of the food they buy. [12]

The 2muse survey found that women, in particular, pay more attention to what they buy in the store, reaching more often for healthy products, organic and gluten- and lactose-free foods. According to the survey, dairy products, fruit, vegetables, chicken and others are the most frequently purchased.[12] Consumers buy organic food for a variety of reasons (Figure 3). Many want to buy food products that do not contain chemical pesticides or are grown without conventional fertilizers. Some simply like to try new and different products.

Table 3. Factors influencing the purchase of organic food

Factors influencing consumers when buying organic products and organic food.	health and safety
	environmentally friendly
	nutritional value
	product price
	product certification
	availability of products

Organic food has various benefits that make it better for the planet, livestock and human health. However, there are also barriers to buying organic food.

Organic food has various benefits that make it better for the planet, livestock and human health. What consumers consume can also directly affect other people's health. Organic food contributes greatly to environmental protection because chemicals such as fungicides, herbicides and insecticides must not be used on organic food. They also save water and energy, reduce soil erosion and increase soil fertility.

The higher price of organic products is still a barrier for many consumers. According to consumer surveys in recent years, the willingness to consume organic food is still low compared to conventional food qualities, ranging between 10 and 20%. (Willer - Trávníček - Meier - Schlatter, 2021) [13]

Price is not the only barrier to buying organic food. There are many other purchasing barriers, which can be divided into three groups [14]:

- Information barrier - mainly refers to the lack of information about organic food;
- distrust - some consumers, despite the trademarks on the organic origin of the product and the associated controls, do not trust the labels 'organic' and 'eco' or do not see any difference between organic and conventional food;
- the problem of willingness - lack of breadth of range or consumer convenience and indecision can be considered as decisive factors associated with purchase reluctance.

3 DATA AND METEDOLOGY

The aim of the questionnaire was to determine consumer awareness of organic food, identify barriers and motives for buying organic food and identify consumer preferences when purchasing organic food.

identify the advantages and disadvantages that are perceived by the citizens of the Slovak Republic. The questionnaire was created in February 2021 and conducted a survey of 318 respondents agend from 18 to 70. To achieve the main objective, the following questions were identified:

- Where were you first introduced to organic food?
- Reasons why consumers buy organic food?
- Reasons why consumers do not buy organic food?

The information obtained from the respondents was categorized from 1 to 10. Where the unit represents the most useful advantage, respectively. disadvantage, and compare the results with the expected advantages and disadvantages set out in Table 1.

Other methods which were used in this article. method of analysis - the method was used in chapters 1. and 2. and represents the decomposition of the studied whole into smaller parts (basic parts, relationships and connections). Synthesis method - the method is the opposite of analysis, it combines and unifies the parts separated by the analysis into a certain whole. Inquiry method - this method was used for the electronic questionnaire.

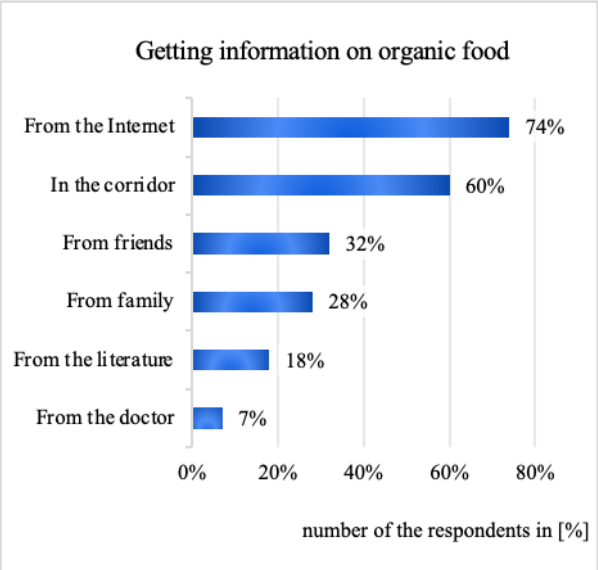
RESULTS AND DISCUSSION

The demographics section showed that the largest proportion, 73% of respondents were female and 27% were male. The respondents belonged to different

age groups. The age identification question showed that the largest number, up to 58% of the respondents were in the age group of 18-25 years. 25% of the respondents belonged to the category of 26-40 years. 15% were in the category of 41-60 years and only 2% were above 61 years.

The education of respondents was also varied. 11% of the respondents had only completed primary school. 7% of the respondents had completed secondary education without a high school diploma. The highest percentage of education completed was secondary education with a high school diploma, where 54% ranked. 28% of the respondents had completed higher education. The following questions related to the objectives set out in the methodology.

Figure 1. shows that 194 (74%) of the respondents obtained information about organic food



via the internet.

Figure 1. The main advantages of e-Government among respondents which are ranked.

Further, respondents found out about organic food in the store, 156 (60%) of the respondents indicated this answer. 28% of the respondents got the information from family and 32% from friends. 18% of the respondents indicated the answer "from literature" and 7% chose the option "from a doctor".

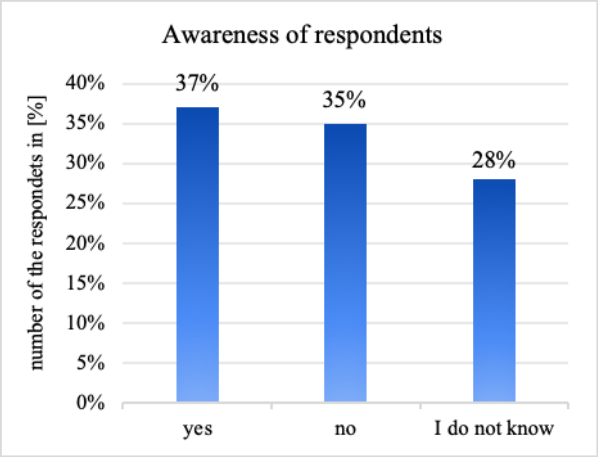
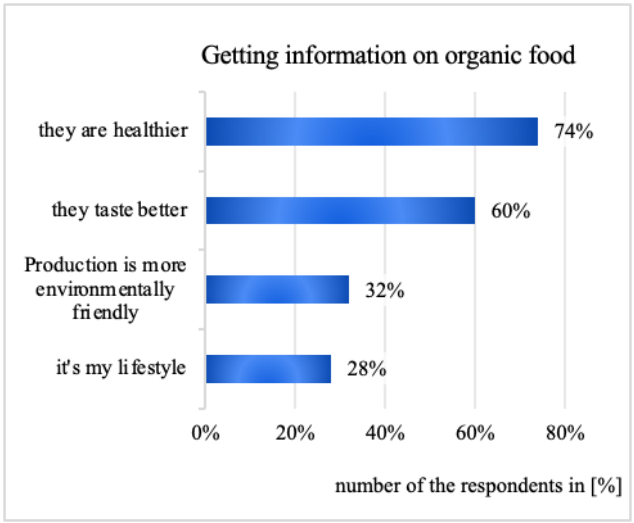


Figure 2. Awareness of respondents about organic foods

Of the 262 respondents, 37% thought they had sufficient information about organic food, 28% could not judge whether their information was sufficient and 35% thought they did not have sufficient information about organic food at all.

The following questions related to respondents who regularly buy organic food. The first question asked about the reasons why they invest their money in organic food. Multiple answers were possible in this question. Figure 3. shows that most respondents marked the answer that organic food is healthier, with 74% of respondents agreeing with this. 55 (40%) of the respondents indicated that organic food production is more environmentally friendly. Better taste was chosen



by 42% of respondents. Organic food is a lifestyle choice for 14% of respondents.

Figure 3. Getting information on organic food

Another question of interest was what would make respondents buy organic food. The most common answer was to reduce the price of these foods. Respondents had the option to mark multiple answers for this question.

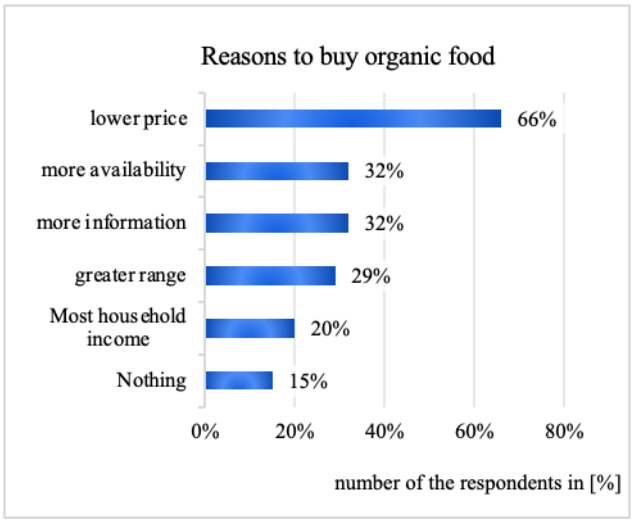


Figure 4. Reasons to buy organic food

A lower price of organic food would be perceived by 66% of respondents as a reason that would make them buy it. If the range of these foods offered was higher, 29% of respondents would buy them. Other

reasons were greater availability (32%), more information (32%) and higher household income (20%). 15% of respondents would not use anything to induce them to start buying organic food.

The second question, aimed at respondents who do not buy organic food, aimed to find out what would make them start buying organic food. Up to 66% responded that if the price was lower or the same as the price of conventional food, they would start buying organic food, the reason may be lower household income, these respondents might even want to invest in organic food, but they cannot afford it.

The categorization of the data found that most of the people who buy organic food are employed women who live in the Žilina region, are between 26 and 40 years old, have a secondary or higher education and have an income of 500-900€.

The most important thing for organic food in the future is to ensure that information about it is frequent, easily accessible and trustworthy. A suggestion could be to create advertising, e.g. through a banner or a video. Advertising would be placed on television and on various websites.

CONCLUSION

The most important reason why consumers should buy organic food is that it does not contain any chemicals that are harmful to animals, humans and nature. However, looking at the food industry from the other side, it is not possible for all consumers in Slovakia to consume only organic food. Current organic production and animal husbandry cannot 'feed' consumers in Slovakia, which is why various chemicals, fertilisers, antibiotics, hormones and others have been used. Therefore, another recommendation is to increase organic land and the number of organic farmers.

It should also briefly list the benefits, i.e. the reasons why citizens should buy organic food, for example that:

- they contribute to environmental protection;
- they save water, energy, reduce soil erosion and increase soil fertility;
- reduce the risk of nitrous oxide, a greenhouse gas, being released into the atmosphere;
- are chemical-free;
- do not use antibiotics or growth hormones;
- they are more nutritious and healthier;
- contain, on average, higher amounts of vitamin C and minerals;
- smell, taste and look better.

If there is enough organic food and organic products for every consumer in Slovakia, they will start to be sold and consumed more. Organic farming is beginning to develop more and more in Slovakia. This may be due to EU subsidies for organic food or the growing consumer demand for healthy, tasty and high-quality food.

Also, respondents do not buy organic food due to the fact that they raise and grow their own. The range of organic food is increasingly available on the Slovak market. If the demands of consumers on the organic food market could be met and the main barriers that discourage the purchase of these foods could be removed, it would not only be possible to protect the country and promote people's health, but also to improve the economic situation in Slovakia.

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REFERENCES

[1] Keydifferences. (2021). Difference between Customer and Consumer - Comparison Table Retrieved from:https://keydifferences.com/difference-between-customer-and-consumer.html [accessed: 22 April 2017].

[2] Vysekalová, J. (2004) *Psychologie spotrebitele*. Praha: Grade Publishing. ISBN 8025703939.

[3] Hubspot. 10 Consumer Behavior Models (& Which OneApplies to Your Business) Retrieved from:https://blog.hubspot.com/service/consumer-behavior-model [accessed: 10 December 2021].

[4] Kotler, P. and Keller, K. (2007) *Marketing managment.* Praha: Grada Publishing. ISBN 8024713595.

[5] Kotler, P. (2004) *Marketing.* Praha: Grada Publishing. ISBN 8024705131.

[6] Stern, H. (1962) The Significance of Impulse Buying Today. Journal of Marketing, SAGE Publications. 26, 59. Sage journal.

[7] Obchodbio. Čo je bio? Retrieved from: https://obchodbio.sk/content/9-co-je-bio [accessed: 19 Marce 2021].

[8] Organic Foods Guide: When To Buy (or Not Buy) Organic. Retrieved from: https://www.medicinenet.com/organic_foods_pictures_slideshow/article.htm. [accessed: 31 Jun 2020].

[9] Who Buys Organic Food: Different Types of Consumers Retrieved from: https://www.liveabout.com/who-buys-organic-food-different-types-of-consumers-2538042. [accessed: 11 November 2019].

[10] Sú skutočne bio? Retrieved from: https://www.unilabs.sk/clanky-invitro/su-skutocne-bio. [accessed: 8 January 2018].

[11] Označovanie bioproduktov a biopotravín | BIOpotraviny.biospotrebiteľ.sk Retrieved from: http://www.biospotrebitel.sk/biopotraviny-bioprodukty/oznacovanie-bioproduktov.htm. [accessed: 30 Jun 2013].

[12] U Slovákov už zaváži viac kvalita ako cena - Ľudia - Ekonomika – Pravda Retrieved from: https://ekonomika.pravda.sk/ludia/clanok/486895-u-slovakov-uz-zavazi-viac-kvalita-ako-cena/. [accessed: 6 Oktober 2018].

[13] Willer, H., Trávníček, J., Meier, C. and Schlatter, B. (2021) *The world oforganic agriculture.* Bonn: FiBL & IFOAM. ISBN 9783037363942.

[14] Biopotraviny: Postoje spotřebitelů a bariéry nákupu. Retrieved from: https://adoc.pub/biopotraviny-postoje-spotebitel-a-bariery-nakupu-organic-foo.html. [accessed: 16 may 2014].

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MODELOVÁNÍ PODNIKOVÝCH PROCESŮ

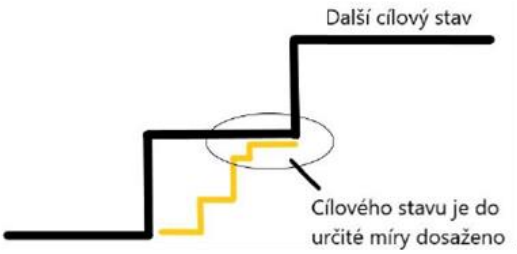
Tomáš Macháč - Michal Šimon

Abstract: *Příspěvek cílí na modelování podnikových procesů a jejich zlepšování. Konkrétně se na modelování procesů využívá metodika BPMN. Tvorba diagramů a jejich zlepšení probíhalo za spolupráce se společností LINTECH, spol. s r.o. která se zaměřuje na laserové technologie. Cílem bylo zmapování a vymodelování podnikových procesů na klíčových střediskách společnosti. Ve vypracovaných BPMN diagramech jsme identifikovali úzká místa a následně se provedly návrhy na zlepšení. Přínosem je zefektivnění procesů a zkrácení průběhu procesu tím, že návrhy přináší zpřehlednění a zjednodušení procesů.*

Keywords: Podnikové procesy, modelování podnikových procesů, zlepšování, BPMN diagram, identifikace úzkých míst, návrhy na zlepšení, lean, kaizen, improvement.

1 ÚVOD

Zlepšování podnikových procesů je nezbytnou součástí pro udržitelnost a konkurenceschopnost společnosti. Průběžné zlepšování procesů je neustálý proces, který se nezastavuje, viz Obrázek 1. Pokud se dosáhne požadovaného cíle, musí být snaha o další zlepšování, jinak může dojít k úpadku zlepšení. [1]



Obr. 1 Neustálý postup vpřed [2]

Řepa [1] popisuje podnikové procesy jako „souhrn činností, transformujících souhrn vstupů na souhrn výstupů pro jiné lidi nebo procesy, používajíce k tomu lidi a nástroje."

Vstup je počáteční stav, který spouští proces. Se vstupem se pojí i zdroj, který reprezentuje prostředky používané pro transformaci vstupu na výstup. Zdroj může být technologie, materiál, finance, informace nebo čas. [3]

Výstup představuje konec procesu. Výstup může být definována jako produkt či služba. Výsledek procesu musí přinášet hodnotu. [3]

Činnost vede k účelové přeměně vstupu na výstup v určitém čase a posloupnosti. [3]

Procesy lze popsat z mnoha hledisek, které napomáhají k rozdělení podle důležitosti a účelu. Základní procesy dělíme na: hlavní procesy, řídící procesy a podpůrné procesy. Též dává přehled o přidané hodnotě pro zákazníka. [4]

Procesy lze definovat jako hmotné procesy a informační procesy. Lukoszová [5] definuje materiálový tok jako „fyzický pohyb surovin, materiálů, náhradních dílů, rozpracované výroby, hotových výrobků v podniku, ale i mimo něj. V širším pojetí dochází k materiálovému toku u všech kategorií zásob, energií a dalších médií, nástrojů a dalších činitelů od výrobního procesu až po distribuci. Předmětem logistického řízení se pak přirozeně stávají takové prvky informačního toku, jako například zakázky, objednávky a dodávky všech výše uvedených částí hmotného toku."

Dle Tomka a Vávrové [6] představuje výrobní proces součástí hodnototvorného řetězce, který vytváří hmotné statky a služby pro splnění potřeb zákazníků.

Mládková [6] popisuje, že je tok informačních procesů spjat s technologickou a lidskou sítí. Jurová [8] ve své publikaci zmiňuje, že můžeme plýtvání nalézt i v administrativních procesech, a to z hlediska spotřeby materiálu, času i financí. Příkladem lze uvést tvorbu duplicitních informací v systému, chybná nebo chybějící data a informace. Lambert, Stock a Ellram [9] uvádí, že „kvalita a rychlost informačních toků, které se liší v závislosti na důmyslnosti systému objednávání a podnikového řídícího informačního systému, významně ovlivňují schopnost výrobce poskytovat rychlé a spolehlivé (tj. vyrovnané) doby cyklu objednávek, konsolidovat dopravu a dosáhnout co nejnižší hladiny zásob."

Nedílnou součástí informačního toku je komunikace. Většinou je ve firmě zavedený odborný jazyk, který může být pro nové osoby v administrativě obtížně pochopitelný. Proto je potřeba, aby se zaměstnanec ve společnosti s těmito procesy seznámil a porozuměl jim. [10]

Modelování procesů se užívá k registrování procesů, které probíhají ve společnosti. Současně je základním nástrojem procesního řízení a zároveň zefektivňuje podnikové procesy. K tomu jsou určeny tzv. procesní diagramy, které graficky vyjadřují provázanost jednotlivých procesů s textovou zprávou uvnitř buňky. Toto znázornění se vytváří z důvodu přehlednosti, jednoduchosti a úplnosti. [1]

Business Process Modeling Notation (BPMN) reprezentuje standard pro grafické znázornění podnikových procesů v podobě diagramu, které je doplněn o tzv. Business Process Modeling Language (BPML). Jedná se o jazyk pro modelování a popis procesů. BPML je určen pro určité aplikace, které grafickou notaci tohoto jazyka specifikují normou BPMN. Cílem grafické notace je jednoduché porozumění pro uživatele i účastníka procesu. Diagram znázorňuje aktivity a tok informací. [11]

2 PŘÍPADOVÁ STUDIE

Případová studie se zaměřuje na zpracování procesních diagramů společnosti LINTECH. V procesních diagramech se identifikují úzká místa a provedou návrhy na jejich zlepšení.

2.1 Zpracování procesních map

Společnost LINTECH byla založena roku 1993 se sídlem v Chrastavicích. Tehdy společnost LINTECH započala podnikání v oblasti výroby, instalace, opravy elektronických strojů a přístrojů, elektronických a telekomunikačních zařízení, zámečnictví, nástrojářství a obráběčství. V důsledku růstu společnosti se část výroby přesunula do přilehlého města Domažlice, kde se nyní nachází vedení společnosti a nejdůležitější střediska společnosti.

V průběhu doby se společnost LINTECH postupně zaměřila na vývoj a výrobu v oblasti laserové technologie a automatizace, též na stavbu jednoúčelových strojů a zakázkovou výrobu, zejména v oblasti průmyslového značení. Společnost začala rozšiřovat nabídku v oblasti výroby razidel, identifikačních a výrobních štítků, včetně výroby ovládacích panelů. S rozšiřujícím se automobilovým průmyslem se rozrostly služby o montáž elektrotechnických dílů pro automotive, např. ŠKODA AUTO a.s., Valeo Compressors s.r.o., Varroc, TRW.

Mapování procesu probíhalo na dvou ze tří středisek, a to na klíčových střediscích v Domažlicích. Jedním je středisko zakázkové výroby, které se zabývají zakázkovou výrobou v širokém spektru. V případě, že má zákazník specifické požadavky, středisko mu vyhoví. V určitém případě dochází i ke kooperaci s jinou společností, tak aby se uspokojil požadavek zákazníka, přestože společnosti s požadovanou technologií nedisponuje. Největší poptávkou je výroba razníků, gravírování a laserové značení dle požadavků zákazníka. Unikátností je různorodost zakázek, a to tak, že nejsou totožné. Středisko disponuje dvěma výrobními halami. Každá hala má svého mistra výroby, který přímo zodpovídá za zpracování zakázky a řízení výroby. Součástí střediska je administrativní část a expedice, v neposlední řadě menší sklad.

Druhé středisko se zaměřuje na výrobu jednoúčelových strojů s využitím laserové technologie. Středisko garantuje zákazníkovi výrobu jednoho stroje v horizontu 10-12 týdnů, tedy předání stroje od objednání. Zakázky se přidělují dvěma projektovým manažerům, kteří projekty přebírají od obchodního asistenta, manažer řídí a zodpovídá za úspěšné ukončení projektu. Na středisku dochází k mnohem většímu propojení jednotlivých skupin, kdy během zpracování společně spolupracuje oddělení montáže, konstrukce, programování s managementem. Součástí tohoto střediska je i menší mechanická dílna. Zde se vyrábí i velká část komponentů. Ostatní díly jsou vyráběny formou kooperace nebo jako prefabrikát.

Popis podnikových procesů byl uskutečněn formou rozhovorů se všemi zainteresovanými osobami. Na počátku proběhlo seznámí se skladbou jednotlivých středisek, hal a pracovišť. Komunikace o průběhu procesů se diskutovalo od vedoucích středisek a manažérů, až k samotným pracovníkům, kteří obsluhují stroje na hale. Na základě získaných informací a načerpaných postřehů z výroby i prostředí, se zpracovaly BPMN diagramy, kdy se zkonzultovaný postup ověřoval v reálném běhu. Tyto procesní diagramy následně slouží jako vstupní údaj pro identifikaci úzkých míst.

Hierarchie procesů – Výroba jednoúčelových strojů:

- Tvorba nabídky
- Tvorba projektu
- Tvorba modelu
- Zpracování zakázky
  - Správa zboží na skladě
  - Kooperace
- Ukončení projektu
- Servis

Hierarchie procesů – Zakázková výroba:

- Tvorba zakázky
- Výroba zakázky
  - Detail tech. proces nástrojárna
    - Externí kooperace
      - Interní kooperace
      - Proces naskladnění materiálu
  - Detai tech. proces laser
    - Externí kooperace
    - Interní kooperace
    - Proces naskladnění materiálu
- Expedice zakázky
- Reklamace zakázky

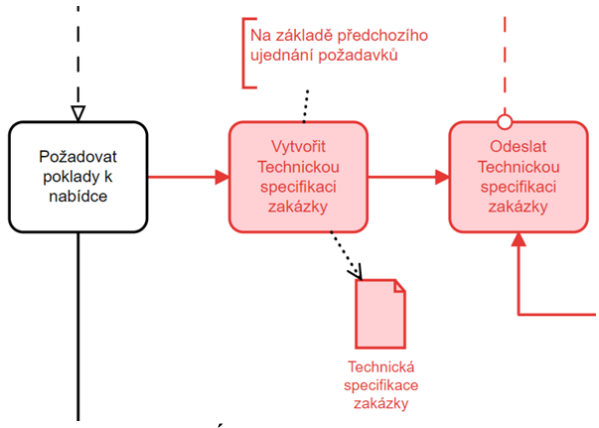
2.2 Identifikace úzkých míst

Na základě zpracovaných BPMN diagramů si identifikujeme úzká místa procesů. Cílem je tato místa eliminovat, logicky uspořádat či zlepšit. Výsledek je tyto procesní diagramy zjednodušit, zpřehlednit a zrychlit. V procesech můžeme nalézt činnosti, které celý proces prodlužují, vytváří složitější a nepřehledný. Tím, že tato místa identifikujeme, popíšeme a dokážeme, že má proces potenciál být jednodušší a přehlednější. Konkrétní činnosti si vyznačíme a popíšeme. Zároveň uvedeme, proč k daným situacím dochází. Z důvodu rozsahu práce si v příspěvku představíme ty nejzásadnější a blíže si je představíme.

a) Úzké místo střediska výroby jednoúčelových strojů

Podklad, který by měl předcházet nabídce, je technická specifikace zakázky. Jedná se o soupis jednotlivých technických náležitostí, které bude obsahovat budoucí zařízení. O jeho zpracování a vyřízení zodpovídá obchodní zástupce.

Často se stává, že je nabídka zpracovaná a odeslaná dříve, než se technická specifikace zakázky začne zpracovávat. Musí se dodělávat již v době, kdy je přijatá objednávka a došlo k zahájení projektu. Tyto údaje jsou nezbytné a v případě, že si určité náležitosti společnost se zadavatel neupřesnila, je nutné vyvolat další jednání, viz Obr. 2.

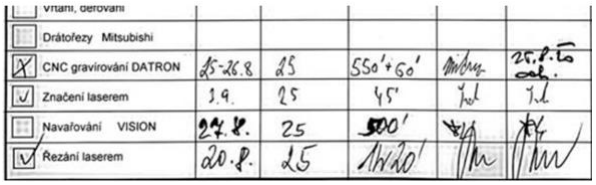


Obr. 2 Úzké místo nabídky [12]

Postřehy z mapování procesů ve společnosti:
- Při definování počátečního návrhu některé podniky požadují i nabídky;
- Přeposílání emailů na ostatní oddělení – zahlcování emailové pošty.

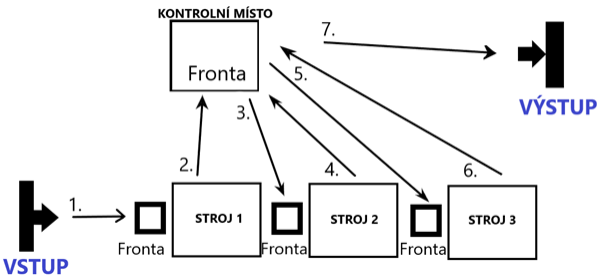
b) Úzké místo střediska zakázkové výroby

Průvodka, kterou obdrží mistr na poradě, má vyplněnou pouze hlavičku. Výrobní postupy jsou předvyplněné, viz Obr. 3. Toto způsobuje, že je průvodka nepřehledná a nelze z průvodky vyčíst, jaký je technologický postup. To, jaký je technologický postup, udržuje mistr zpaměti. Proto bylo zřízení stanoviště kontrolní místo. Zde se umístí výrobek z každého pracoviště po provedené operaci. Na kontrolním místě probíhá ověření správně provedené operace, nebo se stanoví další operace na základě přiložené dokumentace v podobě výkresů. V případě, že je výrobek v pořádku, umisťuje se do další fronty k příslušnému stroji. [3]



Obr. 3 Průvodka [12]

Pro příklad zde znázorňuji postup výroby zakázky, která obsahuje tři výrobní operace, viz Obr. 4.



Obr. 4 Příklad výroby zakázky [12]

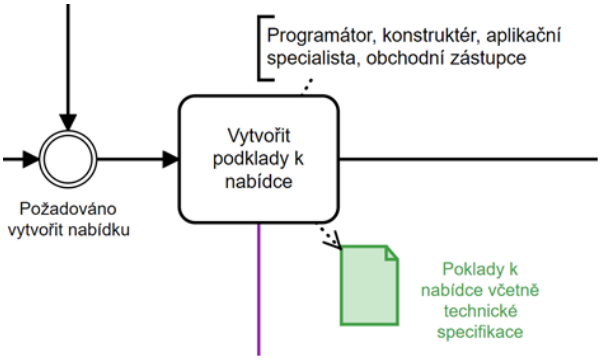
Aby mohla být zakázka zpracovaná musí projít minimálně dvojnásobkem front, oproti počtu výrobních operací.

2.3 Návrh na zlepšení

Zde si nastíníme návrhy na zlepšení, které vychází z identifikovaných úzkých míst. Návrhy nahrazují červenou část diagramu. Návrhy na zlepšení se odlišují zelenou barvou, tak abychom rozlišili, která část procesu je změněná, tedy nová.

a) Návrh pro středisko výroby jednoúčelových strojů

Při tvorbě nabídky se zpracovávají dva zásadní dokumenty. Technická specifikace zakázky a podklady pro nabídku. Následně je z podkladů vytvořená nabídka, která se odesílá zákazníkovi. V ideálním případě je Technická specifikace odeslána a schválená zákazníkem před odesláním nabídky. Ale nastává i situace, kdy je specifikace zařízení řešená až po odeslání nabídky a přijetí objednávky. V tomto případě, kdy se konstrukční oddělení má zabývat modelováním zařízení, se zaměřuje na procesy, které měly být již ukončené.
Návrhem je sjednocení dokumentů do jednoho dokumentu, který se odesílá zákazníkovi, a to do samostatné nabídky. Zajistí se tak, že je zákazník informován o všech náležitostech, viz Obr. 5.



Obr. 5 Sjednocení dokumentů [12]

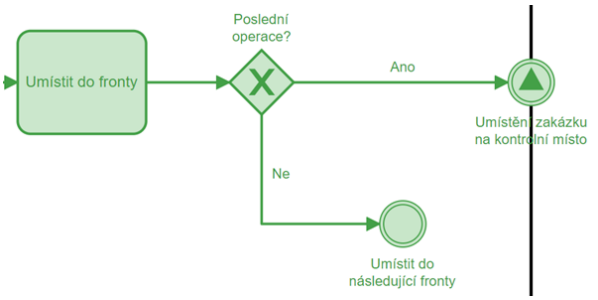
b) Návrh pro středisko zakázkové výroby

Zásadním úzkým místem výroby je velké množství front. Nejen, že výrobek musí procházet dvojnásobkem front, aby prošel výrobním postupem, ale není stanovený ani výrobní postup. Průvodka vstupuje do výroby prázdná. Mistr umisťuje průvodku do fronty dle přiloženého výkresu a znalosti výrobních operací, které jsou nezbytné pro vytvoření požadované zakázky.
V závěru celý technologický postup dané zakázky drží v hlavě. Při komunikaci s mistrem výroby v průměru denně projde výrobou 50–60 zakázek. Pro zpřehlednění si mistři zřídili kontrolní místo, kde umístí po vykonané operaci obsluha stroje výrobek. [3]

1. Návrhem je eliminace kontrolního místa a nahradit ho místem pro hotové výrobky, kde se budou shromažďovat zpracované výrobky, které jsou připravené pro kontrolu a odvoz na expedici.
2. Sníží se množství front, do kterých zakázka vstupuje, a je pevně daný technologický postup. Snížení front je v závislosti na potřebných technologických operacích, které jsou nezbytné pro zpracování zakázky.
V zakázkové výrobě nelze přímo určit o kolik se počet sníží, ale v závislosti na počtu těchto operací vždy o

polovinu. Za průběh výroby zodpovídá mistr, který je ve výrobní hale nejzkušenější.

3. Kontrolního místa se nahradí místem pro hotové výrobky. Obsluha stroje přenáší zakázku na další frontu dle technologického postupu průvodky, viz Obr. 6.



Obr. 6 Předávání zakázky dle technologického postupu [12]

3 ZÁVĚR

V závěrečném shrnutí si představíme nejzásadnější vyhodnocené návrhy procesů. Procesy jsou rozděleny na tři konkrétní kategorie, kterými přispívají ke zlepšení.

a) Redukce osob v procesu

Ve zhodnocení procesů musíme brát v úvahu, že se jedná o malou společnost a dochází ke kumulaci funkcí. Ve společnosti probíhá nízkosměnný provoz, současně je nízká fluktuace zaměstnanců. Nelze provést redukci zaměstnanců, a proto se zaměřit na jejich současné přetížení a příčiny přetížení eliminovat. Činnosti, které nejsou pro proces podstatné je nutné odstranit. Případně činnosti delegovat na jiné osoby, u kterých nedochází k přetížení.

b) Zrychlení procesu

Snahou návrhů je zrychlení procesů ve smyslu vyčištění činností, které nejsou potřebné a zpomalují tok procesu.

Návrh na zlepšení ze střediska zakázkové výroby:

Z výrobního procesu se odstraní kontrolní místo. Tím, že se odstraní kontrolní místo, se zrychluje výroba. Jelikož se zakázka přesouvá po výrobní operaci vždy na kontrolní místo, eliminujeme tím počet front na polovinu. V úvahu lze brát kontrolu před nejnákladnější technologickou operací.

c) Zpřehlednění procesu

Procesy nemají standardizovaný průběh a nelze stanovit jeho řízení. Proto je potřebné proces zpřehlednit a určit meze jeho průběhu.

Návrh na zlepšení ze střediska výroby jednoúčelových strojů:

Zpřehledňuje komunikaci aplikačního inženýra se zadavatelem. Zároveň eliminuje obchodního zástupce, který informace předával. Vstupním předpokladem návrhu je, že aplikační inženýr má k dispozici kontakt na zadavatele, konkrétně na předem stanovenou osobu pro technické řešení zakázky. Zvyšuje se zpřehlednění v procesu a reakční doba ze strany zadavatele.

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POUŽITÁ LITERATURA

[1] Řepa, V. (2007*). Podnikové procesy - procesní řízení a modelování - 2., aktualizované a rozšířené vydání.* Grada Publishing.
[2] Mike, R. (2017). *Toyota Kata: Systematickým vedením lidí k výjimečným výsledkům.* Grada Publishing.
[3] Svozilová, A. (2011). *Zlepšování podnikových procesů.* Grada Publishing.
[4] Grasseová, M., Dubec, R., & Horák, R. (2008). *Procesní řízení ve veřejném sektoru: teoretická východiska a praktické příklady.*
[5] Lukoszová, X. (2012). *Logistické technologie v dodavatelském řetězci.*
[6] Gustav, T., & Věra, V. (2014). *Integrované řízení výroby: Od operativního řízení výroby k dodavatelskému řetězci. Grada Publishing.*
[7] Mládková, L. (2005). *Moderní přístupy k managementu – tacitní znalost a ji řídit.* Nakladatelství C H Beck.
[8] Marie, J., & kolektiv. (2016). *Výrobní a logistické procesy v podnikání.* Grada Publishing.
[9] Lambert, D. M., Stock, J. R., & Ellram, L. M. (2005). *Logistika: příkladové studie, řízení zásob, přeprava a skladování, balení zboží.*
[10] Toman, M. (2016). *Zamrzlá produktivita: proč produktivita práce stagnuje a co se s tím dá dělat?*
[11] Jan, V., & Kolektiv, V. M. a. (2013). *Podnikové řízení. Grada Publishing.*
[12] Macháč, T. (2022). *Mapování a zlepšování procesů* [Západočeská univerzita v Plzni]. https://dspace5.zcu.cz/bitstream/11025/49325/1/DP_mapovani_a_zlepsovani_procesu_Machac.pdf. [citace: 16.10.2022]

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INOVAČNÉ VÝZVY A NÁSTROJE PRE UDRŽATEĽNÝ ROZVOJ TECHNOLÓGII

Milan Majerník [1] – Jana Chovancová [2]

Abstract: *The role and purpose of sustainable socio-economic development is to ensure a balance between its economic, social and environmental pillars. Technology plays a key role in addressing the sustainability of production through its innovation and green orientation. The paper systematises development challenges over time and according to the scope of societal interest and identifies development directions towards increasingly holistic thinking and a more sustainable orientation in innovation and in meeting the requirements of Smart Industry 4.0 and 5.0. The position and roles of progressive tools for greening production and environmentalising technologies such as Cleaner Production (CP), Environmental Accounting (EAc), Pollution Prevention (PP), Recycling (R), Life Cycle Analysis (LCA), Ecolabelling (EL) and Environmental Technologies Action Plan (ETAP) in the process of the transition to Smart Industry and sustainable development are specified and articulated. It also addresses the timing of innovation strategies by a backward decision-making system and the choice of innovation tool in meeting the objectives of Industry 4.0 and the development concept of Smart and Sustainable Industry Generation 5, based on the recognition that an economic viability of each technology is necessary in approximately in 20+ years.*

Keywords: sustainable development, product and technology, environmentalisation, innovation strategies, tools and methods, environmental engineering, green growth

1 ÚVOD

Fungovanie ekonomiky v globalizovanom prostredí je stále výraznejšie ovplyvňované technologickým pokrokom, intenzifikáciou technologických inovácii, efektívnosťou a zvyšovaním produktivity pri signifikantnom prepojení ekonomiky na environmentálne a sociálne aspekty podnikania.

Technické a produktové inovácie sú kľúčovým prvkom a nástrojom na dosiahnutie cieľov trvalo udržateľného spoločensko-hospodárskeho a neustáleho zlepšovania a komplexnosti kvality produkcie vo všetkých oblastiach ekonomických činností.

Technológie pre udržateľný rozvoj a na druhej strane environmentálne technológie neplnia tie isté funkcie. Zatiaľ čo environmentálne technológie vzhľadom k produkcii, obnove a servisu riešia prioritne problematiku minimalizácie, eliminácie a kompenzácie znečisťovania životného prostredia, udržateľné technológie sledujú aj širšie ciele v podobe neprekračovania ekologickej kapacity obnovy a konsolidácie zvýšenej nespravodlivosti pri napĺňaní ekonomických, sociálnych a environmentálnych cieľov rozvoja. Technológie pre udržateľný rozvoj využívané v súčasnosti sú charakterizované aj ako najlepšie dostupné technológie (BAT) z pohľadu technického prevedenia, ekonomickej dostupnosti a špičkovej environmentálnej kvality pre príslušné priemyselné odvetvia [5, 8].

Pri napĺňaní ambicióznych cieľov globálnych rozvojových stratégií trvalo udržateľného rozvoja a pri environmentalizácii technológií sa využíva široká škála preventívnych nástrojov a metodík. Tieto nástroje sú globálne koordinované, výskumom precizované a štandardizované ako normy ISO. Z technologického pohľadu sú dnes kľúčové metodické postupy implementácie stratégie inteligentného priemyslu 4. generácie a jeho intenzifikácie v rámci rozvoja konceptu Priemysel 5.0 pri ozeleňovaní hospodárstva.

2 CHARAKTERISTIKA UDRŽATEĽNÝCH TECHNOLÓGII

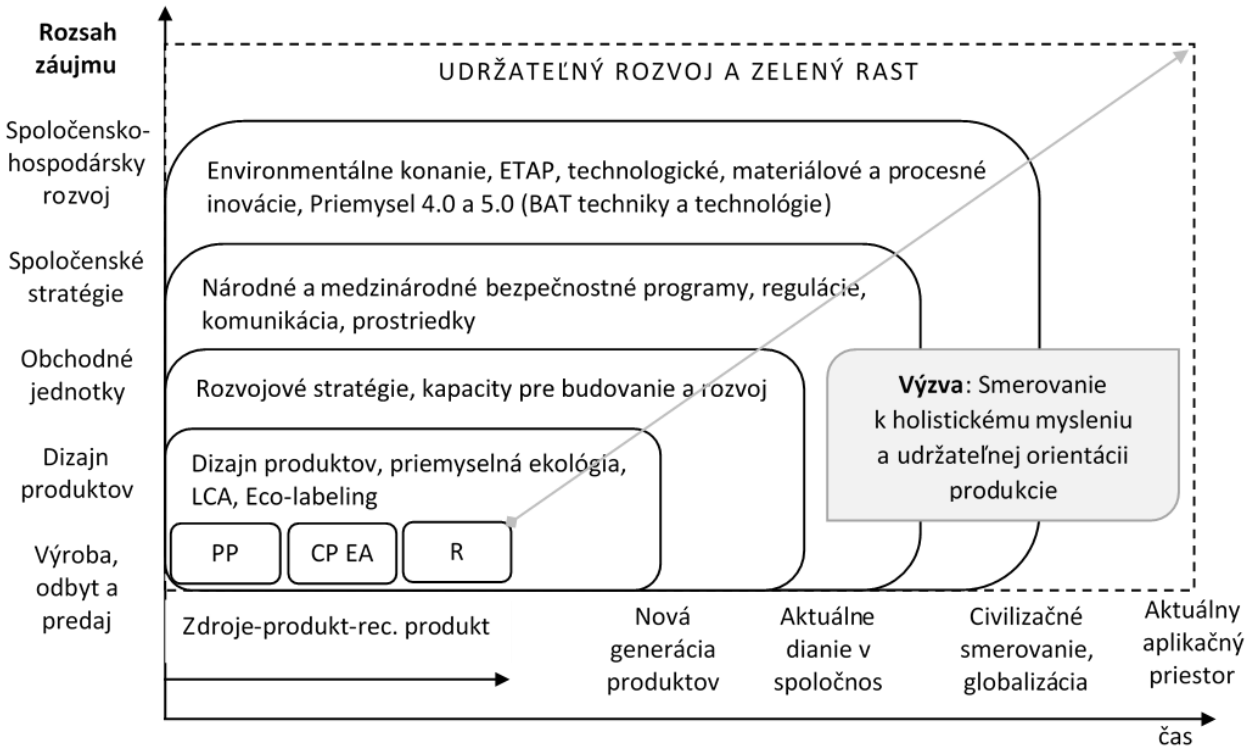
Technológie pre udržateľný rozvoj majú pri neustálom zlepšovaní produkcie širšiu pôsobnosť než len minimalizáciu znečisťovania životného prostredia a predchádzanie ekologickej deštrukcie. Udržateľné technológie sú prostriedkom napĺňania potrieb populácie takou cestou, aby neboli prekročené disponibilné kapacity planéty a vrámci toho kapacity lokálnych ekosystémov. Ich cieľom je posúvať svetové konanie v produkcii smerom k prírodným princípom a neprekračovaniu únosnej kapacity Zeme, v kontexte napĺňania globálnych potrieb ľudstva a štandardizovanými ekonomickými a sociálnymi indikátormi udržateľného spoločensko-hospodárskeho rozvoja.

V tabuľke 1 sú uvedené kľúčové aspekty a úlohy pri riešení udržateľného rozvoja technológií a pri ich inovácií. Koncept globalizácie inovácií je pojítkom medzi dvoma základnými javmi moderných ekonomík: zvýšenou medzinárodnou integráciou ekonomických aktivít a rastúcim významom znalostí v ekonomických procesoch [1].

Technologická inovačná schopnosť je v súčasnosti aj do budúcnosti považovaná za ultimatívnu podmienku zachovania konkurencieschopnosti a nasmerovania rozvojovej udržateľnosti podnikov a celého hospodárstva. V dynamicky sa meniacom podnikateľskom prostredí, ktorého hnacou silou sú stále náročnejšie požiadavky zákazníkov, rast ponuky a služieb a tým aj vyššia konkurencia na trhoch, technologický rozvoj a globalizácia podnikania, sú inovácie efektívnym prostriedkom zvládnutia zmien.

Tabuľka 1: Charakteristika udržateľných technológii

KĽÚČOVÉ ASPEKTY A ÚLOHY UDRŽATEĽNOSTI TECHNOLÓGII		
Napĺňanie rozvojových potrieb globalizovanej spoločnosti	**Globálne rozvojové myslenie a zodpovedné konanie**	**Hľadanie včasných termínov pre riešenie potenciálnych problémov**
- Analýza potrieb technológií a ich zabezpečovania udržateľnosti; **- Odhaľovanie špecifických a skrytých potrieb ich zákonnosti;** **- Identifikácia nových udržateľnejších ciest napĺňania;** **- Preferovanie a časovanie alternatív z pohľadu environmentálnych, sociálnych a etických aspektov.**	- Účinnejšie a udržateľné riešenia sú pred ďalší rozvoj nevyhnutné, - Environmentálne výkonnejšie technológie: zmierňujú negatívne účinky v rôznych oblastiach, majú dlhodobejší účinok a zatiaľ sú používane v malom rozsahu.	- Environmentálno-bezpečnostné aspekty prevádzkovania zastaralej technológie; - Absencia inovačného potenciálu vs. konkurencieschopnosť na trhoch; - Energetická efektívnosť a materiálová dostupnosť, integrované manažérstvo OH.
SYSTÉMOVOSŤ INOVÁCII V TECHNOLÓGIÁCH – ROZVOJOVÁ UDRŽATEĽNOSŤ		
Zmeny primárnej energetickej základne	**Výmena surovinovej a materiálovej základne**	**Eliminácia produktových emisií**
- Širšie využívanie obnoviteľných zdrojov energie; **- Vytváranie energetických mixov;** **- Využívanie medzinárodných štandardov pre manažovanie energetickej efektívnosti (ISO);** **- Vylúčenie fosílnych palív pri získaní energií;** **- Uplatňovanie vodíkových technológii a elektromobility.**	- Využívanie odpadov ako zdroja cenných surovín – obehové hospodárstvo; - Využívanie biologicky rozložiteľných obalov a materiálov; - Používanie recyklačne znášanlivých materiálov v konštrukciách; - Uprednostňovanie obnoviteľných zdrojov surovín; - Využívanie biotechnológii a nanotechnológii.	- Širšie využívanie environmentálne vhodných produktov a technológii (EVP a ETAP – podľa ISO); - Využívanie najlepších dostupných techník a technológii (BAT/BATT podľa BREFF); - Preventívne posúdenie vplyvov činností na životné prostredie (EIA/SEA/HIA); - Hodnotenie životného cyklu produktu LCA/LCI; - Uplatňovanie princípov obehového hospodárstva.



PP – prevencia znečistenia; CP – čistejšia produkcia; EA – environmentálne účtovníctvo; R - recyklácia

Obr. 1 Rozvojové výzvy pre inováciu technológii a udržateľnosť produkcie

K základným modelom inovačného potenciálu patrí technologická flexibilita a high-tech. Všeobecná významnosť úrovne technológie pre konkurencieschopnosť a rozvojovú udržateľnosť vyplýva z nasledujúcich faktov:

- technologický systém viaže podstatnú časť zdrojov podniku,
- technológia je dominantným faktorom určujúcim výkonnosť a efektívnosť (produktivitu a kvalitu),
- zmeny technológii v celosvetovom meradle sú založené na transfere technológie, high-tech a systémových prístupoch.

Na obr. 1 sú sumarizované inovačné výzvy a kľúčové nástroje pre udržateľný technologický rozvoj. Pri hľadaní a zabezpečovaní budúcich ziskov sa globalizovaná spoločnosť môže dnes orientovať na široké perspektívy v čase obsiahnuté v celosvetovo koordinovaných rozvojových stratégiách. Vo vzťahu k udržateľnosti rozvoja je prvoradou úlohou generálne zlepšovanie sa environmentálneho správania výrobných prevádzok a ekologizácia ich technológii.

Kľúčovými nástrojmi zlepšovania environmentálneho správania a ekologizácie technológii sú:

1. Čistá výroba a environmentálne účtovníctvo
2. Integrovaná prevencia a kontrola znečisťovania a recyklácia
3. Akékoľvek metódy pre komplexnú environmentálnu optimalizáciu produktov a ekologizáciu priemyslu
4. Metódy a nástroje, ktoré boli zahrnuté do obchodných stratégii
5. Národná bezpečnosť a jej dlhodobá perspektíva
6. Technicko-ekonomické rozvojové stratégie Industry 4.0 a 5.0.

3 METÓDA SPÄTNÉHO VÝBERU UDRŽATEĽNÝCH TECHNOLOGICKÝCH INOVÁCII

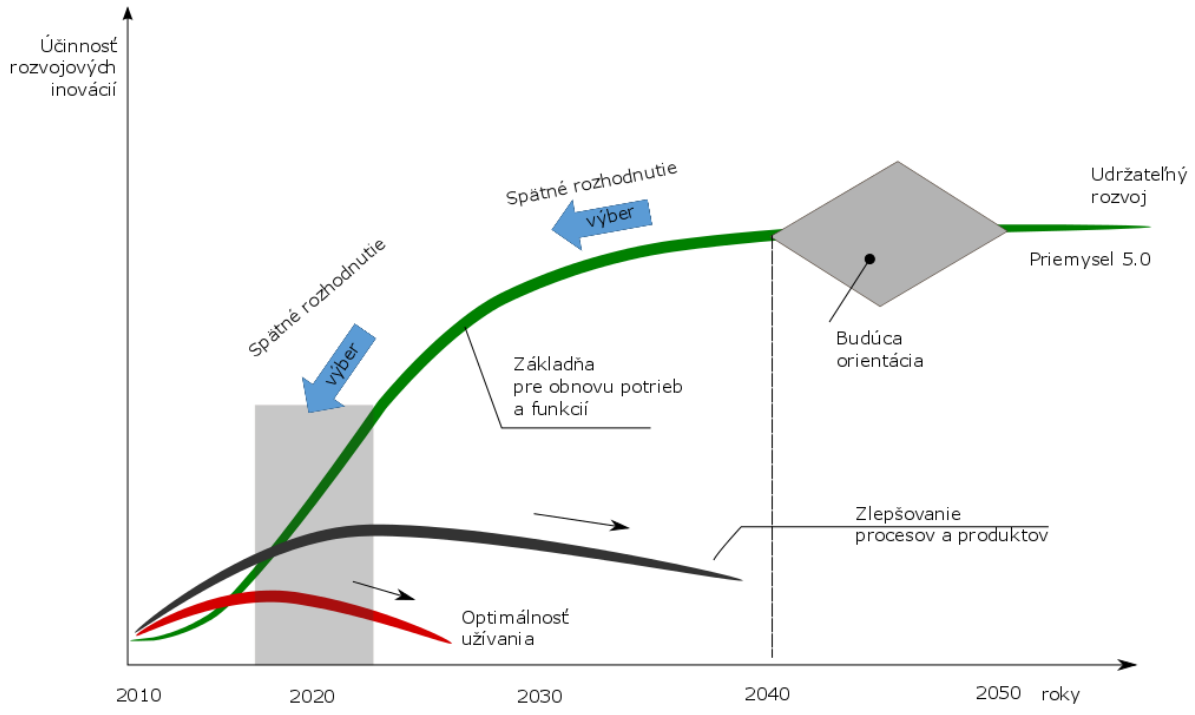
Optimalizácia súčasných technológii je vo väzbe na ich udržateľnosť veľmi dôležitá, ale potenciál pre ich zdokonaľovanie je často obmedzený.

Spätný výber inovácií (obr. 2) je metodologickým priblížením a určením udržateľných technologických inovácií a vychádza z analýzy v čase aktuálnych spoločensko-hospodárskych potrieb. Jej účelom je generovanie dlhodobých termínov optimalizácie a inovácie a získavanie konsenzu stakeholderov, čo sa týka obnovy a jej voliteľnosti.

Rozhodovanie a spätný výber inovácií (Tab. 2) spočíva v:

- Analýze a identifikácii spoločensko-hospodárskych potrieb;
- Identifikácií optimálneho času pre zlepšovanie technológií;
- Tvorbe všeobecných vízií pre stakeholderov do budúcnosti;
- Rozvoji konceptov postupových ciest, ktoré vedú k napĺňaniu vízií;

Rozvoji dosiahnutého konsenzu pre efektívnu cestu ďalšieho postupu k víziám budúcnosti.



Obr. 2 Spätné rozhodovanie o rozvojových inováciách – výber technológie

4 ZELENÝ TECHNOLOGICKÝ RAST PRE UDRŽATEĽNÝ ROZVOJ

Súčasťou UR je zelený spoločensko-hospodársky rast (ZR). Zelený rast sa zameriava na ekologizáciu výroby a spotreby [4, 6] prostredníctvom vynájdenia zelených technológií a využívania čistej energie. Technologické inovácie tak riešia emisie založené na výrobe aj na dopyte, a preto sa považujú za hlavnú hnaciu silu priemyselného vývoja [16].

Navrhovanie, vývoj a realizácia čistých technológií zvyšujú udržateľnosť [2].

Zelený rast a jeho rozsah je užšie zameraný cez operačný politický plán, na dosahovanie konkrétneho, merateľného pokroku na rozhraní medzi ekonomikou a environmentom. Kľúčová je pritom podpora nevyhnutných podmienok pre inovácie, investície a konkurencieschopnosť, ktoré by viedli ku vzniku nových zdrojov ekonomického rastu v súlade s pružnými ekosystémami. Stratégie a akčné plány ZR musia byť orientované aj na viaceré špeciálne sociálne aspekty a problémy rovnosti. Tie môžu vzniknúť ako priamy dôsledok uplatňovania ekologických princípov v ekonomike a to na štátnej aj medzinárodnej úrovni. Stratégie by sa preto mali implementovať súčasne s iniciatívami orientovanými na indikátory sociálneho piliera UR.

Svetoví činitelia čelia tradičným otázkam rozvoja (napr. ekonomická stagnácia, kríza, pretrvávajúca chudoba, hlad a choroba), ako ja novým výzvam (ako napr. globalizácia, klimatické zmeny, energetická kríza). Kľúčovým prístupom, ktorý sa v tejto oblasti objavil, je koncepcia trvalo udržateľného rozvoja, „rozvoj, ktorý trvá“ [10].

Tabuľka 2 Metóda spätného výberu technologickej inovácie

KĽÚČOVÉ ASPEKTY SPÄTNÉHO VÝBERU TECHNOLOGICKEJ INOVÁCIE			
Analýza potrieb a stotožnenie sa s ich voľbou	**Dobrovoľné stotožnenie sa so zlepšovaním a rozvojom technológie**	**Tvorba všeobecných vízií do budúcnosti**	**Overovanie rozvojových ciest k víziám spoločnosti v budúcnosti**
Základné ľudské potreby: **-jedlo** **-bývanie** **-čisté ovzdušie** **-bezpečnosť** **-obliekanie** **-voda** **-ľudská komunikácia** **-zdravie** **-sebaúcta** **-transport atď., ktoré v čase nezmiznú** **Na zadováženie potrieb sú vo všeobecnosti nevyhnutné prinajmenšom:** **-energie** **-materiály a technológie** **-priestor** **-výchova a vzdelávanie** **-atď.**	**Všeobecné princípy skokovej zmeny technológií zahŕňajú:** -voľbu špičkového systému (BATT) pre produkt aj proces -minimalizáciu a prevenciu tvorby od pádov (CP) -uzatvorenú slučku v životnom cykle (LCA), renováciu, recykláciu (R) -organizáciu produkcie a spotreby a zvyšovanie výkonnosti využívaním obnoviteľných energetických zdrojov -používanie málo materiálov s možnosťou zmeny ich dizajnu -minimalizácia poškodzovania ecosystému (PP) -zavádzanie pružných technologických inovácií, adaptibilných k rozvojovým cestám (TUR, Industry 4.0 a 5.0)	**Zrýchľujúci sa tg. pokrok:** -výskum biotechnológií napr. pri produkcii potravín, zneškodňovaní odpadov, výrobe liečiv, revitalizácii pôdy, GMO v poľnohospodárstve, potravinárstve, medicíne atď. -rozvoj nanotechnológií, tvorba nových látok s požadovanými vlastnosťami (napr. extrémna pevnosť, elektr. vodivosť a pod.) využívanými vo fyzike, chémii, biológii, pri výrobe materiálov a príprave liekov **Inovované technológie prispievajú:** -k zvyšovaniu kvality života -môžu predstavovať aj hrozby z hľadiska zdravia a environmentu -rapídny rast nových látok s neznámymi vplyvmi, znečisťovanie vody a pôdy farmaceutickými rezíduami a pod.	**Socio-technická mapa ako nástroj zahŕňa:** -stav v rozvoji a jeho technológiách -dynamiku rozvoja a jeho technológií -odlišné komplikácie stakeholderov počas týchto technológií -pohľad a záujmy stakeholderov pokiaľ ide o tieto technológie **Analýza scenárov:** -obecný nástroj pre tvorbu rozhodnutí – priemyselných stratégií udržateľného spoločensko-hospodárskeho rozvoja

Udržateľnosť možno interpretovať a pristupovať k nej rôznymi spôsobmi. Tento pojem môže ostať buď otvorený, aby sa ním dalo zaoberať v rámci procesu, alebo viac uzavretý a vopred definovaný. Jedným z prvých príkladov je "riadenie prechodu", ktoré do veľkej miery ponecháva otvorený priestor na to, aby si účastníci vytvorili chápanie udržateľnosti v každom konkrétnom prostredí. "Planetárne hranice" sú jedným z príkladov druhej možnosti, ktorá rámcuje udržateľnosť vo forme "hraničných podmienok", ktoré fungujú ako

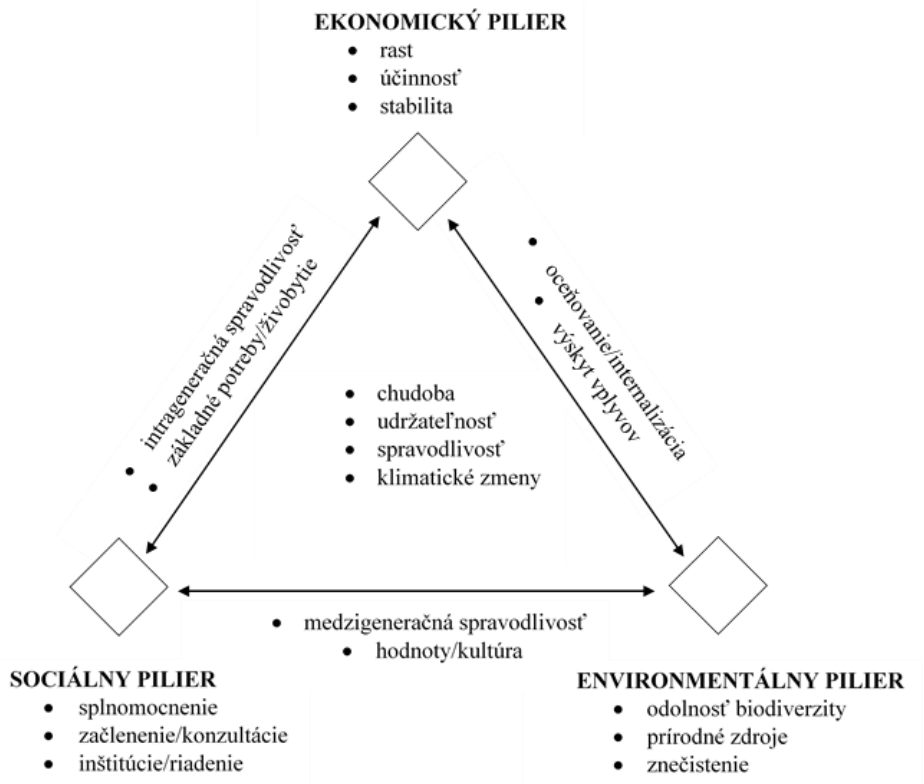
biofyzikálne limity, ktoré sa nesmú prekročiť [12]. Udržateľný rozvoj je proces zlepšovania možnosti, ktoré umožnia jednotlivým ľudom a spoločenstvám dosiahnuť ich ambície a plný potenciál počas dlhého časového obdobia, pri zachovaní ekonomických, sociálnych a environmentálnych systémov.

Na základe tohto prístupu vznikol cielenejší a praktickejší prístup k udržateľnému rozvoju ako pokračujúce zlepšovanie súčasnej kvality života na nižšej úrovni intenzity využívania zdrojov, čím sa zanechá pre budúce generácie nezanedbateľný rast výrobných aktív (t. j. výrobného, prírodného a sociálneho kapitálu), ktoré sa využijú na zlepšenie kvality života.

Základný rámec udržateľnosti spočíva na nasledovných princípoch a metódach:

a) zvyšovanie udržateľnosti rozvoja krok za krokom (making development more sustainable) (MDMS),
b) trojuholník trvalo udržateľného rozvoja a vyvážené zaobchádzanie s troma piliermi (Ek-Soc-En),
c) prekročenie konvenčných hraníc pre lepšiu integráciu,
d) úplné uplatňovanie praktických analytických nástrojov a metód od zberu údajov po politiku, implementáciu a operačnú spätnú väzbu-inštitucionálny pilier.

Súčasné myslene o koncepte sa vyvinulo tak, aby zahŕňalo tri hlavné hľadiská: ekonomické, sociálne a environmentálne, čo predstavuje tzv. trojuholník trvalo udržateľného rozvoja obr. 3. Tieto tri dimenzie udržateľnho rozvoja vychádzajú z Brundtlandovej definície a sú všeobecne používané a medzinárodné uznávané. Každé z hľadísk zodpovedá doméne (a systému), ktorý má svoje vlastné odlišné hnacie sily a ciele. Ekonomika je orientovaná hlavne na zlepšenie ľudského blahobytu, predovšetkým prostredníctvom zvýšenia spotreby tovarov a služieb. Environmentálna oblasť sa zameriava na ochranu integrity a odolnosti ekologických systémov. Sociálna oblasť zdôrazňuje obohatenie ľudských vzťahov a dosiahnutie individuálnych a skupinových ambícií.



Obrázok 3 Trojuholník trvalo udržateľného rozvoja – kľúčové prvky a prepojenia

Udržateľnosť je praktický, transdisciplinárny rámec, ktorý sa snaží vytvoriť zastrešujúci „holistický“ model pre analýzu a politické usmernenia, zatiaľ čo zložky (princípy, metódy a nástroje z mnohých iných disciplín) sú prísne „redukcionistické“ stavebné kamene a základy [7].

V Agende 2030 OSN pre udržateľný rozvoj sa uvádza, že "sú naliehavo potrebné odvážne a transformačné kroky ... na to, aby sa svet posunul na udržateľnú a odolnú cestu" [15].

Diskusie o transformačných zmenách na dosiahnutie udržateľnosti sú v centre pozornosti výskumu transformácie smerom k udržateľnosti [9]. V tomto prípade sa takáto zmena chápe ako "systémové inovácie" alebo "prechody", ktoré zahŕňajú zásadné procesy zmien na úrovni systémov v spoločnosti, kde sa postupne odstraňujú neudržateľné systémy a vznikajú udržateľnejšie konfigurácie. Prechody sa považujú za dlhodobé, otvorené, koevolučné, multifaktorové procesy, ktoré sú vo svojej podstate zložité, neisté a nejednoznačné [3, 9].

V kontexte riadenia transformačných prechodov zohrávajú dôležitú úlohu vízie udržateľnej budúcnosti a schopnosť vytvoriť transformačný impulz želaného

smeru je základným prvkom vedenia prechodu k udržateľnosti.

ZÁVER

Strategické rozhodnutie tak na úrovni globálnej ako aj regionálnej vo sfére spoločensko-hospodárskej politiky a jej rozvoja musia vždy zohľadňovať dlhší časový hroizont. Modely ekonomického rastu, konceptu udržateľnosti a technologické, materiálové, environmentálne a energetické inovácie úzko súvisia a stavajú na sebe navzájom. Vzniká tým závislosť ich vývoja a vzájomná technologická, environmentálna a inštitucionálna odkázanosť.

Environmentálne vplyvy spotreby a produkcie, technológií a činností sú tiež kumulatívne a niekedy už aj nezvratné. Vzniká tým silné prepojenie medzi dnešnými strategickými rozhodnutiami a budúcimi ekonomickými príležitosťami a úrovňou kvality života spoločnosti.

Veda o problémoch a výzvach súvisiacich s udržateľnosťou musí navrhnúť spôsoby, ako čerpať z konvenčnej vedy, pričom sa zohľadní zložitosť týchto výziev a, čo je rozhodujúce, zachová sa zameranie na inovácie, opatrenia a realizáciu.

POĎAKOVANIE

Príspevok vznikol ako súčasť riešenia projektov KEGA 030EU-4/2022 Integrované manažérstvo environmentálnej kvality v sieti dodávateľov automobilovej výroby, VEGA 1/0121/20 Výskum systémov transferového oceňovania ako nástroja merania výkonnosti národných a nadnárodných spoločností v kontexte earnings managementu v podmienkach Slovenskej republiky a krajín V4 a VEGA 1/0508/21 Hodnotenie energetickej udržateľnosti krajín Európskej únie vo väzbe na ciele Agendy 2030 pre udržateľný rozvoj.

BIBLIOGRAFIA

[1] Archibugi, D., & Iammarino, S. (2002). The globalization of technological innovation: definition and evidence. Review of International Political Economy, 9(1), 98-122.

[2] Bhupendra, K. V., & Sangle, S. (2015). What drives successful implementation of pollution prevention and cleaner technology strategy? The role of innovative capability. Journal of environmental management, 155, 184-192.

[3] Feola, G. Societal transformation in response to global environmental change: A review of emerging concepts. Ambio 2015, 44, 376–390.

[4] Gotschol, A., De Giovanni, P., & Vinzi, V. E. (2014). Is environmental management an economically sustainable business?. Journal of environmental management, 144, 73-82.

[5] Chovancová, J. (2020). Systémy environmentálneho manažérstva, Prešov, Fakulta manažmentu.

[6] Luukkanen, J., Kaivo-Oja, J., Vähäkari, N., O'Mahony, T., Korkeakoski, M., Panula-Ontto, J., & Hogarth, N. (2019). Green economic development in Lao PDR: A sustainability window analysis of Green Growth Productivity and the Efficiency Gap. Journal of cleaner production, 211, 818-829.

[7] Majerník, M., Drabik, P. (2020). Udržateľný rozvoj a environment. Petit s.r.o.

[8] Majerník, M., Chovancová, J., Hodolič, J. (2009). Environmentálne manažérske systémy. Stredoeurópska vysoká škola v Skalici.

[9] Markard, J.; Raven, R.; Truffer, B. Sustainability transitions: An emerging field of research and its prospects. Res. Policy 2012, 41, 955–967.

[10] Mulder, K. (2006). Sustainable development for engineers. A handbook and resource guide. Greenleaf Publishing

[11] Munasinghe, M. (2009). Sustainable development in practice. Cambridge university press.

[12] Rockström, J.; Steffen, W.; Noone, K.; Persson, A.; Chapin, F.S.; Lambin, E.F.; Lenton, T.F.; Scheffer, M.; Folke, C.; Schellnhuber, H.L.; et al. A safe operating space for humanity. Nature 2009, 461, 472–475.

[13] STN ISO 14045 (Majerník, M., Boďová, E.): Environmentálne manažérstvo. Posudzovanie environmentálnej výkonnosti systémov produktu. Princípy, požiadavky a pokyny.

[14] STN ISO 14051 (Majerník, M., Boďová, E.): Environmentálne manažérstvo. Účtovanie nákladov materiálového toku.

[15] United Nations. Transforming Our World: The 2030 Agenda for Sustainable Development; United Nations: New York, NY, USA, 2015.

[16] Yao, M., Di, H., Zheng, X., & Xu, X. (2018). Impact of payment technology innovations on the traditional financial industry: A focus on China. Technological Forecasting and Social Change, 135, 199-207.

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IMPACT OF STANDARDIZATION ON PRODUCTION PROCESSES DESIGN

Peter Malega [1] – Juraj Kováč [2] – Vladimír Rudy [3]

Abstract: *Standardization is a poorly understood discipline in practice. While there are excellent studies of standardization as an economic phenomenon, or as technical a phenomenon, or as a policy initiative, most of these are ex post facto and written from a dispassionate academic view. They are of little help to practitioners who actually are using and creating standards. The arena in which standardization is played out is reasonably large. Nearly every industry is affected by standards, some more so than others.*

Keywords: standardization, normalization, production process, design

1 INTRODUCTION

Standardization is a systematic, dynamic process of selection, unification and effective stabilization of individual variant solutions, processes, input elements and their combinations, output elements and their combinations, activities and information in process management of enterprises or sections thereof. The goal is to reduce diversity, chances in controlled processes. An important goal is also to ensure clarity of interpretation of decisions, approaches and elements adopted. [1, 2]

Effective creation and dynamic customization of standardization ensure greater stability, clarity, uniqueness and efficiency of the production process.

The result of the selection, i.e. the standardization process itself, is a norm or standard. The standardization process therefore can be understood as an activity leading to creation of standards. The results of the standardization activity are quantitative and qualitative definition and a clear formulation of the conclusions. [3, 4]

This activity may relate to the production factors, parts, product components, activities, combinations of factors and activities in the processes that use them, custom methods of production process management, etc. Standards or norms are then binding procedures, organizational standards, tools that express a unified, relatively stable process over time, which is binding for creating rules focusing on the arrangement of selected activity. It brings positive benefits to all involved, especially by achieving general economy of production, considering functional requirements and requirements of work safety. The results of science, technology, and practical applications are applied. [5]

2 PRINCIPLES OF STANDARDIZATION

Object of standardization activity in engineering production can be all elements of complex structure of objects and processes of engineering production.

The added value of standardization activity depends on the principles by which the individual standards are done. [6, 7]

Standardization is understood as a consistent, dynamic process focused on selection, consolidation and effective stabilization of variant solutions, procedures, input and output elements and their combinations, activities and information in management process of enterprises or the parts thereof. There are several positive benefits of standardization:

- In organizing production, technical, economic and commercial, personnel and other activities.
- In the unification of information and in unequivocal verbal capacity thereof.
- In intensifying production and increasing the level of its specialization.
- In more efficient use of resources.
- In higher economic efficiency of enterprises and especially production processes.
- In higher security and reliability of implemented processes, and so on.

Common principles are: complexity, progressivity, purposefulness, maximum resource economy, work safety priority, active feedback, optimal quality, optimal number of species, uniqueness (Tab. 1). [8, 9]

Table 1. Basic principles of standardization

Principle	Description
Principle of complexity	This principle requires detailed and versatile analysis of possible links of the established standards or methods of their creation with the recognition of standards existing in other areas. Standardization of, for example, technological processes must harmonize with the results of standardization of tools, parameters of production machines, materials and so on. The second aspect is the complexity requirement in the vertical direction, that is, at different levels of the company hierarchy. The third aspect is the requirement for complexity of standardization of machine or technological systems that create a collaborative complex of machines at the customer. This aspect comes to the forefront mainly when

	composing multi-element production systems by designing machines from modular elements, knots and aggregates.
Principle of progressivity	Requirement of one-way acting of standards to qualitative parameters of standardization subjects. Adopted standard should not be a brake on progress in development. The role of the standard is to set an unrestrained lower limit of qualitative parameters, whether physical, functional or economic, and at the same time for specific conditions, to establish a guideline on how to achieve this limit reliably. The second aspect of the principle of progressivity is that as a standard is adopted at the stage of development that one of the possible methods and methods of production, which is the most progressive one and the best results are supposed to be achieved by. The role of the standard is to direct other identical or similar production processes, structures, and so on.
Principle of purposefulness	There is a need for a close link between the creation and innovation of standards with the use of standards in practice. Requirements of practice are determining factor, in particular the general economy and work safety. Standardization activity is not allowed to become self-serving.
Principle of maximum resource efficiency	Maximum resource efficiency is the central principle of any standardization activity. For methodological reasons, it is expedient to divide this principle into secondary levels. The set of resources consists mainly of raw materials, semi-finished products, existing production and non-production machines, tools, preparations, labor forces, energy sources, etc. An important group consists of intangible resources such as the potential of science and technology as a productive force.
Principle of work safety	Work safety is superior to the questions of economy of work. This principle is also reflected in the field of standardization. Work safety must be understood throughout the range of issues explored by scientific methods, many of which are currently only developing.
Principle of active feedback	This principle is a dynamizing factor in standardization activity. It emphasizes the necessity of active influence of feedback both internal inside standardization systems and external, linking the standardization system with its surroundings, i.e. with the production process. Execution of these links requires that the effect of each standardization on the dynamics of the development of the standardization object be examined. Thus the added value of standardization is that it can instigate formation of new qualities based on which further innovation of content or form of standards shall take place.
Principle of optimal quality	The production quality management theory presents methods of determining optimal production quality depending on the development of market requirements and the method of production. These rules have to be respected in standardization activity. Likewise, known rules of choice to achieve optimal reliability, durability and product life have to be respected.
Principle of optimal number of types	Reducing the number of shape and dimensional modifications of a product of a given type initially reduces the consumption of labor to produce one functional unit. Further reduction beyond the optimal number of variants may worsen the general economy, especially on the user side, by raising the total volume of dead values for over-dimensioning of spare-parts, nodes and machines.
Principle of unambiguity	Standardization is required to create clearly interpretable standards that clearly define a standardized product under particular conditions. Depending on the nature of processes in engineering, this uniqueness can be understood in a stochastic or interval sense. However, more contradictory interpretations cannot be accepted.

Standardization activity is ensured by [10, 11]:

- The arrangement (systemization) − the state of chaos and disorder is changed into the state of organization.
- Unification − leads to unified interpretation of terms, names, symbols.
- Interchangeability − creates prerequisites for the exchange of one component for another one, one aggregate for another one, etc..
- Optimal quality and product differentiation− maintain the optimum of these values by both, manufacturers as well as consumers.
- Production guidelines −□direct production in the direction of the most progressive methods and structures.
- Production economization − increases the proportion of higher production types,

increases seriality and reduces demands on equipment of the machines.

3 NORMALIZATION ACTIVITIES

Normalization activities are developed by several related methods (Tab. 2). [9, 12]

Table 2. Normalization activities

Activity	Description
Simplification (reduction)	Method of technical standardization based on reduction in the number of types or other different features of products to technically and economically necessary number in terms of meeting the needs of the users. Any differences among the products (technological operations) that are not necessary, are excluded. The reduced number of product elements within a given range is a number that suffices to cover the need.
Type definition	With the methods of scientific procedures and the participating specialists, the number of existing or possible type variants, sizes and shapes is reduced to the optimal number. Type definition aims to stabilize a certain area of performance, dimensions, and other product parameters at the most appropriate quantitative intervals. It leads to the stabilization of the series by type on machines and equipment (e.g. machine tools and forming machines), electrotechnical products and so on.
Unification	In general, it leads to unification, interconnecting or linking the existing and possible variants into one. There exists a boundary case of unification, in which the merging of several variants creates one equivalent. This is especially true for the shape of components and processes that make up the elements of more complex systems. Unified products are interchangeable in their use. The application of unification leads to the unification of diverse product solutions, technological processes, working, testing and control methods, management procedures. The quantitative and qualitative parameters of unified objects are also unified.
Aggregation	It is based on the geometric and functional interchangeability of different aggregates and nodes, each of which can be used to build multiple machine modifications. (basis of modularity of machines and systems).

Standardization activities, developed at different stages of scientific and technological development, have led to standardization systems, characterized by the target focus. Standardization systems are of a special nature, corresponding to two different standardization eras [13]:

- The system based on simplification, standardization and specialization represents the first generation of standardization development. It is the product of the industrial revolution era in developed countries. The system displays the time sequence of each standardization process. The first stage was the process of simplification, of simple limitation of types and of the range of materials, semi-products and products, auxiliary and other materials. The next stage of standardization in the strict sense is its central role in the system. Number of variants reduced by simplification enabled development of various methods of standardization, in particular type specification and unification, namely in the area of design and technology.
- System based on standardization, specialization and automation. The system represents the II. generation of standardization development. The automation stage is a crucial stage of development. The system is characterized by its dynamism. It enables development of processes of production and research specialization, to specify the bases for the development of automation of production.

4 LINKS OF STANDARDIZATION

The success of standardization is mainly due to its comprehensive solution. Uniform areas of standardization are only relatively isolated activities because the production process creates the necessary context between them. For methodological and personnel safety, the following stages are generally required of enterprises [14]:

- Standardization of the management process.
- Standardization of input elements of the production process.
- Standardization of activities in the production process.
- Standardization of the consumption and the use of production factors.
- Standardization of combinations in the operational management of production.
- Standardization of outputs elements of the production process.

The relations between the basic methods of standardization are shown in Fig. 1.

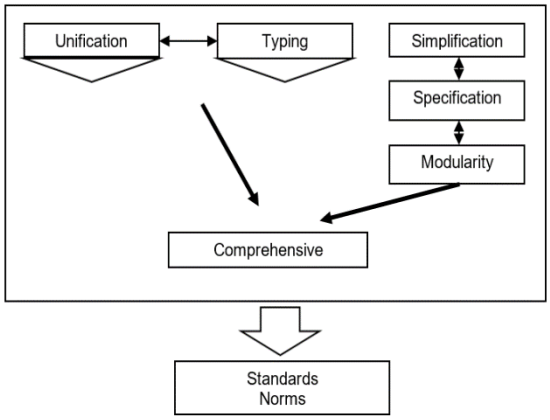

Figure 1. Links between the basic methods of standardization [9]

The main importance of complex approaches when using standardization in the design of manufacturing processes and systems is that they guarantee:

- A unified consistent approach to the selection and the use of methods and means of production preparation that correspond to the scientific, technological and production findings.
- Adoption of production of products of higher quality and reliability, with minimal consumption of labor, material and energy.
- Organization of the production at a high degree of flexibility, enabling a rapid transition to the production of new products.
- Rational organization of automation of the engineering-technical and management work complex.
- The reciprocity of TPP and its management with other systems and subsystems of management.

The structure of standardized types of technical and economic information procedures includes the following [9]:

- Uniform design documentation.
- Uniform technological documentation.
- Uniform classification and coding of technical and economic information.
- Uniform production quality attestation.
- Uniform rates and tolerances.
- Planning and organizational-management documentation with a high degree of unification.
- Normative technical documentation, which includes:
  - Type and group procedures.
  - Methods of type specification and standardization.
  - Machinery and equipment of technological equipment as well as methods of their unification, standardization and aggregation.
  - Means of automation of engineering-technical Works.
  - Methods of calculation and experimental work in the field of production preparation.
  - Methods of standardization and collection of normative data.
  - Methods of TPP organization and management according to specific products and types of production.
  - Documentation for automation of information processing.

Technical standards are documents that contain technical specifications or other determining criteria used as rules, guidelines or definitions of properties to ensure that materials, products, production processes, services, and so on are fit for the given purpose.

5 STANDARDIZATION IN PRODUCTION PROCESSES

Technological standardization is based on design standardization. Design standardization is a necessary condition of normalization of technology and its preparation. It is based on an analysis of the specific features of a particular group of components and their possible unification. In addition to component properties that directly determine their activities, the properties that are crucial for the technology of their production are examined, too. The following aspects are examined in particular [15]:

- The final function of the component.
- Functional features of the component.
- Design-technological features of the component.
- Particularities of the use of the component.

The standardization activity focuses on optimizing the needs of components, nodes and assemblies to eliminate insignificant variety of design solutions and to ensure the maximum degree of technological design compliance. The basic ways of component standardization:

- Unification of components - following the uniform shape and size of component for differently designed product types.
- Normalization of components - definition of the most suitable shapes that are then applied to different but predefined component sizes. Dimensions are arranged in exact ranges, the shape remains the same.
- Type specification of components - compliance with very similar shape and size.
- The heritability - of components, preferred use of ready-made design already adopted in production of components in other product types.

The unified and standardized components and parts, as well as the assembly group of products, ensure significant reduction in labor intensity and costs. They enable to substantially increase the serial production and

thus to use current production methods and high-performance devices. In this way, unification and standardization provide additional possibilities of product manufacturing.

Another important manner of how serial production can be increased is the application of standardization of technological processes, i.e. the development of technological procedures for different design groups and technologically similar product parts. The standardization of technological processes in lower-degree production brings about a visible change. The individual technology of each component (operation) changes to a group or a type technology. This reduces the number of technological processes, shortens the time for technical preparation of production and reduces the number of types of the tools used and the preparations made (the same preparations are used for more types of components). All of this positively impacts the production unit costs. Due to standardization of technological processes, the number of production batches is higher and a higher-level type of production is achieved. [16]

All of the above and other assumptions of increasing the serial and mass engineering production bring about the possibility of substantially increasing the efficiency of production, particularly in increasing labor productivity and reducing the cost per unit of the products produced.

The main directions of standardization of technological processes are type and group technologies.

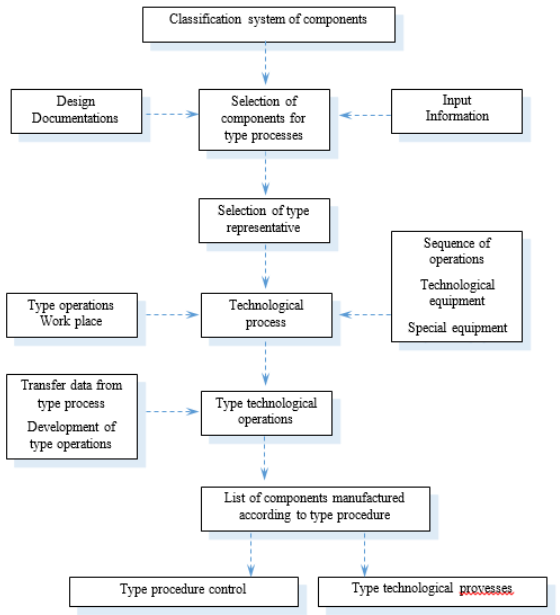

Figure 2. Hierarchy of type-specific technological procedures [9]

Type technology is a method of technological standardization. It is based on the development of a uniform manufacturing process for a group of components that are structurally and technologically similar. The technological process related to a type is established for a group of components with the same technological features. It specifies the type and order of major operations performed, using the same means of production.

A Type Representative is a concrete or abstract object of production whose technological process includes all major and auxiliary operations occurring within a given set of components.

A hierarchy of the technological processes related to development of a type is shown in Fig. 2.

The following procedure is typical for establishing a technological process type [16]:

1. Classification of components (elementary surfaces).
2. Design of type-specific technological process (operations).
3. Determination of individual stages of technological processes.
4. Draft of the type-representative technological process.
5. Transfer of type-specific technological instruction to a particular component.

According to the proposed classification system, the components are categorized into a type and a representative is designated for each type. Type designs of technological procedures are developed for those representatives.

The respective procedures are governed by the following principles:

- They must apply to all component types.
- They must include all basic and auxiliary operations for individual component manufacturing.
- Operations description should contain the constant parameters that are type-specific for all the components to which the given operation is applied.
- They must allow for an alternative solution of the specific component features.

Type-specific technological processes are applied in bulk and large-scale production and, in some cases, in serial production with a steady nomenclature.

6 CONCLUSION

A standard is that which has been selected as a model to which objects or actions may be compared. Standards for industry may be devices and instruments used to regulate colour, size, weight, and other product attributes, or they may be physical models.

Standards may also be written mathematical or symbolical descriptions, drawings, or formulas setting forth the important features of objects to be produced or actions to be performed.

Standards that are applied in an industrial setting include engineering standards, such as properties of materials, fits and tolerances, terminology, and drafting practices; and product standards intended to describe attributes and ingredients of manufactured items and embodied in drawings, formulas, materials lists, descriptions, or models.

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REFERENCES

[1] Hans-Peter, W., Reichardt, J., & Nyhuis, P. (2015). *Handbook Factory Planning and Design.*

[2] Münstermann, B., & Weitzel, T. (2008, May). *What is process standardization?*. In Conf-IRM 2008 proceedings (p. 64). Retrieved from: https://aisel.aisnet.org/cgi/viewcontent.cgi?article=1063&context=confirm2008

[3] Tassey, G. (2000). Standardization in technology-based markets. *Research policy*, 29(4-5), 587-602. Retrieved from: https://www.sciencedirect.com/science/article/pii/S0048733399000918

[4] Timmermans, S., & Epstein, S. (2010). A world of standards but not a standard world: Toward a sociology of standards and standardization. *Annual review of Sociology*, 36(1), 69-89. Retrieved from: http://www.iheal.univ-paris3.fr/sites/www.iheal.univ-paris3.fr/files/!%20ISO%20Timmermans-Epstein-ARS-WSSW.pdf

[5] Manrodt, K. B., & Vitasek, K. (2004). Global process standardization: a case study. *Journal of business logistics*, 25(1), 1-23.

[6] Cargill, C. F. (2011). Why standardization efforts fail. Journal of Electronic Publishing, 14(1). Retrieved from: https://quod.lib.umich.edu/j/jep/3336451.0014.103?rgn=main;view=fulltext

[7] De Vries, H. J., & Slob, F. J. (2006). Best practice in company standardization. International *Journal of IT Standards and Standardization Research (IJITSR)*, 4(1), 62-85.

[8] Blind, K., Jungmittag, A., & Mangelsdorf, A. (2011). *The economic benefits of standardization. DIN German Institute for Standardization.*

[9] Daneshjo, N., Rudy, V., Repková, K., Mareš, A., Kováč, J., Jahnátek, J., ... & Rusnák, J. (2018). *Intelligent industrial engineering–Innovation potential.* FedEx Print & Ship Center, USA.

[10] Maynard, D. W., Schaeffer, N. C., Drew, I. P., Raymond, G., & Weinberg, D. (2006). Standardization-in-interaction: *The survey interview*. Talk and interaction in social research methods, 9-27.

[11] Ramakumar, A., & Cooper, B. (2004). Process standardization proves profitable. *Quality*, 43(2), 42. Retrieved from: https://www.proquest.com/docview/235237356?pq-origsite=gscholar&fromopenview=true

[12] Kresse, W., Danko, D. M., & Fadaie, K. (2011). Standardization. In Springer handbook of geographic information (pp. 245-271). Springer, Berlin, Heidelberg. Retrieved from: https://link.springer.com/chapter/10.1007/978-3-540-72680-7_13

[13] Lindgren, R., Mathiassen, L., & Schultze, U. (2021). The Dialectics of Technology Standardization. *MIS Quarterly*, 45(3).

[14] Jiang, H., Zhao, S., Zhang, Y., & Chen, Y. (2012). The cooperative effect between technology standardization and industrial technology innovation based on Newtonian mechanics. *Information Technology and Management*, 13(4), 251-262. Retrieved from: https://link.springer.com/article/10.1007/s10799-012-0133-x

[15] Jiang, H., Zhao, S., Li, Z., & Chen, Y. (2016). Interaction between technology standardization and technology development: a coupling effect study. *Information technology and management*, 17(3), 229-243. Retrieved from: https://link.springer.com/article/10.1007/s10799-015-0215-7

[16] Igor, H., Bohuslava, J., & Martin, J. (2016, June). *Proposal of communication standardization of industrial networks in Industry 4.0.* In 2016 IEEE 20th Jubilee International Conference on Intelligent Engineering Systems (INES) (pp. 119-124). IEEE. Retrieved from: https://ieeexplore.ieee.org/abstract/document/7555105

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SUPPLY CHAIN MANAGEMENT AND CIRCULAR ECONOMY COOPERATION

Marcela Malindzakova [1] – Patrik Garaj [2]

Abstract: *The subject of the contribution is the connection of the logistics strategy with the requirements of the circular economy. The purpose is to implement a proactive approach in a rapidly changing business environment. It requires anticipation of changes, readiness of the company to react in case of any changes. In the fulfillment of management goals, in addition to the principles of management, it is necessary to realize that several managements, with several individual goals, enter into management decision-making. The individual links of the logistics chain present the transformations of the orders of the respective products (components, goods), whether production or assembly for deliveries.*

Keywords: proactive approach, logistics strategy, Supply Chain Management, circular economy.

1 INTRODUCTION

The priority of every production company is continuous improvement, innovation and moving forward to a higher level in terms of technology, environment, information and logistics, with the aim of meeting customer and market requirements. Within the framework of business cooperation, each business must define its own mission, thereby creating an opportunity for other businesses to participate in the fulfillment of the vision with their own mission. The direction towards the fulfillment of the vision stimulates a lot of interactions between companies as well as social partnerships. Information about the state of the market, sales quantities, terms of delivery, terms of payment, prices, customs, insurance, etc. are important when making decisions. Market-related results are linked by information about the product itself. The implementation of a logistics strategy requires the creation of a specific plan of activities and measures that would move the company towards the desired results. Considerable emphasis is also placed on the maximum efficient use of resources as well as the elimination of waste production, which is the purpose of the circular economy as one of the development strategies.

2 LOGISTICS STRATEGY

The design of a logistics strategy requires knowing the overall strategy of the company as well as the key losses that occur in the company. An important goal of logistics in various companies is to ensure the support of the planned level of customer service quality efficiently and economically. To achieve this goal, it is necessary to focus on the following areas:

1. customer requirements, that anticipate quality and consequently the scope of customer service,
2. focus on competition in the area of customer service,
3. the level of customer service of the company concerned, specifically in areas that are important to customers.

It follows from these areas that logistics managers need to know the company's strategy in order to be able to make decisions in accordance with the overall interests of the company. For the needs of strategy implementation, it is necessary to create a plan and continuously monitor its implementation. The implementation of the logistics strategy requires the creation of a specific plan of activities and measures that would move the company towards the desired results. Management must implement a proactive approach in a rapidly changing business environment; it must anticipate change, prepare the company for responses in the event of any changes, absorb change, and take advantage of that change. In the absence of a proactive approach, management only responds to emergencies and is unable to move forward in meeting the company's goals and mission [1].

How can logistics affect a company's strategy? Attributes that affect the company's strategy in terms of logistics are:

1. Assess the allocation of the company / firm.
2. Assess the layout of machines / equipment of a particular company / firm.
3. Examine market segments - focus on operating in the market, who should be customers of the company, or gaining new customers.
4. Specify the product range.
5. Implement supplier evaluation, supplier selection.
6. Identify production strategies.
7. Assess capacity strategies.
8. Focus on participation in SCM (Supply Chain Management) with all the consequences.
9. Evaluate whether the relevant organizational structure corresponds to the selected strategy.
10. Specify internal logistics activities.

3 SUPPLY CHAIN MANAGEMENT (SCM)

In the 1990s, a new concept of logistics began to come to the fore, which reflected the change in the organization of the business environment in the form of so called supply chains. With this form of supply chain, are associated the principles of supply chain

management, and therefore nowadays we often come across the phrase Supply Chain Management. The goal of the supply chain is cooperation between companies and firms, in order to support the strategic position and improve operational efficiency. Supply chain issues have already been addressed by the Council of Supply Chain Management Professionals in 2002. The members of the congress defined the supply chain as follows: "It is a summary of the following activities: planning, management of activities related to procurement and supply, as well as all activities related to supply chain management. The supply chain involves the coordination and cooperation of distribution channel participants, which include suppliers, intermediaries, providers and customers. "Author Mentzer [2] defined supply chain management as a logical process for logistics development. In terms of functional development, he specified four stages of development:

1. Physical distribution - includes the integration of transport and storage.
2. Logistics - adds supply, production and order management to physical distribution.
3. SCM integration - involves suppliers and customers.
4. "Super" SCM - complements other areas specifically marketing, product development, customer care.

Larson et al. (2007) identified four groups of logistics and supply chain management relationships:

- traditionalist - SCM represents a certain part, or special logistics function. This group understands SCM as external and inter-operational logistics, the purpose of which is to involve suppliers and customers in the company's processes.
- renaming - understands logistics as SCM in the narrower sense and mainly includes processes and functions.
- unionist - SCM is defined in a broader sense as the term logistics.
- penetrating - this is a comprehensive cross-cutting strategy that focuses on business processes and distribution channels within the company. Part of this group of relationships is the change of organizational structure from divisional to matrix within which the functions are integrated. In the practical application of the penetration group of relationships, teams of executive managers of relevant areas (eg logistics, marketing, purchasing) as well as institutions (manufacturer, seller, 3PL provider) are created.

SCM includes a full range of functions within the company / firm, including raw material procurement, logistics and marketing processes. Cooper [3] defines "SCM as the integration of key business processes from the consumer to the primary (primary) supplier, whose task is to provide goods, services and information that add value to customers and other shareholders." Lambert [4] considers the following to be key business processes:

- customer relationship management,
- customer service management,
- demand management,
- order fulfillment,
- production flow management,
- supplier relationship management,
- product development and sales,
- revenue management.

The current organization of the company is influenced by basic features such as integration, information sharing and collaboration. These attributes have further deepened the implementation of supply chain management principles within the understanding of logistics, logistics management, but also other areas of business management. It is important to note that on the supplier's side there is cooperation in the field of orders, for example in the field of delivery conditions, production dates, but also in the design of common products. On the customer's side, it is possible to see cooperation in the area of delivery schedule, sales support, inventory levels, as well as delivery dates. Part of the cooperation of large, or multinational corporations (for example KIA, Volkswagen, U. S. STEEL) is a document that is referred to as the logistics concept, or a proposal for joint management or optimization of a common network structure.

The author Pernica [5] defines the logistics concept as an important tool for implementing an integrated policy in the company, which in terms of structural and process can define the logistics system at a strategic, dispositional level according to products and logistics chains. The phrase agile supply chain can be understood in connection with the connection to the philosophy of lean management and lean logistics. From the point of view of management, business entities can be part of some of the following common structures Baker (1996), Sarkis (2001), Bartošek (2014):

- supply chain:
- adaptable,
- agile,
- efficient,
- integrated (total),
- lean,
- resilient.

– e-supply chain,
– supply network,
– e-supply network,
– cluster, etc.

The advantage resulting from the implementation of SCM is increasing capacity even when there are no orders, the company produces in stock. Creating large production batches (sequences) leads to higher productivity and lower costs.

Disadvantages resulting from the implementation of SCM are, for example, the acceptance of an order, which must be fulfilled very quickly. In case of non-fulfillment of the order, there is a risk of the customer falling out.

4 SELECTION OF SUBJECTS TO SCM

On the basis of a flexible supply and demand chain, a more advantageous implementation of the production process is possible even outside the sales markets (for example outside European countries). The decisive factor is very often the stability, which represents, in addition to the level of the economy, or the financial

markets and cultural differences and the reliability of suppliers, or subcontractors. At present, for the needs of Supply Chain Management, key factors such as stability, information interconnection via Electronic Data Interchange (EDI) are presented, as well as material flow optimization according to precisely set time schedules for production and dispatch of materials / components / goods to ensure product production in the specified time without creating unnecessary stocks and changes.

Criteria for selection of subjects to SCM:

1. Large multinational companies with several plants, or operations.
2. Stability of volume, frequency.
3. Demanding technologies.
4. Large national companies with which a long-term contract is concluded.
5. Small companies with a narrow range.
6. Information link via EDI.

Product selection criteria:

1. The need for demand.
2. Significant consumption, production in large batches.
3. Periodicity, or regularity.
4. Challenging technologies.

In terms of capacity involvement in SCM, there are two dangers:

1. seasonality - a typical feature of large companies,
2. loss of the customer, bankruptcy of the company, purchase by competitors.

5 GREEN SUPPLY CHAIN

Supply chain managers may often believe that greening is associated with higher costs. But this is no longer always true. Environmental management schemes, such as ISO 14001 certification, are becoming the industry standard in determining strategic partnerships. Adapting to stricter future environmental legislation, raising consumer awareness of the environment and the share of environmentally friendly consumers, as well as the requirements of business partners, can therefore only bring benefits in the long term [6].

Life Cycle Assessment (LCA) is currently the only standardized method (within the ISO 14,000 series) to assess environmental impacts throughout the life cycle. LCA alone is only the first step towards a more environmentally friendly Supply Chain (SC), as it only detects environmental impacts, but does not actually minimize them. The next step is then for example the use of Eco / Green design tools that allow to minimize the environmental impacts identified with the LCA [6].

The results of research among Hungarian companies in the automotive industry show the popularity of various ecological techniques in the field of product design, purchasing, production and logistics in the external supply chain [7]:

1. Green design - Design of new products for resource efficiency - including reduced energy consumption, reduced material consumption, renewable energy use and waste reduction. Green design is a less commonly used area because its techniques require large investments and the return is slow compared to other green activities.
2. Green purchasing - The basic idea is to reduce the environmental impact caused by the resources used in the products. This can be determined by selecting suitable materials and / or suppliers. The field of organic purchasing has a large set of tools and they found large differences in the degree of application of individual techniques. The most popular green shopping techniques are administrative, that is requiring certain documents and standards from the supplier.
3. Green manufacturing - The green manufacturing process must use inputs with a low environmental impact, work with high efficiency and generate a minimum amount of waste and pollution. Green production has great average popularity because it provides companies with fast and tangible results.
4. Green logistics - Consists of ecological packaging and transport. Eco-friendly packaging includes downsizing, the use of "green" packaging materials, working with suppliers to standardize packaging, minimizing the use of material and time required for unpacking, adopting returnable packaging methods, promoting recycling and reuse programs. Ecological transport means deliveries directly to the user's place, the use of vehicles with alternative propulsion, distribution in large batches and the change of transport to another, more environmentally friendly mode of transport.

6 CURRENT STATE IN THE FIELD OF GREEN LOGISTICS IN SLOVAKIA

The European Union's plans for the efficient functioning of the circular economy include the maximum material and energy use of waste. For the implementation of this plan, it is essential to eliminate landfilling of waste and focus on its maximum recycling. If recycling is not possible, energy recovery is important. Various forms of waste treatment have a significant impact on the environment and human health, which is why efforts should be focused on ecological solutions. The current, very ambitious goals of the European Union are towards a 60% recycling rate for municipal waste by 2030 and the elimination of landfilling of municipal waste below 25% by 2035 [8]. In 2019, 2.3 million tons of municipal waste was produced in Slovakia, of which up to 52% was deposited in landfills (Fig. 1) and only 38.5% recycled (Fig. 2). Fig. 2 presents that only Germany (66.7%) meets the set waste recycling target, which means no country has yet met this 60% recycling target [9] [10].

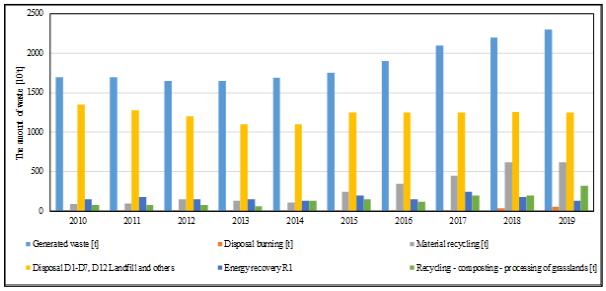

Figure 1. Classification of municipal waste in terms of management activities [9]

The issue of waste management in Slovakia is addressed by the Act of the National Council of the Slovak Republic no. 79/2015 Coll. on waste, which regulates [12]:

1. programming documents in waste management,
2. waste prevention measures,
3. the rights and obligations of legal persons and natural persons in the prevention of waste generation and in waste management,
4. extended producer responsibility,
5. management of reserved products and waste streams,
6. municipal waste management,
7. cross country boundary movement of waste,
8. waste management information system,
9. the competence of state administration bodies and municipalities in matters of state administration of waste management,
10. liability for breach of obligations in the field of waste management.

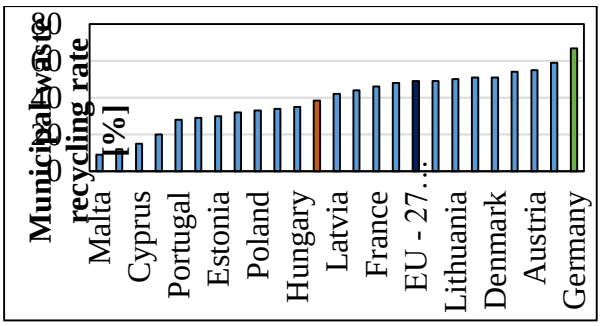

Figure 2. Municipal waste recycling rate in 2019 [10]

From the point of view of circular economy (circular economy), the essential "hierarchy of waste management", which is specified in the first part of the law, namely - Basic

Provisions, § 6 for clarity, which is presented in Fig. 3 [13].

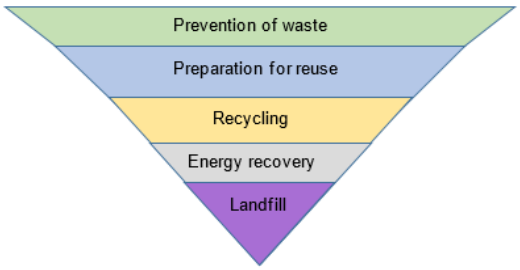

Figure 3. Waste management hierarchy [13]

7 DESCRIPTION OF THE BACKUP SYSTEM

The OECD glossary of statistics explains the acronym DRS from the English word Deposit Refund Scheme, which means a surcharge for the price of potentially polluting products. If pollution is prevented by returning the products or their residues, the surcharge will be refunded [14]. This represents a deposit system.

The DRS system can be perceived as a combination of taxes and subsidies. The implementation of this system consists in returning used goods (PET bottle or can) to a designated collection point, obtaining a payment (deposit) as compensation for environmental protection (non-pollution of the environment). The consumer is motivated to improve the environment. This method creates a PULL incentive as the consumer is directed towards a "good" behavior. As payment for subsidies for policy makers would be very costly and would also have negative distributional effects, the refund offer is linked to an advance (deposit) to be paid in advance. Advance is an incentive not to pollute. It is also possible to talk about PUSH incentives, because the consumer is encouraged to behave appropriately. A consumer who purchases goods that are subject to a deposit system must pay a deposit above the normal price. If a person decides to dispose of the goods in a polluting manner, the deposit is not refunded. The advance paid is the consumer's tax on pollution, according to the "polluter pays" principle [15] [16]. There are 2 ways to back up your system:

1. a market-generated backup system,
2. a government-initiated back-up system.

The market-generated DRS system is initiated by manufacturers or retailers. The reasons for starting the system can be divided into two areas:

1. increasing demand for their product,
2. a reduction in their production costs by reusing the returned second-hand goods.

Spontaneous deposit systems for beverage packaging are not optimal for the whole country, this is the disadvantage of the market-generated backup system [17]. A more advantageous solution is to focus on a deposit system that will be initiated by the government. Part of this system is a backup for disposable packaging, which motivates the return of packaging (after consumption of the relevant beverage) to collection points through a refundable deposit. When purchasing a drink, consumers pay a deposit and subsequently, after returning the container to one of the designated collection points, this deposit will be refunded. It is up to the consumer to decide if he chooses not to return the empty packaging, he will also lose the deposit. Collection points are located in retail outlets or in centralized places where bulk packaging can be collected. In the case of retail outlets, consumers can return empty beverage containers to the store's cash register or to vending machines, so-called Reverse Vending Machine (RVM). Accumulated empty packaging can be recycled into new packaging and then

returned to the beverage industry for filling with new beverages, or can be used for other production purposes [17].

Tracking the movement of material and refunds by monitoring and recording data (data flow - blue, Fig. 4) provides oversight of transactions that take place between participants to ensure an appropriate distribution of costs and revenues, for example in accordance with the contribution of different parties to the system. Financial transactions include a handling fee paid to retailers to compensate for the collection of used packaging.

Within the scheme of the classic backup system, several actors are involved in this backup refund system:

1. Producers, importers of beverages;
2. Retail stores;
3. Carriers;
4. Centralized system;
5. Consumers;
6. Recyclers.

Objects that are irreplaceable for the system, but at the same time complicate this system, as each participant has different interests and needs. Achieving the optimal result for the refund system is possible when all parties are economically and / or emotionally motivated to participate in the refund system [18].

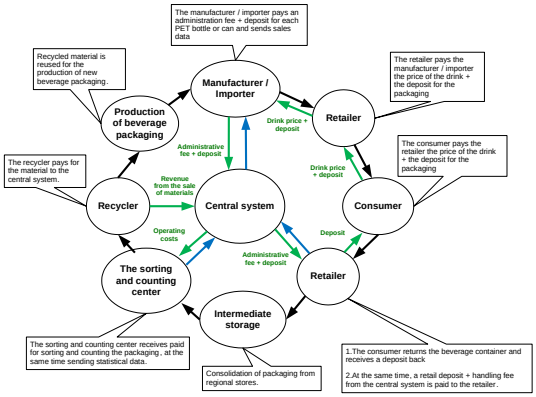

Figure 4. Formalized backup system schema

DRS systems can be mandatory or voluntary. In order to increase recycling, the implementation of DRS systems has become mandatory from originally voluntary systems. At the beginning of the implementation, DRS systems were on a voluntary basis, due to a decrease in production costs for fresh materials compared to the costs associated with collection and recycling. The trend is following mandatory systems for single-use beverage packaging, as well as the implementation of mandatory systems presents a higher collection rate compared to systems based on alternative rules [19].

8 SPECIFICATION OF DRS OBJECTIVES

The primary goal of the DRS system is to increase the level of recovery of packaging waste. Due to the fact that customers have paid a deposit for the products, it is in their interest to return empty bottles and cans in order to return the minute money. Manufacturers are part of the system, as they are obliged to pay a tax on natural resources for each package generated. If the tax exceeds the cost of participating in the refund system, producers are motivated to meet the objectives of the DRS. In general, DRS fulfills the following objectives [20], [21], [22], [17]:

- increase the quality of collected materials,
- reduce littering,
- increase the collection rate,
- shift the burden of sorting recyclable materials to end users - consumers,
- increase the involvement of end-users in the process, increase their environmental awareness,
- collect materials that can be easily recycled,
- shift the costs associated with waste management activities from municipalities to producers,
- serve as a tool for product-oriented initiatives such as RZV (extended producer responsibility).

Differences in the scope of targeted products, established rules, stakeholders, deposit rates, actors involved, flexibility, efficiency and many other characteristics can be seen in the DRS implementation schemes. The main goal of DRS is to ensure a high rate of waste reuse and recycling with a focus on a high level of waste collected. The effectiveness of the system depends on several factors such as waste policy (at local and national level), the flow (movement) of products that cross national borders, the level of the deposit, the flexibility of the system, public awareness and involvement. All factors need to be taken into account to increase the usefulness of the implemented system [21, 23, 24].

9 ALTERNATIVES TO DRS

The use of the DRS system consists in addressing the negative effects that result from pollution and ensuring a higher recycling rate. The realization of the goals can be ensured by various alternative environmental policies in the form of product fees, subsidies and regulations, or prohibition of disposal. The DRS system provides a greater economic incentive for the "correct" handling of second-hand goods and is more cost-effective [15].

10 PIGOVIAN TAX

This tax is levied on private individuals or companies from any activity on the market and creates negative side effects for society. As example can be stated the tax on carbon emissions (environmental pollution) or the tax on the sale of tobacco products (pressure on public health) [13]. On the other hand, this tax does not reduce littering to a similar extent as DRS. As the tax is not an incentive for consumers to dispose of used goods "in the right way". Consumers only pay in advance for the external costs of littering that arise as a result of polluting consumers. It should be emphasized that the tax causes consumer prices to rise and producer

prices to fall, leading to a loss of consumer and producer surplus. The Pigovian tax generates revenue for the government and this revenue could be used to clean up waste, but this is not socially desirable because the external costs of waste are also borne by customers who do not dispose of the waste, and this is not the case for DRS [15].

11 METHOD OF MARKING DRS

The labeling format is important for the solution of key design functions. The reasons for the appropriate designation for the DRS system are [16]:

1. provide the consumer with information on the amount of the deposit,
2. specify the mechanism in the fight against fraud.

There are two types of labeling for the DRS system in the design process:

1. DRS logo
2. ndividual barcode.

With the help of a scanner, it is possible to determine and count each returned package in an automatic form in a Reverse Vending Machine (RVM) or at the cash register. This is a good basis for combating fraud (Fig. 5).

Figure 5. Use of the logo and barcode of the backup bottle abroad [23]

In Norway, beverage manufacturers pay a fee for registering their products to a specific system administrator - Infinitum. Bottles and cans in circulation must be marked with the deposit logo, the value (price) of the deposit and also the barcode. Because the launch of a product requires testing and approval by Infinitum for reading through a RVM. Used bags for transporting used prepackages after collection must be marked with a radio frequency identification chip (RFID) for electronic tracking. The filled bags provided by Infinitum are closed with an integrated sealing tape, due to improper handling of these bags [20]. When the back-up DRS system was introduced in Croatia, these packages contained only small text and no visual marking of the deposits. This new process was misleading and confusing for consumers, and especially for foreigners. In 2015, Croatia carried out an overhaul of the established system, in addition to which the packaging logo was added [26].

In Slovakia, a system for deposit of beverage packaging via the DRS system was launched on 1 January 2022 (Fig.6). For beverages, the selling price was increased by a fee of 15 cents for deposit. Following the return of the plastic bottle, the deposit will be returned to the consumer. The goal of the Slovak Republic in the area of backup is to increase the share of separated beverage packaging from 60% to 90%.

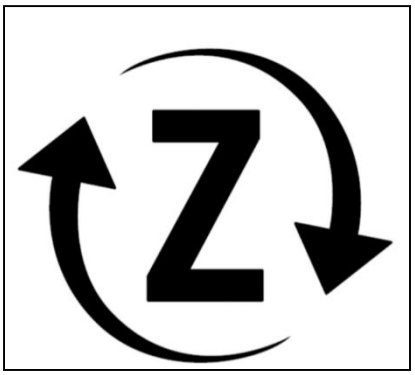

Figure 6. Deposit logo format for Slovak products [25]

3 CONCLUSON

Providing the right infrastructure is an essential part of the success of DRS implementation in terms of both efficiency and cost. It is important to strike a balance between the amount of the deposit (financial incentive), the availability as well as the comfort of the collection infrastructure. In view of the simplicity and clarity of the return of the backup packaging for the consumer, it is necessary to ensure high-performance DRS systems [20]. Some foreign systems use legislation to ensure a suitable collection infrastructure at specific locations. Some countries are using incentives, or ensurie the appropriate infrastructure in the relevant market. On the one hand, there is no metrics for deposit systems, but on the other hand, programs are in place that provide consumers with space where they can retur packaging, that is proportional to population density [20].

REFERENCES

[1] Dupaľ, A., & Brezina, I. (2006). *Logistika v manažmente podniku.*. Sprint.

[2] Mentzer, J. T. (2000). *Supply Chain Management*. Sage Publications Inc.

[3] Cooper, M. C., Douglas, M., Lambert, M. & Pagh, J. D. (1997). Supply Chain Management: More than a new name for logistics. *The international journal of Logistics Management*, *8*(1), 1-14.

[4] Lambert, D., Stock, J., Ellram, L. (2005). *Logistika*. 2. ed. Computer Press.

[5] Pernica, P. (1998). *Logistický management – teória a podniková praxe*. Radix.

[6] Obrecht, M. (2020). *Integrating Life Cycle Thinking, Ecolabels and Ecodesign Principles into Supply Chain Management. Integrating Life Cycle Thinking, Ecolabels and Ecodesign Principles into Supply Chain Management*. Springer Cham.

[7] Szegedi, Z., Gabriel, M., Papp, I. (2017). Green supply chain awareness in the hungarian

automotive industry. *Polish Journal of Management Studies*, *16*(1), 259-268.
[8] MŽP SR (IEP). Zelenšie Slovensko - Stratégia environmentálnej politiky Slovenskej republiky do roku 2030. (2021). Retrieved from:
https://www.minzp.sk/files/iep/publikacia_zelensie-slovensko-sj_web.pdf
Eurostat. Municipal waste by waste management operations. (2021). Retrieved from:
https://ec.europa.eu/eurostat/web/products-datasets/-/env_wasmun
[9] Eurostat. Recycling rate of municipal waste. (2021). Retrieved from:
https://ec.europa.eu/eurostat/web/productsdatasets/product?code=sdg_11_60
[10] Gros, I., & Grosova, S. (2012). Dodavatelské systémy. Supply Chain Management. Vysoká škola logistiky.
[11] Zákon NR SR č. 79/2015 Z. z. o odpadoch a o zmene a doplnení niektorých zákonov.
[12] Hart, M. (2011). Logistics and Its Indisputably Growing Importance in Current Global World's Economy. *Carpathian Logistics Congress, 20*(9), 197-206.
[13] OECD. (2001). Deposit-refund system. Retrieved from:
https://stats.oecd.org/glossary/detail.asp?ID=594
[14] Baumol, W. J., & Bohm, P. (1983). Deposit-refund systems: Theory and applications to environmental conservation and consumer policy. *The Scandinavian Journal of Economics, 85*(3), 437-439.
[15] Deprez, N. Deposit - refund schemes for one - way beverage packaging. (2016). Retrieved from:
https://lib.ugent.be/fulltxt/RUG01/002/304/845/RUG01- 002304845_2016_0001_AC.pdf
[16] Hogg, D., Elliot, T., Gibbs, A., Jones, P., Von Eye, M., Hann, S. (2015). A Scottish Deposit Refund System. Retrieved from:
https://www.zerowastescotland.org.uk/sites/default/files/ZWS%20DRS%20Report_MAIN%20REPORT_Final_v2.pdf
[17] Balcers, O., Brizga, J., Moora, H., Raal, R. (2019). *Deposit Return Systems For Beverage Containers In The Baltic States*. Green Liberty.
[18] Kalinovskaya, I. (2016). Implementation Project for Deposit-Refund System in the Republic of Belarus. Retrieved from:
https://lup.lub.lu.se/luur/download?func=downloadFile&recordOId=8892522&fileOId =8892602
[19] Davies, P. (2017). Cost-benefit analysis of a Container Deposit Scheme. Auckland: Sapere Research Group. Retrieved from:
http://www.wasteminz.org.nz/wpcontent/uploads/2017/12/Container-Deposit-CBA-Report-Final.pdf
[20] Fitzsimons, D., Lee, P., Slater, P., Beukering, P. (2005). Deposit Return Systems for Packaging: Applying International Experience to the UK. Retrieved from:
www.oakdenehollins.co.uk/media/998/Deposit_Returns_2005.pdf
[21] Investopedia. Pigovian daň. (Pigovian Tax). (2018). Retrieved from: https://investopedia.sk/2020/10/26/pigovian-dan-pigovian-tax/
[22] RE-DEPOSIT. Retrieved from: https://www.re-deposit.com/en/
[23] Malindzakova, M., & Puskas, D. (2018). Application of environmental quality approaches to analyse environmental pollutions. *Quality - Access to Success, 19* (166), 107-110.
[24] TOMRA. Rewarding recycling: learnings from the world's highest-performing deposit return systems. (2020). Retrieved from:
[25] https://www.tomra.com/en/collection/reverse-vending/deposit-return-schemes/whitepaper#cta_Download_Center

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USE OF MACHINE VISION SYSTEMS IN INDUSTRIAL ROBOTICS

Jakub Müller [1] – Tomáš Broum [2] – Miroslav Malaga [3]

Abstract: *This article discusses machine vision systems and their use in industrial robotics. The aim of the article is to present the topic of machine vision of industrial robots. The paper also provides an introduction to robotics such as basic classification of robots. Finally, the article focuses on applications and examples of different machine vision systems directly from practice (e.g. 2D camera inspection of product rotation in the automotive industry).*

Keywords: automation, machine vision systems, industrial robotics, collaborative robots, Industry 4.0.

1 INTRODUCTION

This article provides an introduction to industrial robotics, introducing the basic types of robots and examples of robots using machine vision. One example of machine vision in practice is visual inspection of products. In many industries, there are a large number of products that are assembled manually and depend on the skill of the operator to assemble them correctly. Products are often visually inspected by another worker as part of the quality control process. Installing a system that takes control can greatly reduce the likelihood of a defective product reaching the customer.[1]

Automated control systems can be directly connected to the decommissioning mechanism. Products are inspected at high speed. A similar inspection process is used by intelligent cameras that automatically send information to the culling mechanism. Good system integration is a must. [1]

The transport and packaging industry is also under increasing pressure. One solution for speeding up is machine vision introduced into logistics. Logistics solutions with machine vision, including self-driving robots, will improve package accountability and transport times. [2]

Machine vision is a big concept in robotics, so part of the article is also an introduction to robotics.

2 ROBOTICS

Robotics is an interdisciplinary branch of science and technology that deals with the design, construction and use of mechanical robots.

Robotics is the intersection of science, engineering and technology that leads to robots creation. Robots replace or replicate human activities, acquiring intellectual and mechanical capabilities that could, for example, in the future approach those of R2-D2 (the robot from the Star Wars film franchise), Figure 1.).

Figure 1. R2-D2 robot [3]

With development, the term robotics is expanding to include more and more things and activities. In automotive factories, 90% of all robots were involved in car assembly as of 2005. These robots mainly consist of mechanical arms whose job is to weld or bolt certain parts of the car. Today, the definition of robotics includes the development, creation, and use of robots that assist law enforcement, that explore the harshest conditions on earth, and that assist in all areas of healthcare. Robotics performs many different tasks in many different fields, and the number of jobs entrusted to robots continues to grow. Each robot has unique characteristics, varying greatly in size, shape, and capabilities. The following characteristics apply to all robots: [26] [5]

1) Robots all consist of some kind of mechanical structure. The mechanical aspect of the robot helps it to perform tasks in the environment for which it is designed. For example, the Mars 2020 Rover's wheels are individually motor-driven and made of titanium tubes that help it hold firm in the red planet's rough terrain.

2) Robots need electrical components to drive and propel machines. Essentially, electricity (e.g. batteries) is needed to power the vast majority of robots.

3) Robots contain at least some level of computer programming. Without a set of codes telling it what to do, the robot would be just another piece of simple machinery. Putting a program into the robot gives it the ability to know when and how to perform a task.

Main types of robots: [4]

- Industrial - used in a manufacturing environment
- Domestic - daily household tasks (vacuum cleaner, pool cleaner, sweeper, ...)
- Military - bomb disposal robots, various transport robots and reconnaissance drones
- Space - surface movement on another planet and scientific experiments
- Entertaining - trying to evoke a feeling of laughter, surprise or amazement
- Micro - robots that have micrometer scale dimensions and robots that can operate with micrometer resolution (similar to nano robots)
- Educational - 3D printers, programming sets from Lego
- Medical - robots are increasingly used in medicine for surgery, rehabilitation and training (Figure 2.)

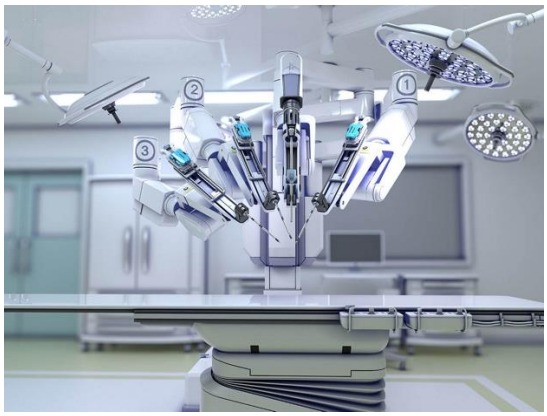

Figure 2. Medical robot [10]

- Research - primarily intended to assist researchers in their research (may work as research assistants) (Figure 3.)

Figure 3. Research robot [11]

- Security - monitoring and guarding large civilian facilities (e.g. power plants) (Figure 4.)

Figure 4. Safety robot [12]

- Nano - the same as micro only on a nanometer scale (Figure 5.)

Figure 5. Nano robot [14]

- Humanoid - most similar to a human, the main components of a humanoid robot are sensors (Figure 6.)

Figure 6. Humanoid robot [15]

- Flying - flying robots are among the most popular types of robots (Figure 7.)

Figure 7. Flying robot [16]

- Floating - these robots can take the form of an insect, a fish or a large slithering snake (they perform similar movements to snakes in water) (Figure 8.)

Figure 8. Floating robot [17]

- Hybrid - most similar to humanoid, striving for the greatest resemblance to a human while meeting all required functionality (Figure 9.)

Figure 9. Hybrid robot [18]

In the near future, robots will be smarter, more flexible and more energy efficient thanks to artificial intelligence and software (Obrázek 2.10). They will continue to take on more challenging tasks and help secure global supply chains. [5]

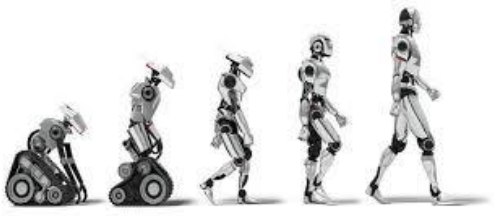

Figure 10. Possible development of robots [4]

This article deals with industrial robots, so they will be described in more detail.

3 INDUSTRIAL ROBOT

Industrial robots work in positions where they perform dangerous, dirty and/or repetitive tasks with consistent accuracy and precision. They are consistently used in a variety of industries and applications. The range of industrial robots is very wide, with the most common distinguishing features being the reach, load capacity and number of axes of movement of their articulated arm.

A combination of programming software and controls control the operation of the robot. The automated function provides the ability to work on weekends, with hazardous materials and in challenging conditions. Robotic technology also replaces demanding activities that could cause injury to workers. Industrial robots increase productivity and profitability.

The most commonly used robots are six-axis robots, which are the closest to human movements. Motors control the rotation of each axis, allowing for greater precision and speed. The main body of the robot is connected to the floor by the first pivoting joint. An arm is attached to the main body of the robot by another pivot joint. A third pivot joint connects the arm to the robot arm (arm). At the end of the arm, the last joint connects the arm to the end effector (wrist). Each robot has its own functional envelope in which it is able to operate. Articulated robots are constrained within this envelope only by power and data cables (new architectures solve this problem internally, allowing the robotic arm to use the entire range field). [6] [21]

The main components of an industrial robot are as follows:

Motors

Robot motors greatly affect the quality of an industrial robot should meet the following basic parameters:

- Smooth starting and braking
- High positioning accuracy
- Sufficient positional rigidity
- Minimum moment of inertia
- High specific power
- Suitable dimensions

Maximum speed is currently around 5 m/s. Handling speed also depends on the weight load (robots with

smaller payloads can move faster). Smooth operation is also required for motors for two reasons. First, because of the safety of holding the object by the end-effector. Less gripping force is required for smooth operation. The second reason is the accuracy in reaching the end position. Smooth running mitigates the oscillation of the end effector that would cause a problem when hitting the end position. In the case of actuator control (servo drives), two types are used:

- Hydraulic
- Electric

The hydraulic actuator is designed for manipulators with high load capacity or large working space. The hydraulic actuator has high dynamics and very high performance, these two parameters are among the main advantages of the hydraulic actuator. Additional equipment (e.g. pump and servo valve) is required for the hydraulic drive. Furthermore, increased maintenance is required for this type of actuator. Increased maintenance, the need for additional equipment and low efficiency are disadvantages of hydraulic actuators.

An electric actuator is standard for industrial robots. The electric actuator has very good steerability, a large range of power and speed. The problem with electric actuators is overheating. [7]

Controls

The control system is used for direct control of the robot. On the control system there is a control panel which contains:

Main switch
Emergency stop
Engines on
Mode switch

A pendant is then connected to the control centre, which is used to give instructions to the robot. There are different kinds of pendants, but all should contain a safety button. The safety button has three positions (1 - not pressed, 2 - first stage of pressing, 3 - squeeze). The robot can only receive movements when the safety button is in the 2nd position. The Pendant is used to directly input movements, create a trajectory, adjust the robot's movement speed along the trajectory and create a program. The created program can then be subsequently edited. [8]

Figure 11. Pendant Kuka [13]

End effector

The end effector must provide a safe and secure grip. The end effector has two basic divisions, namely:

- Division by type of drive
  - Electric drive
  - Hydraulic drive
  - Pneumatic drive
- Classification according to the method of gripping the object

The electric drive means fast, precise and simple operation of the grippers. The main advantage is that it does not need any additional medium. The electric actuator is mechanically very similar to the pneumatic actuator, but the cost is much higher.

The pneumatic actuator as mentioned above is similar to the electric actuator. It is one of the most used drives, mainly due to its price. The disadvantage lies in the difficulty of controlling the force and speed of clamping.

The hydraulic actuator is mostly used with a hydraulic actuator and thus is used precisely when gripping large and very heavy things where a large gripping force is required.

Nowadays there are many principles of gripping. In the case of the end-effector, we distinguish the type of gripping and then the type of grippers. The most widely used grippers are mechanical (force)

Types of mechanical grippers:

- Two-part parallel grippers - they perform linear straight-line motion and are mostly used in technical practice (Figure 12.)

Figure 12. Two-part parallel gripper [19]

- Double-celled angular grippers - move in a circular motion, otherwise similar to parallel grippers
- Centric grippers - have three or more grasping elements distributed around the circumference
- Adaptive grippers - have the ability to adapt to the shape of the object
- Anthropomorphic grippers - resemble a hand in shape, the "fingers" can move independently of each other, giving them more degrees of freedom•

- Collaborative grippers - a type of grippers specifically designed to work with humans (Figure 13.) [9]

Figure 13. • Collaborative gripper [20]

4 TYPES OF INDUSTRIAL ROBOTS

The types of industrial robots are based on the Fanuc catalogue. The main division is by design (articulated, delta and SCARA), followed by application (palletizing, welding and painting) and lastly special collaborative. [22]

Joint robots

Joint robots are the most common type of robots used in industry. They contain rotary joints that are commonly referred to as axes. Joint robots are usually driven by servo motors and can have a simple design with two axes or a complex design with ten or more axes. The most common robots are those with six axes. [23]

Figure 14. FANUC LR Mate [22]

Delta robots

Delta robots are known for their speed, accuracy and lightness. Delta robots resemble the shape of a spider. An architecture of interconnected parallelograms attached to a common base. The robots are mostly used in the pharmaceutical, food and electrical industries for activities such as packaging, loading and feeding of components. [24]

Figure 15. FANUC M1 [22]

SCARA robots

SCARA (Selective Compliance Assembly Robot Arms) are useful in many applications. They can perform precision and repetitive tasks such as loading/unloading, assembly, packaging/palletizing, picking/handling, sorting, stacking and deploying. SCARA robots operate at very high speeds. [25]

Figure 16. FANUC SR-3iA [22]

Palletizing robots

Palletizing is the labor-intensive application of stacking boxes, bags, crates, bottles and cartons on pallets as the last step of the assembly line before loading onto a transport vehicle. Pallet pattern flexibility, tooling flexibility and cycle time are the three main challenges of automated palletizing in today's industry. [24]

Figure 17. FANUC M410 [22]

Electric arc welding robots

Robotics in the welding industry guarantees precise and error-free weld quality. Fanuc offers only

one range of electric arc welding robots with a load capacity of 20 kg and a maximum reach of 3123 mm. [24]

Figure 18. FANUC Electric arc welding [22]

Painting robots

Painting robots are mainly used for reasons of reduced emissions and high quality coatings. The operation of painting robots is very simple thanks to specialized software. This type of robots is mostly used in the automotive and construction industry. [24]

Figure 19. FANUC P-350iA/45 [22]

Collaborative robots

Collaborative robot (Figure 20.) is designed to work with the employee while the industrial robot works instead of the employee.

Figure 20. Collaborative robot CRX-10iA [22]

5 EXAMPLES OF APPLIED SENSOR SOLUTIONS IN PRACTICE

Examples of the use of different types of machine vision in practice (QR code reading, product shooting control, robot guidance and 3D bin-picking).

2D camera inspection of product rotation in automotive industry

2D camera is used here to check the orientation of the product (Figure 21.). The reason for this is the correct positioning of the robot when it is inserted into the spindle of the machine tool. The 2D camera is only able to identify the X and Y position. The use of a camera system was unavoidable in this case, because production is characterized by high variability, which is always a nuisance for any automation. The different product variants only have certain parts that are the same, so it was necessary to use a universal input conveyor in which it was not possible to guarantee the exact position of the product for picking and subsequent feeding into the machine by the robot. After removal, the robot enters a "photocell" where the exact position and rotation of the part in the gripper is defined. The robot then embeds the part into the machine according to the current coordinates.

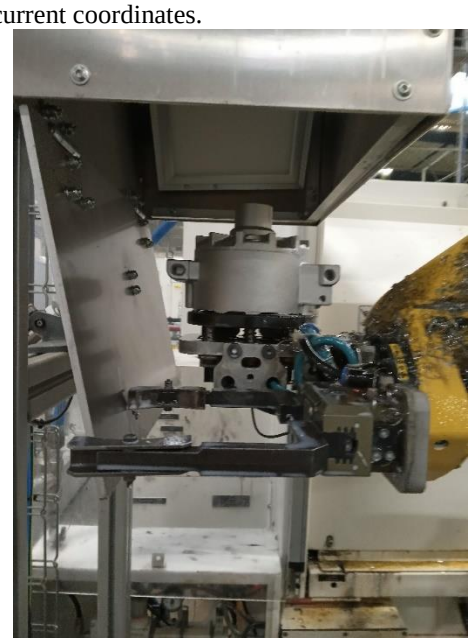

Figure 21. 2D camera

Guiding the robot onto the aluminium profile using a 3D camera

In this case, the aluminium profiles are loosely placed in beds that ensure at least an approximate position of the part and a right/left differentiation (Figure 22.). Using the FANUC 3DV/400 camera system, the part is detected, its position in the horizontal axes, its position in the vertical axis and its inclinations relative to the coordinate system are found. The camera system uses shape identification based on the transition between white and dark pixels. This shape determines the coordinates in the horizontal axes. In certain spaces of the found shape, it creates a 3D map of the points through which it intersects the plane. This plane

determines the coordinate on the vertical axis and the inclination with respect to the coordinate system.

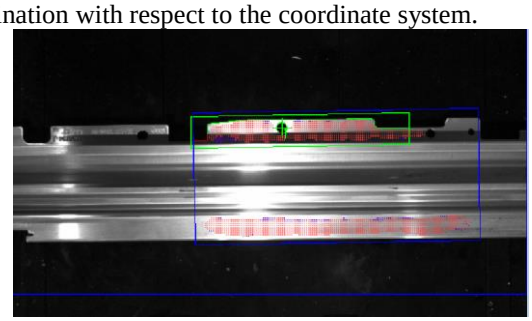

Figure 22. 3D camera

3D bin-picking of steel shafts

3D bin-picking is a system that helps to pick items from a container such as a bin and place them, for example, on a pallet or in a process (Figure 23.). In this case, the FANUC 3DV/400 system (3D sensor from Fanuc) was used to position the robot for selecting steel shafts in bulk in the KLT box. To identify the shaft, a tool that is able to recognize the part from the 3D model was used. Unfortunately, the system is not able to accurately identify the orientation of the part at 180° intervals, so a bed was integrated to the robot where this orientation is defined by an optical sensor.

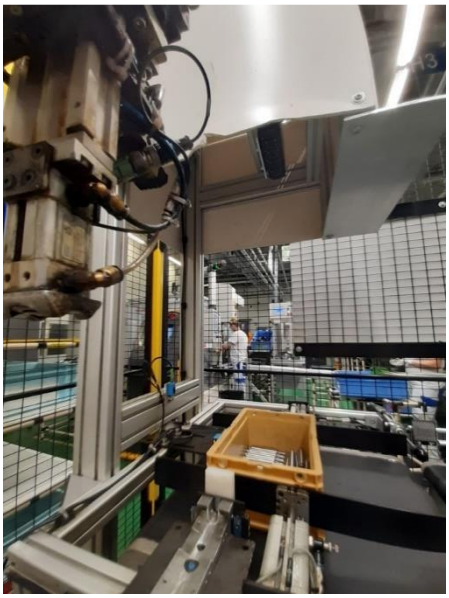

Figure 23. Bin-picking

QR code reading

Example of using a QR code reader (Figure 24). In this application, the numeric string from the QR code reads, for example: information about the product type, its unique identification number, OK/NG status and processing rate. QR code readers are also used in the cooperation of industrial robots.

Figure 24. QR code reading

The chapter covers a brief introduction to robotics, a complete breakdown of robots, an introduction to the most well-known manufacturers of collaborative robots, a description of collaborative robots and what they consist of. The chapter concludes with the practical applications of sensing sensors. In the next chapter, the use of a 2D camera in collaboration with a collaborative robot will be presented.

6 CONCLUSION

The article deals with a brief introduction to robotics, a complete breakdown of robots, an introduction to types of industrial robots and their components. The most relevant part of the article concludes of four industrial use of sensors used by the industrial robots in practice.

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REFERENCES

[1] Chlebny, J. (2014). *Automatizace a automatizační technika* [Print version]. Brno: Computer Press.

[2] *INTEGRO*. (2021). Integro Technologies. Retrieved October 5, 2022, from https://www.integro-tech.com/5-machine-vision-innovations-to-expect-in-2021/

[3] *Advanced Graphics*. (2022). Advanced Graphics. Retrieved October 1, 2022, from https://advancedgraphics.com/r2-d2-cardboard-cutout/

[1] *15 Main Types of Robotics*. (2018). Vapulus. Retrieved October 3, 2022, from https://www.vapulus.com/en/15-main-types-of-robotics/

[2] *Robotics Technology*. (2022). Builtin. Retrieved October 5, 2022, from https://builtin.com/robotics

[6] Chakraborty, E. (2022). *Co je kloubový robot?* Lambda Geeks. Retrieved October 4, 2022, from https://cs.lambdageeks.com/articulated-robots/

[7] Skařupa, J. (2007). *Průmyslové roboty a manipulátory*. Vysoká Škola Báňská – Technická Univerzita Ostrava. Retrieved October 4, 2022, from http://www.elearn.vsb.cz/archivcd/FS/PRM/Text/Skripta_PRaM.pdf

[8] Lipina, J., & Marek, J. (2012). *Ovládání a programování robotů ABB*. Vysoká Škola Báňská – Technická Univerzita Ostrava. Retrieved October 4, 2022, from https://projekty.fs.vsb.cz/147/ucebniopory/978-80-248-2753-7.pdf

[9] Jaroš, D. (2018). Koncové efektory robotů pro uchopování objektů z různých materiálů. In *Bakalářská práce*. Liberec: Technická univerzita v Liberci. https://dspace.tul.cz/bitstream/handle/15240/152174/Bakalarska_prace_2018_David_Jaros.pdf?sequence=1

[10] *Safety Testing in Healthcare Robotics*. (2022). UL. Retrieved October 3, 2022, from https://www.ul.com/news/safety-testing-healthcare-robotics

[11] *Pal Robotics*. (2022). Pal Robotics. Retrieved October 4, 2022, from https://pal-robotics.com/research/

[12] *Security robots are mobile surveillance devices, not human replacements*. (2022). The Verge. Retrieved October 5, 2022, from https://www.theverge.com/2019/11/14/20964584/knightscope-security-robot-guards-surveillance-devices-facial-recognition-numberplate-mobile-phone

[13] *Wireless teach pendants for robots*. (2022). Book: Industrial robots and cobots. https://roboticsbook.com/wireless-teach-pendants-for-robots/

[14] *Blood Nano robot with camera, claws and needle over blood cell on A...* (n.d.). iStock. https://www.istockphoto.com/cs/fotografie/krvav%C3%BD-nano-robot-s-kamerou-dr%C3%A1py-a-jehlou-nad-krevn%C3%ADmi-bu%C5%88kami-3d-vykreslov%C3%A1n%C3%AD-gm655733506-119299479

[15] Roth, E. (2021). *A humanoid robot makes eerily lifelike facial expressions*. The Verge. https://www.theverge.com/2021/12/5/22819328/humanoid-robot-eerily-lifelike-facial-expressions

[16] *33 547 flying robot Snímků, stock fotografií a vektorů*. (n.d.). Shutterstock. https://www.shutterstock.com/cs/search/flying+robot

[17] *Robot shows how simple swimming can be*. (2021). IEEE Spectrum. https://spectrum.ieee.org/swimming-robot-eel-epfl

[18] *Smart intelligent robot Alpha robot K3 hydroelectric hybrid intelligent robot RC/Sound control – koupit Za nízké ceny V internetovém obchodě Joom*. (n.d.). Joom. https://www.joom.com/cs/products/5ce2163d28fc710101dd74da

[19] *Koncový efektor jako důležitá periférie robotů | WPEng.cz*. (n.d.). WP Engineering - vývoj ve strojírenství. https://www.wpeng.cz/l/koncovy-efektor-jako-dulezita-periferie-robotu/

[20] Oneindustry. (2017). *Kolaborativní chapadlo (HRC) V okolí obráběcího stroje*. oneindustry – průmyslový portál, výroba a technologie. https://www.oneindustry.cz/strojirenstvi/kolaborativni-chapadlo-hrc-v-okoli-obrabeciho-stroje/

[21] *Industrial robots*. (n.d.). MHI - The Industry That Makes Supply Chains Work. https://www.mhi.org/fundamentals/robots

[22] *Přehled sortimentu robotů FANUC - Fanuc*. (n.d.). FANUC | The Factory Automation Company - Fanuc. https://www.fanuc.eu/cz/cs/roboty/str%c3%a1nka-sortimentu-robot%c5%af

[23] *What is an articulated robot?* (2019). Robots Done Right - Used Robot Sales. https://robotsdoneright.com/Articles/what-is-an-articulated-robot.html

[24] FANUC Czech s.r.o. (2022). *Průmyslové roboty: Jake jsou jejich druhy?* FactoryAutomation.cz. https://factoryautomation.cz/prumyslove-roboty-jake-jsou-jejich-druhy/

[25] *SCARA industrial robots | Stäubli*. (n.d.). Www.staubli.com. https://www.staubli.com/en/robotics/product-range/industrial-robots/4-axis-scara-robots/

[26] Kolíbal, Z. (2016). *Roboty a robotizované výrobní technologie*.

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UDRŽATEĽNÁ SPOTREBA S INOVATÍVNYMI PRVKAMI V MÓDNOM PRIEMYSLE

Dominika Popovičová[1] - Dominika Vernerová[2]

Abstract: *The article deals with the fashion industry and the innovations that affect it in the context of sustainable consumption. In the introductory part it approaches the terminology of the subject, pointing out the importance of sustainability in the fashion industry, the influence of fast fashion and the innovations we are currently dealing with. In the second part we approach the fashion industry and the behavior of consumers in it, revealing their attitudes. The main objective of the article is to identify the main challenges and obstacles that affect innovative processes in the selected area of the fashion industry, based on the review of theoretical approaches and conducting primary research in the field of consumers. At the end of the article, we analyzed the obtained data from the respondents and found significant differences between the behavior of the two groups of respondents, where different attitudes can be observed.*

Keywords: fashion, generation Z, innovation, sustainable consumption

JEL Classification: Q56

ÚVOD

Žijeme v modernej dobe, ktorej spoločnosť je ovplyvňovaná globalizáciou každodenného života ľudí, ktorá môže pozitívne ale aj negatívne ovplyvňovať životné prostredie a kvalitu života ľudí. Veľmi diskutovanou témou je spotrebiteľské správanie konečných zákazníkov, ktoré vytvára do veľkej miery základ fungovania spoločnosti budúcich generácií. V literatúre sa stretávame s novým druhom "udržateľného spotrebiteľa", ktorého správanie je zodpovedné a ktorý prihliada na to, ako jeho spotrebiteľská činnosť ovplyvňuje všetko okolo neho. Môže ísť o zaobchádzanie s potravinami v rôznych fázach životnosti, konkrétnym druhom potravín, ktoré sú predmetom jeho nákupnej preferencie, voľba dopravných prostriedkov, či podpora slow-fashion v maloobchodných reťazcoch. Hlavným predmetom predkladaného článku sú práve inovácie v módnom priemysle, ktoré môžu prispievať k zvyšovaniu kvality životného prostredia rôznymi spôsobmi – či už sa jedná o využívanie prírodných materiálov vo výrobnom procese, moderných technológií, ktoré eliminujú množstvo odpadu, či moderných prístupov, ktoré umožnia spomaliť životný cyklus produktu a zvyšovať jeho kvalitu. Pomocou rôznych nových postupov a používaním modernejších technológií možno hovoriť o pretrvávajúcom hnutí, ktoré presadzuje udržateľný dizajn módnych výrobkov a poukazuje na ich dôležitosť.

1 METODIKA PRÁCE

Hlavným cieľom príspevku je na základe preskúmania teoretických prístupov viažucich sa na problematiku udržateľnej spotreby a realizácie primárneho prieskumu v spotrebiteľskej sfére, identifikovať hlavné výzvy a bariéry vplývajúce na inovatívne procesy a prvky vo vybranej oblasti módneho priemyslu. Východiskovým krokom predkladaného príspevku bolo zhromaždenie a spracovanie sekundárnych zdrojov z profesijnej literatúry a online zdrojov. Sekundárne zdroje slúžili ako relevantný základ pre konštrukciu primárneho prieskumu, ktorý bol realizovaný prostredníctvom elektronického dopytovania formou štruktúrovaného dotazníku. Cieľovou skupinou primárneho prieskumu bola generázia Z, ktorá bola ďalej selektovaná na respondentov zo Slovenska a respondentov zo zahraničia, aby bolo možné dosiahnuté výsledky komparovať a vyvodzovať na ich základe závery pre budúce smerovanie výskumu. Dotazníku sa zúčastnilo celkom 200 respondentov (100 zo Slovenska a 100 zo zahraničia). Na spracovanie sekundárnych údajov boli využívané vedecké metódy syntézy, dedukcie a analýzy. Pri vyhodnotení primárnych údajov sme pracovali s grafickými metódami prevažne v podobe grafov a kontingenčných tabuliek.

2 VÝSLEDKY A DISKUSIA

2.1 Udržateľná spotreba

Spotrebiteľa ako osobu charakterizujú tieto znaky: 1. Nakupovanie výrobkov a služieb na uspokojenie potrieb, 2. je to konečný konzument výrobkov alebo služieb za ktoré si zaplatil, 3. účel konania nemá profesionálny charakter. Podľa Zákona o ochrane spotrebiteľa: „Spotrebiteľom je fyzická osoba, ktorá pri uzatváraní a plnení spotrebiteľskej zmluvy nekoná v rámci predmetu svojej podnikateľskej činnosti, zamestnania alebo povolania". [1] Avšak v modernom svete je životný štýl ľudí založený na enormnom konzume, pričom spotreba má stále rýchlejšiu rastúcu tendenciu, je potrebné svoje spotrebiteľské správanie ako spotrebiteľa zmeniť tak, aby bolo prijateľnejšie, environmentálnejšie a hlavne šetrnejšie k našej planéte. Začína sa spomínať pojem zelený spotrebiteľ, pričom sa jedná o spotrebiteľa, ktorý je uvedomelý v ekologickom smere a všíma si materiál produktov, zaoberá sa otázkou recyklácie a šetrí energiu a životné prostredie. Podľa prieskumu spoločnosti Experian Research Services boli zelení spotrebitelia rozdelení do štyroch skupín:

1. Spotrebitelia so zeleným správaním, ktorí konajú ekologicky a majú negatívny postoj k výrobkom, ktoré znečisťujú životné prostredie.

2. Spotrebitelia so zeleným myslením, ktorí sa snažia myslieť ekologicky, ale ich konanie nie je vždy ekologické.
3. Potenciálni zelení spotrebitelia, sú takí, ktorí sa nesprávajú a neuvažujú ekologicky, ale zostávajú pri kľúčových ekologických otázkach na vážkach.
4. Praví hnedí, ktorí nie sú ekologicky uvedomelí a môžu mať negatívny postoj k takým médiám, ktoré majú veľký dôraz na životné prostredie. [2]

Výskumníci identifikovali tri premenné, ktoré dokážu lepšie klasifikovať definíciu pri zelenom spotrebiteľovi. Zameriavajú sa na environmentálne a sociálne hodnoty, sociodemografické premenné a psychologické faktory. Pri environmentálnych a sociálnych hodnotách je vysoká úroveň environmentálneho aktivizmu,, ktorá je silne spojená s vysokými hodnotami životného prostredia. Taktiež ďalej inklinujú k míňaniu svojich financií na drahšie ekologické produkty v porovnaní s tými neekologickými, pričom majú vysoké vnímanie spojenia človek – príroda, vďaka čomu aj svoje sociálne správanie prispôsobujú práve prírode. Pri sociodemografických premenných sa pozeráme na vývoj rolí, zručností a postojov, ktoré preberajú pri jednotlivom pohlaví. Niektoré štúdie sa zhodujú, že ku environmentálnemu správaniu inklinujú viac ženy ako muži, pričom nakupujú viac ekologických výrobkov a podieľajú sa na separácii obalov určených na recykláciu. Po tretie, existujú psychologickými faktory, ktoré sú osobnými postojmi jednotlivca v súvislosti s príslušným správaním. Psychologické vplyvy zelenej spotreby sa môžu týkať napríklad spotrebiteľskej efektivity, sociálnej zodpovednosti či vernosti značky. Mnoho spotrebiteľov sa snaží svoje spotrebiteľské správanie meniť podľa vplyvu produktov na životné prostredie. Vďaka tomuto trendu, ktorý sa stáva čoraz viac populárny sa stretávame s ekospotrebiteľom. Pri tomto druhu spotrebiteľa hovoríme o jeho ekogramotnosti, čiže o tom, že vníma svojou mysľou potrebu využívať zdroje tak, aby boli zabezpečené aj pre budúce generácie.

Udržateľnosť možno charakterizovať ako uspokojovanie svojich vlastných potrieb bez toho, aby došlo k ohrozeniu budúcich generácií v uspokojovaní ich budúcich potrieb. Udržateľná spotreba je charakterizovaná ako „využitie takých služieb a produktov, ktoré prinesú lepšiu kvalitu do života a zároveň minimalizujú využívanie prírodných zdrojov a toxických materiálov, rovnako ako emisií odpadov a znečisťujúcich látok počas celého životného cyklu služby alebo výrobku tak, aby nebolo ohrozené uspokojenie potrieb budúcich generácií“.[3] Hovoríme tu o pojme spoločenská zodpovednosť, ktorá zdôrazňuje zodpovednosť, ktorú nesú spotrebitelia za svoje správanie počas nákupov a za dopady tohto ich správania pre spoločnosť. Udržateľnosť sa prejavuje aj v nákupnom správaní, pričom spoločensky zodpovedný spotrebiteľ je podľa Frederica Webstera: „Spotrebiteľ, ktorý berie do úvahy verejné dôsledky svojej osobnej spotreby, alebo ktorý sa snaží využiť svoju kúpnu silu, k dosiahnutiu pozitívnej spoločenskej zmeny. Spotrebiteľ túto kúpu výrobku alebo služby považuje za etickú a taktiež aj eticky vyrobenú. Pozerá pri tom na minimálne poškodzovanie ľudského zdravia, životného prostredia a ubližovania zvieratám.“ [4] Hodnota nových atribútov produktu poukazuje na výhody vlastností produktov, ktoré sú ekologické, vďaka čomu získavajú konkurenčnú výhodu oproti neekologickým výrobkom. K správaniu zodpovedného spotrebiteľa možno taktiež zaradiť postoj k separovaniu spotrebovaných tovarov. [5] V neposlednom rade možno udržateľnosť spájať aj s pojmom nákupného správania, ktoré spravidla prebieha tromi fázami: 1. Vstupná fáza, 2. Procesná fáza, 3. Výstupná fáza. Typickým znakom vstupnej fázy správania ekologického spotrebiteľa je jeho záujem o pôvod tovaru prípadne jeho výrobný proces. V procesnej fáze sa pri špecifických kritériách, ktoré zahŕňajú čo najnižšiu klimatickú stopu, snažia zamerať na hľadanie výrobkov, ktoré tieto kritéria spĺňajú. Pri výstupnej fáze, hodnotí spotrebiteľ svoje rozhodnutie a zhodnotí, či je jeho potreba uspokojená. [6]

Súčasťou primárneho prieskumu bola identifikácia úrovne záujmu spotrebiteľov o problematiku životného prostredia. Až 89% respondentov uviedlo, že sa o životné prostredie zaujíma, avšak až 54% aktívne nevyhľadáva informácie o tejto problematike. 11% respondentov sa o životné prostredie nezaujíma. Nasledujúca kontingenčná tabuľka znázorňuje porovnanie odpovedí slovenských a zahraničných respondentov.

Tabuľka č. 1: Zaujímaš sa o životné prostredie? – porovnanie podľa krajín (slovenskí študenti = 1, zahraniční študenti = 2)

Crosstab

		Zaujímaš sa o životné prostredie?			Total
		Áno, zaujímam sa a aj aktívne vyhľadávam informácie o životnom prostredí.	Áno, zaujímam sa, ale aktívne nevyhľadávam informácie o životnom prostredí.	Nie, nezaujímam sa o životné prostredie.	
1	Count	25	66	9	100

kraji na 2	% within krajina	25,0%	66,0%	9,0%	100,0%
	Count	45	43	12	100
	% within krajina	45,0%	43,0%	12,0%	100,0%
	Count	70	109	21	200
Total	% within krajina	35,0%	54,5%	10,5%	100,0%

Zdroj: vlastné spracovanie

Tabuľka č.2

Chi-Square Tests

	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	10,996[a]	2	,004
Likelihood Ratio	11,115	2	,004
N of Valid Cases	200		

Zdroj: vlastné spracovanie

Ako možno vidieť, p = 0,004, tzn., že existujú rozdiely medzi zahraničnými a slovenskými respondentami a za uvedomelejších možno považovať zahraničných respondentov. Na tento fakt poukazujú aj percentuálne výsledky jednotlivých otázok, nakoľko aktívne vyhľadáva informácie až 45% zahraničných respondentov, pričom zo SR je to len 25%. Na základe uvedeného je možné konštatovať, že slovenskí spotrebitelia sú pasívnejší, čo potvrdzuje aj to, že 66% z nich uviedlo, že nevyhľadávajú informácie o životnom prostredí.

Kľúčovou otázkou prieskumu bola aj otázka týkajúca sa spôsobu, akým respondenti pozitívne ovplyvňujú životné prostredie. Najviac respondentov sa zhodlo na odpovedi, že triedia odpad, kupujú produkty z recyklovaného materiálu, nenakupujú zbytočne veľa oblečenia, zbierajú odpadky okolo seba a neplytvajú jedlom. Pri zahraničných študentoch sa objavila jedna odpoveď viac ako pri slovenských a to, že jazdia často na bicykli, prípadne, že nevyužívajú svoj automobil pokiaľ to nie je nutné, túto odpoveď sme pri slovenských študentoch nezaznamenali. Z pohľadu faktorov, ktoré najviac ovplyvňujú ich nákupné rozhodovanie bola pre slovenských respondentov kľúčová kvalita, zloženie a pomer ceny a kvality. Pre zahraničných respondentov pomer ceny a kvality nezohrával až takú dôležitú úlohu, naopak rozhodujú sa aj na základe toho, odkiaľ výrobok pochádza.

2.2 Módny priemysel a jeho vplyvy na životné prostredie

Módny priemysel zahŕňa viac ako 92 miliónov ton odpadu vyprodukovaného ročne a 79 biliónov litrov spotrebovanej vody. Ekologický založený spotrebitelia sa snažia o zníženie svojich nákupov odevov a snažia sa zvýšiť životnosť odevov, ktoré už vlastnia. Tieto zmeny zdôrazňujú potrebu urýchleného prechodu späť k "pomalej" móde, minimalizácii a zmierniť škodlivé vplyvy na životné prostredie, aby sa zlepšil dlhodobý udržateľnosť dodávateľského reťazca v oblasti módy. [7] Pri fast fashion nehovoríme len o rýchlosti výroby oblečenia, ale hovoríme aj o preberaní nových trendoch v malých časových intervaloch, ktoré udáva celosvetový módny trend. Oblečenie je vyrábané v masovej výrobe pri vidine predania čo najväčšieho počtu s vidinou zisku bez ohľadu na to, ako to ovplyvňuje životné prostredie. K takýmto spoločnostiam, ktoré sú známe týmto konceptom sú napríklad Zara, Pull & Bear, H&M. [8] Pre príklad uvedieme, že výroba jedného páru džínsov si vyžaduje stovky litrov vody, pesticídy, čistiace prostriedky a tisíce kilometrov cesty, pokým sa dostane do obchodu, kde si ich môžeme zakúpiť. Cesta takéhoto kusu oblečenia pritom vyzerá nasledovne. Základná surovina sa pestuje, respektíve spracováva zvyčajne v Indii a to bavlna. Niť na šitie získame v Pakistane, rifľovinu získame v Číne, avšak rifle môžeme v skutočnosti pre lacnú pracovnú silu ušiť a oprať v Turecku. Zips ako substitút pre rifle môže byť k dispozícii za dobrú cenu znova na druhej strane planéty a to v Japonsku. Celý tento výrobný proces aby sme dostali jeden pár riflí môže predstavovať vzdialenosť až 65 tisíc kilometrov, pokým sa dostane do Európy. [9] Proti fast fashion bojuje organizované sociálne hnutie Fair Trade, ktoré je považované za spravodlivý obchod a zobrazuje obchodné partnerstvo založené na dialógu, transparentnosti a rešpekte, ktorého stratégiou je spolupráca s výrobcami a pracovníkmi v prospech zodpovedných spotrebiteľov, ale aj výrobcov. Nákup výrobkov je v súlade s prísne vymedzenými normami a môže tak urobiť svet spravodlivejším a poskytnúť spoločnosti dôstojnú životnú úroveň. Sociálne hnutie Fair Trade má za svoj cieľ zlepšiť životné podmienky poľnohospodárov a pracovníkov v rozvojových krajinách. Na dosiahnutie týchto cieľov sa snažia splniť niekoľko usmernení, medzi ktoré radíme napríklad určovanie spodnej hranice cien, zabezpečovanie bezpečných pracovných podmienok, či ochrana životného prostredia pri ktorej dochádza k nahrádzaniu štandardných vstupných materiálov prírodnými a biologickými metódami.

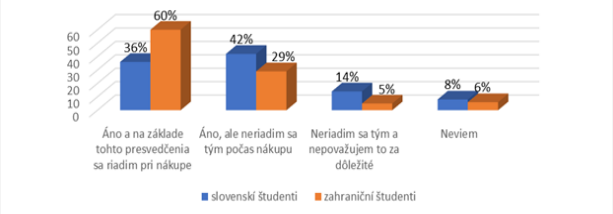
V súvislosti s pozitívne hodnoteným ekologickým oblečením sa v terminológii čoraz viac objavuje výraz slowfashion. Možno povedať, že tento nový fenomén spĺňa všetky atribúty pre ekologicky založených spotrebiteľov a neovplyvňuje životné prostredie negatívnymi vplyvmi a taktiež ani budúce generácie. Slow fashion bol definovaný v roku 2008 Kate Fletcherovou ako nadčasová móda, ktorá vychádza z trvalo udržateľného princípu a neriadi sa často meniacimi módnymi trendami. Dôraz je kladený najmä na kvalitu, výrobný proces textilných výrobkov. [10] Čoraz viac spotrebiteľov sa zaujíma o výrobný proces, čo by malo viesť výrobcov používať lokálne materiály,

čím by obmedzili logistiku výroby na užšie okolie a výrobok by neprecestoval celý svet len kvôli tomu, aby sa dostal ku konečnému spotrebiteľovi. V rámci módneho priemyslu môžeme hovoriť o normalizácii udržateľných princípov, ktoré poukazujú na to, že pri realizovaní nákupu sa do rozhodovacieho procesu dostáva aj etický aspekt. Tento aspekt tvorí pre spotrebiteľa normu a očakáva, že značka ktorú si vybral pre svoj nákup sa správa udržateľne a angažuje sa v tejto oblasti naplno a nevyužíva len greenwashing na získanie si zákazníkov, ale naozaj tvorí svoje výrobky s udržateľným prístupom. [11] Pri podpore slow fashion sa vyvíja nový udržateľný trend tzv. kapsulový šatník. Jednotlivec sa snaží svoj šatník udržiavať na obmedzenom množstve kusov oblečenia, zvyčajne sa jedná o 40k. pričom toto oblečenie je ľahko kombinované a je nadčasové z módneho hľadiska. Nadšenci udržateľného rozvoja, ktorí sa pozerajú na svoje spotrebiteľské správanie a jeho dôsledky a vďaka ktorým možno túto myšlienku ďalej rozvíjať, sú kľúčovým faktorom pre zachovanie našej planéty budúcim generáciám. [12]

Je všeobecne známe, že výroba textílií a odevov prispieva približne 10 percentami k celkovej mase emisií uhlíka v životnom prostredí. Farbenie textílií je asi pätinovým znečisťovateľom našich vôd. Dennodenne sú vyvíjané nové a inovatívne techniky produkcie textilných materiálov, ktoré znižujú tento negatívny vplyv. Vo výrobe sa čoraz viac používajú nanotechnológie a nanomateriály či prírodné materiály. Nanomateriály sa integrujú do produkcie textílií s dôrazom na ich hlavné prínosy, medzi ktoré patrí okrem nákladovej a energetickej efektivite aj eko-udržateľnosť či možnosť recyklácie. Využívajú sa najmä na pripevnenie antibakteriálnych povrchových úprav na tkaniny. Nové textilné vlákna sú produkované z rias, ktoré sa nazývajú kelp a môžu byť farbené prírodnými pigmentmi a degradované na prírodnej báze. Prírodné textilné vlákna, získavané zo semien zrelých plodov vlnovca, známe aj ako kapok, slúžia ako zdroje prírodných priadzí, výplní a vláken. V súčasnosti si na svoje prídu aj vegánski milovníci kože, ktorá pochádza z povrchového pektínu jabĺk, čím vzniká kompostovateľný prírodný materiál. Kožu už vieme vytvoriť aj v laboratóriu z vláken kolágenu. [13]

V spojitosti módneho priemyslu a udržateľnosti nás ďalej zaujímalo, či respondenti vnímajú kombináciu týchto dvoch pojmov, a či to má nejaký vplyv na ich nákupné správanie

Graf 1: Spojitosť udržateľnosti s módnym priemyslom



Zdroj: vlastné spracovanie

.

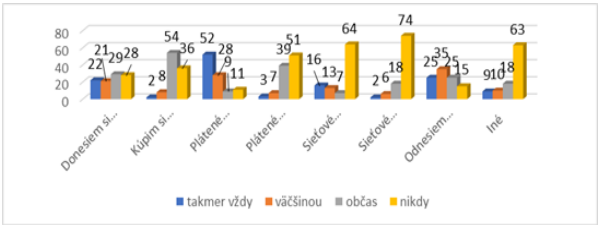
Pri zahraničných 100 opýtaných až 60% z nich sa týmto výrokom riadi, zatiaľ čo pri slovenských študentoch sa tým riadi len 36% zo 100 opýtaných. 42% študentov zo Slovenska s týmto výrokom súhlasí, ale neriadia sa tým a až 14% študentov to nepovažuje za dôležité. Pri zahraničných s týmto výrokom súhlasí 29% študentov, ale neriadi sa tým a len pre 5% študentov to nie je dôležité a neriadia sa tým.

Nakoľko jedným zo spomínaných trendov udržateľnej spotreby v oblasti módy je koncept kapsulového šatníka, do prieskumu bola zaradená aj otázka týkajúca sa tejto problematiky. 20% slovenských a 25% zahraničných respondentov uvádza, že tento koncept pozná a riadi sa ním, 24% slovenskýc a 16% zahraničných respondentov ho pozná, ale neriadi sa ním a 56% slovenských a 59% zahraničných respondentov sa s týmto pojmom zatiaľ nestretlo. Tu možno pozorovať vyššiu informovanosť slovenských spotrebiteľov o danej problematike.

Na základe teoretických východísk týkajúcich sa udržateľnej (zelenej) spotreby možno konštatovať, že zeleného spotrebiteľa možno rozoznať aj na základe toho, ako si odnáša svoj nákup z obchodu. Na základe prieskumu, v ktorom boli porovnávaní slovenskí a zahraniční respondenti možno konštatovať, že respondenti nepochádzajúci zo Slovenska viac inklinujú ku sieťovým vreckám a takmer nikdy si nekúpia alebo neprinesú plastovú tašku. Takýchto zahraničných študentov, ktorí uprednostňujú sieťové vrecká bolo zo 100 opýtaných až 22% oproti 16% tých slovenských a tých ktorý si nekupujú plastovú tašku je až nadpolovičná väčšina zo zahraničia oproti 36% slovenských študentov, ktorí si ju nikdy nekúpia.

Graf 2: Spôsob pre odnesenie nákupu z obchodu (slovenskí študenti)

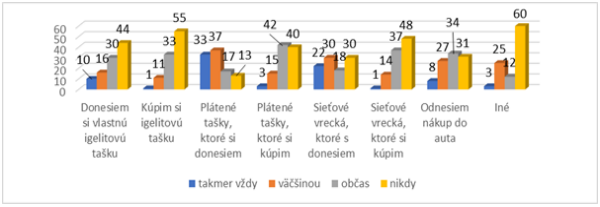
(údaje sú uvedené v %)



Zdroj: vlastné spracovanie

Graf 3: Spôsob pre odnesenie nákupu z obchodu (zahraniční študenti)f

(údaje sú uvedené v %)



Zdroj: vlastné spracovanie

ZÁVER

Módny priemysel je v súčasnosti rýchlo rastúcim odvetvím. Čoraz vyššie požiadavky sa kladú na tzv. „fast fashion“. Tento typ produkcie oblečenia má výrazný negatívny dopad na environmentálne prostredie. Mnohé značky sa snažia uberať smerom inovatívnych spôsobov znižovania množstva odpadov, zlepšenia možností recyklovania či zvyšovaním povedomia o tzv. upcyklácii. Ide o proces, pri ktorom dochádza k premieňaniu odpadových materiálov či nepotrebných produktov na nové materiály a produkty lepšej kvality. Avšak aby sme mohli módny priemysel považovať za udržateľný, musia spolupracovať obe základné skupiny, výrobcovia aj spotrebitelia. Jednou z možností, ako dosiahnuť zníženie negatívneho dopadu textilnej produkcie na životné prostredie, je efektívny klesajúci trend dopytu zákazníka, čím sa automaticky dosiahne pokles predaja módneho priemyslu. [14] Hlavným cieľom článku bolo zosúladiť teoretické vedomosti o inováciách, využiteľných v módnom priemysle v zmysle udržateľnosti kvality životného prostredia. Článok bol však zameraný aj na dáta, získané elektronickým dopytovacím dotazníkom od respondentov z generácie Z. Na základe prieskumu je možné skonštatovať, že doposiaľ vidíme markantné rozdiely medzi respondentmi zo zahraničia a zo Slovenska. Porovnanie ukázalo, že zahraniční respondenti sú v otázke udržateľného módneho priemyslu uvedomelí viac ako respondenti zo Slovenska, pričom taktiež majú zvýšené povedomie o možnosti stať sa tzv. zeleným spotrebiteľom. Inovatívne metódy recyklovania, upcyklácie, opätovného používania či repasovania odevov a textílií sú však krátkodobým prínosom. Skutočný pozitívny dopad by mohlo mať vytvorenie nových cyklických obchodných modelov, ktoré už v počiatočnom koncepte zohľadňujú celkový životný cyklus odevu a samotného dizajnu. Ak chceme maximalizovať hodnotu každého kúsku, je nutné mu dopriať viacero šancí na život [14].

REFERENCIE

[1] Zákon č. 40/1964 Zb. Občiansky zákonník s účinnosťou k 1.12.2019. § 52

[2] POLLACK, Birgit Leisen. Green service attributes and amplifiers of the warm emotions evoked by them. Journal of Service Theory and Practice. [online].2021.[cit 2022-16-01]. Dostupné na: https://www.emerald.com/insight/content/doi/10.1108/JSTP-07-2020-0163/full/html

[3] Sustainable consumption and production policies. [online].2021.[cit 2022-21-01]. Dostupné na: https://www.unep.org/explore-topics/resource-efficiency/what-we-do/sustainable-consumption-and-production-policies

[4] JANČOŠEKOVÁ, M.. Zodpovedné správanie spotrebiteľov: bakalárska práca. Bratislava, 2012, 50 s. Obchodná fakulta EU. Školiteľ D. Vokounová

[5] KULČÁKOVÁ, Marta - Kornélia RICHTEROVÁ. Spotrebiteľ na trhu: faktory stratégia reakcie. Bratislava: Sprint, 1997. ISBN 80-88848-19-9.

[6] SÚKENÍKOVÁ, Katarína. Proces nákupného rozhodovania: štúdia publikovanej terminológie a názorov. Studia commercialia Bratislavensia. 2017. 9s.

[7] United Nations Climate Change. *UN helps fashion industry shift to low carbon*. [online]. 2018 [cit 2022-25-01]. Dostupné na https://unfccc.int/news/un-helps-fashion-industry-shift-to-low-carbon

[8] CROFTON, Stephanie - Luis DOPICO. Zara-Inditex and the growth of fast fashion. Essays in Economic & Business History. [online].2007[cit 2022-26-01]. Dostupné na: https://www.ebhsoc.org/journal/index.php/ebhs/article/view/181

[9] Fast fashion: čo je to rýchla móda a prečo ju musíme poraziť. [online].[cit 2022-26-01]. Dostupné na: https://ecohero.sk/rychla-moda/

[10] FLETCHER, Kate. Slow fashion: An invitation for systems change.[online].2010[cit 2022-26-01]. Dostupné na https://www.tandfonline.com/doi/abs/10.2752/175693810X12774625387594?casa_token=Sr2NmqyDYc0AAAAA:PWsCtbVCJsv1vD_B_M2kx8oLGAazoYR9xLCfq_jQ6AgFMLbobhOIfQf-PRhxb89uJTBBTDgEb588

[11] ARMSTRONG, Kate et al. The Epiphanic Sustainable Fast Fashion Epoch: A New Fashion Ethical Fashion Mandate. Springer International Publishing. 2017. ISBN 978-3-319-51252-5.

[12] DRUGDOVÁ, Zdenka Musová–Jennifer. Udržateľné odievanie ako nový trend v kontexte princípov kru-hovej ekonomiky. Studia commercialia Bratislavensia. 2021

[13] SHAH, Mudasir Akbar et al. Applications of nanotechnology in smart textile industry: A critical review. In *Journal of Advanced Research*. 2022. Dostupné na: 10.1016/j.jare.2022.01.008.

[14] MOORHOUSE, Debbie. Making Fashion Sustainable: Waste and Collective Responsibility. In *One Earth*. 2020. Dstupné na: 10.1016/j.oneear.2020.07.002.

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BUSINESS MODEL OF A RETAIL UNIT BASED ON THE ASSORTMENT POLICY OF A SELECTED FOOD RETAIL NETWORK IN THE ERA OF DIGITALIZATION

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Abstract: *The article contains business model of a retail unit based on the assortment policy of a selected food retail network in the era of digitalization. The paper included assortment policy for a specific retail chain is elaborated and summarized. A separate part is the evaluation of the assortment from Slovak suppliers to the given chain. The article also contains information about current trends in marketing in relation to digitization in retail chains.*

Keywords: business model, digitalization, assortment, food retail, marketing

1 INTRODUCTION

In today's global environment, marketing is constantly changing and developing. This fact brings many opportunities for retail chains to use new marketing trends and technologies, with the help of which they can get closer to the demands of their and potential customers and thereby create a better position on the market. The current pandemic situation also affects marketing in retail chains, especially in the area of production and sales. Retail marketers must implement various measures, procedures and changes, either by expanding the product portfolio or overall transformation, and also apply new marketing strategies when communicating with customers. It would be naive to think that proven marketing strategies will work as reliably as they did before the pandemic. Many retail companies implement their marketing strategies through online marketing tools to bring new trends to the market. Today, digital marketing is an increasingly used form of selling and promoting products and services.

This article is output of project VEGA 1/0012/22 Innovative business models of retail unit formats based on geomarketing data and their impact on the creation of value proposition and food retail network in the era of digitization.

2 NEW TRENDS IN MARKETING

According to (American Marketing Association, 2017) Marketing is an activity, a set of institutions and processes for creating, communicating, delivering and exchanging offers that have value for customers, clients, partners and society as a whole".

Marketing, as defined by (P. Kotler et al. 2007), is a social and managerial process through which individuals and groups obtain what they need and want through the creation and exchange of products and value with others. Identifying consumer needs and wants is a critical aspect of marketers' role. Marketing strategies must be based on known consumer needs."

"Marketing is the effort to adapt organizations to consensual markets in order to influence the behavior of their audiences in their favor through an offer whose perceived value is consistently higher than that of the competition" states (Lendrieve et al, 2006).

According to (P. Kotler and G. Armstrong, 2004), "marketing is defined as a social and managerial process through which individuals and groups satisfy their needs and wishes in the process of production and exchange of products or other values."

(O.C. Ferrell and W.M. Pride, 2006) define marketing as "the process of creating, distributing, promoting, and pricing goods, services, and ideas to facilitate satisfying customer exchange relationships in a dynamic environment."

(K.L. Keller, 2014) states that the term marketing has two basic definitions, social and managerial. Spoločenská defines marketing as "the process by which individuals and groups obtain what they need and want, and during which they create, offer, and freely exchange products and services that have value." From a managerial perspective, marketing is considered the art of selling products. "

Marketing is generally referred to as the process of planning and implementing activities that are designed to meet the needs or wants of customers. Marketing pays attention to product development, pricing, promotion and distribution. It aims to create an exchange where the customer gives up something (usually money) for a product or service that they believe is of equal or greater value. Although the term product directly refers to tangible objects, it is quite common to use it to represent the entire offering for consumers including services. The goal of marketing is not only to entice people to try products or services, but also to retain them as long-term customers, writes (Aaron C.T. Smith and B. Stewart, 2015).

(P. Kotler et al, 2016) present a simple five-stage model of the marketing process. The first four stages express that companies work to understand consumers, create value for the customer and build strong relationships with customers. Ultimately, companies will benefit from creating superior customer value. By creating value for consumers, they in turn gain value in the form of sales, profits and a long-term equal relationship with customers. This model consists of the following stages:

1st level of understanding the needs and wishes of customers and the market,

2nd stage of designing a marketing strategy focused on the customer,

3rd stage of creating a marketing program that will bring extraordinary value,

4th stage of building profitable relationships and creating pleasure for customers,

5th degree of capturing value from customers and creating profits and quality.

With the advent of new technologies, marketing is constantly changing and developing. There are always new applications, various new tools and ways to get the attention of customers. Marketers must also adapt to new trends, through which they will perform a more effective selection of the target market and provide better values and communication to customers. Marketers say that the customer's first experience with a product should be positive, because the consumer chooses products more carefully, needs more information about products, is looking for the best offer and price. That is why marketing must fulfill demanding tasks and look for new forms of marketing communication. The more the market saturated with goods, the use of marketing technologies is more important. The creative enthusiasm, ideas and thinking of marketers is the basis of success. Among the new trends in marketing, we primarily include digital marketing, viral marketing, guerilla marketing.

Digital marketing is “a general term for the targeted, measurable and interactive marketing of goods or services using digital technologies to reach and convert potential customers into customers and retain them. The main objective is to promote brands, shape preferences and promote sales through several digital marketing techniques" (WSI, 2013).

Digital marketing is a form of marketing that reaches consumers through digital channels while offering products and services. The key goal of digital marketing is the promotion of brands of products and services mainly via the Internet and through other online technologies such as computers, mobile phones, tablets and other digital media and platforms. Digital marketing can cover more traditional areas of marketing such as direct marketing by providing the same method of communicating with the audience but in a digital way. Digital marketing has changed the way businesses and other organizations communicate with their audiences. Consumers now have access to a much greater selection of entertainment, products, services and prices from a variety of suppliers and a more convenient way to select and purchase items. Organizations have the opportunity to expand into new markets, offer new services, interact with audiences in new ways, and compete on a more equal footing than larger businesses. Business people working in these organizations have the opportunity to develop new skills and use these new tools to increase the company's competitiveness. Therefore, digital marketing should be one of the main focuses of the overall marketing strategy in almost every business. The basic types of digital marketing include (D. Chaffey and F.E. Chadwick, 2019).

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1. Search engine optimization.
2. Content marketing.
3. Social media marketing.
4. Pay-per-click marketing.
5. Affiliate marketing.
6. Native advertising.
7. Marketing automation.
8. Email Marketing

The author (M. Petrescu, 2014) defines viral marketing as "an online and offline market of activities carried out with the aim of influencing consumers by transmitting commercial messages and content to other consumers in their social network".

According to (M. Kaplan and M. Haenleian, 2011), viral marketing is "an electronic method of communication where some form of marketing message regarding a company, brand, or product is transmitted in an exponentially growing manner, often using a social media application."

Viral marketing offers consumers various incentives to spread the word on their social networks. These incentives usually come from the entertainment potential of marketing messages, especially when it comes to viral ads, but there can also be material and financial incentives in the form of discounts, lottery entries or other rewards. Viral marketing helps businesses build a new customer base and improve brand image at a very low cost through consumer-to-consumer communication. It is based on the concept of incentivizing commercial recipients of messages to transmit messages to members of their network, thereby creating the potential for exponential growth in message dissemination capacity and efficiency (K. Libert and K. Tynski, 2013).

Viral marketing involves online marketing strategies and actions to identify consumers who will forward, usually in their original form, a commercial message to members of their social network to create large-scale peer-to-peer viral diffusion. Viral marketing can take the form or forms of various marketing tools and techniques. Among the most well-known and widely used forms of viral marketing is viral advertising, the creation of advertisements that are creative, entertaining or shocking enough to convince consumers. However, we also analyze other tools, such as blogs, social media posts, updates and newsletters (M. Petrescu and P. Korgaonkar, 2011).

Guerilla marketing is a type of marketing, the main goal of which is to use not only financial, but also creative and intellectual resources. More attention is paid to bold, modern ideas and encourages the investment not of money, but of time, energy, imagination and information. (K. Lun and R. Yazdanifard, 2014) state that guerilla marketing is "the activity of how, in an unconventional way, companies can increase public awareness of a brand, product or service at relatively low cost by creating a surprise and diffusion effect." Although traditional and guerilla marketing have many features in common, guerilla marketing is much more advanced and adapted to the changing market and technology of the time. It therefore represents a creative and innovative marketing strategy

for a product brand, where the customer gets a much greater impression than in the case of traditional forms of advertising. Guerrilla marketing strategies are mainly aimed at small and medium-sized businesses that have a small budget. The purpose of guerilla marketing is to tilt a company's marketing efforts from as much as possible to the most accurate target audience. The collection, processing and use of information is one of the main elements of guerrilla marketing, and as a result of the development of this marketing method, knowledge and communication with customers, information about them is an important part of the whole set. Guerilla marketing reaches the consumer at moments and places where his advertising consciousness is not active, that is, when he least expects it. (M. Išoraité, 2018) state the main principles of guerrilla marketing:

1. measuring success by profits, not by sales,
2. instead of prioritizing new customers, it prefers to increase the number and size of transactions from existing customers and obtain referrals,
3. focus messages on small groups instead of mass audiences,
4. focus on obtaining the consumer's consent to send additional information,
5. skip campaign tracking effective frequency instead of creating a new message.

Companies that apply guerilla marketing must monitor competitors' marketing campaigns and stay in touch with the latest trends. They must also be aware of what is happening in the world and the situation in the immediate vicinity, otherwise they could fall behind their competition.

3 ANALYSIS OF THE ASSORTMENT STRUCTURE OF LIDL

In this part, we focused on a detailed analysis of Lidl's assortment structure in the area of social responsibility. One of the main factors of Lidl's business strategy is the use of its own private brands. It is thanks to these private brands that the Lidl retail chain brings its customers the best price-quality ratio on the market for a long time. Currently, Lidl offers more than 200 private brands, which account for 80% of the total assortment. As part of its business interest, Lidl brings products with a positive impact on the environment and constantly increases the volume of products with sustainable certification. At the same time, Lidl also focuses on pre-selection of products, which makes shopping easier for customers and gives them the opportunity to save. Lidl has approximately 2,000 such products, which are represented in a permanent assortment.

Food assortment Sustainable fishing and meat products: the goal of the discount chain is to offer customers only products that meet the conditions of ecological responsibility and come from sustainable sources. Since 2019, Lidl has included only MSC certified raw materials for items such as: fresh fish, deep-frozen fish, fish delicacies and canned fish in its permanent assortment of private brands. Thus, the chain does not include endangered species of fish and marine animals in its assortment. As part of the sale of fish meat products, Lidl has become a member of the international control program "Dolphin Safe," which is aimed at protecting dolphins and other marine animals. All canned tuna products that are marked with the "Safe" logo indicate that the chain participates in the protection of dolphins, which are endangered by tuna fishing. It is true for Lidl that it offers fish and other aquaculture products exclusively from natural farms. With this, Lidl wants to increase the consumption of fish and seafood and increase customer interest. In order to maintain transparency, the packaging of all private label fish products must contain the following information:

- Slovak designation,
- Latin designation,
- hunting area,
- hunting method,
- country of origin (Lidl, 2021).

In the area of meat products, Lidl adheres to high standards and contributes to the development of conventional poultry farming. He therefore prefers high quality products from ecological and sustainable agriculture. An average of 30% of meat products for the 2019 business year came from Slovak suppliers. The discount chain offers in its assortment two private brands oriented towards meat products, namely: Dulano and Pikok Pure.

Fresh fruits and vegetables: The basic principle of the discount chain in maintaining the freshness of fruits and vegetables is to ensure food safety. When it comes to the freshness of these products, their storage and logistics are also important. Together with its suppliers and growers, Lidl launched a program aimed at permanently reducing pesticides in the entire range of fruit and vegetables. Based on this program, the discount chain has determined its own limits for the freshness of fruits and vegetables, which ensure the maximum possible protection of consumers. We can see that the determined limits of the active substance must not exceed more than 33.3% of the maximum limit determined by law. Due to the permitted maximum limits, the sum of all active substances must not exceed 80%. The number of detected substances in one product can be no more than 5, and the percentage content of one active substance residue cannot exceed 100%.

Certified cocoa, coffee and tea: the company Lidl is increasingly expanding its offer of private label products with products that come from certified agricultural production. To achieve sustainable production, the chain cooperates with international organizations that ensure certification such as: Fairtrade, Fairtrade Cocoa Program, Rainforest Alliance, Bio and UTZ. When growing these Fairtrade ingredients, Lidl supports small farmers and ranchers by creating adaptation projects, courses and training for them to provide them with knowledge about better quality, more productive, more sustainable cultivation and how to adapt to climate change. This means that the raw materials they grow must meet social, economic and ecological criteria according to certification standards. Customers can find such Fairtrade products in Lidl stores mainly under private brands such as: Favorina, Getatelli and J.D. Gross.

The Fairtrade Cocoa program allows cocoa producers to increase sales through new marketing channels while respecting trade conditions. The Fairtrade Cocoa label is displayed by the chain only on the packaging of products with 100% cocoa content. Lidl also supports the global UTZ program, with the help of which the chain uses cocoa with UTZ certification in its products of the private brands Fin Carré and Mister Choc. The offer of the permanent assortment includes special products that are intended especially for consumers who have food intolerances, allergies or are interested in healthy nutrition. The chain has thus expanded its offer to include products with a low lactose content, gluten-free products and vegan products. A separate category consists of BIO products originating from organic farming, that is, they do not contain any preservatives or growth stimulants and no chemicals were used in their cultivation.

Table no. 4 Number of Lidl private label products with certifications sustainability

	Názov Certifikácie	Year 2020	Year 2021
1	BIO	154	170
2	Fairtrade	164	191
3	FSC	37	48
4	Rainforest Alliance	5	13
5	UTZ	346	395
6	MSC	60	76

Assortment from Slovak suppliers: The retail chain Lidl created the project "Make yourself known," the goal of which is to find and establish cooperation with Slovak local suppliers with whom they have not previously cooperated. As part of the project, Lidl approached members of the Food Chamber of Slovakia and the Slovak Chamber of Agriculture and Food. The discount chain also this project communicates through its leaflet. When selecting offers from suppliers, Lidl has a superimposed purchasing model in such a way that it prefers a Slovak supplier to a foreign one. Following on from these activities was also the introduction of Slovak products in the themed weeks "Made in Slovakia." With this offer, Lidl takes into account products typical of Slovakia and supports mainly Slovak dairy farmers and fruit and vegetable growers. Lidl applied these activities across the board, so customers could buy Slovak products in all stores. Over the last monitored period, Lidl increased the share of Slovak products in its turnover by 25%

Currently, the company Lidl has introduced a new private brand "Slovenskô" to its product range. The private brand Slovenskô provides a wide range of high-quality Slovak products, from vegetables, meat products, dairy products to bakery products. With this project, Lidl continues to support the Slovak food industry and agriculture. . The private brand is easily distinguished from other products and is visually unified. For customers who prefer Slovak products, this private brand will make it easier to choose when shopping. As part of this project, the discount chain cooperates with Slovak suppliers such as: Tatranská mliekareň and Zeleninárska družstvo, whose products are also found among the range of private brands.

We can see that the Kaufland retail chain is characterized by the highest number of displayed Slovak products. On average, Kaufland has 6,482 pieces of Slovak products, which represents a year-on-year increase of 574 exhibited Slovak products. Depending on the width of the product range, the percentage of Slovak products in the Kaufland chain makes up 40% of the total number of products. In second place in the number of 5179 pieces of Slovak products is Tesco. However, it recorded a year-on-year decrease of 109 products, which is a 39% share of the total number of exhibited products. The Billa retail chain has an average of 2180 pieces of Slovak products, which is 79 pieces less than in 2019. The percentage of Slovak products is thus 40%. As we can see, the largest year-on-year decrease in number, but also in percentage shares, was achieved by the company Coop Jednota, which has 1281 pieces of Slovak products, which is 48% of the total number of exhibited products. From the graph, we can see that even though the Lidl retail chain has the least number of Slovaks exposed as a percentage of products, so every year it increases the share of products from Slovak suppliers in its assortment. In 2020, Lidl had an average of 1,252 pieces of exhibited Slovak products, which is 111 more than in 2019. As a result of the growing support of Slovak suppliers, the Lidl chain increased the percentage of Slovak products by 4% year-on-year, which makes up 24% of the total number of exhibited products. Currently, the retail chain CBA has the largest percentage of displayed Slovak products, 52%, which represents an average of 1,234 displayed Slovak products.

We can see that the purchase price for Slovak products from 2015 to 2021 is growing at an exponential rate, increasing also the percentage difference between individual business years. At the end of 2021, the value of goods from Slovak suppliers reached an average of 266 million euros, which was a 15% increase compared to 2018. The graph shows that the number of Slovak suppliers who increase the value and share of their products in Lidl's assortment is growing every year.

4 CONCLUSION

As a discount chain, Lidl continues to promote the strategy of low prices and high quality. In the area of social responsibility, this means that the chain wants to offer its customers a wide range of high-quality products that are fully certified and come from sustainable sources with regard to a gentle approach to the environment. As for the retail sector, Lidl is a relatively strong player in the field of social responsibility compared to its competitors on the Slovak market. As part of social responsibility, the business chain focuses on long-term activities and goals that connect to each other and help achieve greater social changes. Lidl has set the following goals in the area of assortment:

- Continuous expansion of the permanent assortment and time-limited offers with products with sustainability certification.

- Reduction of salt and sugar content in private label products by 20% by 2025.
- Increasing the share of the value of products from Slovak suppliers by 20% by 2021.

Based on the data obtained by performing several analyses, such as macro- and micro-environment analyses, SWOT analyzes and analyzes of Lidl's assortment structure, we tried to create individual proposals for improvement and recommendations in the area of its assortment, as one of the segments of social responsibility in the marketing sector, which could help eliminate risks and its weaknesses and also help the company in promoting and selling its private label products. Subsequently, we proposed several recommendations and suggestions for improvement. Among the first recommendations that could improve the sale and promotion of private label products with sustainability certification is the inclusion of a food assortment in the e-shop. We think that the introduction of food into an online e-shop would represent an easier and faster way for many consumers to purchase food, and at the same time it would also attract a new group of customers. As for its competition, we think it would be a step forward, because the other retail chains in the Slovak market, apart from the Tesco chain, only offer a non-food assortment through online sales. However, after communicating with the Lidl company, we came to the conclusion that it would be a rather complex process and the company does not yet plan to include the food assortment in the e-shop, because it wants to continue to expand the range of non-food products and thus bring stable and functional products to our customers. However, Lidl does not rule out such an alternative of online food sales in the future. The second recommendation we would suggest for Lidl is the introduction of service counters with meat and dairy products. In such a counter sale, the discount chain would offer mainly meat products, fresh fish and fish delicacies, a mixture of salads and dairy products, especially cheeses. We think that with such a step, the Lidl company could increase the promotion of products and at the same time strengthen the interest of customers in private label products from free range and sustainable sources. By selling over the counter, the chain would at the same time point out the freshness of the given products and highlight their level of quality.

Another suggestion for improvement could also be the introduction of an online blog on Lidl's website, which would be focused on the product range in the area of social responsibility. This means that the content of the blog would consist of private label products mainly oriented towards sustainability, about which detailed information would be provided, such as product composition, production process, price, supplier, country of origin, quality level, source and sustainability certification. These products would be divided into different sections and sorted by category, so each product would be specified separately. Basically, it would be something like a Lidl kitchen blog. Customers would thus be able to find out more detailed information about private label products, and would also become familiar with the area of social responsibility, which would allow Lidl to gain new customers and thus increase sales of the given products. Regarding the representation of Slovak products in Lidl, we can say that the share of products from Slovak suppliers is very low compared to the competition. However, Lidl is gradually trying to solve this shortcoming. Currently, the discount chain has introduced a new private brand Slovenskô into its permanent assortment, under which only products from Slovak suppliers are included. We would not propose any changes in this area, as the company has set long-term goals, with the help of which they should increase the total share of Slovak products up to 30%. Thanks to this, we evaluate this project as the right step for the support of Slovak suppliers and Slovak agriculture. We also have nothing to suggest in terms of overall social responsibility, because the Lidl company has its usual strategies and set goals, which it tries to apply to the developing new trends.

REFERENCES

[1] Kotler, P. et al.(2007). *Moderní marketing.* 4. Grada Publishing, a.s.

[2] Lendrieve, J. et al. (2006). *Mercator: Théorie et pratique du marketing,* Dunod.

[3] Kotler, P. - Armstrong, G. *Marketing,* Grada Publishing, a.s.

[4] Pride, W., & Ferrell, O.C. (2016) *Marketing.* Cengage Learning.

[5] Kotler, P. & Keller, K. *Marketing management.*(2014) Pearon Education Limited.

[6] Smith, A. & Stewart, B .(2015). *Intorduction to sport marketing.* Routledge.

[7] Kotler, P. & - Armstrong, G. (2016) *Principles of marketing.* Pearon Education Limited,

[8] WSI. (2013) *Digitak minds: 12 things every business needs to know about digital marketing.* Friesenpress.

[9] Chaffey, D. - Chadwick, F. (2019) *Digital marketing.* Pearson.

[10] Petrescu, M. (2014) *Viral marketing and social networks.* Business Expert Press, LLC.

[11] Kaplan, A. & Haenlein, M. (2011) *Two hearts in three-quarter time: How to waltz the social media/viral marketing dance.* Elsevier, 253 – 263. Retrieved from: http://www.sciencedirect.com/science/article/pii/S0007681311000152 [accessed: 4 October 2022].

[12] Libert, K. & Tynski, K. (2013) *Research: The emotions that make marketing campaigns go viral.* Harvard business review, 1-7. Retrieved from: https://hbr.org/2013/10/research-the-emotions-that-make-marketing-campaigns-go-viral [accessed: 19 April 2022].

[13] Petrescu, M. & Korgaonkar, P. (2011) *Viral advertising: Definitional review and synthesis.* Haworth Press, 208 – 226. Retrieved from: https://www.tandfonline.com/doi/abs/10.1080/15332861.2011.596007 [accessed: 19 April 2022].

[14] Lun, K. & Yazdanifard, R. (2014) *Guerrilla marketing: A successful business model for Xiaomi*.

Global Journals Inc. 1-6. Retrieved from: https://globaljournals.org/GJHSS_Volume14/3-Guerrilla-Marketing-A-Successful.pdf [accessed: 4 October 2022].
[15] Išoraité, M. *Guerilla marketing features.* (2018) Vilniaus kolegija, Ecoforum, 1-6. Retrieved from: http://ecoforumjournal.ro/index.php/eco/article/viewfile/709/450 [accessed: 19 April 2022].
[16] AMERICAN MARKETING ASSOCIATION. (2017) Definitions of marketing. Retrieved from: https://www.ama.org/the-definition-of-marketing-what-is-marketing/ [accessed: 4 October 2022].

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ANALÝZA ZÁUJMU SLOVENSKÝCH SPOTREBITEĽOV O CERTIFIKOVANÉ VÝROBKY

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Abstract: *Záujem ľudí o certifikované výrobky, environmentálne organizácie a problematiku súvisiacu s ochranou životného prostredia predstavuje široko koncipovanú problematiku a zároveň je čiernou skrinkou pre zelený marketing. Príspevok sa zaoberá analýzou záujmu slovenských spotrebiteľov o certifikované výrobky a environmentálne organizácie. Cieľom je na základe výsledkov realizovaného dotazníkového prieskumu sledovať a analyzovať záujem o certifikované výrobky a environmentálne organizácie a poukázať na významné rozdiely z pohľadu rodu, veku a bydliska respondentov na environmentálne správanie. Z výsledkov skúmania je známe že dané environmentálne certifikáty registrujú, no zároveň nie všetky poznajú. Najznámejším je pre nich ekologický certifikát Environmentálne vhodný produkt. Takto označený produkt v nich vzbudzuje dojem šetrnosti k životnému prostrediu a garanciu vyššej kvality. Tieto produkty spotrebitelia registrujú najmä z webových stránok a masmédií. Potvrdené boli rodové rozdiely v prejavovaní záujmu o environmentálne certifikáty produktov a neboli potvrdené rozdiely v nákupnom rozhodovaní spotrebiteľov ohľadom certifikovaných environmentálnych produktov z hľadiska bydliska.*

Keywords: environmentálne označovanie produktov, spotrebiteľské správanie, certifikované výrobky.

1 ÚVOD

Problémy životného prostredia sú čoraz aktuálnejšou témou tejto doby, najmä v súvislosti s priemyselnou výrobou. Každá organizácia má na životné prostredie určitý dopad. Na svete existuje množstvo organizácií, pre ktoré je ochrana životného prostredia hlavným cieľom. Ide o environmentálne organizácie, kde patria spoločnosti alebo občianske združenia, ktoré sa snažia uverejňovať správy o zmenách v životnom prostredí, ktoré sú nežiadúce a usilujú sa im zabrániť. Environmentálne organizácie sa delia na miestne, globálne, regionálne a národné, respektíve je možné ich chápať aj ako štátne alebo súkromné (Taylor 2014).

Najznámejšou environmentálnou organizáciou je Greenpeace. Na Slovensku vykonáva Greenpeace svoju činnosť takmer 30 rokov. Greenpeace tvrdia, že na dosahovanie svojich cieľov využívajú výskumy, diplomaciu a priame nenásilné akcie, aby upozornili na problémy a našli spôsob riešenia spolu s kompetentnými osobami. Greenpeace využíva niekoľko metód pri vedení rôznych kampaní, ktoré zahŕňajú politický lobbing, vedecké výskumy, vzdelávanie verejnosti a priame akcie. Verejnosť vníma Greenpeace prostredníctvom ich rôznych nenásilných protestných akcií, ktoré slúžia ako upozornenie na poškodzovanie životného prostredia. Okrem toho robia rôzne vedecké analýzy, pripomienkovanie zákonov a tiež spolupracujú s rôznymi inštitúciami a zabezpečujú informovanosť verejnosti. Od svojho vzniku na Slovensku sa venovali témam ako energetika a problematika klimatických zmien, geneticky modifikované organizmy, toxické látky, staré environmentálne záťaže či ochrana lesov (Greenpeace 2021). Zelená farba v logu Greenpeace je symbol prírody a znamená, že Greenpeace pracuje pre zachovanie prírody a snaží sa zabrániť tomu, aby bol zničená. Kombinácia zelenej a bielej farby symbolizuje nekonečnú lásku k životu, duchovnú prosperitu, láskavosť a zdravie (Jurnal Humanis 2022). Ďalšou významnou organizáciou je Priatelia Zeme. Je to neziskové občianske združenie, chrániace životné prostredie, prírodu na Slovensku, aj v európskom kontexte. Na Slovensku pôsobia od roku 1996 a zameriavajú sa na dve témy: minimalizáciu znečisťovania prostredia odpadmi a toxickými látkami. Okrajovo sa venujú aj podpore udržateľných riešení ďalších ekologických problémov a ich ekonomickým a sociálnym súvislostiam. Pracujú na zastavovaní činností škodlivých pre ľudí a prírodu, ale hlavne vytvárajú a realizujú pozitívne udržateľné riešenia v prospech budúcich generácií a ostatných foriem života. Priatelia Zeme sú nezávislí na akejkoľvek vláde, strane, politických či skupinových záujmoch (Priatelia Zeme 2021). K ich aktivitám patria informačné kampane, odborné semináre, školenia, prednášky, pomoc obciam a mestám v znižovaní množstva odpadov, pri rozvoji triedeného zberu odpadov a ich zhodnocovaní, realizácia pilotných projektov, ktoré prezentujú trvalo udržateľné riešenia (napr. triedenie, kompostovanie, recyklácia, znižovanie množstva odpadov), pomoc občanom a samosprávam dotknutým zámermi, ktoré by mohli znečisťovať ich životné prostredie, výskum, monitoring, vypracovanie odborných analýz a práca na legislatívnych zmenách (Ekoforum 2022). Organizácia je členom Friends of the Earth International (FoEI), najväčšej federácie ekologických organizácií na svete, pôsobiacej v 71 krajinách. Vo svojom logu majú zelený kruhový symbol, reprezentujúci planétu Zem (Priatelia Zeme 2021). Strom života je environmentálna, mimovládna, dobrovoľná a nezisková organizácia, nezávislá na politických subjektoch, registrovaná ako občianske združenie. Má za sebou 40-ročnú históriu s pôsobnosťou na celom území Slovenskej republiky. Pozornosť venuje témam zameraným na osobnostný rozvoj detí a mládeže, predovšetkým na rozvoj tvorivosti, komunikačných a prezentačných zručností,

talentu, čitateľskej gramotnosti, kompetentného zaobchádzania s médiami a kritického myslenia. Strom života podporuje aj umelecké aktivity mladých ľudí, aktivity podporujúce zdravý životný štýl a aktivity rozvíjajúce inovačné, technické a bádateľské zručnosti, ktoré mladí ľudia využijú pri uplatnení sa v ďalšom živote a spoločnosti. Pre Strom života je dôležité aj formovanie zdravého národného historického vedomia, vychádzajúceho z vlastnej kultúry a histórie, smerujúceho k tolerantnému spolunažívaniu všetkých kultúr v integrovanej Európe. Organizujú celoročné programy pre školy, rodiny, ale aj širokú verejnosť, tréningy, workshopy, semináre, exkurzie, najmä v oblasti environmentálnej výchovy, kultúrneho dedičstva a zdravého životného štýlu ako aj v oblasti kvalitatívneho zlepšovania výchovno-vzdelávacieho procesu. Venujú sa aj edičnej činnosti či práci s dobrovoľníkmi a komunitami. Logo organizácie je tvorené stromom, ktorý označuje symbol ochrany prírody (Strom života 2021). Ďalšou významnou organizáciou na Slovensku je Lesoochranárske zoskupenie VLK. Je to občianske združenie, ktoré funguje od roku 1993 a jeho cieľom je ochrana životného prostredia. Medzi najznámejšie projekty združenia patrí prvá súkromná prírodná rezervácia v Strednej Európe. VLK vlastní alebo spravuje viacero prírodných rezervácií na Slovensku. V rámci svojich aktivít sa podieľajú na ochrane lesov, obmedzovaní ťažobných aktivít, rozširovaní chránených území, podpore ochrany dravcov. V logu zoskupenia sa nachádza vlk, aj z toho dôvodu, že svojimi aktivitami dlhodobo bojujú za zlepšenie situácie vlkov a pokles počtu ulovených vlkov (VLK 2022). World Wide Fund for Nature (WWF) je medzinárodná mimovládna organizácia podporujúca ochranu, výskum a obnovu životného prostredia. Bola založená v roku 1961 a dnes je najväčšou nezávislou ochranárskou organizáciou na svete, s viac ako 5 miliónmi podporovateľov v celom svete. Jej aktivity sú realizované v takmer 100 krajinách sveta, v ktorých podporuje viac ako 1300 ochranárskych a environmentálnych projektov. Zámerom WWF je zastaviť degradáciu prírodného prostredia na Zemi a vybudovať budúcnosť, v ktorej ľudia budú žiť v súlade s prírodou, zachovať svetovú biodiverzitu, zabezpečiť udržateľnosť využívania obnoviteľných prírodných zdrojov a podporovať znižovanie znečistenia a nehospodárnej spotreby. Kancelárie WWF vykonávajú ochranárske práce, ako sú praktické terénne projekty, vedecký výskum, poradenstvo miestnym a národným vládam v oblasti environmentálnej politiky, podpora environmentálneho vzdelávania a zvyšovanie povedomia o otázkach životného prostredia. Logu WWF dominuje panda veľká ako symbol všetkých ohrozených druhov, ktoré by boli zachované, ak by bolo zachované ich prirodzené prostredie pre život (WWF 2022).

Organizácia, ktorá je environmentálne zameraná, má primárnu úlohu pri svojich aktivitách dbať na stav životného prostredia s cieľom zlepšiť ho, znižovať využívanie vstupov z vyčerpateľných zdrojov, obmedziť produkciu odpadu, podporovať recykláciu, minimalizovať potenciálne environmentálne riziká a podobne (Gates 2021). Podľa Ottmana (2011), firmy môžu stratiť ich dôveryhodnosť tým, že uvedú produkty a služby, ktoré nie sú v súlade s environmentálnymi zásadami. Produkcia environmentálnych produktov enormne stúpa. Jedným z hlavných dôvodov je, že krajiny prijímajú normy, ktoré sa podstatne zameriavajú na zníženie škodlivého dopadu na životné prostredie. Popularita týchto výrobkov rastie aj u spotrebiteľov. Weisstein, Asgari a Siew (2014) uvádzajú, že environmentálne správanie spotrebiteľov pri kúpe ekologicky šetrnejších produktov nie je ovplyvňované len ich snahou o zvyšovanie ochrany životného prostredia, ale aj inými faktormi ako sú cena ekologických produktov, ich kvalita, dostupnosť či značka. Za environmentálneho spotrebiteľa je označovaný spotrebiteľ, ktorý kladie dôraz na ochranu životného prostredia pri nakupovaní produktov a pri všetkých aktivitách súvisiacich so spotrebou týchto produktov. Vo všeobecnosti je každý spotrebiteľ, ktorý sa správa šetrne k životnému prostrediu považovaný za environmentálneho spotrebiteľa (Shabani a kol. 2013).

Global Ecolabelling Network - GEN (2004) charakterizuje environmentálne označovanie tovarov, tzv. ecolabelling, ako typ označovania tovarov, ktorého poslaním je poskytovať spotrebiteľovi informácie o relatívnej environmentálnej kvalite produktov. Hlavnými participantmi na ecolabellingu sú vláda, priemyselné a obchodné asociácie, maloobchodníci, firmy a spotrebitelia. Prioritným cieľom environmentálneho označovania tovarov je prostredníctvom poskytnutia presných a overiteľných informácií o environmentálnych aspektoch produktov zvyšovať dopyt a ponuku takýchto výrobkov a služieb. Tieto produkty majú pomerne nízky dopad na životné prostredie, čím sa stimuluje potenciál pre trhovo orientované trvalé zlepšovanie životného prostredia. K ďalším cieľom ecolabellingu patria: Ochrana životného prostredia, ktorá zahŕňa podporu efektívneho riadenia a zabezpečenie dostupnosti obnoviteľných zdrojov, podporu efektívneho využívania neobnoviteľných zdrojov, uľahčovanie recyklácie, opätovného používania a znižovania produkcie spotrebného odpadu a pod.; Podpora environmentálne vhodných inovácií - trhový stimul pre inovatívne a progresívne podniky, ktoré sú schopné ponúkaním produktov šetrných k životnému prostrediu zaplniť medzeru na trhu či vytvoriť pozitívny imidž medzi spotrebiteľmi; Budovanie environmentálneho spotrebiteľského povedomia. Environmentálne označovanie pozitívne vplýva na úroveň environmentálneho povedomia spotrebiteľov, keďže poskytuje spoľahlivé informácie o environmentálnych vlastnostiach produktov, ale aj o dôsledkoch nákupných rozhodnutí spotrebiteľov. Česká informačná agentúra životného prostredia CENIA (2019) uvádza, že za environmentálne šetrné môžu byť označované len produkty alebo služby, ktoré sú v priebehu celého životného cyklu preukázateľne šetrnejšie k životnému prostrediu, ale aj k ľudskému zdraviu, avšak ich kvalita zostáva na vysokej úrovni. Tieto produkty sú ľahko rozpoznateľné vďaka environmentálnemu symbolu, tzv. ekoznačke. Podľa zákona č. 469/2002 národná environmentálna značka je značka, ktorou sa na základe overenia postupom ustanoveným týmto zákonom osvedčuje, že príslušný

produkt spĺňa nadštandardné požiadavky z hľadiska ochrany životného prostredia oproti iným produktom z tej istej skupiny produktov. Národná environmentálna značka môže byť len produktu s vlastnosťami, ktoré mu umožňujú vo významnej miere prispieť k zlepšeniu životného prostredia v súvislosti s kľúčovými environmentálnymi aspektmi počas celého životného cyklu produktu.

K významným environmentálnym značkám patrí GOTS – Global Organic Textile Standart. V ich výrobkoch sa nenachádzajú žiadne zo škodlivých látok. Zaujímavosťou je že získala certifikát, ktorý je jedným z najťažšie získateľných certifikátov. Týmto certifikátom sa produkt stáva prísne sledovaný počas celej výrobnej fázy produktu. Ďalšou významnou ekoznačkou je Environmentálne vhodný produkt. Táto značka sa získava, ak výrobca dodržiava isté kritériá, napríklad vplyv produktov na zlepšenie životného prostredia. Úlohou je minimalizovať negatívne dopady výroby a spotreby na životné prostredie, klímu a zdravie. Európska únia má tiež ekoznačku na označovanie ekologických produktov. Na udelenie tohto certifikátu je potrebné, aby boli výrobky overené oficiálnym európskym predpisom ekologického poľnohospodárstva. Tento certifikát môže získať každý, kto je pracovníkom v obore potravinárskeho priemyslu, buď sa priamo venuje poľnohospodárstvu alebo dovozu či výrobe potravín. Na Slovensku je využívaná značka kvality ISK. Touto značkou sa jednoznačne odlišujú slovenské potraviny od zahraničných, čím sa podporuje Slovenská domáca produkcia potravín. Značka sa udeľuje iba produktom ktoré spĺňajú nadštandardné kvalitatívne parametre. Produkty ako káva, banány, čaj či bavlna často označujú značkou Fair Trade. Farmári, ktorí tieto plodiny pestujú, dbajú na životné prostredie, a na základe toho dostávajú adekvátne zaplatené, preto sú plodiny predávané za vyššie ceny. Významným certifikátom je aj certifikát Forest Stewardship council, ktorý sa udeľuje buď lesnému podniku po kontrole podmienok, alebo spracovateľskému reťazcu, teda firme, ktorá používa drevo od lesného podniku s certifikátom (Mobake 2022).

Cieľom a pridanou hodnotou príspevku je analýza záujmu slovenských spotrebiteľov o certifikované výrobky a environmentálne organizácie a poukázanie na významné rozdiely. Práve ich poznanie je podľa autorov kľúčovou podmienkou pre zelené správanie. Z tohto pohľadu sa javí diferenciácia spotrebiteľských preferencií týkajúcich sa veku, miesta bydliska a pohlavia, ako jedna najväčších premenných, ktoré dopĺňajú atribúty zelených slovenských konzumentov.

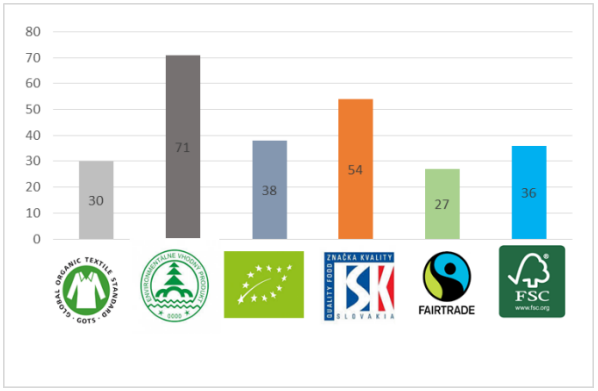
2 VÝSKUMNÁ METÓDA

Podkladom pre spracovanie teoretických východísk boli vedecké databázy, medzinárodné žurnály a internetové portály. Zdrojom primárnych dát pre realizované analýzy bol dotazníkový prieskum vytvorený pomocou Google formulára. Dotazníkový prieskum bol realizovaný na výskumnej vzorke 125 respondentov. Použité boli otázky s možnosťou jednej odpovede (Likertova škála: 1-určite áno, 5-určite nie) alebo s možnosťou výberu viacerých odpovedí. Následne boli výsledky spracované prostredníctvom popisnej štatistiky a frekvenčných grafov. Stanovené hypotézy boli testované pomocou štatistického programu IBM SPSS Statistics 26.

Zo 125 respondentov sa prieskumu zúčastnilo 76 žien a 49 mužov, čo v percentuálnom vyjadrení predstavuje 61% žien a 39% mužov Najviac odpovedí bolo od respondentov vo veku 26 až 45 rokov. Väčšia časť respondentov pochádza z vidieka, konkrétne 66 obyvateľov, teda 52,8 %. Z mesta je 59 obyvateľov, čo v percentách činí 47,2% .

3 VÝSLEDKY VÝSKUMU

Respondenti dostali otázku, ktoré environmentálne certifikáty na produktoch respondenti poznajú, kde mohli vybrať viacero možností (Obrázok 1).

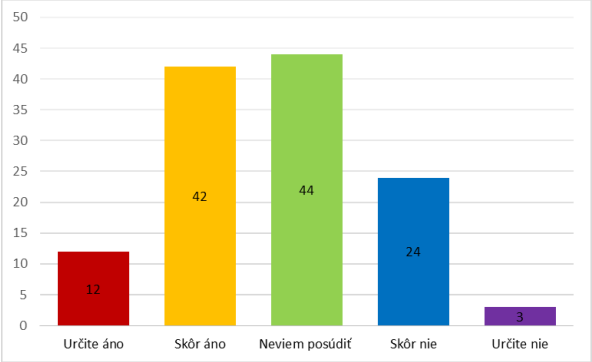


Obrázok 1. Grafické znázornenie odpovedí na otázku: Ktorý ekologický certifikát na produkte poznáte? (Zdroj: vlastné spracovanie)

Certifikát environmentálne vhodný produkt poznalo najviac respondentov, čo značí 71 respondentov, v percentách 56,8%. Druhým najznámejším medzi respondentmi bol certifikát značka kvality ISK, poznanie tejto značky označilo 54 respondentov, teda 43,2%. Treťou v poradí poznaní certifikátov, bolo logo Ekologického poľnohospodárstva v Európe túto možnosť označilo 38 respondentov, čo značí 30,4%. Certifikát Forest Stewardship Council pozná 36 respondetov, v percentuálnych hodnotách 28,8%. Certifikát Global organic textile standard označilo 30 respondentov, teda 24% opýtaných. Najmenej poznaným certifikátom medzi respondentmi bol certifikát Fair trade, túto možnosť označilo 27 respondentov, čo značí 21,6%.

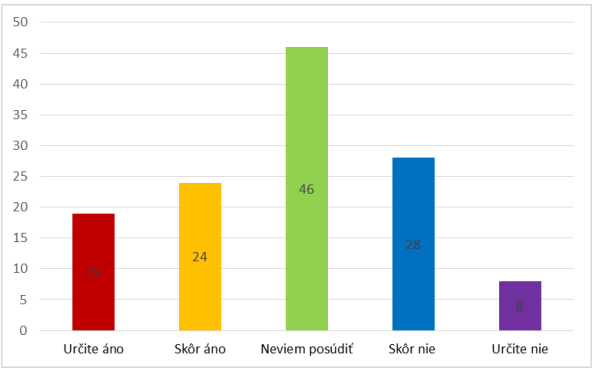
Ďalšou otázkou sa skúmalo, či sa respondenti zaujímajú aj o význam daných ekologických certifikátov (Obrázok 2). Z grafu môžeme vidieť, že najviac respondentov označilo odpoveď „Neviem posúdiť“. Túto možnosť označilo 44 respondentov, teda 35,2%. Možnosť „Skôr áno“ označilo 42 respondentov, čo značí 33,6%. Treťou najčastejšou odpoveďou bola možnosť „Skôr nie“, označilo ju 24 respondentov, teda 19,2%. Možnosť „Určite áno“ označilo 12 respondentov, teda 9,6%. Najmenej označenou

možnosťou bola odpoveď „Určite nie“, ktorú označili 3 respondenti, teda 2,4%.



Obrázok 2. Grafické znázornenie odpovedí na otázku: Zaujímate sa aj o význam daného ekologického certifikátu na produkte? (Zdroj: vlastné spracovanie)

Ďalej sme zisťovali, či nákupné rozhodnutia respondentov ovplyvňuje označenie produktu ekologickým certifikátom, resp. značkou (Obrázok 3).

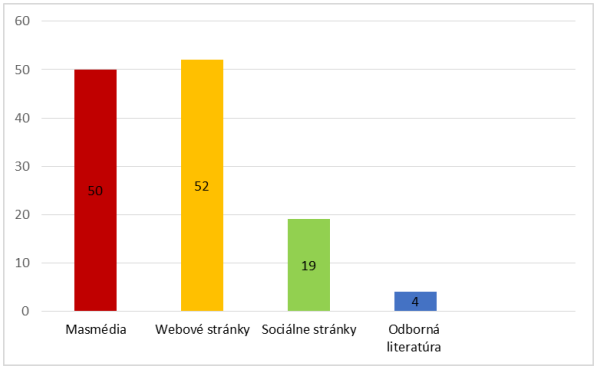


Obrázok 3. Grafické znázornenie odpovedí na otázku: Ovplyvňuje Vaše nákupné rozhodnutie označenie produktu ekologickým certifikátom, resp. značkou? (Zdroj: vlastné spracovanie)

Až 46 respondentov označilo odpoveď „Neviem posúdiť“, čo značí 36,8%. Možnosť „Určite nie“ označilo 28 respondentov, percentuálne 22,4%. Odpoveď „Skôr áno“ označilo 24 respondentov, čo značí 19,2%. Možnosť „Určite áno“ označilo 19 respondentov, teda 15,2%. Odpoveď „Určite nie“ označilo 8 respondentov, percentuálne 6,4%.

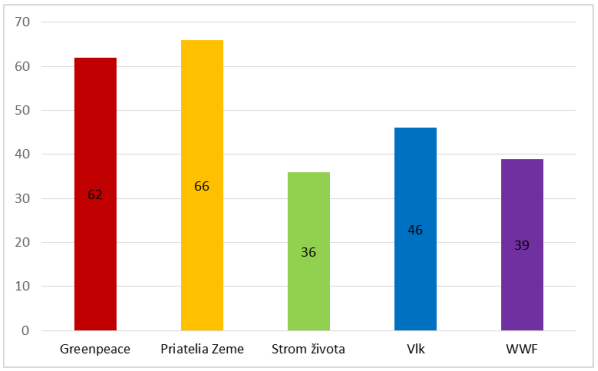
Zisťovali sme aj to, odkiaľ respondenti získavajú informácie o environmentálnych produktoch a certifikátoch (Obrázok 4).

Z celkového počtu 125 respondentov, 52 opýtaných označilo že ich zdrojom informácií sú webové stránky, percentuálne to je 41,6%. 50 respondentov získava informácie z masmédií, čo značí 40%. Informácie o environmentálnych produktoch a certifikátov zo sociálnych sietí získava 19 respondentov, čo značí 15,2%. Poznatky z odbornej literatúry získavajú 4 respondenti, v percentuálnom vyjadrení 3,2%.



Obrázok 4. Grafické znázornenie odpovedí na otázku: Odkiaľ získavate informácie o environmentálnych produktoch a certifikátoch? (Zdroj: vlastné spracovanie)

Ďalšia otázka bola zameraná na to, ktoré environmentálne organizácie respondenti poznajú (Obrázok 5).

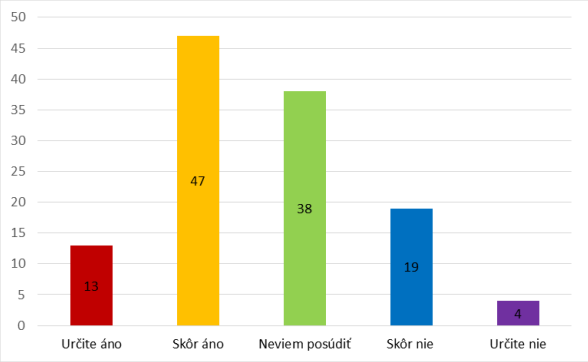


Obrázok 5. Grafické znázornenie odpovedí na otázku: Ktoré environmentálne organizácie poznáte? (Zdroj: vlastné spracovanie)

Pri tejto otázke si respondenti mohli vybrať viacero z možností. Najviac poznanou organizáciou bola organizácia Priatelia Zeme, tú označilo až 66 opýtaných, čo značí 52,8%. Organizáciu Greenpeace pozná 62 respondentov, teda 49,6%. Organizáciu Vlk označilo 46 respondentov, percentuálne 36,8%. Organizáciu WWF označilo 39 opýtaných, teda 31,2%. Najmenej poznanou organizáciou bola organizácia Strom života, túto možnosť označilo 36 respondentov, percentuálne 28,8% z opýtaných.

Skúmali sa sme aj to, či sa respondenti o dané environmentálne organizácie aj detailnejšie zaujímajú (Obrázok 6).

Najviac respondentov označilo odpoveď skôr áno, v počte 47 respondentov, percentuálne 37,6%. Odpoveď neviem posúdiť označilo 38 respondentov, čo značí 30,4%. Možnosť skôr nie označilo 19 respondentov, čo značí 15,2%. Odpoveď určite áno označilo 13 respondentov, percentuálne 10,4%. Odpoveď určite nie označilo 8 respondentov, čo značí 6,4%.



Obrázok 6. Grafické znázornenie odpovedí na otázku: Zaujímate sa podrobnejšie o dané environmentálne organizácie?
(Zdroj: vlastné spracovanie)

Stanovili sme si nasledujúce dve výskumné otázky a následne z toho vyplývajúce dve výskumné hypotézy.

RQ1: Existujú štatisticky významné rozdiely v záujme spotrebiteľov o certifikované produkty z hľadiska rodu?

RH1: Predpokladáme, že existujú štatisticky významné rozdiely v záujme spotrebiteľov o certifikované produkty z hľadiska rodu.

RQ2: Existujú štatisticky významné rozdiely v nákupnom rozhodovaní ohľadom certifikovaných produktov z hľadiska bydliska?

RH2: Predpokladáme, že existujú štatisticky významné v nákupnom rozhodovaní ohľadom certifikovaných produktov z hľadiska bydliska.

Premenné boli najprv overené testom normality dát (Shapiro-Wilk W test). V tomto teste je hypotéza H0 zamietnutá, ak je p-hodnota p menšia ako hladina významnosti 0.05. V tom prípade premenná nemá normálne rozdelenie, a preto je vhodné použiť neparametrický test. Výsledky testovania normality ukázali, že v našom prípade je $p < 0.05$, a teda skúmané premenné nemajú normálne rozdelenie. Preto použijeme neparametrický Mann-Whitney U test.

Testovanie RH1

H0: Neexistujú štatisticky významné rozdiely v záujme spotrebiteľov o certifikované produkty z hľadiska rodu.

H1: Existujú štatisticky významné rozdiely v záujme spotrebiteľov o certifikované produkty z hľadiska rodu.

Tabuľka 1. Výsledky Mann-Whitney U testu (rodové rozdiely)

Mann-Whitney U test		**Mean**	
p-value	0.003	Male	Female
p-value	< 0.05	3.31	**2.61**
H0 zamietame, teda existujú štatisticky významné rozdiely v záujme spotrebiteľov o certifikované produkty z hľadiska rodu.			

(Zdroj: vlastné spracovanie použitím IBM SPSS Statistics 26)

Na základe výsledkov Mann-Whitney U testu (Tabuľka 1) je možné konštatovať, že medzi mužmi a ženami existujú významné rozdiely v záujme o certifikované produkty. Na základe priemerných hodnôt je možné tvrdiť, že ženy prejavujú vyšší záujem o certifikované produkty. Týmto testom sme dokázali zodpovedať prvú výskumnú otázku.

Testovanie RH2

H0: Neexistujú štatisticky významné rozdiely v nákupnom rozhodovaní ohľadom certifikovaných výrobkov z hľadiska bydliska.

H1: Existujú štatisticky významné rozdiely v nákupnom rozhodovaní ohľadom certifikovaných výrobkov z hľadiska bydliska.

Tabuľka 2. Výsledky Mann-Whitney U testu (rozdiely v mieste bydliska)

Mann-Whitney U test		**Mean**	
p-value	0.370	Male	Female
p-value	> 0.05	3.12	2.93
H0 nezamietame, teda neexistujú štatisticky významné rozdiely v nákupnom rozhodovaní ohľadom certifikovaných výrobkov medzi spotrebiteľmi z mesta a z vidieka.			

(Zdroj: vlastné spracovanie použitím IBM SPSS Statistics 26)

Na základe výsledkov Mann-Whitney U testu (Tabuľka 2) je možné konštatovať, že medzi spotrebiteľmi žijúcimi v meste a spotrebiteľmi žijúcimi na vidieku neexistujú významné rozdiely v nákupných rozhodnutiach ohľadom certifikovaných výrobkov. Týmto testom sme dokázali zodpovedať druhú výskumnú otázku.

3 ZÁVER

Slovenská republika sa rovnako ako mnohé ďalšie krajiny Európskej únie, ale aj celého sveta nevyhla následkom spoločenskej a ekonomickej transformácie. Vzájomná prepojenosť medzi problematikou životného prostredia a ekonomikou je pomerne vysoká. Environmentálny prístup zaznamenal v posledných rokoch prechod pozornosti od výrobných zariadení a procesov výroby ku finálnym výrobkom a ich vplyvu na životné prostredie, ako je napríklad ekologická účinnosť výrobku, ekologický dizajn, systém environmentálneho manažérstva orientovaný na produkty, environmentálne označovanie a obehové hospodárstvo.

Cieľom príspevku bola analýza záujmu slovenských spotrebiteľov o certifikované výrobky a environmentálne organizácie a poukázanie na významné rozdiely. Zistili sme, že najviac respondentov pozná certifikát Environmentálne vhodný produkt. Takmer polovica respondentov sa detailnejšie zaujíma o certifikované produkty a uviedla, že ich nákupné rozhodnutie je ovplyvnené označením produktu ekologickým certifikátom, resp. značkou. Informácie o ekologických produktoch a certifikátoch spotrebitelia najčastejšie získavajú z webových stránok a masmédií. Najviac poznanou environmentálnou organizáciou bola organizácia Priatelia Zeme, nasledovaná organizáciou Greenpeace, pričom viac ako polovica respondentov sa o tieto organizácie detailnejšie zaujíma. Testovaním

hypotéz boli potvrdené rodové rozdiely v prejavovaní záujmu o environmentálne certifikáty produktov a neboli potvrdené rozdiely medzi obyvateľmi z mesta a z vidieka v ich nákupnom rozhodovaní ohľadom certifikovaných environmentálnych produktov.

Environmentálne povedomie nadobúda v dnešnej dobe nesmierny význam a prejavuje sa vo viacerých oblastiach nášho života. Záujem o certifikované výrobky a environmentálne organizácie zo strany spotrebiteľov je rôznorodý s ohľadom na vek, vzdelanie, miesto trvalého pobytu, či pracovné zaradenie spotrebiteľov. Výrobné podniky sa usilujú ukázať spotrebiteľom, že je aj v ich záujme zachovanie udržateľného rozvoja, a okrem iného vyzdvihujú aj potrebu označovania environmentálne vhodných výrobkov. Označovanie environmentálnych produktov je jedným z prostriedkov ako poukázať na ekologickejšie produkty a poskytnúť tak verejnosti možnosť výberu produktov šetrnejších k životnému prostrediu.

Poďakovanie

Príspevok vznikol ako súčasť riešenia projektov VEGA 1/0648/21 Vytvorenie multikriteriálneho modelu hodnotenia efektívnosti plnenia cieľov programu Agenda 2030 pre manažment udržateľného rozvoja a VEGA 1/0508/21 Hodnotenie energetickej udržateľnosti krajín Európskej únie vo väzbe na ciele Agendy 2030 pre udržateľný rozvoj.

REFERENCES

[1] GREENPEACE. O nás. 2021. [online]. [cit. 13.december 2021]. Dostupné z: http://www.greenpeace.org/slovakia/sk/

[2] JURNAL HUMANIS, Fakultas Ilmu Budaya Unud Verbal and Visual Signs of theGreenpeace Advert. p-ISSN: 2528-5076.

[3] PRIATELIA ZEME – SPZ -Kto sme [online].[cit. 03.apríla 2021]. Dostupné z: http://www.priateliazeme.sk/spz/o-nas/kto-sme

[4] Ekoforum. 2022. PRIATELIA ZEME-SPZ. [online].[cit. 29. marca 2022]. Dostupné z: Priatelia Zeme – SPZ Ekoforum.sk

[5] STROM ŽIVOTA – O nás [online].[cit. 03.apríla 2021]. Dostupné z: https://stromzivota.sk/o-nas

[6] VLK 2022. https://www.wolf.sk/

[7] WWF 2022. https://www.worldwildlife.org/

[8] OTTMAN, J., 2011. The new rules of green marketing: Strategies, tools, and inspiration for sustainable branding. Sheffield, UK: Greenleaf Publishing, 2011. ISBN 978-1906093-44-0.

[9] GATES B., Ako sa vyhnúť klimatickej katastrofe 2021, ISBN 9788055178004. [online].[cit. 21.marec 2022]. Dostupné z: Kniha: Ako sa vyhnúť klimatickej katastrofe, Martinus

[10] WEISSTEIN, Fei Lee, ASGARI Mohammadreza a Shir-Way SIEW, 2014. Price presentation effects on green purchase intentions. In: Journal of Product & Brand Management [online]. Roč. 3, č.23, s. 230-239. Dostupné z: https://doi.org/10.1108/JPBM-06-2013-0324

[11] SHABANI, Nazanin a kol., 2013. The study of green consumers' characteristics and available green sectors in the market. In: International Research Journal of Applied and Basic Sciences [online]. [cit. 2018-10-05]. Roč. 4, č. 7, s 1880-1883. ISSN 2251-838X. Dostupné z: http://www.irjabs.com/files_site/paperlist/r_925_130610221654.pdf

[12] GLOBAL ECOLABELLING NETWORK, 2004. Introduction to ecolabelling [online]. Tokio: GEN. Dostupné z: https://globalecolabelling.net/assets/Uploads/intro-to-ecolabelling.pdf

[13] ČESKÁ INFORMAČNÁ AGENTÚRA ŽIVOTNÉHO PROSTREDIA CENIA, 2019. Ekoznačení [online]. [cit. 2019-01-11]. Dostupné z: https://ekoznacka.cz/

[14] Zákon č. 469/2002 Z. z. o environmntálnom označovaní výrobkov.

[15] MOBAKE. Čo znamenajú Ekologické certifikáty? [online].[cit. 10. novembra 2021]. Dostupné z: Čo znamenajú Ekologické certifikáty? | 12 Certifikátov | Mobake.sk

[16] Taylor, D., 2014. The State of Diversity in Environmental Organizations, Green 2.0 Working Group. Retrieved from https://policycommons.net/artifacts/1847690/the-state-of-diversity-in-environmental-organizations/2593907/ on 14 May 2022. CID: 20.500.12592/96jtck.

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DESIGN OF TECHNOLOGICAL PROCESSES – INFORMATION PROCESSING

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Abstract: *Information age manufacturing begins with information age design. The design process for products and the processes by which they are produced involve compiling and understanding the products' requirements, converting the requirements into engineering specifications, and producing plans that marshal the materials, equipment, and people needed to make and deliver the products. To enable the designer to overcome challenges of today´s environment, the information age integrated product and process design environment must help the designer to link product design and manufacturing to an unprecedented extent with minimal use of physical prototypes or construction aids.*

Keywords: technological process, design, information, knowledge, information processing

1 INTRODUCTION

A design engineer deals with the regularities of production processes. Designing is generally focused on innovative production projects and structural transformations. The technological processes of material and semi-finished product processing in mechanical engineering can be classified into basic types.

Detailed development of the technology of machine parts production is based on a technical and economic analysis of possible production process variants, ensuring the required quality of components, high production and minimal cost. The design process is divided into a number of partial processes, differing by the level of design execution.

2 STAGES OF TECHNOLOGICAL PROCESS DESIGN

The technological process design is divided into different content stages:

- Structural and technological assessment of the drawing of the manufactured component is carried out. According to the production method, the component material, the shape of the surfaces, the dimensions, the precision requirements, the surface layer condition, etc. are analyzed. Changes in component design are proposed to improve its technology.
- According to the general principles and the specific conditions, the semi-finished product of the component and the method of its production is proposed.
- Methods of technological processing of individual form elements of the component are selected. The physical, kinematic, dynamic and economic properties of the technological methods and their relation to the component element parameters are assessed. According to the technical limits of the individual technological methods, such methods are chosen for the elements of the components that meet all the requirements. From these variants, an optimal technological method is generally chosen based on the machine time minimization.
- Selected variants of the technological methods are further evaluated in terms of the possibility of simultaneous / parallel technological processing. The overall synthesis of technological methods for processing of the entire component is focused on the maximum concentration of operations to ensure minimum machine time.
- The operation structures are selected. Possible ways of main and secondary time overlap is taken into account as is its relation to component parameters and to proposed technological methods. The model of operation structure for technological processing of the component is created and the variant that best suits the technical and economic conditions is established.
- In the next technological process stage, the sequence of operations and their detailed design (selection of the machine, selection of the assembly and clamping of the component, selection of the clamping device and determination of the sequence of sections and operations) are established. In individual sections, inter-operational additions, tools, gauges, technological conditions are determined, and standards of time consumption are calculated.
- The resulting documentation is processed according to established forms of suitable production type and enterprise standards.

Technological procedure is usually developed by checking the possible variant solutions and considering the specific characteristics of production system in which the technological process is expected to be carried out. The technological process must ensure that:

- The functional requirements specified by the specification, drawing documentation and standards are met.

- The components are produced with minimal work involved and at minimal cost.
- The capacities of the means of production deployed are used to the maximum extent.
- Work safety is maintained in course of the technological process.
- Ecological aspects of production are maintained.

Technological projects include also the stages related to the preparation of production execution. These include: technical-organizational project design, technical assignment of development of single-purpose production facilities, design development of equipment, production facilities layout, production of prototypes, prototype tests, preparation and start of serial production.

Each design work is focused on creating comprehensive and complex ideas about the object of design. Images are processed into information files. Documentation on designed object is called a project and its extent depends on the complexity of designed object and its properties. In technical practice, the term "project" usually means a design of a structure or a set of structures and technological activity happening in those structures.

Design system is important in investment construction. Technological design begins with pre-design preparation. In connection with the modernization and refurbishment of production bases, the methodology of technological design is transformed. Project work is divided into three parts:

- Preparatory stage.
- Solution and project processing.
- Execution.

In the preparatory stage, the project is registered and subjected to evaluation. The projects are registered as a construction, modernization, refurbishment or establishment of a production group, etc. The questions of funding and legislative issues or strategic and tactical aspects of envisaged work are clarified.

The technical specification of the project or work is drafted to assess the feasibility of the project, to estimate the costs, the demands on R & D, the demands on suppliers and other services. In addition, a project task, which defines the main task objectives and verifies technical specification of the project, is elaborated. Following is the processing of technical solution in variants which take into account the project's execution, the possibility of using a known technique and the necessity of cooperation between the engineering research and development work. Finally, according to chosen alternative of intention, the main tasks of solution and its technical and economic specification are outlined in the preparatory stage.

For the coordinated workflow in the project solution and the processing stage, flowcharts are compiled. They indicate critical paths and crucial solution nodes. Part of the problems is solved in parallel so that the partial results are evaluated at the specified time before decision on the variant or alternative designs of technical solutions meeting the intention and task parameters is taken. Work in this stage is generally divided as follows:

1. Project task. During this stage, product data, conceptual and structural designs of technological, handling and control devices with a general assembly of production and management system are usually developed in parallel. Simultaneously, new technological methods and structures are verified.
2. Project task approval to ensure a final adoption of the production concept, in which binding technical and capacity parameters of equipment and technologies (graph node point) are established.
3. The initial production design includes the technological and construction part, the production execution budget, including the investment construction. A time schedule for construction is also worked out.
4. Approval of the initial design and adoption of the procedure and conditions of the production execution (graph node point).
5. Implementation design of a production cell or group, i.e. execution of the task and subsequent investment construction.
6. Preparation of premises for assembly of the means of production (execution of construction work, energy supply, preparation of workforce, etc.).

Depending on the state of scientific and technological progress in production facilities and technologies, stages such as technological development, design development, production and recovery of the equipment are also included in the project solution and processing stage. In the implementation stage, a flowchart of coordinated procedure is created. This takes into account the concurrence of assembly and verification works and cooperation of the participating organizations of directors: designer, contractor and suppliers.

Technological design also includes an alternative keeping in mind that the given technology is designed for the existing production systems. First, the technological procedure or process to which new means of production are constructed or developed, is created.

Production clusters are designed to be located in the existing buildings, or the buildings for designed technologies are planned. The second approach is characteristic for new investment construction.Work on the technological design is usually divided between the technology user and the organization implementing the project. The hierarchy of the project work and of its division is presented in Tab. 1. According to accepted approaches, work can be divided into two parts: technological preparation of production and technological construction design, modernization or refurbishment activity.

Table 1. Project activity hierarchy

Technological design	Hierarchical level of technological process	Main content of work
Technological and organizational structures of new productions	Macro level of technological processes	Dynamics of production program, specialization, cooperation, concentration, capacity relations in space and time, quality and quantity of production technology, links to information and material flow, control and management
Technological and organizational structures of refurbishment and modernization	Level of technological processes	Changes in production programs, changes in equipment according to production technology, automation
New technological equipment projects	Level of partial technological processes	Design of operations, the structure of the machine system and its technical and economic parameters
Rationalization designs	Technological operations and sequences	Identification of shortcomings in technological methods and structures, draft changes to the structure of operations, procedures for implementation of project stages

3 INFORMATION AND KNOWLEDGE APPLIED TO PRODUCTION DESIGN

Activities of designing a production can also be characterized as activities focused on information processing and the use of the existing knowledge. The principal methodological basis for effective work with information is outlined in the theory of information. The general principles of the flow of obtaining, processing and storing information, irrespective of their meaning, represent the subject matter of the information theory. Information theory displays the objects and phenomena in a formalized form, for example in the form of a set of digits and letters (alphabet). Such formalized sets are referred to as data. The data obtained from the information source are referred to as a message. Information is also considered to be such messages that reduce the uncertainty existing during the time until they are obtained.

Other starting concepts in the theory of information are signal and code. Signals are considered to be the physical objects (optical, audio, electrical, etc.) that carry out transmission of messages. The term code refers to the way the information is displayed during its recording, transmission and processing in the system, the shape of relations between the elements of the message and the signals that can be affixed thereto.

In solving information tasks, it is especially important to quantify the amount of information contained in a report. Generally, the number of N messages that can be generated by variations of n elements of a certain alphabet consisting of m elements is:

$$N = m^n$$

The quantitative amount of information I can be expressed as the logarithm of the number of possible combinations:

$$I = \log N = n \log m$$

This principle expresses the exponential character of the dependency of possible code combinations and symbols in the input alphabet number and complies with the general Boltzman law of entropy in the statistical thermodynamic system:

$$Ht = k \log p$$

Where: Ht is the thermodynamic entropy,
k - constant,
p - probability of a given system state.

In the theory of information, the degree of indeterminacy (entropy) H there is a lot of information pertaining to one element of the message (the alphabet character). For the message containing m elements, the following holds true:

$$H = -\sum_{i=1}^{m} p_i \log p_i = \sum_{i=1}^{m} p_i \log \frac{1}{p_i}$$

Where pi is the probability of the $_i$ element.

The amount of information I is given by the change (difference) between the uncertainty of the state before $_{H0}$ and after obtaining the information $_{H1:}$

$$H = H_0 + H_1$$

The unit of information quantity is a bit that expresses the amount of information obtained on the state of the system with two possible states, while the probability of both states is the same.

From the information processing viewpoint, in real systems, and in particular in the management of production processes, it is also necessary to take into account the characteristics expressing the speed of transmission of the information and its connection to the transmission channels and other criteria.

Designers' work with information is closely related to the activity of solution finding combined with designing the production. The flow of information processed in space and time passes through the nodal cooperation and resolvable points, and is directed by complex system of linkages.

The information is transmitted by horizontal, vertical and transverse flow. The vertical flow happens among the elements of the hierarchical management structure (executives, technologists, production operators, etc.). Horizontal flow occurs between elements of one level (technological sections, team workers, etc.). In terms of external flow of information between enterprises, the vertical flow is generally carried out within a single sector, the horizontal flow inside the sectors and trade unions.

The structure of information flow in time is similar. Information transmitted horizontally at a given time proceeds to several processing units, while vertically it is processed in a sequence. Generally, cross-sectional information proceeds horizontally, specialized information proceeds vertically.According to the structure level, the information systems are divided into:

1. National information systems. The role of these systems is to provide scientific and technical information in particular to the governing bodies of national economy. At the same time, they are methodical bases for the construction of all lower-level information systems and provide information on interprofessional issues.
2. Trade union information systems. The second level of information structure consists of the systems providing information from an existing division as well as information that is important for its development.
3. Specialized trade union information systems. They specialize in topic-defined areas of the respective division, which are representatives of technical progress (e.g. robotization, CNC machines and systems in engineering production). Their role is to provide information, in particular, on the development of new products and the introduction of new technologies.
4. Information systems of enterprises, institutes, organizations, etc. They work with information base linked to the specific conditions and tasks of the respective organization.

A direct and mediated flow of professional information is recognized. In the direct flow, the knowledge processed by an individual directly proceeds to other creative workers who use this knowledge (submitting papers, providing documentation, experimental results, experience). This form of information exchange is often used in practice. Its development and rationalization is based on the improvement of human relationships and teamwork.

In the mediated flow, information is processed by specialized information workers. Starting with primary sources of information, information workers develop secondary or tertiary information. The information system and other category of information workers ensure the distribution of information to solution-seeking teams or to the designers involved. Distributed information is without superfluous elements, enabling rational processing and increased level of utilization. By shifting the most complex and the most labor intensive operations involving information to specialists, the designers' working time can be dedicated to their creative work. A mediated cycle of information processing, using information and knowledge services, may be considered a significant force of rationalization of designers´ work with information.

Innovation of information work requires switching from one-way transmission of information to two-way transmission. Two-way exchange of professional information and knowledge not only increases the amount of information provided to users, but also makes it possible to improve the quality thereof through feedback.

To improve the production preparation work, it is necessary to enhance the information activity linked to specialized professional information. The focus of the information is shifted to technological data, technological procedures, methodologies of solving technological tasks and other information directly related to the development of production procedures.

The biggest part of information processed in technological preparation of production involves technological processes, instructions, schemes, setup procedures, preparation sketches, technological sheets, lists and other materials that are the result of technological design. Deficiencies in production technological documentation may occur if:

- There are variations of the forms used. This diversity causes problems in moving production from one plant to another, in utilizing experience from other plants, and in introducing type and group technological processes.
- Unpreparedness of the documentation for machine processing, labor-intensive performance, complexity with which it is written and approved.
- Information disparities and redundancies. Documentation often fails to meet system requirements for clarity, minimal redundancy and completeness.

- Absence of succession between the different forms of documentation and the ways of its preparation.

Rationalization of the documentation is to ensure:

- That the costs of documentation processing are reduced.
- That the interval of designing new production processes shortened.
- That communication between documentation users is improved.
- That there is a possibility of using computing technique.
- That there is a possibility of information centralization.
- That there is a possibility of using progressive forms of production preparation.
- That the documentation is independent of the specific conditions of its use.
- That there is a possibility of recording the information on a storage medium.
- That there is a possibility of a progressive method of reproduction and archiving.
- That the information is complete while its volume is minimized.

As its methodological principle, the rational technology documentation system uses the classification and coding of information. A consistent division of objects into subsystems with the same features is generally understood under classification. The purpose of classification is to define classes of the same structure for which separate methods of encoding, writing, and processing of information should be found.

The basic role of classification is the orientation in a large number of existing elements and relationships. A suitable methodological classification tool can be the set theory.

Let D be a set of components (elements, subsystems, etc.) of the production process, and let any random component of this set be uniquely described by the set of characteristics P_{ij}:

Pij Pi

where Pi is the set of properties of the $_i$ characteristic feature.

The sets P_i *(i = 1,2, ..., n)* are the range of structural, technological, design, planning, organizational, controlling and other properties according to which the components of the set D are classified. If individual sets Pi are expressed by element properties in the form:

$$P1 = \{P_{11}, P_{12}, \ldots, P_{1m}\}$$
$$P2 = \{P_{21}, P_{22}, \ldots, P_{2m}\}$$
$$\ldots\ldots\ldots\ldots\ldots\ldots$$
$$P_n = (P_{n1}, P_{n2} \ldots, P_{nm}\}$$

Then combinations of the P_i set properties are their Cartesian multiplication:

$$D = P_1 x P_2 x \ldots x P_n$$

In this case, the subset D of the set *D (D € D)* is characterized by a fully defined properties combination of the sets *P1,P2, ...,Pn* ,

$$D \in P1x\ P2x \ldots xPn$$

In this case, D includes all the components grouped by the established manner according to all the *Pi* properties.

The intersection of D set with the Pi subset is Di subset including all the groups of components classified according to the characteristic feature $_i$.

This way, the groups of components created at each classification stage are expressed as follows:

$D1 = D\ (P1_{)}$ - the intersection of the set D with the subset P1 (the group of components created in the first stage of classification),

$D_2 = D\ (P_1\ xP_2) = D_1\ \{P_2)$ - the intersection of the set with the subset P2 (group of components created according to further first stage classification).

$$D_k = D\left(\prod_{i=1}^{k} P_i\right) = D_{k-1}(P_k)$$

.....

$$D_n = D\left(\prod_{i=1}^{n} P_i\right) = D_{n-1}(P_n)$$

The intersection of the set D with the last subset P_n (the group of components created according to the penultimate grade classification).

The above-mentioned classification scheme structure has a hierarchical form and is shown in Fig. 1.

The suggested theory shows that the information giving rise to creation and functions of classical, and especially automated and robotized, productions requires a system of classifiers of these production components and of the sets of technical and economic information and knowledge associated therewith.

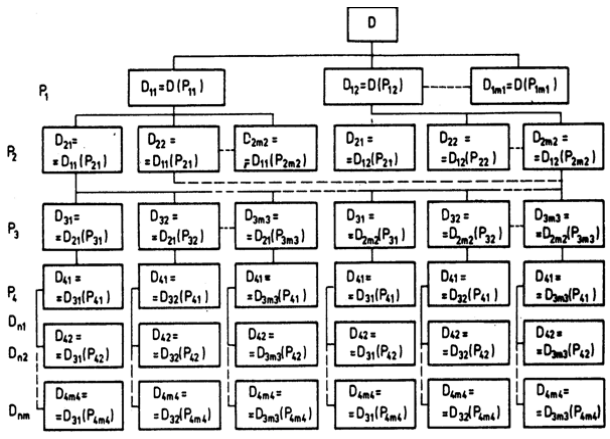

Figure 1. Information classification based on the set theory

Classification systems of technological information represent a tool for rationalization and automation of the technological preparation of production. Unless the

classification system represents material that is used at various levels of the TgPP and in the production itself, it has no justification. In this respect, it is important to standardize classification systems to ensure their broadest scope of application possible.

The classification of information processed in the production preparation can be done in several respects.

Fig. 2 shows a general classification scheme for information used in production design according to content classes, source and user, according to the way the information is recorded, transmitted and processed.

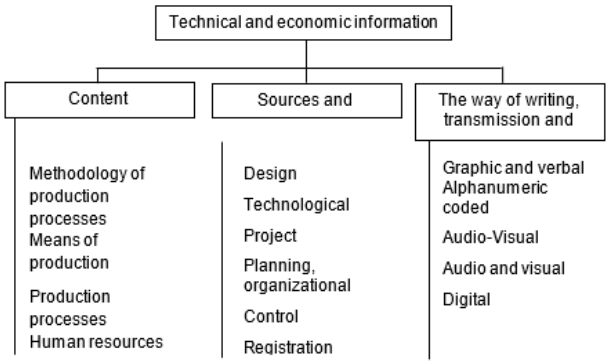

Figure 2. Information classification in production design

This division of information is particularly important in terms of creating integrated information systems because this is how automatic information is processed. Coding systems follow the classification. Technological information can be encoded according to three principles. Digital encoding allows accurate description of different types of technological information. However, multi-faceted digital codes cause coding difficulties and increase the probability of error.

Alphabetical descriptive encoding is applied to general information systems, especially when searching and sorting information of a certain kind (e.g. keyword systems). Technological information systems are limited in their use.

Alphabetic-digital encoding combines the benefits of both principles. The alphabetical section serves as an identification, numerical section as a quantitative expression of information. The creation of complex automated systems of technological information can be based on alphanumerical codes. In engineering practice, mainly the structural and technological classes of components, nodes and machines, technology process classes, and other useable classes have been useful from among the classification and coding systems.

Classification and encoding of technological information depends on the method of automated processing and on the types of information carriers.

5 CONCLUSION

The information processing is evaluated through the amount of information produced per unit of time and the cost of the information service. The use of computers for recording, processing and distributing information substantially improves the efficiency of information services.

Implemented innovation of information services shows that this is one of the most effective ways of improving the technological preparation of production. The benefits are achieved in the area of production preparation itself, where the proportion of the time consumed and of the cost of information activity is reduced, as well as in the production area, because better information use improves the quality of production process design.

Information in sufficient volume and of the quality corresponding to the creativity needs of the staff involved in the technological production preparation provides information systems based on the advances achieved in information technologies and systems.

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REFERENCES

[1] Bubeník, P., Bubeníková, E., Korbel, P., & Nagy, P. (2004). *Information Technology for Business Practice.* Edis, Žilina, Slovak republic.

[2] Kovač J., Rudy V., & Kováč J. (2017). *Methods for the design of production processes. Specifics of designing production systems*. TU UK Košice, Slovak republic.

[3] Daneshjo, N., Rudy, V., Repková, K., Mareš, A., Kováč, J., Jahnátek, J., ... & Rusnák, J. (2018). *Intelligent industrial engineering–Innovation potential*. FedEx Print & Ship Center, USA.

[4] Plinta, D., & Krajčovič, M. (2015). *Production system designing with the use of digital factory and augmented reality technologies.* In International Conference on Automation (pp. 187-196). Springer, Cham.
Retrieved from:
https://link.springer.com/chapter/10.1007/978-3-319-15796-2_19

[5] Kováč, J., Rudy, V., Kováč, Ju. (2016). *Automation of production.* TU UK Košice, Slovak republic.

[6] Fairbank, J. F., Labianca, G. J., Steensma, H. K., & Metters, R. (2006). Information processing design choices, strategy, and risk management performance. *Journal of Management Information Systems*, 23(1), 293-319.
Retrieved from:
https://www.tandfonline.com/doi/abs/10.2753/MIS0742-1222230110

[7] Kalyakulin, S. Y., Kuz'min, V. V., Mitin, E. V., & Sul'din, S. P. (2020). Automated design of information processing in preproduction. *Russian Engineering Research*, *40*(5), 413-415.
Retrieved from:

https://link.springer.com/article/10.3103/S1068798X2005010X

[8] Christiaans, H., & Restrepo, J. (2001). *Information Processing in Design: a theoretical and empirical perspective.*

[9] Cooper, R. B., & Wolfe, R. A. (2005). *Information processing model of information technology adaptation: An intra-organizational diffusion perspective.* ACM SIGMIS Database: the DATABASE for Advances in Information Systems, 36(1), 30-48.
Retrieved from:
https://dl.acm.org/doi/abs/10.1145/1047070.1047074

[10] Swanson, L. (2003). An information-processing model of maintenance management. *International Journal of Production Economics*, 83(1), 45-64.
Retrieved from:
https://www.sciencedirect.com/science/article/pii/S0925527302002669

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CLIMATE CHANGE ADAPTATION MEASURES IN CITIES - EXAMPLES OF GOOD PRACTICE

Stanislava Strelcová [1] – Michal Titko [2]

Abstract: *The environment around us is constantly changing. As a result of technical progress, society has ever greater demands for energy, more and more waste and greenhouse gases are produced, industrial areas and cities are growing. In order to prevent irreversible changes in the atmosphere, it is necessary for countries and cities themselves to take measures to reduce emissions, as well as to reduce the negative consequences of a changing climate. The paper presents selected adaptation measures that can be adopted in urbanized areas with the aim of increasing biodiversity, collecting rainwater, lowering the temperature in the centers and, in overall, improving the living conditions of the inhabitants. Using examples, it points out the fact that adaptation measures that have been adopted in the world are also used in the conditions of the Slovak Republic.*

Keywords: environment, climate change, measures, adaptation, revitalization.

1 INTRODUCTION

Climate change poses increasingly serious risks to ecosystems, human health and the economy. It manifests itself as a long-term change in temperature and weather patterns, which until the beginning of the 19th century had a natural character. However, with the invention and introduction of steam power, electricity and gradually other achievements of the modern age, human activities are the main driving force of climate change [1].

The consequences of climate change are of different frequency and intensity in different regions. A solution that should prevent, or at least minimize, the risks and negative consequences of climate change is a suitable combination of measures aimed at reducing greenhouse gas emissions (mitigation measures) with adaptation measures. Adaptation measures represent a set of possibilities for natural and socio-economic systems to adapt to the ongoing or expected impacts of climate change, with the aim of reducing possible negative consequences and using the positive effects of climate change [2].

Municipalities often have to make a decision whether they will respond to climate risks only afterwards as part of the recovery actions (after a disaster), or whether they will take preventive measures to reduce the likelihood of negative phenomena occurring in their territory, or at least reduce their effect (before a disaster).

In the paper, the authors present a selection from the portfolio of adaptation measures that are used on almost all continents. The aim of the paper is to point out that despite the fact that in Slovakia the topic of climate change and environmental protection has only been emphasized in recent decade, Slovak cities have already been inspired by foreign good practice and are applying adaptation measures when arranging public spaces. For that purpose the example of the city of Žilina was used.

2 POSSIBILITIES OF CITIES IN ADDRESSING CLIMATE CHANGE

Climatic conditions in cities have certain specifics compared to extravillas, which are associated with the thermal conductivity of the materials used, as well as the color treatment of surfaces and buildings. Therefore, if cities want to adapt to climet change, they should, according to Lapin [3], focus on:

- adjustment of color, shape, surface, material and technological solutions of buildings,
- optimal combination of lawns, city parks and other residential vegetation with stone, concrete and asphalt surfaces.

Tóth in [4] sees water areas integrated into landscape architecture as the most important functional factor for cooling cities.

Another specific feature of cities lies in the density of built-up areas. The opinions and solutions of experts differ greatly. Landscape architects, e.g. on the website istavebnictvo.sk, they recommend the construction of high-rise buildings. They see the benefit of saving space, which can then be used for green planting. Climatologists, e.g. Šteiner in [4], point to the negative impact of high-rise buildings on air flow, and thus the warming of built-up areas.

In the next part of the article, examples of good practice from Slovakia and the world will be presented.

2.1 MEASURES ADOPTED IN THE WORLD

It is possible to find a large number of good practice examples in the field of adaptation measures adopted by cities. The authors selected only a small fraction of them. The common attribute of these measures is water.

The main effort of landscape architects is to retain as much water as possible in city centers. Considering the density of the built-up area, this is a big challenge. However, in almost every city there is an abandoned

unused area that can be revitalized. A good example is Parc Clichy-Batignolles in Paris, which was created on the site of a former freight railway station. Trails were built on the original rails and the energy needed to run the park is obtained from wind farms and solar panels. A reservoir was built in the park to collect rainwater and the plants planted in this park require little maintenance [5]. A similar project is also being created in Vienna, for example, by transformation the Nordbahnhof area into a park [6].

Figure 1. Parc Clichy-Batignolles in Paris
Source: Martin Argyroglo Photographe

Another option is to use the features of the landscape and connect them with the urbanized area. Although such connections exist in the urban areas, they are not properly maintained and therefore decay. A good example is the revitalization of the Avon River flowing through Chistchurch in New Zealand. The river is now the source of many recreational activities such as boating and at the same time sustains the city's diverse plant and animal life. The river flows through the university campus, where pollution-resistant plants have been planted and all rainwater from roofs and sidewalks has been channeled into this river [4], [8].

Figure 2. Avon River
Source: Christchurchnz.info

An increasingly common solution is the use of green roofs or walls. There is a whole range of such examples. Due to the scope of the article, we present at least two.

The California Academy of Sciences in San Francisco is a research institution and natural history museum. Its roof with an area of 2.5 hectares resembles rolling hills. The roof is covered with plants whose roots intertwine and create excellent thermal insulation. In addition, the plants capture rainwater and create a habitat for birds, bees and butterflies [9].

Figure 3. Living Roof
Source: California Academy of Science

„Living buildings“ based on thermal stabilization are also being built in the Czech Republic. An example is the LIKO_VO Hall in Slavkov near Brno. The green walls and roofs of this hall are simultaneously a root wastewater treatment plant. The water is then used to irrigate the surrounding greenery.

Figure 4. LIKO-VO – the first living hall
Source: Liko-Stezka

The hall is part of the 21st century industrial complex. The hall uses the most modern technology, which respects the connection between man and nature [10].

2.2 MEASURES ADOPTED IN SLOVAKIA

Adaptation measures adopted in Slovakia are significantly inspired by foreign ones. The authors focused primarily on the adaptation measures applied and designed in the city of Žilina and its surroundings.

Žilina is located in the northwest of Slovakia. Its climatic character is influenced by the fact that it is located at the confluence of three rivers. A waterwork is built on both sides of the largest of them (Váh). The city is an important transport hub, and at the end of the 20th century several industrial parks linked to the automobile industry were built in its vicinity.

At the beginning of the 20th century, the city management came up with an ambitious plan to connect the city center with a recreation zone, which would be created by the river Váh and would be accessible to pedestrians and cyclists. However, the railway station was an obstacle. Experts from the field of architecture suggested to make an underground railway hub and revitalization of the area into a park (undersurface proposal). Figure 5 shows one of the revitalization proposals.

Figure 5. Proposal for revitalization of the Žilina railway hub
Source: Dušan Voštenák

The central white area in the figure 5 covers the railway tracks, which was proposed to be at a depth of eight meters under ground (the red area shows the exit of the railway tracks to the surface). The yellow line indicates the pedestrian connection of the city center with the railway station and the recreation area on the right bank of the Váh River. According to the mayor of the city Igor Choma (at the time), the undersurface proposal was about 60% more expensive than the surface version and therefore it was not implemented [12].

The city of Žilina and its suburbs implement financially less demanding projects aimed at adapting to climate change. A good example is e.g. creation of St. Juraj Park in the Trnové district (Figure 6).

The park is bordered by a local stream with a natural meander flowing through a wetland that was not accessible until now. The original natural vegetation of the wetland was preserved and a wooden walkway was built across it. The park acts on the surroundings as a significant ecostabilizing element, accumulates rainwater and increases biodiversity in the surroundings [13].

Figure 6. St. Juraj Park, Žilina-Trnové
Source: Autor

Another example of good practice from the city of Žilina is the construction of family houses in the Veľký diel, which was designated as a University Town in 2006 (Figure 7). It is located in the peripheral part of the panel housing estate and is adjacent to the city forest park and the campus of the University of Žilina. The two-story terraced family houses provide the feeling of living in connection with nature. This feeling is achieved by connecting the building to the terrain and the surrounding landscape, as well as by covering the roofs with extensive greenery in a thickness of 30-40 cm [15].

Figure 7. University Town of Žilina
Source: Jozef Cernava

These are just a few of the many activities carried out in the city of Žilina as part of climate change adaptation measures.

There is a lot of possiblities how to improve the environmental conditions in the cities. A good example is also the reconstruction of non-functional infrastructure as disused railway lines into cycle paths. In Slovakia, we can find several locations where such a change was implemented, for example in Kysuce or Záhorie. It is advisable to look for inspiration abroad, in Europe, North America or Australia, where many adaptation measures are already implemented.

3 CONCLUSION

The adverse consequences of climate change, such as extreme temperatures and heat waves, torrential rains, or periods of drought, affect the quality of life of the inhabitants of every city. The most vulnerable groups are the elderly, young children and chronically ill patients. City leaders should adopt an adaptation strategy that would be part of the territorial plan of each city. This is the only way to effectively implement climate change measures.

Such an adaptation strategy often includes financially and spatially demanding measures, such as e.g. revitalization of old unused buildings or industrial sites. However, cities must not forget the fact that even small changes can have a significant effect. Such a change can be the installation of mobile greenery, the drainage of rainwater and its reuse, the planting of green water retaining belts, or the recultivation of existing green areas.

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REFERENCES

[1] *What is Cimate Change?* (2022). Retrieved from: https://www.un.org/en/climatechange/what-is-climate-change

[2] Ministerstvo vnútra SR (2022). *Klimatická zmena.* Retrieved from:

[3] Lapin, M. (2007). Climate Changes and Possible Impacts in Urban Areas. *Životné prostredie, 41(5),* 240-244.

[4] Barát, A. *Klimatická zmena je šanca mať zelenšie mestá*. Retrieved from: https://zurnal.pravda.sk/fenomen/clanok/347350-klimaticka-zmena-je-sanca-mat-zelensie-mesta/ [accessed: 19 September 2022].

[5] *Parc Clichy-Batignolles.* (2022). Retrieved from: https://www.parisetmetropole-amenagement.fr/en/clichy-batignolles-paris-17th [accessed: 19 September 2022].

[6] *Rudolf-Bednar-Park.* (2022). Retrieved from: https://www.wien.gv.at/english/environment/parks/bednar.html [accessed: 19 September 2022].

[7] Argyroglo, M. (2014). *Parc Clichy-Batignolles - Martin Luther King, Paris, 2014.* Retrieved from: martin-argyroglo.com [accessed: 19 September 2022].

[8] *Avon River*. (2022). Retrieved from: https://www.christchurchnz.info/business/avon-river [accessed: 25 September 2022].

[9] *Living Roof*. (2022). Retrieved from: https://www.calacademy.org/exhibits/living-roof [accessed: 25 September 2022].

[10] *Liko-Stezka*. (2022). Retrieved from: https://www.liko-stezka.cz/ [accessed: 1 October 2022].

[11] Voštenák, D. (2012). *Revitalizácia železničného uzla – architektornický návrh*.

[12] Milo, J. (2013). *Železničná stanica mala byť pod zemou, nikdy však nebude*. Retrieved from: https://myzilina.sme.sk/c/6921663/zeleznicna-stanica-mala-byt-pod-zemou-nikdy-vsak-nebude.html [accessed: 1 October 2022].

[13] *Park Sv. Juraja Trnové*. (2022), Retrieved from: https://www.zilinaklima.sk/park-sv-juraja-trnove/ [accessed: 29 September 2022].

[14] VISTO (2006). Zámer činnosti podľa zákona NR SR č. 24/2006 Z.z. Retrieved from: https://www.enviroportal.sk/en/eia/detail/univerzitne-mestecko-velky-diel-zilina [accessed: 29 September 2022].

[15] Cernava, J. (2018). Univerzitné mestečko. Retrieved from: Univerzitné mestečko – Mapy Google [accessed: 29 September 2022].

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VYUŽITIE DIZAJNU V PRODUKTOVÝCH INOVÁCIÁCH AKO ZDROJ KONKURENČNEJ VÝHODY

Renáta Ševčíková[1]

Abstract: *The paper focuses on the attitude of firms operating in the Slovak Republic in selected industrial sectors at the high, medium, and low technology level towards innovation and the use of design in product innovation as a source of competitive advantage. The research was carried out in the period from July to November 2021 on a sample of 239 firms operating in the Slovak Republic in different industrial production sectors. The relationships between variables were tested for statistical significance and expressed using Pearson's sample correlation coefficient. The test results show the relationship and connection between the role of design in the firm and its attitude towards innovation as a source of competitiveness. The influence of the technological level of the firm's industry on its attitude towards design and its role in the firm was also confirmed.*

Keywords: product design, innovations, competitive advantage, high, medium, and low technology level.

1 ÚVOD

V dnešnom rýchlo sa meniacom ekonomickom a podnikateľskom prostredí firmy súťažia o zákazníkov, výnosy a podiel na trhu s produktmi, ktoré čo najviac spĺňajú potreby zákazníkov. Globálna konkurencia priniesla technologické zmeny, kedy zákazníci požadujú produkty najvyššej kvality za nižšie ceny. Hoci existuje veľa cieľov, ktoré by firma chcela v dnešnej dobe dosiahnuť, dva hlavné sú (i) dosiahnuť udržateľnú konkurenčnú výhodu a (ii) zlepšiť výkonnosť svojej firmy v porovnaní s výkonnosťou ich konkurentov [1]. Téma dosiahnutia konkurenčnej výhody a jej udržanie je úzko prepojená so samotnou konkurencieschopnosťou a má interdisciplinárny presah. Pozornosť venovanú konkurenčnej výhode možno nájsť v ekonomickej teórii, histórii, architektúre, sociológii a kultúre. Hoci konkurenčná výhoda sa stala stredobodom diskusií o obchodnej stratégii, jednoznačná definícia tohto pojmu je ťažko uchopiteľná. Spoločnou témou však zostala „tvorba hodnôt“.

2 PRODUKTOVÝ DIZAJN AKO ZDROJ KONKURENČNEJ VÝHODY

Konkurenčná výhoda je základom úspechu každej firmy na konkurenčnom trhu. Konkurenčnou výhodou je schopnosť firmy zatraktívniť svoju ponuku v očiach spotrebiteľov pred konkurenciou. Podľa definície Portera [2] je konkurenčnou výhodou schopnosť firmy vytvoriť si prevahu nad konkurenciou. V ére globalizácie si každá firma uvedomuje potrebu získať konkurenčnú výhodu. Ak je pripravená na radikálne zmeny a aplikáciu inovatívneho dizajnu na svoje výrobky, umožní jej to vytvoriť konkurenčnú výhodu a zároveň si túto konkurenčnú výhodu udržať. Zdroje konkurenčnej výhody môžeme podľa Blazeskej a Ristovskej [3] porovnávať so základmi domu. Ak môžeme povedať, že dom je bezpečný, iba ak má kvalitný základ, môžeme tiež povedať, že konkurenčnú výhodu je možné si udržať, iba ak sú jej zdroje stabilné, jedinečné a ťažko napodobniteľné.

Podľa Portera [2] je konkurenčná výhoda základom úspešnosti a výkonnosti firmy na konkurenčných trhoch, konkurenčná výhoda znamená mať nízke náklady, výhodu diferenciácie alebo úspešnú stratégiu zamerania. Porter tiež tvrdí, že konkurenčná výhoda zásadne rastie z hodnoty, ktorú je firma schopná vytvoriť pre svojich zákazníkov a ktorá prevyšuje náklady firmy na jej vytvorenie. Porterove argumenty odrážajú spoločný rámec silných a slabých stránok, príležitostí a hrozieb na hodnotenie konkurenčnej výhody. Konkurenčná výhoda pramení zo schopnosti firmy využiť svoje vnútorné silné stránky, aby reagovala na vonkajšie príležitosti a zároveň sa vyhýbala vonkajším hrozbám a svojim vnútorným slabým stránkam.

Podľa Lesákovej [4] konkurenčnú výhodu možno definovať ako vlastníctvo výnimočných zdrojov, alebo výnimočný spôsob využívania týchto zdrojov, alebo špecifické aktivity, ktoré firme poskytujú určitú výhodu pred konkurenciou.

Konkurenčná výhoda sa vyznačuje niekoľkými vlastnosťami:

(1) výnimočné schopnosti (zdrojmi týchto schopností môžu byť napr. zručnosti a schopnosti pracovníkov, materiálové, surovinové a strojové vybavenie firmy, finančné zdroje a distribučná sieť);

(2) existencia nedokonalej konkurencie;

(3) udržateľnosť (konkurenčná výhoda by mala byť dlhodobá, nemala by byť ľahko kopírovateľná konkurentmi);

(4) súlad s vonkajším prostredím (firma by mala sledovať aj celkové podmienky trhu, aby konkurenčná výhoda bola akceptovateľná);

(5) dosiahnutie nadpriemerných ziskov (konkurenčná výhoda je cestou k dosiahnutiu udržateľnej ziskovej pozície).

Intenzívna konkurencia na domácich a medzinárodných trhoch, náročnejší, asertívnejší zákazníci a rýchly pokrok v technológii vytvorili väčší tlak na firmy, aby hľadali spôsoby, ako dosiahnuť trvalú konkurenčnú výhodu. Mnohé štúdie naznačujú, že výrobné firmy považujú stratégiu diferenciácie za

dôležitejší a zreteľnejší prostriedok na dosiahnutie konkurenčnej výhody než stratégiu s nízkymi nákladmi [5], [6], [7], [8], [9], [10]. Dôsledkom globalizácie sa zintenzívňuje konkurencia medzi výrobnými firmami, s rastúcimi požiadavkami zákazníkov firmy majú väčšiu tendenciu vytvárať konkurenčnú výhodu tým, že vyrábajú produkty s vyššou hodnotu. Stratégia diferenciácie by týmto firmám poskytla väčší priestor na výrobu produktov s hodnotnejšími a žiaducimi vlastnosťami.

Porterova stratégia diferenciácie sa podľa niektorých autorov ďalej rozvinula do špecifickejších stratégií, ako je diferenciácia podľa inovácie produktov, podľa reakcie zákazníkov alebo marketingu [7], [11], [9].

Stratégia diferenciácie podľa Dirisu a kol. [12] znamená, že firma vytvára produkt, ktorý sa považuje za jedinečný v niektorých aspektoch, ktoré si zákazník cení, pretože sú uspokojené jeho potreby. Zdrojom diferenciácie môže byť niečo, čo firma vytvára, čo je pre ňu charakteristické a ťažko replikovateľné, tiež známe ako kľúčová kompetencia [13]. Morgan, Kaleka & Katsikeas [14], merali kľúčovú kompetenciu produktu (diferenčnú výhodu) podľa niekoľkých aspektov: (1) vyššia kvalita produktu, (2) balenie produktu, (3) dizajn a štýl produktu. Autori Chenhall a Langfield-Smith [15] merali stratégiu diferenciácie produktov pomocou piatich premenných: (1) poskytovanie vysoko kvalitných produktov, (2) poskytovanie rýchlych dodávok, (3) zmeny v dizajne, (4) zavádzanie nových produktov a (5) poskytovanie produktov s jedinečnými vlastnosťami. Autor Aliqah [16] vo svojej štúdii prijal nasledujúce premenné na meranie stratégie diferenciácie produktov: (1) vysoká kvalita produktu, (2) rýchle dodanie, (3) dizajn a nové produkty a (4) jedinečné vlastnosti produktu. Zhrnutie jednotlivých aspektov pre dosiahnutie stratégie diferenciácie je znázornené na obrázku 1.

Obrázok 1 Stratégia diferenciácie – dosiahnutie konkurenčnej výhody

Dobre navrhnutý produkt ponúka spotrebiteľom funkčné aj estetické výhody, ktoré by sa mohli stať dôležitým zdrojom diferenciácie. Dizajn produktu môže pomôcť spotrebiteľovi určiť výber medzi produktami rovnakých značiek a kategórií. Dobre navrhnutý produkt môže byť tiež bodom rozdielu na trhu, ktorý pomáha spotrebiteľovi prijať produkt cez jednoduchosť používania, životnosť, spoľahlivosť alebo balenie. Dizajn produkt môžeme akceptovať ako zdroj konkurenčnej výhody a silné marketingové aktívum firmy.

3 METODIKA PRÁCE

Cieľom príspevku je overiť postoj vo firmách pôsobiacich v Slovenskej republike vo vybraných priemyselných sektoroch na úrovni vysokých, stredných a nízkych technológií k inováciám a k využitiu dizajnu v produktových inováciách ako zdroja konkurenčnej výhody. V súlade s cieľom tohto príspevku uvádzame nasledovné hypotézy:

H1 Medzi úlohou dizajnu, ktorú zohráva vo firmách a postojom firmy k inováciám ako zdroja konkurencieschopnosti existuje pozitívny vzťah.
H2 Technologická úroveň priemyselného odvetvia ovplyvňuje prístup firiem k dizajnu.

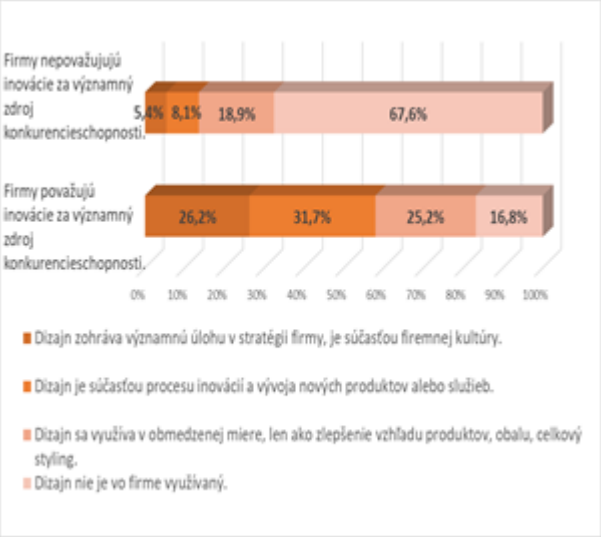
Objektom skúmania primárneho výskumu boli slovenské firmy s prevažujúcou činnosťou v priemyselných odvetviach podľa štyroch úrovní technologickej náročnosti. OECD vymedzila štyri základné priemyselné odvetvia klasifikované podľa technologickej náročnosti: vysoká technológia, stredne vysoká technológia, stredne nízka technológia, nízka technológia. Stupne technologického sektora sú definované podľa intenzity výskumu a vývoja v danom odvetví (výdavky na výskum a vývoj/pridaná hodnota). Zber údajov prebiehal v období júl - november 2021 a z dôvodu protipandemických opatrení prebiehal najmä online prostredníctvom štruktúrovaného dotazníka. Základný súbor tvorilo 239 firiem z rôznych oblastí priemyselnej výroby. Vzťahy medzi premennými sme testovali na štatistickú významnosť modelu a vyjadrili sme ich pomocou Pearsonovho výberového korelačného koeficientu.

4 VÝSLEDKY A DISKUSIA

Takmer 85 % našej výskumnej vzorky (202 firiem) považuje inovácie za významný zdroj konkurencieschopnosti a len 37 firiem, čo tvorí 15% našej vzorky tento názor nezdieľa.

Graf č. 1 znázorňuje vzájomný vzťah postoja skúmaných firiem k inováciám a postavení dizajnu a jeho úlohe vo firmách. Úloha dizajnu vo firme vychádza z konceptu G. Kootstru [17] a vymedzuje využitie dizajnu v rámci 4 stupňov:

1. Dizajn zohráva významnú úlohu v stratégii firmy, je súčasťou firemnej kultúry.
2. Dizajn je súčasťou procesu inovácií a vývoja nových produktov alebo služieb.
3. Dizajn sa využíva v obmedzenej miere, len ako zlepšenie vzhľadu produktov, obalu, celkový styling.
4. Dizajn nie je vo firme využívaný.



Graf č. 1 Postoj firiem k inováciám a úloha dizajnu vo firmách

Zistenia prieskumu firiem ukazujú značný vplyv a súvislosť medzi úlohou dizajnu vo firmách a ich postojom k inováciám. Viac ako 67% firiem, ktoré nepovažujú inovácie za významný zdroj konkurencieschopnosti zároveň tvrdí, že dizajn nie je vo firme vôbec využívaný. V prípade firiem, ktoré považujú inovácie za významný zdroj svojej konkurencieschopnosti len v 16,8% z nich nie je dizajn vôbec využívaný. V 83,2% firiem z tejto kategórie je dizajn určitým spôsobom využívaný, či už zohráva významnú úlohu v stratégii firmy (26,2%), je súčasťou procesu inovácii a vývoja nových produktov (31,7%) alebo sa využíva v obmedzenej miere, len ako zlepšenie vzhľadu produktov (25,2%).

Vyhodnotenie stanovenej hypotézy H1:
H1 Medzi úlohou dizajnu, ktorú zohráva vo firmách a postojom firmy k inováciám ako zdroja konkurencieschopnosti existuje pozitívny vzťah.
Hypotézou sme chceli overiť, či existuje vzťah a súvislosť medzi úlohou dizajnu, ktorú zohráva vo firme a jej postojom k inováciám ako zdroja konkurencieschopnosti. Stanovili sme nulovú hypotézu, ktorú sme následne otestovali.
H0 – Neexistuje žiadny vzťah medzi úlohou dizajnu, ktorú zohráva vo firmách a postojom firmy k inováciám ako zdroja konkurencieschopnosti.
Koeficient korelácie medzi týmito dvomi premennými vykazuje miernu pozitívnu koreláciu s hodnotu 38,2%. Pomocou testu významnosti koeficientu korelácie overíme, či závislosť skutočne existuje. Na základe výsledkov testu (obrázok č. 2) môžeme potvrdiť, že nameraná korelácia je štatisticky významná a medzi pozorovanými veličinami existuje preukázaná závislosť. Nulovú hypotézu preto na hladine významnosti 1% zamietame a prijímame hypotézu 1.

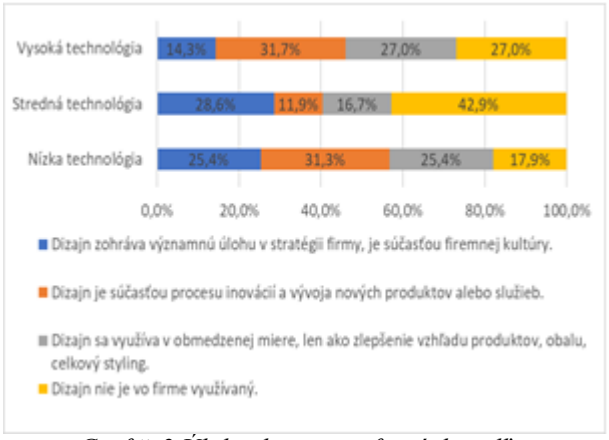
Correlations

		uloha dizajnu	inov_zdroj konkurenc
uloha dizajnu	Pearson Correlation	1	,382**
	Sig. (2-tailed)		<,001
	N	239	239
inov_zdroj konkurenc	Pearson Correlation	,382**	1
	Sig. (2-tailed)	<,001	
	N	239	239

**. Correlation is significant at the 0.01 level (2-tailed).

Obrázok č. 2 Vzťah medzi úlohou dizajnu a postojom firmy k inováciám

Graf č. 2 uvádza akú úlohu vo využívaní dizajnu zohráva technologická náročnosť odvetvia, v ktorom firma pôsobí. Výsledky naznačujú, že firmy, ktoré pôsobia v odvetviach s nízkou technologickou náročnosťou vo veľkej miere dizajn využívajú (82,1%; 110 respondentov). V prípade odvetví s vysokou technologickou náročnosťou dizajn využíva 73% firiem (46 respondentov) a najmenej je dizajn využívaný v prípade odvetví so strednou technologickou náročnosťou (57,1%; 24 respondentov).



Graf č. 2 Úloha dizajnu vo firmách podľa technologickej náročnosti odvetvia

Vyhodnotenie stanovenej hypotézy H2:
H2 Technologická úroveň priemyselného odvetvia ovplyvňuje prístup firiem k dizajnu.
Hypotézou sme chceli overiť, či technologická úroveň priemyselného odvetvia firmy ovplyvňuje jej prístup k dizajnu a k jeho úlohe vo firme. Stanovili sme nulovú hypotézu, ktorú sme následne otestovali.
H0 – Neexistuje žiadny vzťah medzi úlohou dizajnu, ktorú zohráva vo firme a technologickou náročnosťou odvetvia. Koeficient korelácie medzi týmito dvomi premennými vykazuje slabú pozitívnu koreláciu s hodnotu 13,3 %. Koeficient korelácie je na hladine významnosti 5 % štatisticky významný, tzn. že zamietame nulovú hypotézu H0 a preukázali sme, že medzi technologickou náročnosťou odvetvia a úlohou dizajnu, ktorú zohráva vo firme existuje štatisticky významná závislosť, prijímame hypotézu H2 (obrázok č. 3).

Correlations

		technologia	uloha dizajnu
technologia	Pearson Correlation	1	,133*
	Sig. (2-tailed)		,040
	N	239	239
uloha dizajnu	Pearson Correlation	,133*	1
	Sig. (2-tailed)	,040	
	N	239	239

*. Correlation is significant at the 0.05 level (2-tailed).

Obrázok č. 3 Vzťah medzi úlohou dizajnu a technologickou úrovňou odvetvia

5 ZÁVER

Analýza údajov získaných z primárneho prieskumu firiem pôsobiacich v Slovenskej republike vo vybraných priemyselných sektoroch na úrovni vysokých, stredných a nízkych technológií naznačuje vzájomnú prepojenosť dizajnu a inovácií. Podľa našich zistení takmer 85 % našej výskumnej vzorky (202 firiem) považuje inovácie za významný zdroj svojej konkurencieschopnosti a len 37 firiem, čo tvorí 15 % našej vzorky tento názor nezdieľa. Výsledky ukazujú značný vplyv a súvislosť medzi úlohou dizajnu vo firmách a ich postojom k inováciám. Viac ako 67 % firiem, ktoré nepovažujú inovácie za významný zdroj konkurencieschopnosti zároveň tvrdí, že dizajn nie je vo firme vôbec využívaný. V prípade firiem, ktoré považujú inovácie za významný zdroj svojej konkurencieschopnosti len 16,8 % z nich nie je dizajn vôbec využívaný. V 83,2 % firiem z tejto kategórie je dizajn určitým spôsobom využívaný, či už zohráva významnú úlohu v stratégii firmy (26,2 %), je súčasťou procesu inovácii a vývoja nových produktov (31,7 %) alebo sa využíva v obmedzenej miere, len ako zlepšenie vzhľadu produktov (25,2 %). Na základe otestovania stanovenej hypotézy H1 sme potvrdili štatistickú významnosť korelácie medzi úlohou dizajnu, ktorú zohráva vo firmách a postojom firmy k inováciám ako zdroja konkurencieschopnosť. Výsledky naznačujú, že firmy, ktoré pôsobia v odvetviach s nízkou technologickou náročnosťou vo veľkej miere (82,1 %; 110 respondentov) dizajn využívajú. V prípade odvetví s vysokou technologickou náročnosťou dizajn využíva 73 % firiem (46 respondentov) a najmenej je dizajn využívaný v prípade odvetví so strednou technologickou náročnosťou (57,1 %; 24 respondentov). Otestovaním stanovenej hypotézy H2 sme potvrdili štatistickú významnosť korelácie medzi technologickou úrovňou odvetvia a postavením dizajnu vo firemnej stratégii.

Z výsledkov nášho prieskumu vyplýva vysoká miera záujmu firiem o dizajn a inovácie. Potvrdili sme značnú súvislosť a vzájomný vplyv medzi dizajnom a zavedenou inováciou vo firme. Čím je vyššie postavenie dizajnu vo firme, tým je firma aktívnejšia v zavádzaní inovácií. Firmy, s cieľom zvýšenia využitia dizajnu v produktových inováciách a dosiahnutia udržateľnej konkurenčnej výhody, by sa mali zameriavať na produkty a služby s vyššou pridanou hodnotou alebo inými/novými vlastnosťami, ktoré dizajn vytvára pre zákazníka, využívať dizajn ako pridanú hodnota pre produkty a služby a vytvoriť efektívnejšie a výraznejšie služby.

REFERENCIE

[1] Rose, R. C., Uli, J., Abdullah, H., & Ismail, A. I. (2009). A conceptual framework of the relationship between organizational resources, capabilities, systems, competitive advantage, and performance. *Research Journal of International Studies*, (12), 45-58.

[2] Porter, E. (1985). M. Competitive advantage: creating and sustaining superior performance. *New York*.

[3] Blazeska, D., Ristovska, N., (2016). The product design as a significant element of differentiation for achieving market competitiveness. *Economic Development* 1-2, 41-58

[4] Lesáková, D. a kol. (2007). *Strategický marketing*. Bratislava: Sprint, ISBN 978-80-89085-92-7.

[5] De Meyer, A., Nakane, J., Miller, J. G., & Ferdows, K. (1989). Flexibility: the next competitive battle the manufacturing futures survey. *Strategic Management Journal*, *10*(2), 135-144.

[6] Kotha, S., & Orne, D. (1989). Generic manufacturing strategies: a conceptual synthesis. *Strategic management journal*, *10*(3), 211-231.

[7] Miller, D. (1988). Relating Porter's business strategies to environment and structure: Analysis and performance implications. *Academy of management Journal*, *31*(2), 280-308.

[8] Kotha, S., & Vadlamani, B. L. (1995). Assessing generic strategies: an empirical investigation of two competing typologies in discrete manufacturing industries. *Strategic Management Journal*, *16*(1), 75-83.

[9] Lillis, A. M. (2002). Managing multiple dimensions of manufacturing performance—an exploratory study. *Accounting, organizations and society*, *27*(6), 497-529.

[10] Baines, A., & Langfield-Smith, K. (2003). Antecedents to management accounting change: a structural equation approach. *Accounting, organizations and society*, *28*(7-8), 675-698.

[11] Perera, S., Harrison, G., & Poole, M. (1997). Customer-focused manufacturing strategy and the use of operations-based non-financial performance measures: A research note. *Accounting, organizations and Society*, *22*(6), 557-572.

[12] Dirisu, J. I., Iyiola, O., & Ibidunni, O. S. (2013). Product differentiation: A tool of competitive advantage and optimal organizational performance (A study of Unilever Nigeria PLC). *European Scientific Journal*, *9*(34).

[13] Prahalad, C. K., & Hamel, G. (2009). The core competence of the corporation. In *Knowledge and strategy* (pp. 41-59). Routledge.

[14] Morgan, N. A., Kaleka, A., & Katsikeas, C. S. (2004). Antecedents of export venture performance:

A theoretical model and empirical assessment. *Journal of marketing, 68*(1), 90-108.

[15] Chenhall, R. H., & Langfield-Smith, K. (1998). The relationship between strategic priorities, management techniques and management accounting: an empirical investigation using a systems approach. *Accounting, organizations, and society*, *23*(3), 243-264.

[16] Aliqah, K. M. A. (2012). Differentiation and organizational performance: Empirical evidence from Jordanian companies. *Journal of Economics*, *3*(1), 7-11.

[17] Kootstra, G. L. (2009). The incorporation of design management in today's business practices. *Holland University of Applied Sciences*.

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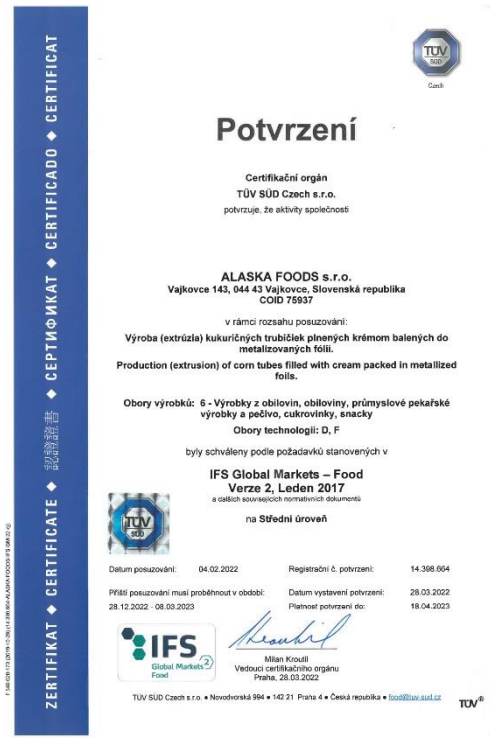

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potvrzuje, že aktivity společnosti

ALASKA FOODS s.r.o.
Vajkovce 143, 044 43 Vajkovce, Slovenská republika
COID 75937

v rámci rozsahu posuzování:

Výroba (extrúzia) kukuričných trubičiek plnených krémom balených do metalizovaných fólií.

Production (extrusion) of corn tubes filled with cream packed in metallized foils.

Obory výrobků: 6 - Výrobky z obilovin, obiloviny, průmyslové pekařské výrobky a pečivo, cukrovinky, snacky

Obory technologií: D, F

byly schváleny podle požadavků stanovených v

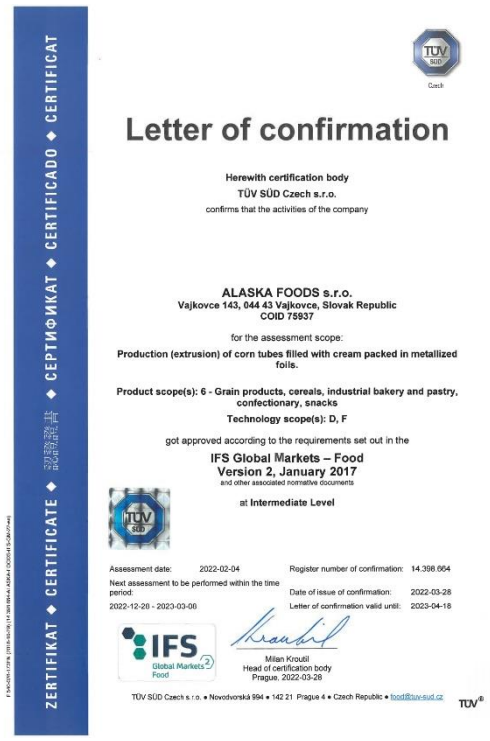
IFS Global Markets – Food
Verze 2, Leden 2017
a dalších souvisejících normativních dokumentů

na Střední úroveň

Datum posuzování:	04.02.2022	Registrační č. potvrzení:	14.398.664
Příští posuzování musí proběhnout v období:		Datum vystavení potvrzení:	28.03.2022
28.12.2022 - 08.03.2023		Platnost potvrzení do:	18.04.2023

Milan Kroutil
Vedoucí certifikačního orgánu
Praha, 28.03.2022

TÜV SÜD Czech s.r.o. • Novodvorská 994 • 142 21 Praha 4 • Česká republika • food@tuv-sud.cz



ZERTIFIKAT ◆ CERTIFICATE ◆ 認證書 ◆ СЕРТИФИКАТ ◆ CERTIFICADO ◆ CERTIFICAT

Letter of confirmation

Herewith certification body
TÜV SÜD Czech s.r.o.
confirms that the activities of the company

ALASKA FOODS s.r.o.
Vajkovce 143, 044 43 Vajkovce, Slovak Republic
COID 75937

for the assessment scope:

Production (extrusion) of corn tubes filled with cream packed in metallized foils.

Product scope(s): 6 - Grain products, cereals, industrial bakery and pastry, confectionary, snacks

Technology scope(s): D, F

got approved according to the requirements set out in the

IFS Global Markets – Food
Version 2, January 2017
and other associated normative documents

at Intermediate Level

Assessment date:	2022-02-04	Register number of confirmation:	14.398.664
Next assessment to be performed within the time period:		Date of issue of confirmation:	2022-03-28
2022-12-26 - 2023-03-06		Letter of confirmation valid until:	2023-04-18

Milan Kroutil
Head of certification body
Prague, 2022-03-28

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Workshop proceedings

A collection of papers presented at the international scientific workshop Engineering Science and Production Management 2022 (ESPM 2022) held on 10. - 11. november 2022 in Sorea Titris, Tatranská Lomnica, Slovakia.

Tatranská Lomnica, 2022

ProEnviro

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7. – 13. NOVEMBER 2022

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