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EDITORIAL

Articles in this issue are focused on area of study of development of management, leadership and human capital and management and in different type of organizations – mainly in educational organizations and in public sector in different contexts of regional development and changes in society 4.0. The main aim of the issue is to describe different point of view in theory and practice of regional development in international context. The regional aspect is becoming from Central Europe as Czech Republic and Eastern Europe as Russia. Articles are based on the results of the long-term cooperation with universities in Russia - Moscow Polytechnic University and Technological University, Korolev, Moscow Region and Educational management Faculty of education, Charles University.

Michaela Tureckiová in article “The influence of covid-19 pandemic on changes in the roles of school managers in regional education” examines the content of the roles of managers in regional education and the possible impact of the COVID-19 pandemic on changes in these roles. The aim of the survey was to update the contents of key roles of managers in regional education and to determine whether the COVID-19 pandemic also changed the importance that respondents attribute to certain types of roles or partial activities of managers in regional education. The influence in the period from March 2020 to January 2021 was reflected.

Renata Skýpalová, in article “Corporate social responsibility as a tool for motivating primary school staff in South Moravian Region” describe the role of human capital in schools. There are focused on corporate social responsibility (CSR) activities as tools for motivating the staff of selected primary schools in the South Moravian Region. The questionnaire survey took place in 2020 and was attended by 230 teachers from 24 schools. The survey results show that knowledge of the CSR concept and the use of its motivation instruments among primary school teachers depend on the size of the school.

Viktoriya S. Artemenko, Vladimir D. Sekerin, Lev D. Gurtskoy in article “Marketing communication in the digital environment” devoted to the role of marketing communication in digital environment. The key features of marketing communication strategy are revealed. Authors analyze the efficiency of marketing communication, which make enable companies to increase their business results. The article refers to vital marketing trends in the digital environment.

Ivan A. Zaytsev, Anna E. Gorokhova, Yuri N. Popovskii in article “Justification of the choice of mathematical methods when calculating the index of the innovative potential of an enterprise in the digital economy” to consider and analyze several basic mathematical methods used in the process of calculating the index of innovative potential of an enterprise in the digital economy. The presented article has high scientific value due to the evidence base, which allows us to conclude about the need to use regression analysis when assessing the innovative potential of an enterprise.

Tatiana S. Zaytseva, Elena E. Shurukova, Ivan A. Zaytsev in article **“Development of human resources as a factor of economic security”** focus on the need to develop human resources to ensure the economic security of the organization. The main determinants of the microlevel that affect economic security are identified. Their characteristics and ways of influencing the economic security of the organization are given.

Jana Marie Šafránková, Martin Šikýř in article “Leadership challenges in public sector in in a regional context” analyse different views on leadership in management in public sector in a regional context and view on approaches to human resource management in public administration in the Czech Republic. The survey was conducted during the years 2019 - 2020. The results show that in surveyed organisation are many managers not managing and using as leadership.

MARKETING COMMUNICATION IN THE DIGITAL ENVIRONMENT

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Keywords:

Marketing communications, digital environment, trend, marketing strategy

Abstract:

The article is devoted to the role of marketing communication in digital environment. The key features of marketing communication strategy are revealed. Authors analyze the efficiency of marketing communication, which make enable companies to increase their business results. The ways how companies interact with customers and carry out their operations are considered. The article refers to vital marketing trends in the digital environment.

Introduction

Traditionally the theory and practice of marketing considered attracting new customers and selling their goods and services to them as their main activities. However today modern marketing prioritizes not only attracting new customers, but also maintaining strong and long-term relationships with existing customers. Marketing includes a range of activities such as analysis, planning, event management and monitoring of activities aimed at establishing, strengthening and maintaining beneficial relationships with target customers. The ultimate goal is to achieve the required sales level, profit margins and market share using a series of marketing activities such as new product development, marketing research, communication, distribution, pricing and service. Marketing communications is the process of communicating product information to the target audience. Nowadays marketing communications play a key role in the whole process. It can be anything: advertising, personal selling, direct marketing, sponsorship, communication, and public relations.

1.The role of marketing communication in digital environment

Marketing communications is the process of communicating information about companies, their brands, products and services to the target audience using various channels and tools. Marketing communication is the one of the elements of the marketing mix (promotion) aimed at delivering information to consumers about companies, their brands, products and services to achieve the following business goals.

- Creation of awareness of the company, its brands and products among the target audience or the general public.

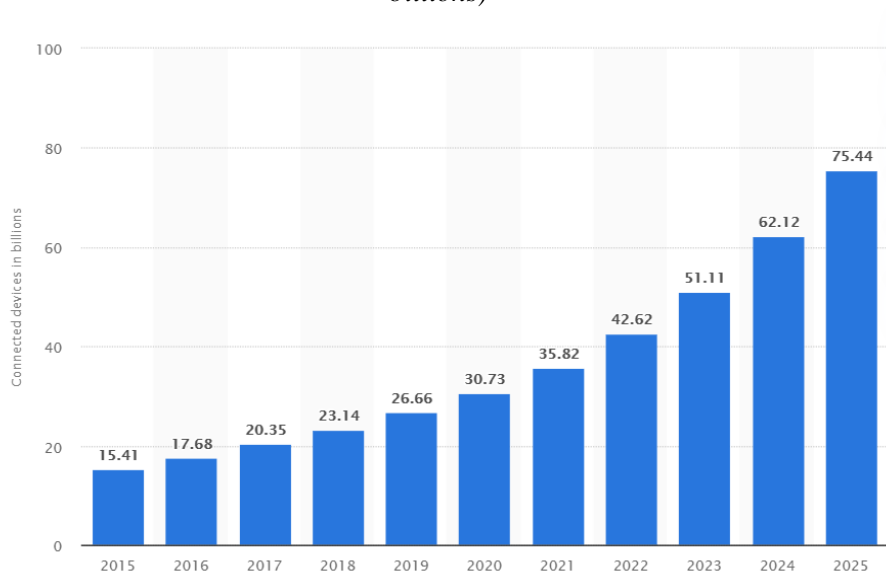
- Delivering information about the company and its proposals to the target audience.
- Stimulating purchases by the target audience in a specific place and at a specific time. Alignment of seasonality and dips in sales.
- Detachment from competitors, realized through communications (delivering information to consumers about the uniqueness and advantages of the company, its brands, goods and services).
- Formation of loyalty of existing consumers to the company, its brands and products.

Marketing communication is implemented as part of a business communication strategy, developed separately for each brand, business direction, product category and so on. The communication strategy is formed in accordance with the chosen business development strategy (corporate strategy), taking into account market trends, motivation, value system, characteristics of consumer behavior of the target audience, the level of competition in the market, as well as the goals of the company. In addition, marketing communications cannot be divorced from the rest of the marketing mix (product, price, place). This means that the communication strategy and communication plan must be interconnected with the assortment plan, sales plan and price positioning.

2. Efficiency of marketing communication strategy

The rapid development of digital communications stimulates the development of Internet marketing strategies for the company. According to the forecast on the Fig. 1, by 2025, there will be more than 75 billion Internet of Things (IoT) connected devices in use. The IoT refers to a network of devices that are connected to the internet and can “communicate” with each other. Such devices include daily tech gadgets such as the smartphones, smart home, industrial devices. These smart connected devices are able to gather, share, and analyze information and create actions accordingly. Hence, companies should develop in the frame of marketing communication strategy.

Figure 1: *Internet of Things (IoT) connected devices installed base worldwide from 2015 to 2025(in billions)*



Source: Statista (2021)

Internet marketing communications strategy - a set of methods that allow a company to be present in the digital environment and ensure the achievement of marketing goals. The modern internet marketing strategy includes the following areas and tactics: Search engine optimization of the site (SEO-strategy), Pay-Per-Click (PPC) marketing, webinar production, content marketing (blogging & article writing), targeted and contextual advertising, display advertising, PR, social media marketing (SMM), mailing list, viral marketing, call-to-action strategy, website design A/B testing.

The main problem of creating an effective Internet marketing communications strategy is the selection of the optimal Internet marketing tools both in terms of target audience and in terms of the cost of a contact. In internet marketing, media planning is used for this. Successful media planning is facilitated by the presence of a clear and understandable metric for assessing the effectiveness of a company's digital communications. Evaluating the effectiveness of marketing communications is the most discussed topic among marketers. Approaches to assessing the effectiveness of digital communications are constantly being improved, which is facilitated by the development of modern software, which somewhat simplifies the problem of assessing effectiveness. On the other hand, quantitative data obtained by a marketer regarding the number of visits, clicks on links, etc., may not always reflect the real picture, since they often need a qualitative interpretation of visitor behavior.

The main criterion for the effectiveness of activities in the digital environment can be recognized as CTR- click-through rate, measures how many people click on a link or advertisement. CTR is one of your key performance indicators (KPIs) and is commonly used to determine the success of digital marketing campaigns. A CTR can be used to measure the effectiveness of emails and digital ads. In the case of online advertisements, such as Google Awards and Facebook advertising, a higher CTR will lead to a greater Quality Score or Relevance Score. This can help to save on cost-per-click rates and lead to more visible ad positioning (Little, 2019).

Also, a popular approach to assessing the effectiveness of digital communications is assessing traffic to the company's website, moving the target audience to the most important sections of the website and improving social actions, such as: buying a product, leaving information about yourself, the number of comments, etc. This approach also reflects communicative efficiency, since the actions of visitors on the site do not always end with a purchase but can lead to it in the future (delayed communication effect). It is obvious that practitioners want to get a specific toolkit for assessing the economic efficiency of digital communications, that is, an approach that links communicative efficiency with the sale of goods.

However, there is a risk, when the company focuses only on the economic efficiency of digital communications, to lose some of the Internet users who are not the company's customers, but who can create a positive atmosphere around the brand in the Internet environment, be a link between the company and the end consumer through active product recommendations and company services.

Measuring the effectiveness of various digital media tools allows to assess what is happening at different points in the purchasing decision process. Promotion in the digital environment, as a type of marketing communication used to inform target audiences, is assessed by the following performance indicators, which are used depending on the project objectives:

- engagement - the interaction of the audience with the content (the number of subscribers, comments, responses, republishing, clicks on shortened links and other social actions);
- the number of conversions of the target audience to the target web page;
- forecasts of sales in pieces (or in margin);
- PR-effect (number of references and coverage of readers of the 1st and 2nd circles);
- user cost (costs per user who joined the group, for interaction, or reduced costs for user support);
- dynamics of changing the tone of statements about the company;
- the share of positive votes about the company in relation to similar indicators of competitors.

The following stages of assessing the effectiveness of digital communications are distinguished:

1. Development of goals for the use of digital communications, expressed in a specific set of indicators of communicative and economic efficiency. A set of targets can be viewed as a performance metric. Achieving or not achieving these goals will show the effectiveness of digital communications.
2. Fixing the level of baseline indicators (by metric) in comparison with which further assessment will be carried out. (for example, sales volume, number of customers, number of site visitors, etc.).
3. Development of a calendar plan for communicative events. This is necessary in order to be able to correlate events with the web analytics data that the company receives.
4. Implementation of the digital communications plan and ongoing monitoring of the dynamics of target indicators.
5. Study of additional data available in the company and allowing better interpretation of the results of digital communications. For example, it is possible, in parallel with an advertising campaign, to carry out consumer surveys, to attract data from consulting companies, etc.
6. Comparison and analysis of data such as activity, social media data, web data, transactions, customer loyalty and other data.
7. Evaluation of the effectiveness of digital communications and the degree of achievement of targets.

Achieving or not achieving goals will show the effectiveness of digital communications used by company. The effectiveness of digital communications should, by analogy with offline communications, be divided into communicative and economic. Post-tests are used to assess the communicative effectiveness of digital communications. Post testing answers a wider range of questions, more specified, and generally inexpensive. Moreover, it calculates how advertising performed, and finally examines whether the conditions of introduction and purchase are genuine, not imitated.

So, evaluating the influence of marketing communication, particularly advertising on a brand (its recognition, customer attitude, memorability, etc.), it is vital to take into account following factors:

1. Measuring exposure – the average duration of contact of Internet users with advertising.
2. Measurement of interaction with advertising - reflect indicators of duration and frequency (the proportion of Internet users who interact with advertising; time of user interaction with advertising.).

3. Assessment of "brand experience" (brand experience) - visiting the site of the brand or partners, participating in digital promotions, etc.

Marketing communications, as a process of forming and maintaining relationships with real and potential consumers of the company's goods and services in digital era are beginning to play a particularly crucial role. The growing global competition, risks, the widespread decline in consumer loyalty to traditional brands, and high consumer awareness thanks to Internet technologies force companies to reconsider their approaches to developing customer relationships and switch to something new.

3. Key trends in digital marketing 2021

Digitization is transforming how companies in every industry go to market, interact with customers, and carry out their operations. The digital transformation is complex, time consuming, and expensive process, and it affects every aspect of the enterprise. Hence, it is essential that companies actively plan and monitor their digital investments in order to get their money's worth out of the effort. Some of the change agents are Apple, Amazon, Facebook, Twitter and Google—representative companies that are shaping the digital landscape and redefining what it means to find information, connect with people and buy products and services. Change is largely being driven by affluent customers and millennial (also known as Generation Y) who are between ages 18 and 30 and have grown up largely as “digital natives.” To them, online experiences are as important as in-person experiences (PWC, 2016). So there are 10 marketing trends that should be taken into account by companies:

1. Artificial intelligence and machine learning

Gradually and almost imperceptibly, artificial intelligence (AI) crept into the life of modern people and took a significant place in it. Already, the role of artificial intelligence in marketing and business can hardly be overestimated. Artificial intelligence helps to analyze consumer data and interests, offer them targeted ads, track sales, improve communication with customers and predict their behavior patterns. The use of machine learning is also growing, useful in the analysis of text, images and audio, as well as so valuable for the development of another trend - personalization. (Bondade, 2019). As for example, Microsoft and Uber use Knightscope K5 robots to patrol parking lots and large outdoor areas to predict and prevent crime. The robots can read license plates, report suspicious activity, and collect data to report to their owners. There is a possibility to rent these robots for acceptable price which is less than a human security guard's wage.

2. Chatbots

Consumers appreciate the ability to instantly resolve issues and receive feedback from a company or seller 24/7. AI-powered chatbots are capable for deep learning and can develop dialogue, get customer requests, collect data and analyze consumer needs and concerns, and naturally interact with a person, forging their connection with a company or brand. In 2020, even the World Health Organization launched a chatbot: a free service in English provides information about the coronavirus and how to stop its spread. Chatbots will continue to be an important part of digital marketing in 2021. This AI-based technology uses instant messaging to chat in real-time, day or night, with your customers or site visitors. Surveys show that the top benefits of chatbots are 24-hour service (64%), instant responses to inquiries (55%), and answers to simple questions (55%) (Gigante, 2019). Many brands already use chatbot

technology, the brands that are successfully using chatbot technology include Whole Foods Market, Fandango, Sephora, Staples, The Wall Street Journal and Pizza Hut.

3. Voice search

Voice search is a technology that allows person to search the Internet by making a request orally. For consumers, this way of searching has ceased to be just entertainment - people are getting used to it and are increasingly using it in everyday life. And although regular forecasts promising that voice search will outstrip and supersede text queries are not yet justified, there are still more people who like to chat with Alice, Siri, or just turn to Google out loud, and it is important to take into account their preferences and optimize content not only for text but also for voice search.

4. Personalization

Personalization means personalized content, products, emails and more - individual approach. Statistics show that: 63% of consumers are highly annoyed with generic advertising blasts, then 80% say they are more likely to do business with a company if it offers personalized experiences, and finally, 90% claim they find personalization appealing. Kevin George from EmailMonks asserts that “personalized, triggered emails based on behavior are 3x better than batch-and-blast emails.” As an example of the power of personalization, it’s necessary to underline the Netflix and Amazon actions, with their tailored recommended products or movie titles. Recommendation algorithm consistently makes headlines for its strategic approach to personalized marketing. Moreover, Starbucks uses a gamified mobile app that draws on data like purchase history and location to get as personal as possible, allows customers to customize their drinks, and encourages further use with its rewards system. The personalization system skyrocketed the revenue to \$2.56 billion (Keane, 2019).

5. Influencer Marketing

Influencer marketing is a type of word-of-mouth marketing that focuses on using key leaders to amplify brand message to a larger market. Influencers can be well-known celebrities or Instagram or YouTube personalities with a huge niche following who can help spread the word about the business and its product through their social channels. Consumers trust influencers’ opinions of products much more than what brands say about themselves.

6. Marketing through video and visual storytelling

Competition in this area is growing rapidly, and we have to invent more and more original formats in order to compete with those who create truly professional content to attract an audience. About 86% of businesses use video as a marketing tool. Video is by far the most popular way customers want to learn about new products (Rinaldi, 2019).

7. Micro-Moments

A micro-moment is an intent-rich moment when a person turns to a device to act on a need – to know, go, do or buy. The growing popularity of micro-moments means that marketers must rethink the following things: awareness, consideration and decision. In 2021 and beyond, the customer journey will be more dynamic and unpredictable, as it needs to respond to rapid changes in consumer desires. After all, in the digital environment, people have become accustomed to instant gratification - they think or talk about something, have a desire to learn more, see more and buy more of the product or service with just a few clicks of a button.

8. Browser Push Notifications

Push notifications are on the rise, with 85% of online stores using them in 2019. At least twice as many people sign up for web push notifications compared to a newsletter. Only 10% of the best email marketers can achieve a newsletter sign-up rate that matches the performance of web push. 6.4 hours is the average time that passes before the recipient opens a newsletter. In the case of web push, the recipient will see the message immediately. The updates to the GDPR (General Data Protection Regulations) and stricter filters have dented the potency of email marketing. Moreover, the younger audience favors other methods of communication and prefers to deal with less touchpoints when engaging brands. As part of the bid to engage users on multiple channels, browser push notifications. More and more brands adopting push notifications and they are getting more sophisticated and personalized. In fact, using personalized push notifications increases conversions: 7% open rate for segmented push messaging compared to a 3% open rate for generic, broadcast messages (a 2x improvement). 54% of users convert from a segmented push notification, compared to only 15% for broadcast messages (a 3x improvement). Notifications triggered by behavior are being used to re-engage people who have shown interest but failed to convert, and in recovering revenue from abandoned shopping carts (Ann, 2019).

9. Augmented Reality (AR) & Immersive Technologies

The leading research and advisory company Gartner predict that by 2022, 70% of enterprises will be experimenting with immersive technologies, and 25% will have deployed to production. While virtual reality (VR) makes a lot of noise and gets everyone excited with grand sci-fi ideas, AR is much more implementable from a marketing standpoint. Experts predict that AR will continue to outpace VR in terms of market share. As an example – ModiFace company, which has recently been acquired by L’Oreal, produces AR applications for brands. Sephora Virtual Artist, an outstanding example of ModiFace’s technology, allows you to see how the different colors of various forms of make-up will look on your face, without having to go to a store and physically apply it (Panetta, 2018).

The above trends will help the leaders of organizations overcome uncertainty about the future and take the necessary measures. Understanding these trends will enable them to properly respond to changing customer needs, adjust their business models as needed, and improve marketing communications.

Conclusion

The theoretical substantiation of the marketing communication in digital environment is important both for the development of the market itself and for increasing the competitiveness of companies. Digital environments enable marketing to develop current ideas about marketing, contribute to the effectiveness of marketing activities in enterprises and create new trends. Sweeping technological change has revolutionized marketing and its tools, while societal challenges have raised expectations about marketers’ social performance. This has altered customer needs, accelerated the entry of new types of competitors, and generated novel opportunities for value creation.

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JUSTIFICATION OF THE CHOICE OF MATHEMATICAL METHODS WHEN CALCULATING THE INDEX OF THE INNOVATIVE POTENTIAL OF AN ENTERPRISE IN THE DIGITAL ECONOMY

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Keywords:

Innovation potential, assessment methods, mathematical methods, digital economy

Abstract:

The main purpose of this article is to consider and analyze several basic mathematical methods used in the process of calculating the index of innovative potential of an enterprise in the digital economy. The methods of giving the coefficients of significance to indicators are considered. As a result, a conclusion was made about the advantages of the methods, as well as proposals for their use in the method were put forward. The proposed mathematical apparatus can be applied in the evaluation methodology, which provides a reliable result for the evaluators. As a topic for future research, we propose to consider other actions in the methodology for calculating innovative potential and to prove the use of certain mathematical actions. The presented article has high scientific value due to the evidence base, which allows us to conclude about the need to use regression analysis when assessing the innovative potential of an enterprise.

Introduction

The innovation vector of development plays a strategically important role both at micro levels and at macro levels of economic development. Researchers have proven the economic efficiency and feasibility of innovative developments and their implementation at Russian industrial enterprises, which is a catalyst for their growth and development (Baneliene. R. et al. 2018).

One of the key essential foundations of the system of the innovation process is innovation potential, which reveals the ability of an enterprise to modernize and renew, determines technical leadership and class superiority (Davidson. N. et al. 2018).

Assessment of the innovative potential of an enterprise is a logical continuation of the very concept of innovative potential. The innovative potential of an enterprise is its ability and ability to form and use innovative resources that are necessary for innovative development, which allows you to create, distribute and use various types of innovations (new types of goods and

services). The purpose of the potential assessment is to develop an effective innovation policy of the enterprise (Toomsalu L., et al. 2019).

The calculation of the index of innovative potential is based on the collection of indicators at the enterprise and their subsequent processing, based on an algorithm consisting of mathematical actions (Akhunzhanova I. N., et al. 2020). One of the actions in the algorithm is to bring the collected data to a single form, for this the three-sigma method is often used. The second step is the assignment of significance coefficients to the indicators, which express the degree of connection with innovation potential.

The forms and types of connections that exist between phenomena are very diverse in their classification. The subject of statistics is only those of them that are quantitative in nature and are studied using quantitative methods (Kalinichenko L. L., 2010).

In order to analyze, plan and predict the economic and economic activities of an enterprise, correlation and regression analysis is often used. Correlation-regression analysis is a widespread method of stochastic modeling, which is used to study the form of connection between random variables of the process under study. This analysis differs from other methods of model research in that it studies the relationship of all process indicators, while taking into account the influence of extraneous, random factors. In socio-economic forecasting, this method is used to construct conditional forecasts (Tsybrii L.V., 2019).

Correlation and regression analysis methods are used in a complex. With the help of these types of analyzes, they measure the closeness of the relationship between the varying variables and identify the factors that have the greatest influence on the effective trait (Joksimović M. et al, 2018).

1. Regression analysis technique

The next step is to put down the coefficients of influence on the main indicator of innovativeness, that is, the number of implemented innovations, for each indicator. This is done on the basis of mathematical statistical methods. There are many methods, for example, the regression analysis method is used, the result of which is the coefficient of the relationship between the indicator and the number of implemented innovations. The method describes the nature of the relationship between two variables. There is also a method of correlations that shows the existence of a relationship between two indicators and its strength.

Let's take a closer look at what regression analysis is. The goals of regression analysis are:

- Determination of the degree of determinism of the dependent variable options by independent variables
- Calculation of the value of the dependent variable using independent
- Determination of the contribution of private independent variables to the variation of the dependent

Regression analysis shows the degree to which characteristics influence the main factor. The method is built from regression equations, mathematical formulas that are applied to variables in order to predict the dependent variable.

$$E(Y | X) = F(X, \beta) \tag{1}$$

$$Y = \beta_0 + \beta_1 x_1 + \beta_2 x_2 + \dots + \beta_n x_n + \varepsilon \tag{2}$$

Where:

Y – dependent variable for which we need to determine.

The variable describes the process that is the main one for us. In our case, this is the number of implemented innovations.

β – the coefficient of influence of the variable x on the dependent, main variable Y , the coefficient describes the strength and type of relationship between two variables.

ε – random error is a collection of all random variables that arise and cause an error.

x – variable, the degree of influence and connection of which on the dependent variable we find by the regression method.

Regression model creation is an iterative process that seeks to find effective x variables that explain the Y variables. The process is repeated many times, adding or removing variables.

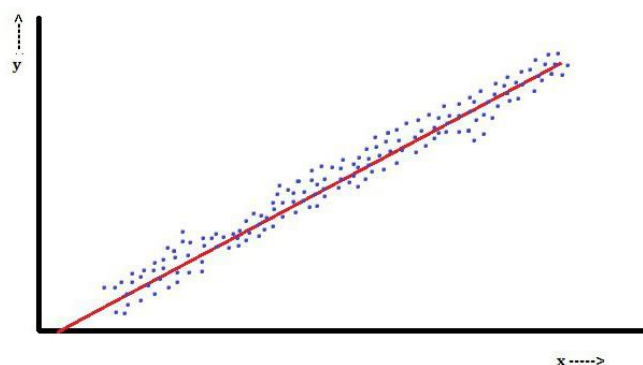
A regression method is a collection of different methods that are included in it. There are many methods for conducting regression analysis: linear regression, least squares ... Parametric regression is built from a set of indicators, parameters, and not parametric consists of a set of functions. The parameters of the model are tuned so that the model best fits the data. The criterion for the quality of the approximation is usually the root mean square error: the sum of the squares of the difference between the values of the model and Y . Regression analysis is a branch of mathematical statistics and machine learning. The method is based on data generation hypotheses, that is, assumptions about the nature of the dependent quantity. Residual analyzes, statistical tests are performed to confirm or disprove this hypothesis.

Consider a linear regression function. In this function, Y is a linear combination of parameters. For example, simple linear regression to model n points uses one independent variable x and two β coefficients. Multiple linear regression consists of many coefficients and x variables or many simple linear equations.

$$Y = \beta_0 + \beta_1 x_1 \quad (3)$$

A popular method for calculating linear regression is the method of least squares, which allows you to obtain an estimate of parameters that minimize the sum of squares of residuals. This minimization leads to the formation of a set of normal equations and linear equations with parameters. The equations are solved when the values of the parameters x are obtained. Since there is an error ε , then confidence intervals are created.

Figure 1: *Linear regression*



Source: Darkenbayev D. K. et al. (2019)

Consider non-linear regression analysis, that is, the function Y is not linear with respect to the parameter x. This indicates that the sum of squares should be minimized using an iterative procedure. This is the main difficulty distinguishing non-linear least squares and linear least squares. Hence it follows that the results of regression analysis are not predictable. Non-linear regressions can be divided into two classes:

a) nonlinear with respect to variables x, independent, but linear with respect to the estimated parameters.

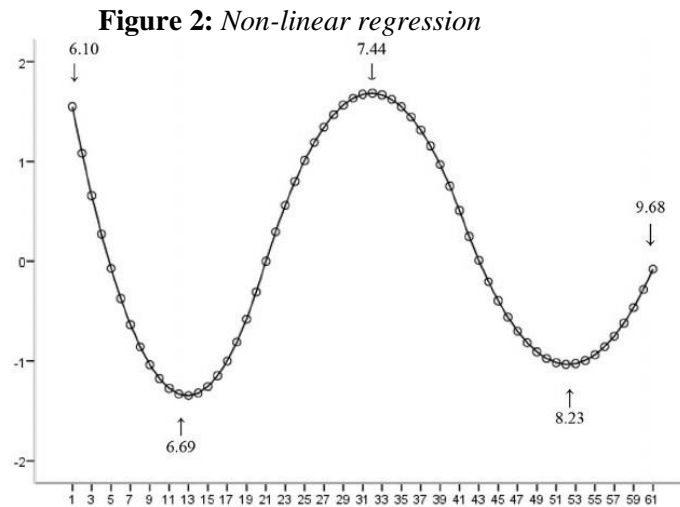
$y = a + b_1 * x + b_2 * x^2 + b_3 * x^3 + \varepsilon$ – polynomials of different degrees

$y = a + \frac{b}{x} + \varepsilon$ – equilateral hyperbola

б) regressions are not linear in the estimated parameters, Y.

$y = a * x^b * \varepsilon$ – *sedate*

$y = a * b^x * \varepsilon$ – *exponential*



Source: Habibullah M. S. (et al. 2010)

Let's consider how the power and sample size are calculated. The method shows the relationship between the number of observations and the number of independent variables in the model. No single method has been developed, but there are some generally accepted methods. Scientists Good and Hardin proposed their power method.

$$N = t^n \quad (4)$$

Where:

N – sample size

n – number of independent variables

t – number of observations

In our case, for example, the indicator was taken 365 times a year, which means the value of N will be 365. The researcher decides that for an accurate determination, 5 observations should be made, that is, $t = 5$. Accordingly, n can be equal to 3.

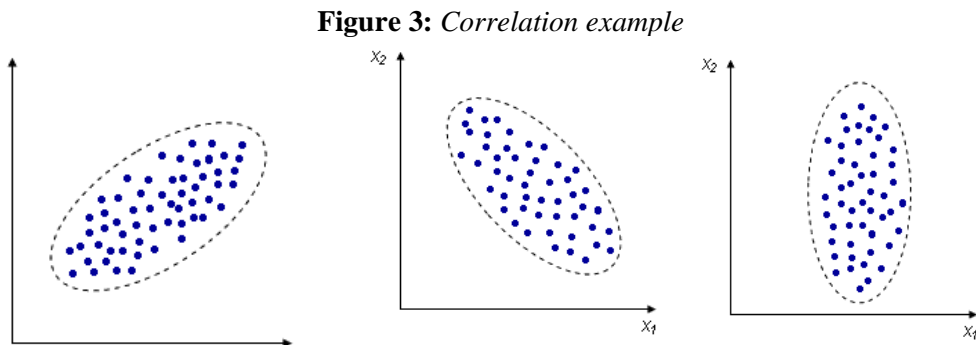
The most common method for estimating the parameters of a regression model is the least squares method. But besides it, others are also used: Bayesian method, percentage regression (cases when it is considered more appropriate to reduce percentage errors), least absolute deviations, method of least absolute deviations (it is more stable in the presence of outliers),

nonparametric regression method (requires a large number of observations and computation), distance learning metric method.

2. Method of correlation analysis

Now we should analyze the second popular method for assessing the relationship of parameters - correlation analysis. Correlation analysis is a statistical data processing method based on the study of correlation coefficients. To determine the correlation, several observations of the same variable are required. The correlation method allows you to determine: a) is there a relationship between the parameters b) what nature and strength this relationship c) allows you to predict the behavior of one parameter based on the data on the second parameter d) helps to classify objects. The advantages of the method are that the coefficients are quite simple to calculate, no special mathematical training is required. The interpretation is also fairly straightforward. The downside is that the method shows only a statistical relationship, not a cause-and-effect relationship.

Let's consider an example of correlation using the example of human parameters. The first figure shows a positive correlation, where each point is one dimension. Figure two shows a negative correlation. Figure 3 shows values without correlation.



Source: Nigmatullin R. R. (2019)

To characterize the degree of correlation, there is a quantity that describes the process of correlation - the correlation coefficient. The correlation coefficient is a measure of the linear relationship between two quantities. The correlation coefficient is of the sample r and the general population ρ . Consider the sample correlation coefficient r . Let's say there is an array of s values (points) $\{x_{1,i}, x_{2,i}\}$. The average value is calculated for each of the parameters.

$$\bar{X}_1 = \frac{\sum x_{1,i}}{s} \quad \bar{X}_2 = \frac{\sum x_{2,i}}{s} \quad (5)$$

Correlation coefficient ρ will be equal:

$$r = \frac{\sum (x_{1,i} - \bar{x}_1) * (x_{2,i} - \bar{x}_2)}{\sqrt{\sum (x_{1,i} - \bar{x}_1)^2} * \sqrt{\sum (x_{2,i} - \bar{x}_2)^2}} \quad (6)$$

$$r = \frac{n \sum x_{1,i} x_{2,i} - (\sum x_{1,i})(\sum x_{2,i})}{\sqrt{n(\sum x_{1,i}^2) - (\sum x_{1,i})^2} * \sqrt{n(\sum x_{2,i}^2) - (\sum x_{2,i})^2}} \quad (7)$$

This coefficient is called the Pearson coefficient and includes moments. If the correlation is linear, then the correlation coefficient is 1 or -1. If there is no correlation between two objects, then the correlation coefficient will be 0.

Table 1: *Distribution table of coefficient values*

Coefficient values r	Communication degree
0,75 – 1	Very high positive
0,50 – 0,74	High positive
0,25 – 0,49	Average positive
0 – 0,24	Weak positive
-0,24 - 0	Weak negative
-0,49 - -0,24	Average negative
-0,74 - -0,50	High negative
-1 - -0,75	Very high negative

Source: Melnikov A. et al. (2018)

For a visual representation of the relationship between two quantities, you can build a graph. Two coordinate axes. Each corresponds to one of the parameters. Consider the correlation coefficient of the general population. This coefficient is calculated under the conditions that:

1. Variables x, y have a linear dependence
2. Variables - random variables
3. Both variables are normally distributed

X, Y – two random variables. Then the correlation coefficient $\rho_{x,y}$, will be expressed by the formula:

$$\rho_{x,y} = \frac{cov(X,Y)}{\sqrt{D(X)*D(Y)}} = \frac{E(XY)-EX*EY}{\sqrt{(E(X^2)-(EX)^2)*(E(Y^2)-(EY)^2)}} \quad (8)$$

Where:

Cov - covariance
D – dispersion
E – expected value
X – random value
Y – random value

If it is necessary to analyze not two quantities, but several, then the correlation coefficient will be expressed somewhat differently.

Results

Often a problem arises in the enterprise, it is necessary to determine the degree of influence of events on the final result. A similar problem arises when assessing the innovative activity of an enterprise, it is necessary to determine how much the final result is connected - the number of innovations produced and the initial parameter.

To solve the problem, correlation or regression analysis is used. Using the example of the TMS Motorsport enterprise, we will consider the applicability of two methods in assessing its innovative activity. Let's make a conclusion about which method is more correct to use in the

calculations. Let us consider the applicability of regression and correlation analyzes to determine the coefficients of the influence of events at the enterprise on innovative activities.

TMS Motorsport is a manufacturer of automotive parts. In particular, one of the directions is the production of limited transmissions with improved characteristics. Through the use of innovative technologies, contributions to personnel and the use of expensive materials, the company produces gearboxes that can withstand high loads compared to competitors. The reliability factor is 1.632, which means that the company's gearboxes show greater durability compared to competitors by an average of 63.2%. It is necessary to evaluate which initial parameters especially influence the innovative activity of the company. The calculation is based on company data. In 2020, the company's revenue amounted to 181,816,000 rubles. Let's analyze the main factors affecting the result (TMS Motorsport, 2020).

In the first column of the table we will give an event that affects the final result, in the second column we will give the value of the correlation coefficient, in the third the value of the regression coefficient, that is, the absolute value of the change in income from a change in the initial indicator by one, in the fourth column we will give the value of the relative regression coefficient, that is divide all the values of the coefficients by the maximum so that all of them do not exceed 1.

Table 2: *Comparison of regression and correlation coefficients for initial parameters*

Initial indicator	Correlation coefficient	Regression coefficient	Relative regression coefficient	delta of correlation and regression analysis
R&D expenses	0,81	9,861	0,88	0,07
Equipment expenses	0,53	6,732	0,60	0,07
Staff training expenses	0,67	5,167	0,46	0,21
Equipment novelty	0,59	7,189	0,64	0,05
IT system expenses	0,49	4,341	0,39	0,1
Amount of administrative expenses	0,41	3,078	0,27	0,14
Environmental expenses	0,18	1,014	0,09	0,09
Number of PhDs at the enterprise	0,51	4,858	0,43	0,08
Marketing expenses	0,97	11,211	1,00	0,03

Source: authors

Table 2 shows that both correlation and regression analysis allow us to show the relationship of events. Most of all, the amount of income is influenced by the provided marketing support for the project, followed by R&D costs. The average discrepancy between the values of the correlation and regression analysis is 0.084 points. At the same time, regression analysis allows you to show the effect of an event on the result not in relative but in absolute terms.

Conclusion

Many methods have been developed to assess the innovative potential. The basis of most methods is the collection of indicators, their reduction to a single form and subsequent calculation.

To bring the values of indicators to a single form, it is advisable to use the three-sigma method. It allows you to keep the original shape of the values, while excluding values that exceed the 3-sigma limit from the sample, which provides an initial data that is easy to calculate. Bringing to a single form will exclude the possibility of distortion of the index values due to extremely large values of the initial indicators.

The correlation analysis method and the regression method are suitable for assessing the connectedness of events. Nevertheless, the regression method is preferable, since it shows not only whether an event is connected or not, but also shows the nature of the relationship, its linearity or non-linearity, positive or negative.

The disadvantage of the regression analysis method follows from the advantages: it shows how much the basic value will change, and in the case of assessing innovation activity - the number of innovations produced when a certain parameter changes, so the change in the number of innovations does not lie in the range from 0 to 1, because of that the resulting value cannot be used as a coefficient. To eliminate this, you need to translate it into a relative form.

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DEVELOPMENT OF HUMAN RESOURCES AS A FACTOR OF ECONOMIC SECURITY

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Keywords:

Economic security, labor resources, personnel, development of labor resource

Abstract:

The article focuses on the need to develop human resources to ensure the economic security of the organization. The main determinants of the microlevel that affect economic security are identified. The authors propose a calculation methodology and threshold values for assessing intellectual, personnel and management determinants. Their characteristics and ways of influencing the economic security of the organization are given. Methods for improving these indicators based on modern information and telecommunication technologies are proposed.

Introduction

The main goal of ensuring the economic security of the organization is to achieve the maximum stability of its functioning, as well as to create a basis for achieving the goals and objectives of the business, taking into account the risk factors of the internal environment of the organization. For the state of security of the enterprise, it is necessary to identify the necessary amount of resources for the needs of the economic enterprise, to determine the overall impact of the threat.

1. Factors affecting the micro-level of the organization

The main goal of ensuring the economic security of the organization is to achieve the highest possible stability of its functioning, as well as to create a basis for achieving the goals and objectives of the business, taking into account the possible risk factors of the internal and external environment. To assess the state of the existing level of economic security of an enterprise, it is necessary to identify the required amount of resources to meet the needs of the enterprise, to determine the overall strength of the impact of threats.

For the most productive construction of an enterprise security system, one should separate the factors affecting the security of the enterprise through the financial environment or the level of impact. Factors influencing the microlevel of the organization are presented in Table 1.

Table 1: Main determinants of the micro level

Key determinants	Characterization of key determinants
Financial	Sufficiency of own and borrowed financial resources
Intellectual and personnel	Sufficiency of labor resources and the level of their qualifications
Technical and technological	Compliance of technological support and technical equipment with development needs
Informational	Reliability and correctness of information support
Resource and production	Possibility for smooth operation
Managerial	Management competence
Marketing	Sales effectiveness

Source: authors

Let us dwell in more detail on the determinants related to the human resources of the organization, as one of the main factors in the formation of the economic security of the enterprise. The intellectual and personnel component is understood as the qualifications and reliability of personnel. In this case, the frame is considered not only as a combination of skills, knowledge and experience, but also from the standpoint of loyal Nost and to the company, its values and interests, the interest in the job and company success.

The managerial factor should be considered taking into account the qualifications, experience of the management body, and also take into account the human factor, features of the approach to management. When characterizing the sales component, it is necessary to take into account the market capacity, the peculiarities of the functioning of the market segment, the position held, the developed and implemented sales policy, the methods and organization of interaction with the target audience, the formation of demand, the presence of a formed sales network.

2. Intellectual personnel and managerial factors of economic security

Consider the calculation methodology and threshold values for assessing intellectual, personnel and management determinants. The intellectual and personnel determinant includes an assessment of the professional and qualification level of personnel, the calculation of the proportion of personnel without violations and the coefficient of staff constancy. The professional and qualification level of personnel is assessed based on the general level of professional training of personnel, using the level of complexity of work to assess, including taking into account the strategic development plan and market trends in general. The share of personnel without violations of labor discipline shows the level of corporate culture of the company and indirectly about the protection of information. With a low value of the indicator, an increase in the facts of theft and disclosure of commercial information is usually observed. Negligence and carelessness of employees can become the main threat to the economic security of an enterprise. The coefficient of staff constancy reflects the change in staff, shows the climate in the team, working conditions. A low level of the indicator reflects a high turnover of personnel, which entails an increase in costs for the services of HR specialists, a slowdown in production processes due to resources for finding and training new employees.

Table 2: Calculation of human resources from the point of view of economic security

Key determinants	Characterizing indicators	Calculation procedure	Threshold value
Intellectual and personnel	Professional and qualification level of personnel	Expert assessment of compliance with enterprise requirements	one
	The proportion of personnel without violations of labor discipline	$\frac{\text{Number of staff}}{\text{Average headcount}}$	0.9
	Personnel persistence ratio	$\frac{\text{Number of staff}}{\text{Average headcount}}$	0.8
Managerial	Professional level of managers	Expert assessment in points (high, sufficient, low)	3
	Enterprise reputation	Expert assessment in points	3
	The pay gap for management and the rest of the staff	$\frac{\text{Number of staff}}{\text{Average headcount}}$	0.5

Source: author

The analysis of the management component includes an assessment of the professional level of managers, the business reputation of the enterprise and the pay gap for the management and other personnel. The professional level of managers directly affects the state of the economic security of the enterprise. The higher the level of competence, the more experience and entrepreneurial abilities, the more efficiently the enterprise works at all stages of the reproduction process. Business reputation is a kind of assessment of the quality of enterprise management, based on the moral and ethical, business characteristics of management, the range and quality of products, the rate of return, and the company's image. The pay gap affects the atmosphere in the team. If the gap is too large, envy and mistrust in the leadership may arise, and if the gap is small, the motivation for development and initiative from the state decreases.

Conclusion

In the digital economy, there is a direct relationship between the level of economic security of a company and its ability to attract employees, manage their efficiency and keep them in the company. In connection with the accelerated obsolescence of professional knowledge, the management of companies must ensure the process of continuous development through training, professional training and retraining, the acquisition of new competencies and advanced training of employees. This process should be focused on improving performance skills and enhancing creative abilities, providing ample opportunities for personal self-realization. The use of modern information and telecommunication technologies makes it possible to implement new areas of education and modernize traditional ones (for example, taking distance courses, interactive business games, business simulations using mobile applications).

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THE INFLUENCE OF COVID-19 PANDEMIC ON CHANGES IN THE ROLES OF SCHOOL MANAGERS IN REGIONAL EDUCATION

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Keywords:

role (work, team), role of manager, manager in regional education, change, survey

Abstract:

The study examines the content of the roles of managers in regional education and the possible impact of the COVID-19 pandemic on changes in these roles. The respondents of the research survey, the methodology of which is presented in the introductory part of the study, were managers and other employees of regional education in various roles of actors in the educational process. The investigation took place within the framework of qualitative research design. The aim of the survey was to update the contents of key roles of managers in regional education and to determine whether the COVID-19 pandemic also changed the importance that respondents attribute to certain types of roles or partial activities of managers in regional education. In the theoretically conceived chapter 1, selected concepts of the roles of managers, known in the domestic context in theories of management and school management, are first introduced. Chapter 1 also specifies the content of the roles of manager for the model created by Plamínek & Fišer (2005), as they were presented in the works of theorists of management. The mentioned model was also used for data collection within the research survey. This means for determining the specific content of these roles and any changes in their meaning that occurred during the period under review. The influence in the period from March 2020 to January 2021 was reflected. The obtained information is presented and the results of the survey are interpreted in chapter 2 of the paper and in its final part. Here, the text deals with changes in the content and importance of such defined sub-roles mentioned by the informants and relevant for the period of changes that the COVID-19 pandemic brought to the segments of regional education. The basic method of the research survey was an analysis of written records of the roles of school leaders (principals) prepared by individual respondents. Questioning and the study of documents in the preparatory phase of the research survey were used as an additional methods.

Introduction (aim and research methods)

In the spring of 2020, as a result of the COVID-19 pandemic, there was an unprecedented change in the organization and, in part, in the content and goals of education. In schools (here within regional education), their principals had to change not only the organizational form and modify teaching methods at the level of the whole school, but also to manage crisis management and the remote management and leadership of other school employees. However, this completely new situation did not end in the school year 2019/2020, when distance learning was considered to be rather temporary and there were also some adjustments in the school attendance obligation. On the contrary, it continues during the current school year, with the

assumption of the return of children, pupils and students to schools whenever the epidemic situation and political decisions at the level of the entire state or sub-regions of the Czech Republic allow. The increased level of decision-making under conditions of risk and uncertainty thus continues, and at the same time distance, preferably synchronous, but also asynchronous online learning is the basic form of education (for more information see Boudová et al, 2021).

It can be reasonably assumed that the situation changes not only in individual schools, but in the whole regional education, that pedagogical and non-pedagogical staff respond to it and at the same time expect to manage the outlined complex situation by school leaders. Let us also remember that the school managers are also representatives of their organization externally, towards the founder, parents and often the general public. At the same time, representatives of associations of school principals also suggest possible solutions in relation to the entire educational system (esp. formal education) and thus act as representatives of institutionalized initial education, which is the subject of intensive public debate. Requirements for school principals can thus be described, among other options, in terms of managing their roles, which are related to their job position, or their roles within various (currently also virtual) teams in the school.

The aim of the research survey presented below was to update the contents of the roles of school principals (from kindergartens to secondary schools) and also capture the changes that occurred in these roles of headmasters in connection with the overall epidemic situation and its development from March 2020 to the end of January 2021. The research survey therefore no longer covers further unfavorable developments, which were reflected from February 2021.

The survey was carried out within the framework of qualitative research design and its intention was to find out what is the current content of partial roles of regional education managers and how these roles and the content of the roles were affected by the pandemic situation due to COVID-19. Two research questions were asked:

RQ1: What is the current content of the roles of leading pedagogical staff (school principals)?

RQ2: What changes are taking place in the roles of school principals in connection with a pandemic situation (COVID-19)?

The basic method used in data collection was written records of the content of partial roles of school principals created by individual respondents (n = 45) and analysis of the information thus obtained. As an additional method, questioning was used (individual, through the digital teaching and communication platform MS Teams). Given the methodology used, the results of the survey will not be statistically evaluated and generalized.

The respondents of the research survey were managers and other employees of regional education in various roles of actors in the educational process with at least theoretical knowledge in the field of school management. A group of respondents, forming a research sample, is currently preparing for the performance of managerial positions in formal education at the university. The choice of respondents was therefore intentional in this case (intentional selection of the research sample).

Respondents were instructed to use the model of managerial roles developed by Plamínek & Fišer (2005) to determine the content of managerial roles of school principals. The roles of the manager, corresponding to the division according to the Plamínek & Fišer model (see also

Chapter 1), were presented to the respondents in an introductory online discussion. For the research survey, Plamínek & Fišer overview of the roles of a manager was chosen as the model most frequently mentioned in the theory of school, known among the professional pedagogical public and used in publications of authors in management and leadership outside the education system (e. g. Pilařová, 2016).

1. Selected models of managerial and team roles and their application in regional education¹

The role of managers has been one of the areas covered by management theory since the 1970s. H. Mintzberg was the first to describe managerial roles (Vodáček & Vodáčková, 2013). The concept of role in this typology of managerial roles basically corresponds to the definition of role in the socio-psychological concept (for example, Štikar et al, 2003). The role of a manager is the set of expected behavior of the holder corresponding to the job position of the manager. The role of each manager can be divided into several types, each of which is part of the general role of a manager, and defined as *"a set of activities that an individual performs in accordance with the role"* (Pilařová, 2016, p.7). Where we talk about the content of roles in this text, we mean just such a definition of roles by a set of activities.

Also within school management as an applied scientific discipline, various models of the roles of managers are used and the application of these concepts is focused primarily on the roles of school principals. In the Czech environment, the most well-known model of the role of school principals is probably the modification of the typology created by Plamínek & Fišer (2005), originally not specified for school management. The general role of a manager (employee in a leading job position) is divided into: the role of a manager, the role of a leader and the role of a process executor (ibid, see also Pilařová, 2016, pp. 20-21). According to theorists of school management, the above division of a complex managerial role is typical for management in regional education (Slavíková, 2008, Trojanová, 2017, etc.).

Slavíková (2008) believes that the role of the executor is connected primarily with the formal organization of the school (with its organizational structure), and even argues that in a school as a learning organization it does not have to be performed by the principal. At present, however, the school principal also remains a teacher and as such is the executor of the pedagogical process (Trojanová, 2017). The role of the manager can be considered as a basic role of managers in regional education. In its usual characteristics, it results from the formal authority of the principal/head teacher, which is derived from his/her position at the top of the organizational structure and is associated with the ability to make decisions and be responsible for the decisions taken. In this role, the school principal primarily ensures the stability of the organization through proper decision making process, in which s/he uses his/her managerial competencies and relies on his/her positional authority. In the role of the leader, the school principal achieves good results and goals of the organization through effective leadership of other staff and as a leader of the pedagogical process participates in achieving the basic goal of the school as an institution and a specific organization that provides public service.

¹ A text of this chapter is based also on previously published texts by the author.

In practice, it is difficult to completely distinguish between the roles of manager and leader. However, at the same time, the characteristics of the manager are still defined, usually in contradiction with the expectations of the leader (see Table 1).

Table 1: *Differences in the role of the school principal as a leader and a manager*

LEADER	MANAGER
Introduces changes and develops new procedures	Continuously performs administrative activities
Encourages the status quo to be maintained	Accepts the status quo
Focuses his attention on the human factor	Focuses attention on the functioning of the system
Solves things with a long-term perspective	Solves current issues
Does not deal with details	Deals with details
Creates a positive atmosphere	Relies on control
Asks <i>what and why</i>	Asks <i>how and when</i>
Sometimes changes the rules	Always follows the rules
Shows the direction, the vision	Plans and processes the budget
Unites and inspires employees	Names and solves problems
Motivates employees	Organizes and staffs

Source: Slavíková (2008, p. 43)

For the purposes of this study, we can state that it is really necessary for school principals to acquire and at the right time to be able to use the competencies necessary to manage both of these roles. At the same time, we cannot forget the role of the administrator and executor of the process.

Concept of a role in the theory and practice of (school) management also appears in connection with team role. By this we mean the tendency of an individual to behave in a certain way within a team, respond to other team members (relationship roles) and contribute to achieving performance goals in the team and for the team (performance roles) (Bělohávek, Košťan & Šuleř, 2001). According to Bělohávek (2008, p. 29) *"the team role is thus a kind of result of connecting the personality with the requirements of the situation"*.

Although the work and team roles are not interchangeable, it is certainly not without interest that also in the probably best-known division of team roles, authored by M. Belbin, the role of "coordinator" is mentioned, defined here as *"needed to focus on the team's objectives, draw out team members and delegate work appropriately"* (The Nine Belbin Team Roles, online). The overview of team roles according to Plamínek also includes nine roles. The central position among them is occupied by the role of a leader (strategist), which is characterized by the ability to combine rational and strategic thinking with empathy and intuition, mostly a charismatic person (Plamínek, 2009, p. 47). The team roles of coordinator and leader (strategist) can be played in the team by their formal leaders. Therefore, especially these roles can be a complement to managerial roles. Likewise, the formal leader (in our case, the school principal) can play other team roles as a team member.

2. Data collection and research results

The aim of the survey was to update the contents of key roles of managers in regional education and to determine whether the COVID-19 pandemic also changed the importance that respondents attribute to certain types of roles or partial activities of managers in regional education.

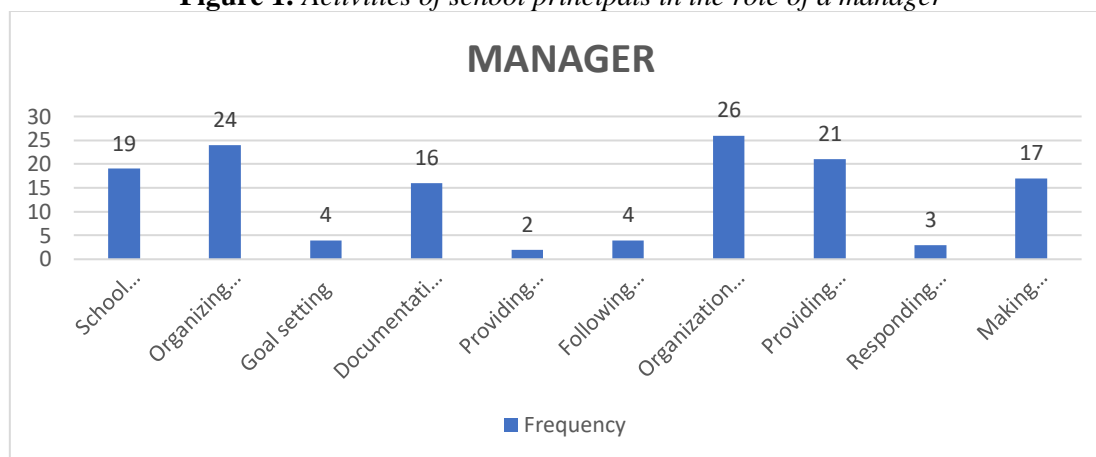
The research survey took place from December 2020 (introductory online presentation of assignments and discussions on a selected overview of management roles, beginning of data collection in electronic form of written record of respondents' statements) to early February 2021 (end of individually conducted online interviews with respondents, analysis and interpretation of research results).

When evaluating the respondents' answers ($n = 45$) to RQ1 (*What is the current content of the roles of leading pedagogical staff /school principals/?*) it is possible to define the following updated content of (activities within) sub-roles of school managers / principals:

- a) role of a manager – school direction and budget planning; organizing school activities and staff; goal setting; documentation and security control; providing feedback; following regulations and recommendations; organization and staff development; providing personnel management activities; responding to change; making decisions in critical situations and eliminating negatives,
- b) role of a leader – having the ability to influence others; giving and delegating tasks; introducing changes; communicating and providing feedback; combining skills and managing conflicts; being capable of lead a team; knowing and understanding current events; motivating and supporting; setting and pursuing goals (vision),
- c) the role of a process executor – providing pedagogical and educational activities; supporting pupils and teachers; providing resources; controlling and influencing mood; reaching goals; solving emergencies and sending out documents; fulfilling other roles and ensuring the running of the school.

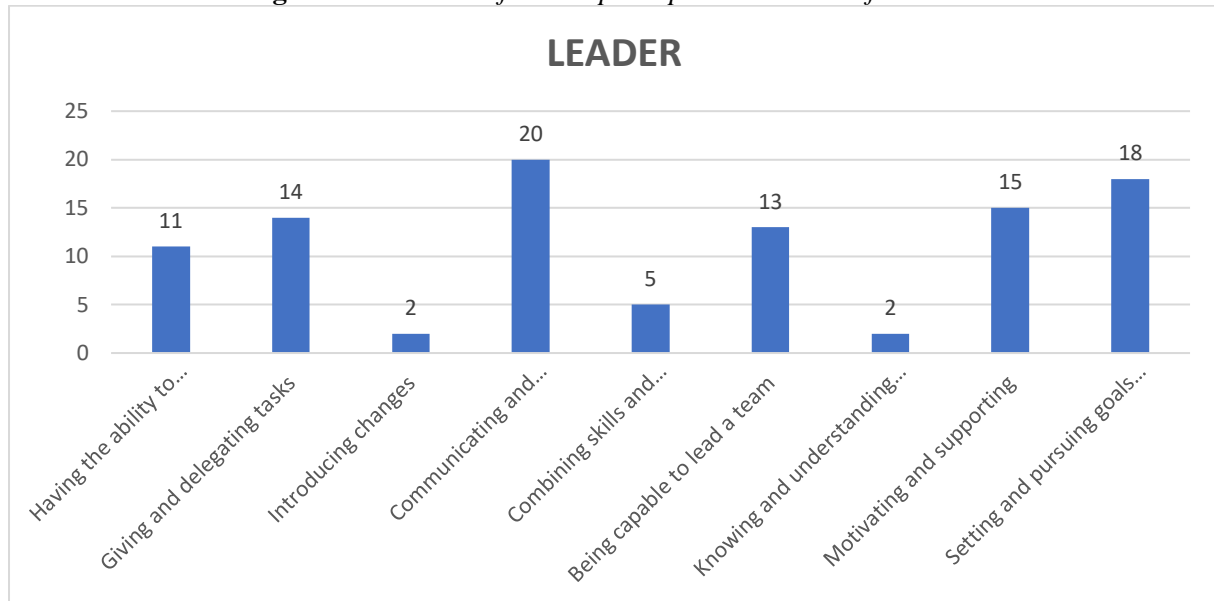
The results included answers that matched at least 2 of the total number of 45 respondents. The frequency of respondents' answers according to the content of individual roles is also shown graphically (see Figures 1-3). In this part of the research survey, all 45 respondents answered, but not all stated the content (key activities) for each sub-role.

Figure 1: Activities of school principals in the role of a manager



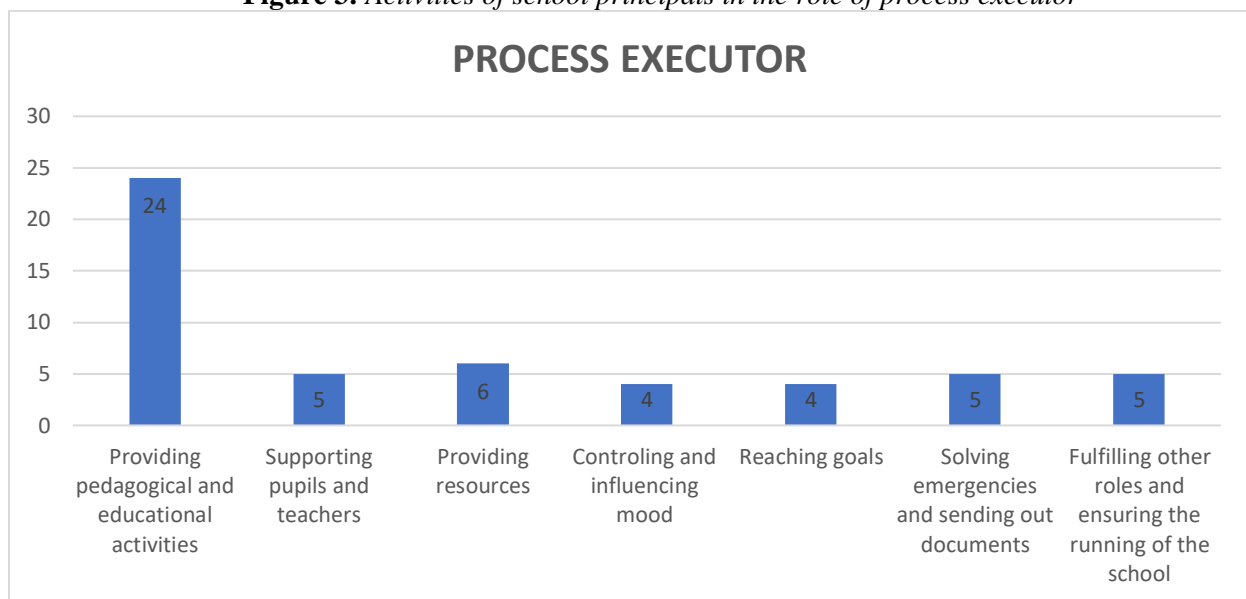
Source: own processing

Figure 2: Activities of school principals in the role of a leader



Source: own processing

Figure 3: Activities of school principals in the role of process executor



Source: own processing

Some respondents (12 out of a total of 45) supplemented the previous overview of the roles of the managers and their content also by determining the content of team roles (according to Plamínek, 2009), which can be held by the school principal. Given the number of responses and the roles of leader and director within the Plamínek model, a graphical output from this part of the research survey is given (see Table 2). Respondents used all 9 types of team roles and linked them to the activities of the school principal (with the overall role of manager). We consider the findings from this part of the research survey as a supplement to the basic overview (Figures 1-3)

Table 2: Team roles of school principals

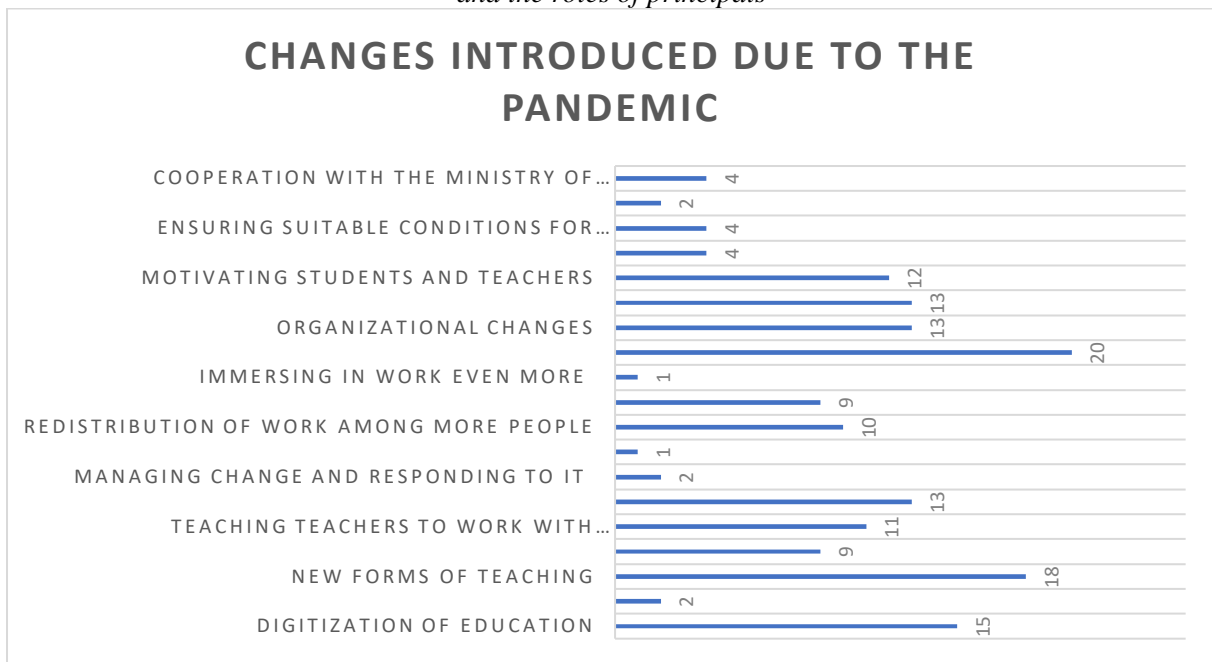
Team role	What it entails	Frequency
Leader	Managing strategic and complex thinking combined with empathy	11
	Having quick responses	3
	Enthusiating others	3
Thinker	Being creative and playful	10
Director	Preparing strategies	6
	Determining tactics	9
	Delegating tasks	8
Dictator	Leading the team out of crisis	10
	Showing one's will at the expense of others	6
Process specialist	Coming up with inovative ideas	3
Caretaker	Caring for team welfare	8
	Solving problems in comunication and relathionships	5
Finisher	Checking and finalising to perfection	9
Specialist	Mastering one's discipline	10
Generator	Generating original methods and ideas	7
Mover	Driving the team	5
	Turning ideas into reality	6

Source: own processing

In response to RQ2 (*What changes are taking place in the roles of school principals in connection with a pandemic situation /COVID-19/?*), Respondents (n = 45) also reported answers that were related to a change in the overall situation, which forms the context for requirements for managing the roles of regional education managers. In this phase of the research survey, the respondents most often stated: digitization of education (15 respondents), immediate change in the form of education from the beginning of the first emergency (18 respondents), the need to reflect on measures introduced and modify them if necessary (9 respondents) and changes in student evaluation (2 respondents). Complete overview of situational changes in the content of the roles of school principals is given in Figure 4.

Respondents also used the possibility of free statements in written records of the roles of regional education managers (school principals) and in subsequent online interviews. In them, they commented most often: on the generally unclear requirements for the role of education and school in today's society, even in the period following the COVID-19 pandemic (*"It is a question of what society expects from education and actors in it... I do not think that the roles of actors in education will change in any fundamental way, as they have not changed over the last few decades"* – R1), to the application of various theories, especially the management of change in practice in a very short time (*"The managerial roles of change management include and a number of stated and written theories had to be put into practice. The school principal managed this"* – R8), to the necessity of managing self-management, well-being and a large number of different social roles already in the current situation (*„... the most important thing for me is mental well-being in the circle of my loved ones. "* – R2; *"Although it is difficult to combine family, school and kindergarten, it works, for now. One has to be good in the role of organizer and sometim es afford not to be in any role."* – R4).

Figure 4: *The impact of the current situation on changes in regional education and the roles of principals*



Source: own processing

Conclusion

The aim of the survey, the methodology and results of which are presented in the paper, was to update the contents of key roles of managers in regional education and to determine whether the COVID-19 pandemic also changed the importance that respondents attribute to certain types of roles or partial activities of managers in regional education.

The identified changes in the roles of regional education managers concerned not only the content of such roles, but also the importance of specific sub-roles and competencies that leading pedagogical staff use in managing ongoing changes in education. These changes were accelerated and came to the forefront of public interest in connection with the COVID-19 pandemic. The statements of the respondents also include their ideas on the transfer of meaning or emphasis on certain types of roles in connection with the change, with possible overlaps with future developments and status.

In addition to the contents of the individual roles of school managers and the influence of the current pandemic situation on changes in the content of sub-roles, some respondents also commented on unclear expectations from the role of the school in society. This is also related to the number of roles that school principals have to handle and changes in the content of these roles. According to the respondents of the research survey, the complexity of the role of school principal is associated with possible conflicts with other social roles and with the search for positive starting points and aspects of overcoming the COVID-19 pandemic in society and school as an organization and institution.

The methodology used in this research does not make it possible to generalize the results. At the same time, defining and updating the contents of the roles of regional education managers

(school principals) and changes in the requirements for managing such a complex role, also resulting from the current pandemic situation, can be used for the development of school management theory and as input data for further research in the post-pandemic period.

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CORPORATE SOCIAL RESPONSIBILITY AS A TOOL FOR MOTIVATING PRIMARY SCHOOL STAFF IN SOUTH MORAVIAN REGION

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Keywords:

corporate social responsibility, primary school, teaching staff, human resource management

Abstract:

The role of human capital in every organization, including schools, is unquestionable. To exploit employees' full potential, it is crucial to properly design a motivation system. The present paper focuses on corporate social responsibility (CSR) activities as tools for motivating the staff of selected primary schools in the South Moravian Region. The questionnaire survey took place in 2020 and was attended by 230 teachers from 24 schools. Most respondents (91 %) consider setting the school's goals jointly with respect to all staff's needs as the strongest motivator to perform well, this, however, occurring sporadically in the practice of schools (14 %). The survey results show that knowledge of the CSR concept and the use of its motivation instruments among primary school teachers depend on the size of the school.

Introduction

Elements of corporate social responsibility (CSR) can be traced back to entrepreneurs in the past who were not indifferent to the social conditions of employees and the wider community, taking care of their well-being (an example is the founder of the Bata Shoes company and social innovator of Czech origin Tomáš Baťa). Such far-sighted companies then benefited from the potential of satisfied employees who, with their experience and commitment, contributed to their growth. At the micro level, the main benefits of adopting CSR policies are the competitive advantage, increased employer brand attractiveness and the financial efficiency of eco-friendly activities (sustainable business initiatives such as reducing waste, preventing pollution, recycling, etc.); see Steinová, Václavíková, Mervart (2008). If the company acts proactively, as noted by Kašparová (2015), CSR proves beneficial by reducing risk management costs (implementing measures that eliminate risks in advance, the company bears lower costs than those of handling an already crisis situation).

According to a Harvard study carried out over 11 years, sustainable development is one of the main benefits of applying the CSR concept. The study reports four times higher growth rates and eight times higher employment growth in companies taking an equal approach to all stakeholders compared to those favouring the owners; cf. CSR Network & Radley Yeldar (2012). The increase in employment is related to the preferences of applicants who place the organization's values above the wages offered. CSR-related policies (minimizing the environmental impact, improving working conditions, etc.) affect the company's productivity and employee loyalty.

The education sector also enjoys the benefits of CSR initiatives, such as streamlining school processes and improving relationships between all stakeholders, i.e. the management, teaching staff, pupils/students, parents, the school's founder and the wider community. Petrová et al. (2008) draw attention to the subsequent increase in the reputation of the school, which makes it more attractive not only to students, but also to partners and potential sponsors. It is worth noting that the above-mentioned benefits result from long-term efforts.

In the Czech Republic, the Quality Council under the auspices of the Ministry of Industry and Trade (MIT) has been in charge of CSR strategy development since 2006, establishing a CSR sub-section to coordinate activities at the national level. According to MIT, CSR issues should also be addressed by non-governmental non-profit organizations and state and local self-government bodies as they share responsibility for the social impact of their operations; cf. MIT CR (2014). However, the implementation of CSR policies in the education sector is still a novelty. Currently, the concept of University Social Responsibility (USR) is being developed; see Wigmore-Álvarez, Ruiz-Lozano and Fernández-Fernández (2020). It is argued by Lo, Pang, Egri and Li (2017) that USR should be integrated into the university's strategy and operational procedures.

Many schools are already pursuing some of the CSR activities, such as energy saving, waste sorting and other environmental projects. However, they usually do not have a comprehensive concept to incorporate into the school strategy (school vision and its long-term goals) and to fully utilize in human resource management to promote employee loyalty and motivation.

Despite many research studies on the motivation of public employees having been conducted worldwide, there are only a few papers focusing exclusively on the motivation of pedagogical staff of state-run primary and secondary schools; see, e.g., Mura, Vlacseková (2018).

The present article summarizes the findings from a survey on social responsibility awareness and activities, and the teaching staff's interest in CSR as a motivation tool in selected primary schools in the South Moravian Region.

1. Analytical framework

The paper aims to determine the awareness of the CSR concept in primary schools, the integration of CSR practices into their operations and the staff's interest in motivational use of CSR tools. The results of the 2020 questionnaire survey undertaken in selected primary schools in the South Moravian Region are presented, relevant data having been obtained from 230 teaching staff in 24 schools. The questionnaire contained "yes or no" questions for each of the three problem areas – the knowledge, implementation and motivational performance of CSR-related activities.

To assess the data collected, the following two pairs of alternative hypotheses were examined:

Hypothesis I

H0: Knowledge of the CSR concept depends on the size of the school.

HA: Knowledge of the CSR concept does not depend on the size of the school.

Hypothesis II

H0: Interest in motivational CSR tools depends on the size of the school.

HA: Interest in motivational CSR tools does not depend on the size of the school.

(The school size is measured by the number of teaching staff.)

To evaluate the hypotheses, the chi-square χ^2 test of the respondent's answer dependence on the school size (in terms of the number of teachers – 10 or less, 11–40, 41–70, 71 or more) is applied. The test utilizes two-dimensional data summarized in a contingency table (where r and s denote the number of rows and columns, respectively) according to the following formula:

$$n_{ij} = \frac{n_{i.} \cdot n_{.j}}{n}.$$

The probability of (in)dependence of variables can be determined by comparing the empirical and theoretical table. The test criterion χ^2 and degrees of freedom $(r-1) * (s-1)$ are applied –

$$\chi^2 = \sum_{i=1}^r \sum_{j=1}^s \frac{(n_{ij} - n'_{ij})^2}{n'_{ij}}.$$

All hypotheses are tested at the 5% level of significance.

2. Results and discussion

This section outlines the outcomes of a questionnaire survey of the awareness and implementation of CSR practices in selected primary schools in the South Moravian Region; see Table 1 below. Out of the total number of 230 respondents, only 40.4 % are familiar with the CSR concept, 59.6 % of participants stating that they do not know it. Based on the data obtained, the null hypothesis that the knowledge of CSR depends on the size of the school was tested at the 5% level of dependence. Since the test statistic was lower than the critical value, the null hypothesis was not rejected in favour of the alternative hypothesis. Familiarity with the concept of CSR depends on the school size in terms of the number of teachers.

The introduction and support of CSR among the teaching staff is the ultimate responsibility of school head teachers. As CSR initiatives are beyond the scope of statutory obligations, it is up to individual headmasters and their assistants whether they acquaint their subordinates with this concept and lead them purposefully to its implementation. Moreover, CSR is part of the strategic management and planning agenda. Large and small schools pursue it with different intensities, the latter managing lower wage and investment budgets (allocated by the government and municipal founders) and paying more attention to operational management.

Table 1: CSR concept familiarity

School size	Yes	No	Σ
10 or less teachers	11	43	60
11 – 40	18	36	60
41 – 70	23	33	62
71 a více	41	25	72
Σ	93	137	230

H0: CSR concept knowledge depends on the size of the school.

HA: CSR concept knowledge does not depend on the size of the school

5% level of significance; chi-square statistic $\chi^2 = \sum_{i=1}^r \sum_{j=1}^s \frac{(n_{ij} - n'_{ij})^2}{n'_{ij}} = 15,371$;

critical chi-square value $\chi_{20,05}(4) = 7,913$

r – number of rows in the contingency table, c – number of columns in the contingency table

Source: author's own elaboration

Respondents were also asked about 20 socially responsible activities appropriate for primary schools, which are performed voluntarily beyond the statutory obligations. They were divided into three basic areas (1) employment conditions (2) nutrition and health and (3) environmental protection. Participants reported whether their schools adopted individual practices. Irrespective of them being followed or not, the respondents were asked whether their promotion would motivate them to better perform.

First, participants responded to eleven CSR activities related to employment conditions. Only four of them already undertaken by the school were identified by more than half of the respondents – namely activities 1E (support for personal and social development beyond participants' professional scope; 55 %), 1F (elimination of social differences, conflicts, bullying or discrimination in the workplace; 57 %), 1J (internal processes of work with parents on and after maternity/parental leave; 51 %), and 1K (regular surveys of work environment satisfaction; 63 %); see Table 2 underneath.

Furthermore, all participants answered the question whether the implementation of a particular activity would motivate them to a better work performance, regardless of whether their school already pursues it or not. In seven out of eleven CSR practices, more than half of the respondents indicated that the activity in question was motivating for them. 91 % of participants described 1C activity (school goals are set taking into account the needs and development of all employees) as motivating, its current application, however, being confirmed by only 14 %. A similarly significant difference between the currently undertaken CSR activities and those that the respondents consider as motivational is evident in 1H activity (employees can consult work-life balance topics with a school psychologist) which was seen as a motivator to perform better by 53 % of participants, but its real implementation was confirmed by only 3 %.

Table 2: Performance and motivational impact of socially responsible activities supporting employee conditions (n = 230; in %)

	Our school engages in this activity	Implementation of this activity is/could be a motivator to better perform at work
1A) Employee health care beyond the scope of legal regulations	31	57
1B) Work-life balance support (e.g., part-time employment)	23	35
1C) School objectives are being set with respect to the needs and development of all staff	14	91
1D) Support for employees to volunteer for non-profit organizations	17	33
1E) The school promotes the staff development beyond the professional scope too (e.g., personal and social growth stimulation)	55	73
1F) Social differences, conflicts, bullying and discrimination in the workplace are eliminated	57	59
1G) Together with the teaching staff, the school management regularly evaluates whether the visions and goals in support of socially responsible activities are achieved	9	21
1H) Employees can consult with a school psychologist on work-life balance problems too	3	53
1I) Employees can utilize services such as coaching, mentoring or supervision	19	35

1J) The school has initiated internal processes of working with parents on and after maternity/parental leave, and with employees caring for a close person	51	67
1K) The school conducts regular surveys and evaluates employee satisfaction with the work environment	63	72

Source: author's own elaboration

As motivating are considered activities 1E (support of employee growth beyond the professional scope; 73 % of respondents), 1K (regular surveys and evaluation of employee satisfaction with the work environment, 72%), 1J (facilitation of internal work processes with parents on and after maternity/parental leave or staff members caring for a close person; 67%), 1F (elimination of workplace conflicts, bullying, discrimination or social differences; 59 %) and 1A (health care of employees beyond statutory legislation; 57%).

In the second part of the survey, participants were presented with four socially responsible activities promoting a healthy lifestyle; see Table 3. More than half of the respondents admitted that their schools engaged in none of the monitored practices. The two most often pursued activities – not work motivators, though – are 2A (providing food also to people with special dietary requirements) and 2C (offering meat-free school meals), reported by 47 % and 48 % of respondents, respectively. Activities 2B (supporting staff's physical fitness) and 2D (use of seasonal and local foods), on the other hand, are considered as work motivational factors by most participants – 89 % and 87 %, respectively.

Table 3: Performance and motivational impact of socially responsible activities supporting a healthy lifestyle (n = 230; in %)

	Our school engages in this activity	This activity motivates me to better perform at work
2A) We provide food also to staff members with dietary restrictions (gluton-free diet, etc.)	47	33
2B) We support staff's physical fitness (e.g., group exercises performed in school facilities)	37	89
2C) At least one vegetarian meal is available in our school canteen every day	48	53
2D) We use seasonal and local/regional foods	23	87

Source: author's own elaboration

In the last part of the survey, five CSR practices to enhance environmentally oriented activities were presented to respondents; see Table 4. Only one activity was identified by the majority (71 %) of participants as currently performed at their school, namely 3C (waste sorting in each classroom). However, only a third (33 %) of respondents consider this relatively widespread activity to be motivating for their work performance. 79 % identified activity 3A (participating in environmental projects) and 51 % 3B (use of environmentally friendly cleaning products) as the strongest motivators in terms of ecological concerns.

Table 4: Performance and motivational impact of socially responsible activities supporting environmentally oriented activities (n = 230; in %)

	Our school engages in this activity	This activity motivates me to better perform at work
3A) We get involved in ecological projects	44	79
3B) We use environmentally friendly cleaning products	31	51
3C) We sort waste in every class	71	33
3D) We prevent leakage of heat (e.g., window replacement, house insulation)	45	47
3E) We use technological means to reduce energy waste	11	29

Source: author's own elaboration

3. Implications and recommendations

A recent research carried out in Slovakia among 320 primary and secondary school staff shows that a higher sense of motivation leads to improved job satisfaction; cf. Mura, Vlacseková (2018). Another study of motivational factors in organizations was conducted in parallel in Slovakia and the Czech Republic on samples of 4444 and 2312 respondents, respectively, indicating that the most common requirements of Czech respondents are related to interpersonal relationships; see Hitka, Balážová (2017).

Within the scope of CSR, school headmasters can develop their staff's teaching skills and knowledge beyond standard professional requirements. According to the present research, CSR activities coordinated by the school management are generally assessed by respondents as motivating factors, enhancing the ability to take initiative and affecting their work performance. These practices at their best result in a synergy. They facilitate the development of pedagogical staff in areas other than exclusively professional ones, while acting as motivational tools. This is relatively rare in state primary schools (contributory organizations maintained by municipalities) compared to private companies established to make profit.

Using CSR tools, human resource management in primary schools should foster staff collaboration in designing a common vision. The initiative should not rest solely on the school management, but on common strategy planning of future development, embracing the views and expectations of all stakeholders, i.e. teachers, pupils, parents, municipal founders and the broader community.

4. Conclusion

The present paper deals with the area of social responsibility and its practices followed by schools, increasing a sense of motivation and empowerment among staff members. 24 primary schools in the South Moravian Region having been addressed, 230 respondents completed the survey questionnaire. Since the performance of CSR activities and the overall motivation of teachers in state primary schools has been explored only sporadically so far, the topic of the paper is unique in its focus.

The results of the survey suggest that both knowledge of the CSR concept and interest in CSR motivational tools depend on the size of the school determined by the number of employees.

Interestingly, most respondents (91 %) agreed on the motivational power of joint setting school goals with respect to the needs of all staff (activity 1C), but very few (14 %) stated that this activity was actually undertaken in their school. On the other hand, sorting of waste in classes (activity 3C) or the use of technologies to reduce energy waste (activity 3E) are considered sufficiently motivating by the fewest respondents (33 % and 29 %, respectively).

The present findings can be used by school management in terms of both strategic development planning and extending the range of employee motivation tools. This paper is also a suitable starting point for research into hitherto neglected issue of social responsibility in schools in other regions of the Czech Republic.

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3D VISUALIZATION OF HISTORICAL BUILDINGS: METHODS, THEIR UTILITY IN THE TOURISM INDUSTRY AND BEYOND

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Keywords:

3D reconstruction, 3D visualization, historical buildings, virtual tourism

Abstract:

What are the reasons and motivation for virtual reconstruction of buildings? What are the possibilities of current-generation 3D visualization in the context of (re)constructing buildings, especially historical monuments, and how can it be utilized in regional development? Such questions are presented and discussed in the article. The following text narrows down the issues from a general/technological overview to focus on the regional development, the tourism industry, and reconstruction of old buildings. Examples of visualization methods are presented and demonstrated with the provided examples. The discussion follows by highlighting the need for collaboration across multiple specializations, considering the untapped potential for utilizing 3D interactive models in the tourism industry, and the ability to observe and collect user behavior in 3D visualization to understand their behavior/interactions better, and to (re)create the 3D user experience to the optimum of their needs and expectations.

Introduction

Significant monuments of human settlements of the past are considered historically valuable or interesting components of the landscape (e.g., for practical utilization in the context of regional history & tourism industry) if they fulfill one or more criteria: the building in question is a remarkable representation of the architectonic style of an era (Davidson, 2017), it is situated in a strategic location with a (once) significant administrative, martial or cultural function (Ching, Jarzombek, Prakash, 2006). To consider such, e.g., with castles, the architectural styles such monuments are (re)built in change through the centuries, and this leads to the castle changing its shape/function through time, or to ruin. With material destruction, however, the historical value of the building is (somewhat) inadvertently lost. Therefore, the question is whether it is possible and/or desirable to create a virtual reconstruction of historical monuments - be it either to capture their current, preserved form, or to at least estimate the shape and form of a building that is no longer there. 3D visualization and documentation of such historical monuments help to keep the history. Moreover, it supports economic growth by stimulating cultural tourism (Koeva, 2016, Scerri et al., 2016).

Through scientific discoveries in the modern era, the scientific fields of archaeology, architecture, and history of material culture have already proposed ways to achieve historical reconstructions. Since the original appearance of a historical monument is not always preserved well, or nearly at all, or is just (wrongly) assumed, some methods of the aforementioned scientific fields do adjust for this: from aerial archaeology (Raczkowski, 2017), negative

remains analysis (Angelo, 2017), experimental archaeology (Ascher, 1961), to visual heuristics based on knowing building construction practices of an era, the missing pieces can, often, be well estimated to provide a probable resemblance of a monument in a given time.

While the aforementioned sciences and methods allow for the extraction of reconstruction data from historical sites even with little or no remains, the standard mediums of reconstruction methods do have limitations - in visuals or adjustability. E.g., physical models are limited by their scale and transportability; if they are to be present in multiple places, multiple copies of the same have to be created. Depictions and imagery are constrained by angle and scale, i.e., the static depiction of a static scale with details or the big picture often being lost. Animations, while digital, are still a set of prerendered frames that offer little/no user interactivity. Enter interactive 3D visualizations, and consider their advantages:

- they can be outlined at first and then worked out in great geometric detail
- 3D structures are transferable across 3D applications and can be worked on using a broad set of production techniques regarding their 3D geometry
- they are (re)editable and customizable (lighting, texture, post-processing)
- they can be made interactive and served through a variety of media, e.g., PCs, smartphones, web interfaces, augmented/mixed/virtual reality

Furthermore, 3D visualization can serve as a basis for producing and distributing the aforementioned static media visualizations (screenshots, fly-through animations, 3D prints), all from a single, easily managed source.

Photorealistic real-time 3D visualizations are now possible due to past technological progress in computer graphics. The technologies have reached a high standard in resolution, 3D model, detail, texturing, and lighting simulation - e.g., through normal mapping, tessellation, physically-based rendering, or ray-tracing (Singer, 2021). Not only this, but the applications purposed for the creation of 3D assets/compositions have evolved their tools to reflect such advancement: while there is more to be done to produce a higher level of fidelity in 3D graphics, 3D tools have streamlined this process, often automating, randomly generating, or visually aiding (Bertolini, 2018) in what would have required manual input in the past. Furthermore, the openness of current-generation 3D real-time graphics engines to scriptability (often using premade classes of C++ or C# languages) allows for custom, tailored interfaces and user experiences.

There are many workflows to achieve a high level of visual fidelity in 3D. For contemporary buildings, BIM (building information modeling (Murphy, McGovern, Pavia, 2009)) is available. BIM - a 3D method intended to replace traditional 2D construction drawings - is five-dimensional: it contains spatial data (3D), with the fourth and fifth dimensions being construction material properties and building modifications through time. Some 3D software, e.g., Tridify BIM tool for Unity, is already streamlined enough to take construction-purposed BIM data and to transform it into a visualization of a building that is often yet to be constructed. For historical buildings, however, we have no such data available; regardless, BIM methodology as such can serve as an inspiration, as similar results are desired to be implementable for historical sites as well - albeit the methods to obtain three-dimensional data of historical sites are different.

Photogrammetry allows for capturing high-detailed 3D meshes of existing (historical) structures. Imaginary, assumed, or otherwise destroyed shapes and structures can then be recreated using either organic modeling (sculpting) or hard surface modeling (Simonds, 2013)

using industry-standard 3D software like Blender, Maya, or ZBrush. Generic 3D models can also be reused from an existing 3D model library, e.g., Quixel Megascans, or 3D engine asset stores (e.g., Unity Store, Unreal Marketplace). The strong suit of a 3D pipeline is that there is no single correct way to (re)create a virtual environment - that is because the 3D techniques and software packages can be used in conjunction with each other. Furthermore, 3D workflows nicely complement and enrich the aforementioned traditional scientific methods. For example, photogrammetry was used in archaeological sites (Jones, Church, 2020), or modeling assumed structures based on known architecture, construction practices, and other (visual) historical sources of an era.

Given the contemporary context of 3D visualization technology and historical visualizations, one has to ask about the utility of such visualizations for the tourism industry. First and foremost, website browsing, mobile browsing/apps, augmented/mixed/virtual reality headsets are all relatively new forms of media that are both becoming increasingly affordable and advanced year by year (Pulli et al., 2007; Dailey-Hebert, Simmons Estes, Choi, 2021). Such mediums can present the user with either the current or the past appearance of a historical site. User viewing can commence either as a supplement to the real visitation of the site or as a substitute/precondition to physically visiting the site (Deng et al., 2020). Provided the user experience and user interface of the virtual application is a good fit for the medium (Weiss et al., 2018) and the targeted types of users (Tomlin, 2018), this can serve to sway the potential visitor to visit the actual site, and/or to enrich the sightseeing experience while physically on site. Therefore, the profitability of such a site can be increased - either indirectly, by converting the potential visitor into an actual future visitor, or directly, by implementing purchases or donations through the virtual application, etc. Disabled or distant potential visitors who would have been otherwise unable to visit a site can also use a virtual visit as a viable alternative - i.e., virtual visitation can represent an improvement in ecology and accessibility.

While the process of creating a virtual representation of a historical site is somewhat universal in terms of 3D graphics (software, supporting reconstruction methods and sources, 3D scene creation pipeline, 3D workflows per specific 3D software), this paper will strive to present such in consideration to the tourism industry, where relevant (user experience, virtual sightseeing commentary).

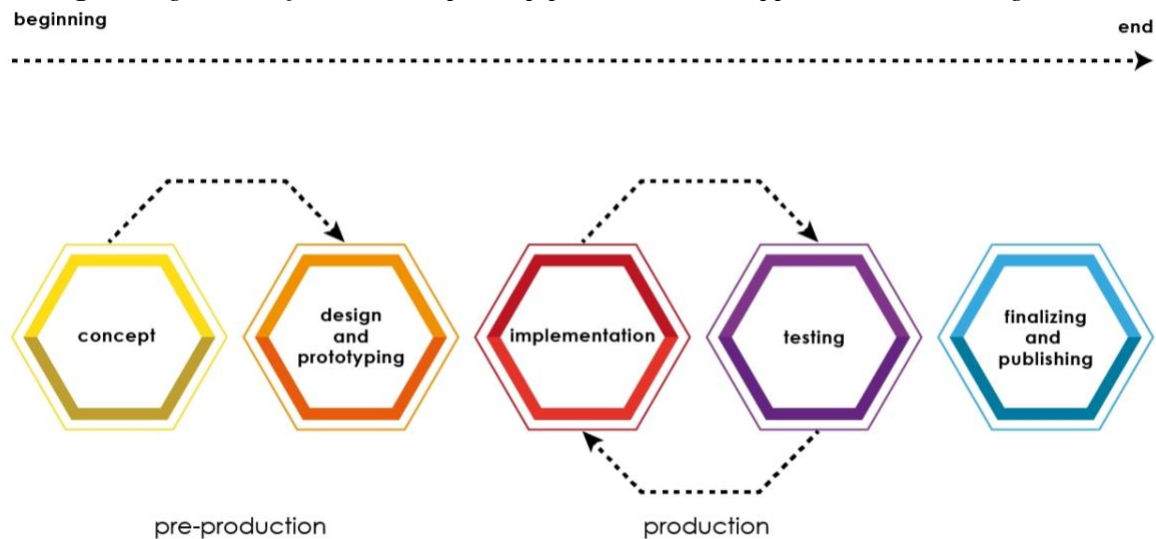
1. Method

The following process of recreating 3D visualizations of historical buildings, as is to be presented, occurred in the semester of summer 2020 at the Masaryk University, through renovating a master's level college course "3D modelování a vizualizace" (Masaryk University, 2020). The students enrolled in the class were assumed not to have had previous 3D modeling experience; therefore, the semester-long course was intended to cover the fundamentals of 3D modeling. I.e., the students were introduced to what a generic 3D modeling pipeline would look like. To explicate, they were asked to model a castle. Likewise will follow through this article - describing the methods that were taught through the course while merely briefly mentioning the alternatives and advanced approaches.

1.1 3D modeling pipeline as a software development pattern

In the simplest of terms, the process of creating compelling 3D environments can be viewed as following the principles of software development (see Fig. 1). I.e., there is a concept phase that summarizes the ideas that are to be reached. A design/prototyping phase follows to make sure the concepts can be implemented. The implementation phase then carries out the main body of work - and as it progresses, it can alter back and forth with the testing phase, to ensure the implementation is done to the desired standard. Once such a standard is reached, post-processing and finalizing work is carried out to ensure the results reach a consistent standard. As such, the software is released.

Figure 1: *generic software development pipeline. It can be applied to 3D modeling as well.*



Source: Ferro, Sapio, 2018

In terms of software development models, this can resemble the classic iterative waterfall model, where the whole process goes through from the beginning to the end (McConnell, 1996). More realistically, although the 3D modeling pipeline and its workflows do incorporate some development iterations, e.g., as in an incremental development model, e.g., as in test-based development or SCRUM (Larman, Basili, 2003), since both the software in use and the development/testing of features and visuals can cycle back and forth - especially in case the 3D visualization is a complex one.

1.2 Simplified 3D pipeline in use

To outline the structure of the 3D visualization pipeline, we chose to break it down into four segments, all with verifiable and measurable milestones of their own. The students in our course followed such a structure, too:

1. **Conceptual phase.** This phase was meant for the creator to choose a historical castle to model, and to gather as many relevant visualizations and other relevant historical sources as possible, to have a good estimate of what is there to model. If multiple visualizations depicting the same castle were present (be it either through depicting different periods or multiple interpretations of a single period), this did not impose an issue, as there was an inherent explorative component to this - and only by the time of

finalizing the concept phase, our students were asked to choose their direction/vision (be it a single existing visualization or a hybrid of a few sources).

2. **Functional prototype.** The purpose here was to create a simplified, gray-boxed, detail-less 3D representation of the visualization to be. That is, only the structures of the terrain and some very primitive man-made structures were extruded, along with placing a first-person movement controller into such a scene. While there were no details, no textures, and very primitive lighting, the purpose of this segment was to establish a 1:1 scale of the visualization to be, and to be able to walk around the place to ensure all intended areas are connected, accessible, and correctly scaled.
3. **3D modeling.** In this stage, the simplified models need detailing, texturing, and adding other environmental details. This, along with terrain tweaks and adding lighting to the scene, does resemble the majority of the actual work done on a 3D project.
4. **Finalizing and bug fixing.** The 3D scenes created in the previous step were then evaluated by a third party (in this case, student works were evaluated by a teacher; a similar dynamic would ensure similarly with a graphics designer/director, in a professional environment). The creators of the scene were notified of the main issues found in their visualization (if any) and asked to fix these. Graphical postprocessing was introduced into the 3D scenes, and so were performance-minded optimizations.

This pipeline is presented on a conceptual level. Based on the software used (in our case, just ArcGIS, Unity, and Blender), there can be another operational level pipeline. Regardless, that one is hardly specific, as the use of different software combinations can produce vastly different workflows and interdependencies. Traditional hard-surface 3D software (e.g., Maya, 3DsMax, Blender) has its way of handling things, and so do 3D packages based on sculpting or generative paradigms (e.g. Zbrush, Houdini, WorldMachine). The details production pipeline (e.g., Substance Painter/Designer) introduces its quirks, and so do the 3D engines (Unity, Unreal, CryEngine) with their plugins and affiliates (e.g., MegaScans). Coupled with GIS software, land surveying and photogrammetry, the actual 3D development pipeline one ends up with can be a rather complex one.

In either case, adhering at least to the conceptual structure above can prevent issues with 3D modeling of complex structures/composition later on. E.g., as long as a correct building/space scale and user controller interface are established throughout the functional prototyping phase, the other visual/functional issues one can encounter later on will only be minor ones. Similarly, adding lighting and postprocessing details into a scene only makes sense once after the majority of the scene's geometry has been put into place. In contrast to this, ignoring such 3D scene production principles can lead to wasted efforts, where emerging issues may require redoing a significant portion of the previous body of work.

1.3 Terrain data acquisition and adjustment

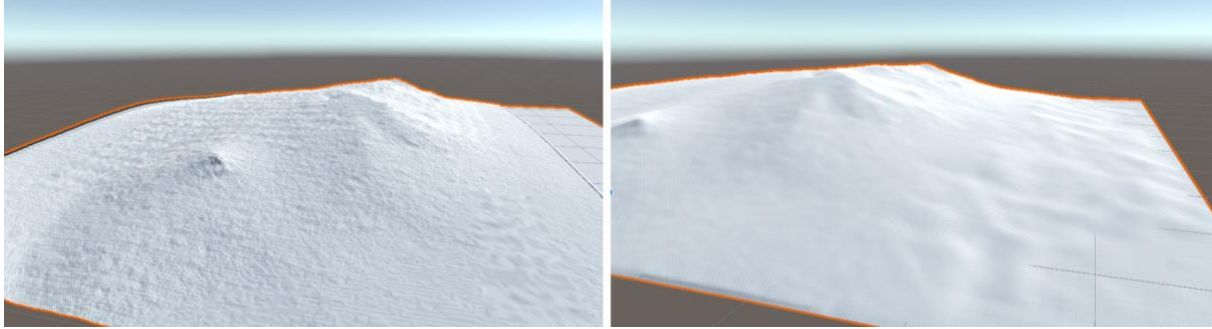
The 3D terrain models, above which historical monuments were modeled, had been generated from the Digital Terrain Model of the Czech Republic of the 5th generation (DMR 5G). DMR5G was created by the Czech Office for Surveying, Mapping, and Cadastre, based on aerial laser scanning performed by the Military Geographic and Hydrometeorological Office (VGHMÚř).

DMR5G data are available as layer files (.lyr) that are implicitly processed in ArcGIS (in our case version 10.4). In the ArcGIS, the area of interest of the immediate vicinity of the historical

monument was extracted (clipped). These extracted Digital Elevation Models (DEMs) were saved as TIFF files).

Upon converting the TIFF DEM into a RAW file, this was then imported into the Unity engine and processed further. As seen in Fig. 2 left, the imported DEM (in Unity terminology, heightmap) did introduce some jitter inaccuracies, given the resolution of the source. Therefore, using the Unity terrain tool (Unity Technologies, 2019a), the jittery terrain was smoothed out a bit to give it natural flow (see Fig. 2 right).

Figure 2: *ArcGIS terrain imported into Unity (left). Terrain jitter smoothed out (right).*



Source: 3D modeling course (Masaryk University, 2020)

Since the acquired terrain is contemporary, it may not completely resemble its historical shape (due to erosion, sedimentation, man-made activities, etc.) Nevertheless, the Unity terrain tools can be used to bring back the desired shape of the terrain, often in conjunction with placing man-made structures onto the terrain.

Since 3D visualization can have a rather large view distance, spanning up to tens of kilometers, the ArcGIS raster created is recommended to be a large one. While importing the terrain into the 3D engine, this can be further separated into two exclusive terrain objects: a near, highly detailed one, upon which the user walks, and a remote, low-detailed one, which covers the view distance. 3D engines can also use a legacy skybox feature (Unity Technologies, 2019b), but using real terrain data (despite being relatively low resolution) is better to preserve the overall visual fidelity.

Other limitations of the DEMs can occur in case of the terrain being highly vertically differentiated - e.g., cliffsides, large rock formations. Because the DEM is only two-dimensional with a single height value per pixel, it cannot capture nonconvex variance along the vertical axis. In such cases, it is recommended to complement the DEM with 3D vertical models (e.g., obtained through photogrammetry), or to replace it completely with a voxel-based terrain (e.g. Unity Technologies, 2019c). Voxels, however, are yet not very well supported across the current generation of 3D applications, both in 3D engines and GIS software.

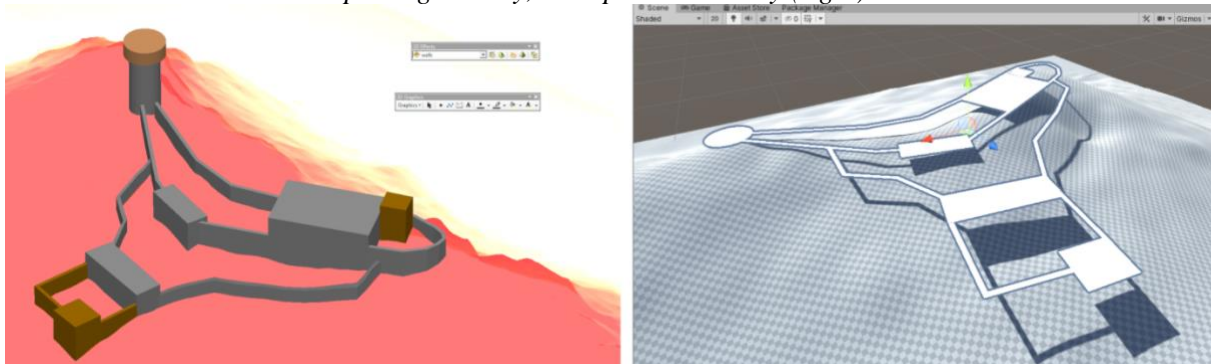
1.4 From acquiring the vector floor plan data to modeling the prototype

Floor plans of the man-made structures were created manually using appropriately visualized DMR5G data and other supporting data sources (geo-referenced plans, reconstruction drawings, photographs, or potential outcomes from a field survey). Using the ArcGIS extension 3D Analyst and their module ArcScene (ArcGIS, 2021), these shapes were then extruded into the third dimension and saved as so-called Multipatch geometries. Fig. 3 left provides an

overview of what the reconstructed castle might look like. These were then also imported into Blender/Unity in the form of Shapefiles.

Since the Blender 3D modeling software has a tight integration with the Unity 3D engine, we used that (simplifying the 3D modeling workflow that was to follow by saving Blender files right into the Unity project, with no importing/exporting needed, as this software did such on their own). Blender, however, did not support the 3D data created in ArcScene (with multipatch geometry), making it effectively so that only 2D floor plans of castle structures were imported and had to be modeled into 3D once again (Fig. 3 right).

Figure 3: original extrusion of the basic castle geometry in ArcGIS using ArcScene (left). Only flat plane geometry, as imported in Unity (right).

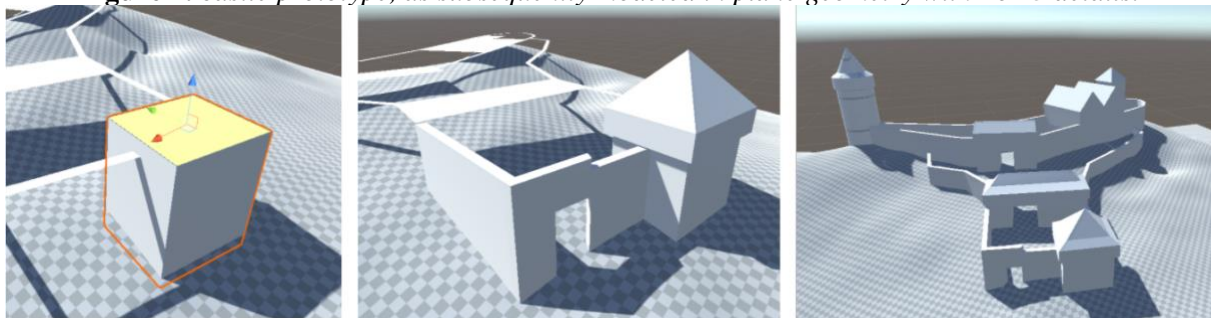


Source: 3D modeling course (Masaryk University, 2020)

Nevertheless, this was not a hindrance for two reasons: one, the 3D geometry to be made required more complexity than ArcScene provided (not just extrusions, but other advanced 3D operations as well), and two, to take this opportunity to teach our 3D modeling class students the principles and basics of the craft.

By modeling the castle from a series of planes with extruded sets of walls and buildings, all with basic doorways and similar physical structures in place, we were able to explain the basics of 3D hard-surface modeling to our students. They tried the different operations available in the vertex/edge/polygon modes and had to think about the desired 3D mesh topology of the objects they were creating (by adding in geometry through extruding beveling, or cutting loops into it; by reducing/optimizing the geometry through deleting polygons and joining vertices; or by using some basic modifiers like mirroring, to aid the modeling process). Such modeling progress is shown in Figure 4.

Figure 4: castle prototype, as subsequently modeled in plane geometry with LoD3 details.



Source: 3D modeling course (Masaryk University, 2020)

As seen in Figure 4, such level of detail (based on the level of detail 3 - LoD3, according to the CityGML standard (Kutzner, Chaturvedi, Kolbe, 2020)) was enough for the prototyping phase. We also provided the students with a basic first-person controller (e.g., Halldin, 2018) so that they could walk through their scene prototype and verify their surroundings from the first-person perspective, ensuring that all intended paths were of a correct scale and accessible. In other words, things like oversized fantasy-like towers, oversized stairs, or steep, unwalkable slopes had to be corrected.

While no other interactive scripts were present in our solution (given the already high complexity of the subjects presented to the students), the prototyping phase is also the time to introduce these. Interactive object functionality, be it animated doors, texts, narration, etc., can be introduced by means of creating a script structure that will carry and deliver their information/interactive content as needed.

Upon finalizing the prototyping phase, we were able to build the first version of an executable, fully walkable 3D visualization application. While our students had different castle assignments to make, they could distribute their prototype builds to their peers to exchange feedback and make adjustments.

1.5 Modeling details and texturing

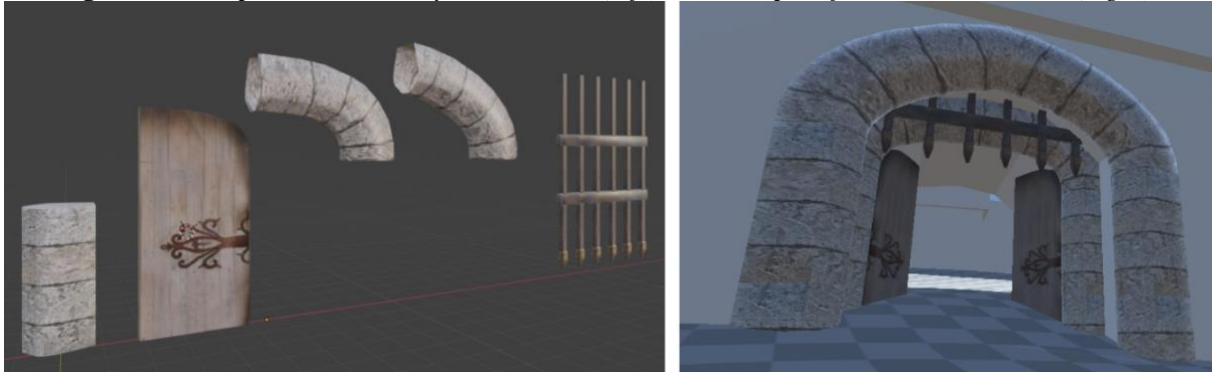
While the process of creating detailed small-scale models is in principle the same as LoD prototyping modeling (the models just get more complex at this point), the issues to be faced and the thinking behind the process are more complex.

First of all, modeling, texturing, and deploying small-scale objects into a scene can be the most time-consuming portion of the whole 3D scene creation pipeline. While being rather simple on the execution level (i.e., a repetitive process of recreating 3D assets repeatedly), this can easily take tens hundreds to thousands of man hours. As such, mismanagement of these efforts can be costly - it is, therefore crucial to have a unifying pipeline and approach in detailing a 3D environment. It is recommended to:

- Have a clear standard of what the 3D assets are to look like. That is, their expected level of detail in both 3D meshing and texturing, a (semi)standardized workflow of their creation, and their overall visual appearance/style. In other words, to have an art direction - in the case of historical visualization, this is likely to follow a realistic art style, but in other cases, e.g., education, something more stylized like conceptual, comic, geometric, or hyper-realistic direction can be used too (Kratt et al., 2014).
- Obtain 3D assets from external sources to save time and resources. For such occasions, there are many 3D marketplaces, some free, some paid. To name just a few, there is the Unity Assets Store, Unreal Marketplace, or Quixel Megascans. Similarly, in our 3D modeling class, we recommended the students share their 3D assets with their peers so that some of the common models would not need creating repeatedly.
- Reuse 3D assets and make some of them modular. It is a common practice in 3D scene detailing to reuse existing assets in multiple instances, to save memory, computing power, and asset creation requirements. Especially, organic, semi-random shapes like rocks can be rotated around their axes, scaled (within reason), and grouped with other similar assets to create unique looking vistas. As for mostly geometric, repetitive, man-made shapes and structures, such can be broken down into modular assets - that is, building blocks, often following a grid structure that can be connected to quickly and

accurately create compelling man-made compositions. An example of such a library of modular 3D assets is shown in Fig. 5.

Figure 5: *a simple door/archway modular set (left). An example of its use in the scene (right).*

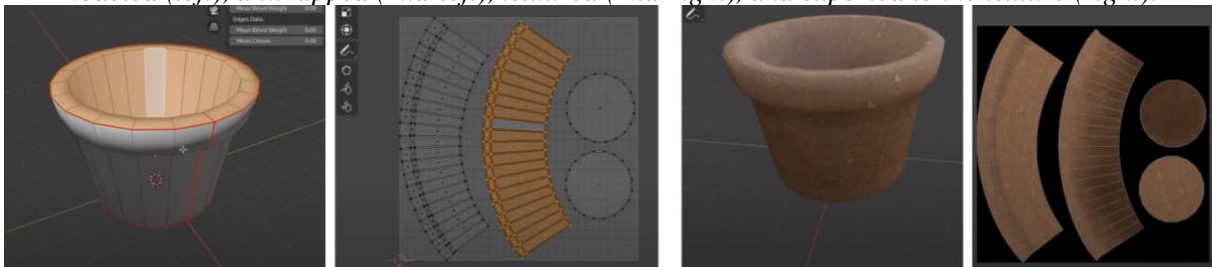


Source: 3D modeling course (Masaryk University, 2020)

In our 3D modeling class, we adhered to a simplified 3D asset modeling workflow that consisted of four steps (for a demonstration, see Fig. 6):

1. 3D mesh creation. Simple objects, just like the flower pot in Fig. 6, were advised to be created from imagination, complex objects to be based on a photoreference (ideally as a series of two to three orthogonal pictures, each per axis - i.e., front, side or top).
2. UV unwrapping. That is, projecting the 3D surfaces of a polygonized model onto strips of 2D planes so that they could be textured later on. Since Blender has integrated Smart UV unwrap, i.e., semiautomated functionality to do this (Selin, 2019), we advised our students to use this.
3. Texturing. This was also done inside Blender, thanks to the texture paint and stencil brush functionality (Blender Foundation, 2021). In principle, this step involves obtaining 2D textures from external sources and projecting them onto a 3D object, moving the 3D object around to obtain better projections in place, and finally, saving the projections represented as a bitmap on top of a UV projection as PNG bitmap files. This created the basic texture (also called albedo).
4. Importing the 3D models of assets into Unity - either through an implicit Blender to Unity converter, or by saving the assets as FBX files (a standardized format to maximize compatibility with other potential 3D modeling software).

Figure 6: *simplified 3D asset modeling workflow, as demonstrated on a flower pot. An object is modeled (left), unwrapped (mid-left), textured (mid-right), and exported to the texture (right).*



Source: Abbit, 2020

While the example workflow described above and shown in Fig. 6 is not exhaustive or producing best-looking 3D assets, it is reasonable enough to be adopted by a 3D modeling beginner, or by a person who strives to produce 3D assets in a reasonable time.

More complex 3D asset creation workflows often also introduce asset sculpting, retopology, baking, and professional-grade texturing (Sairiala, 2015). As illustrated through Fig. 7, a simplified shape of the desired 3D mesh is created at first; then, it is subdivided and sculpted in high-polygon fine detail, often containing up to tens of millions polygons; a good enough low-polygon retopology of this mesh is then created, and the detail contained in the sculpted mesh is then projected onto it using normal maps. With such baked-in mesh, the texturing process can commence in a professional program like Substance Painter, which assists with procedural texture creation and placement based on the shape and form of the 3D mesh it is being applied on. The stack of specialized textures per 3D asset (i.e, not only albedo for color, but also a normal map for details, a specular map for reflections, an occlusion map for shadow casting, etc.) creates what is known as PBR material (physically-based rendering (Pharr, Jakob, Humphreys, 2016)), which is desired to simulate object material properties across all sorts of lighting settings - provided that scene lighting is crucial, dynamic, or when the purpose of the whole visualization is to reach photorealism (Borg, Paprocki, Madsen, 2014). The price for such a complicated 3D asset creation workflow is the time requirements, which easily span to a tenfold of the simple workflow mentioned above.

Another alternative to 3D asset modeling is their acquisition through photogrammetry (if such props are physically available). With specialized photography equipment (Lachambre, Lagarde, Jover, 2017), the photos can be obtained; then, a specialized photogrammetry software, e.g., Meshroom (Alicevision, 2021) converts these into a 3D mesh; using retopology software like Instant Meshes (Jakob et al., 2015), these can be converted into a mesh that is better suited for editing and 3D engines (all with preserving the normal map and the original texture), corrected to eliminate natural light shadows that may be present in the photos (Unity technologies, 2020), and used.

As for obtaining high-quality textures or materials, there are software packages, e.g., Materialize (Bounding Box software, 2018), that can recreate a whole PBR material based on emulating what would have otherwise required the high-polygon sculpting. While the resulting quality may not be a good fit for all objects and may not always be on par with the sculpting/baking workflow, it sure is a fast way to produce compelling results.

Figure 7: *a more complex 3D modeling workflow, as illustrated on a rock formation.*

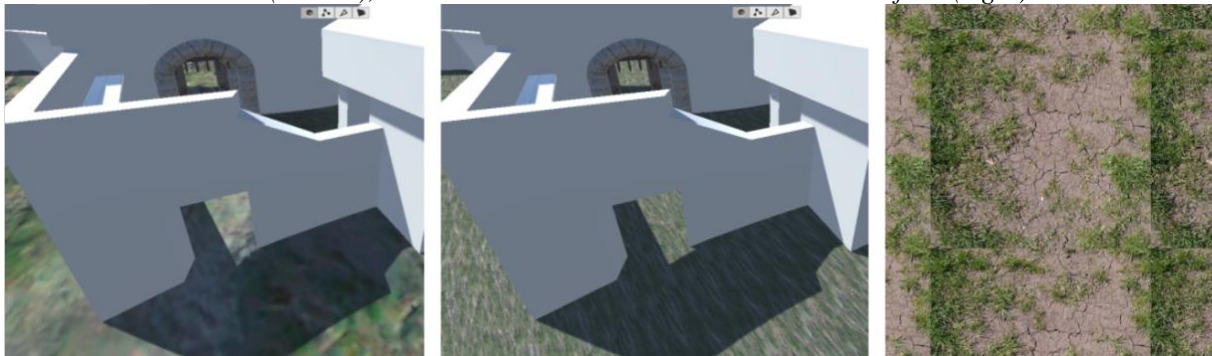


Source: Waterman, 2014

With the texturing workflow, one needs to make sure their surfaces do not suffer from issues - that is, the textures are either under scaled, overscaled, skewed in either X or Y axis, misaligned,

having visible seams or repetition issues (see Fig. 8; this applies to both 3D textured objects, and texturing the terrain), or being too different compared to textures of other objects (a matter of consistency and art direction). While 3D objects are textured as aforementioned, terrains have to be texture painted as well - the reason for this is the user visiting a 3D reconstruction from a first-person perspective, where a satellite scan of the land would look just too blurry and oversized (e.g., Fig. 8 left). For terrain texturing, 3D engines like Unity have their terrain painting toolsets (for textures, their strength and blending, and oftentimes for low-height vegetation like grass, too); while the height of a 3D in-engine terrain is usually stored in a heightmap bitmap, the same goes for terrain textures - functionally speaking, these are just more layers.

Figure 8: *some issues of texture scaling, use, and alignment. An overscaled texture (left), skewed texture (middle), and non-seamless texture on a seamless surface (right).*



Source: 3D modeling course (Masaryk University, 2020)

Completion of a whole 3D scene involves complementing and/or reworking the prototype building by introducing more detailed shapes (unique objects, modular objects, reused objects), terrain heightmap, texturing, vegetation, and clutter. Since man-made structures are oftentimes orderly and geometric, while vegetation and nature form pseudorandom patterns, the contrary of the two can create an interesting dichotomy. By introducing vegetation into a scene, repetitive patterns can be broken. Furthermore, an imperfection in 3D scene composition like texture repetition or 3D model imperfections can be hidden away to an extent. However, artsy, this may sound a good level of integration of all parts present in a scene creating quality environment art (Mon, 2017), which, in turn, makes the user feel comfortable in such a virtual world - i.e. directly improving the immersiveness of the experience (Hudson et al., 2018). What makes or breaks a virtual application is the end feeling of the user/customer. If their impression of a 3D visualization is that a scene is simply “not good enough” (be it because of obsolete or intrusive visuals, cramped space, conflicting user-controller interfaces, etc.), such users would likely not be inclined to visit the real representation of the virtual scene in question. In other words, if a virtual environment is used as a supporting tool to promote tourism, it needs to have a positive conversion rate per potential user/customer (if that is a metric to go by).

This is why the visuals and user interface of a 3D visualization with a real counterpart should cause good impressions in users; this is why they need to be integrated well together. That much can be said for 3D modeling alone; as for user testing for the positivity of such an effect, that is up for discussion.

1.6 Scene lighting, post-processing, and optimization

The purpose of this final stage of the 3D pipeline is two-fold: to make the premodeled 3D scene look presentable considering the context of its use, and to make it run well considering the budget of the hardware it is intended to run on.

Scene lighting is there to accentuate the form and shapes of the composition of the 3D models that were previously put in place. While there surely are dramatic lighting effects like dusk/dawn scenery, photographic magic hours, sun rays (in computer graphics also known as god rays), soft/hard light dichotomies, or reflective, ray-traced scenes (Birn, 2006), which is more of a domain of the film industry, artistic visualizations, or games. When lighting historical visualizations, a more basic approach can do; from thereon, the question on lighting is whether the scene is situated fully outdoors, or whether it includes indoor space.

Generally speaking, with lighting, it is important to consider light sources. With outdoor spaces, just a single global light source can do - sunlight. This is a light source coming from a distance of infinity, with a global reach across the whole visualization is by default enabled. For a straightforward visualization without a cinematic touch, it is recommended to rotate the sunlight in the vertical axis to achieve an effect of a 3 PM to 5 PM sun, or so. The reason for this is that noon lighting looks bland, not giving the shadows any chance to cast themselves across the existing 3D geometry to accentuate the three-dimensionality of the scene; similarly, early morning or late evening lighting has the issue of casting shadows so long that it is no longer clear what shape originates what shadow and the whole lighting composition gets overlayed by shadows from all sorts of origins (this is especially true when the 3D scene is vertically differentiated - as a castle scene might be).

If a scene contains other light sources, e.g., in indoor spaces with little/no sunlight reach, these are to be included as well. In 3D engines, there are usually two basic kinds of local lights: point lights, which distribute their light in all directions equally, and spotlights, which have a limited angle, in which they cast a light cone (Unity Technologies, 2019d). Such local lights can be adjusted for their limited range and color, among other properties. A deliberate play of light and shadow can give a scene an atmospheric feel, especially in indoor spaces.

Scene postprocessing is a collection of camera filters and effects that can further accentuate the artistic feel of a visualization. Some of them are based on their film or photography counterparts (e.g., color grading, depth of field, vignetting), some others are a domain of computer graphics (e.g., antialiasing, distance fog simulation). While these can be used to hide some imperfections of computer graphics, push the depth of three-dimensionality and photorealism of visualization even further, we do recommend using them sparsely. Not only are they overused in computer graphics media, but they can also be very demanding in terms of performance.

Speaking of performance and scene optimization, it is the beginning of the 3D visualization pipeline (conceptual phase), where the overall requirements for 3D visuals and intended platforms are set. While scene optimization is useful, one does not simply, e.g., convert a lightweight, simplistic scene intended for mobile phones into a photorealistic state of the art virtual reality experience or vice versa. In professional 3D pipelines, the conceptual phase sets a budget (in terms of scene complexity and performance requirements), the finalizing optimizations make sure the budget is not exceeded, along with striving for some reserves. This budget often involves the complexity of 3D geometry (number of polygons simultaneously

rendered in a scene), lighting complexity and number of light sources, the size of textures, and the use of postprocessing filters.

While scene optimization can be a complex subject, and while this exceeds both the depth of this article and the topics covered in our 3D modeling course, as taught to our students, adhering to the simple 3D modeling pipeline, as described in this article, ensures performance limits are unlikely to be reached (i.e. a student presenting their semestral work on a standard PC with a dedicated graphics card).

2. Results

Each student in our 3D modeling class was tasked to pick a unique castle they would model. Through the concept and prototyping phases of our simple 3D modeling pipeline, the students were advised on their progress, so that the amount of work necessary in one semester's timeframe would be manageable, without complications.

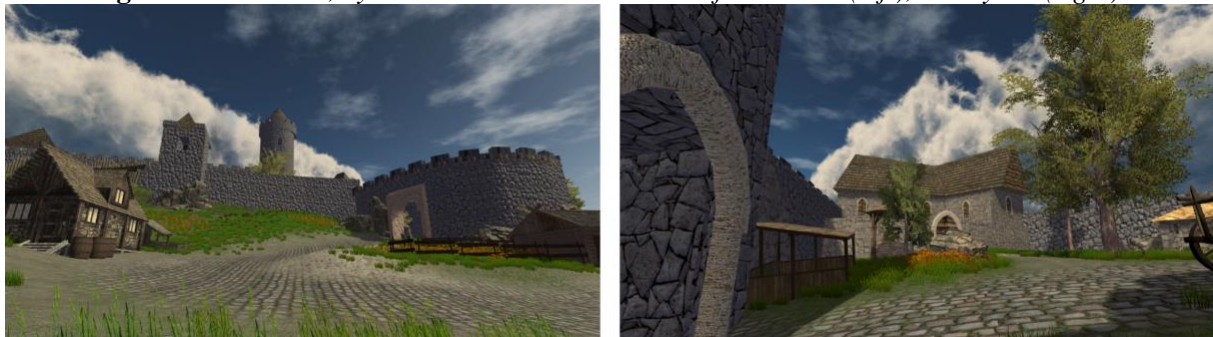
Figures 9-12 present screenshots of the final visualizations of four selected students. The screenshots were taken from the first-person perspective while walking through the virtual environments. This is to illustrate what was made possible in a timespan of one semester; it is also apparent that the students did approach the assignment differently, putting their personalities into the end products.

Figure 9: *Čertův hrádek* by Petr Vodička. Outer courtyard (left), inner courtyard (right).



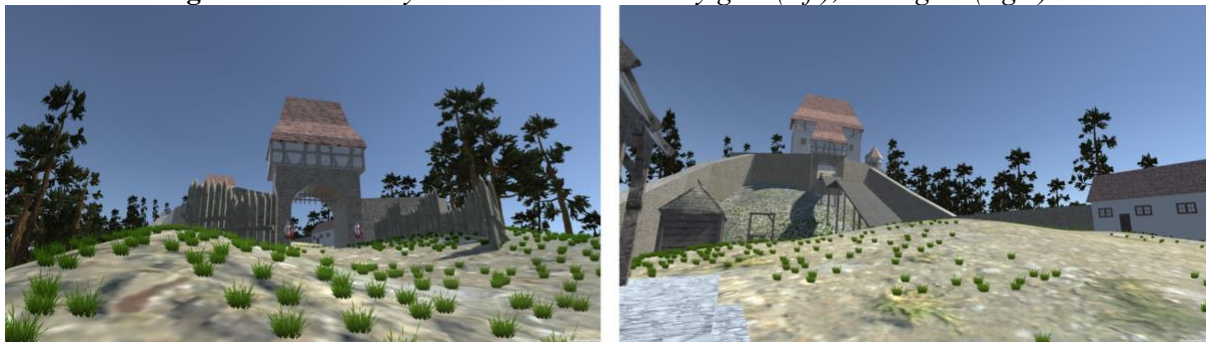
Source: Petr Vodička semestral 3D modeling project (Masaryk University, 2020)

Figure 10: *Lichnice*, by Damián Hruban. Outskirts of the castle (left), courtyard (right).



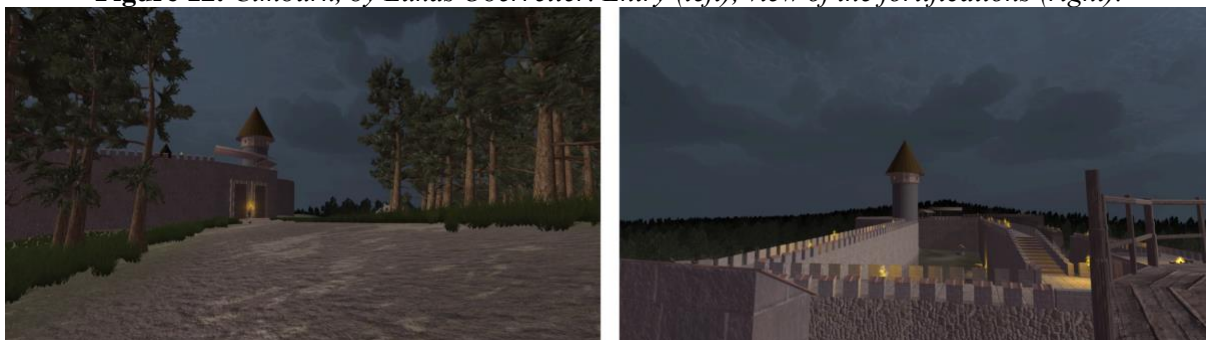
Source: Damián Hruban semestral 3D modeling project (Masaryk University, 2020)

Figure 11: *Zlenice by Rostislav Hořava. Entry gate (left), inner gate (right).*



Source: Rostislav Hořava semestral 3D modeling project (Masaryk University, 2020)

Figure 12: *Cimburk, by Lukáš Oberreiter. Entry (left), view of the fortifications (right).*



Source: Lukáš Oberreiter semestral 3D modeling project (Masaryk University, 2020)

3. Discussion and Conclusions

Throughout the article, we argued for the utility of creating 3D visualizations intended to depict historical buildings (be it as a supplementary to physical tourism, or as an alternative to it). Methods for acquiring depictions of the buildings were mentioned - were it methods applicable to fully preserved or completely derelict historical sites. We then considered the 3D methods intended to bring the buildings onto a virtual three-dimensional canvas.

A simplified 3D modeling pipeline for 3D historical visualization was presented in the body of the article. Its viability, in a pedagogical sense, was also verified by our students from a 3D modeling class, who were tasked to create 3D visualizations of selected castles in a timeframe of one semester.

Although the outcomes of this article are limited, it is so due to the complexity of the subject. Thus, the discussion will consider what are the additional steps should the craft of 3D visualization/modeling be pursued further in the context of geographical sciences and the tourism industry.

3.1 Pedagogical perspective

Were the finalized student visualizations presented in the results chapter success or failure? That depends entirely on the perspective of things.

A professional 3D environment artist would say that the visualizations do not meet today's criteria for the level of detail introduced into the scenes and that the modeling has some apparent errors to it. In other words, in today's market, with consumers and enthusiasts being used to a certain level of quality of 3D graphics, the aforementioned visualizations would likely not impress everyone, was it a commercial market.

The creators of the presented visualizations were, however, no professional environment artists with years of experience; these were university students with no previous background in 3D modeling. Therefore, the perspective here is entirely different: to take someone with no understanding of the subject, and to guide them through it, to make them understand the basics and concepts behind it. While the craft behind 3D modeling does indeed take years to master (e.g., in being able to produce a professional level of quality in organic modeling and anatomy), the castle scene seems to be something even a beginner can handle, with reasonable results. To ensure positive results, however, our students were given feedback along the whole visualization pipeline; and it needs to be stressed that this kind of teaching is suitable for small groups of students, as there is a lot of feedback to give out (our class totaled 8 students).

The students did spend some 20 to 50 hours each on the most consuming phase of the project - i.e., the modeling phase. While a professional may be somewhat faster, such a time budget seems reasonable for a work of depicted quality. The students were also taught not to waste their time by following the recommended 3D visualization pipeline and its software workflows. If they were to decide to follow up on their 3D education, the subject of our 3D modeling class would serve as a good foundation.

It also needs to be noted that teaching future generations of geographers 3D modeling has its relevance. While 2D mapping has had its tradition and utility (Carbonell-Carrera, Jaeger, Shipley, 2018), an increasing number of geographic applications can and do use 3D implementation and visualizations. It is thus more valuable for the scientific field to have skilled experts who can implement or edit 3D applications, as opposed to mere passive observers.

3.2 Technological perspective

Through the 3D visualization pipeline, there are many advanced techniques, software, and plugins to aid or alter the production workflow. Beyond the covered basics, this article only refers to some of the well-known ones, as of 2020. Even though advanced solutions may be out of the scope of this article or an introductory course in 3D modeling, some of the otherwise advanced stuff may find more utility and adoption in the future. For example, there is now procedural art, even in 3D (Matejka et al., 2018), or artificial intelligence-aided texturing and stylization available (Unity Technologies, 2021); it was not so just 10 years ago. Similarly, virtual reality solutions only had appeared on the scene of 3D graphics in the first half of the previous decade, as prototypes; in the second half of the previous decade, production models of virtual reality hardware were made available, with ever increasing availability, user controllability, and overall comfort. Such technologies are here to stay - if not to evolve.

We do not have a universal answer on the implementation of a great 3D application, regardless of the context. Such an answer will always be difficult to grasp, as it depends on many factors out of our current scope: the technology used, the intended level of interactivity of the application, the expected user profile, etc. This is fit for discussion and for future articles - that

is, finding the best solutions, graphics pipelines, and workflows in applied settings, or expanding the methodology.

Methodology-wise, user interactivity and user behavior are topics to be considered. While some interactivity depends on the physical hardware used (e.g., an LCD mouse and a keyboard versus a virtual reality headset with controllers), virtual counterparts of physical interactions can be programmed into the 3D application (Ugwitz et al., 2021). In virtual sightseeing applications, implementing some interactivity may aid in having the user behave as intended (e.g., to make them follow along a designed tour path). As for user behavior in general, it can be logged and analyzed; user behavior also depends on the composition of the virtual environment. Evaluating (and adjusting) the spatial composition of environments with known preferences of human users (Wilson, 1999) can improve user enjoyability regardless of the context - be it virtual sightseeing, or something else.

3.3 Interdisciplinary perspective

This article takes on the task of presenting and considering 3D modeling, in the context of historical visualizations, to be utilized by the tourism industry. And yet, the authors are no star contributors to everything considering 3D modeling, historical reconstruction, or tourism. In other words, there are more relevant scholars or experts out there. Where exactly are they?

Some 3D modelers, environment artists, and concept artists are self-taught, and some others originate from artistic or technical schools/universities; professionally, they tend to gravitate towards game development studios, film, product design, or architecture. Historical reconstruction using modern technology, e.g., photogrammetry in archaeology, is a niche field. Other historians tend to gravitate towards game studios (Bostal, 2019), or to projects of their own (Univerzita Hradec Králové, 2021). Some geographers explore research niches by depicting historical geospatial data in 3D (Tobiáš, Cajthaml, Krejčí, 2017).

If better visualizations are to be produced, more connections between the people involved in the aforementioned fields/professions need to be established. Modeling a few castles with students is one thing, but there is also untapped potential in professional, applied solutions.

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Thanks to your input and consideration, we were able to refine the taught subject, which in turn allowed us to publish it in this form.

SATISFACTION OF INHABITANTS IN DIFFERENT URBAN STRUCTURES. CASE STUDIES IN BRNO, OSTRAVA AND ZLÍN

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Keywords:

Satisfaction of inhabitants, urban structure, demographic parameters, cities, Czech Republic

Abstract:

Cities are built of diverse types of urban structures. The paper is devoted primarily to those structure types in which people live. In Czech conditions, we can find structures of historical cores, blocks of flats from the 19th century, neighbourhoods of family houses, socialist prefabricated housing estates from the 20th century, as well as family houses on the city perimeter or even beyond the city limits. Satisfaction of inhabitants in characteristic localities of these types of urban structures was surveyed through questionnaires. The research includes residential localities in three cities in the Czech Republic: Brno, Ostrava and Zlín. The study looks at the relationship between residential satisfaction and urban structure type, analysing a possible relation between demographic parameters of locals and the satisfaction of inhabitants in the respective urban structures. It appears that happier people live rather in low-rise buildings situated in green areas with the safe environment and good transport availability. Such localities are often inhabited by educated people.

Introduction

Many types of urban structures in cities serve for housing. In Czech conditions, these include, namely, the natural structures of historical cores, blocks of flats from the 19th century, neighbourhoods of terraced houses, semi-detached houses and solitary family houses, modernist prefabricated housing estates from the period of socialism of the late 20th century as well as new residential areas of family houses from the end of the 20th and beginning of the 21st centuries situated beyond the city limits, often linked to original villages. The structures reflect two fundamentally different ideological concepts - the concept of a compact city and the concept of loose, modernist built-up area or garden cities. Pros and cons of these two principles are discussed in a number of studies (Neuman, 2005; Hirt, 2007; Wittmann & Kopáček, 2019).

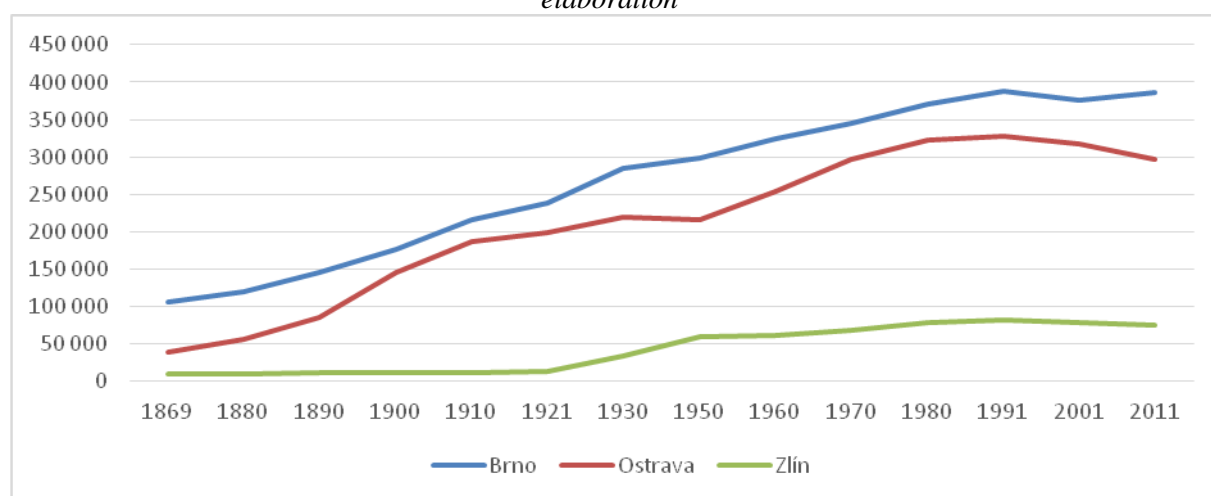
The paper dwells on an extensive research devoted to the relation of urban structures in three cities in the Czech Republic – Brno, Ostrava, and Zlín – to all three usually mentioned pillars of sustainability – environment, society and economy. In this paper, we focused on the societal pillar to determine whether a particular type of urban structure can influence the satisfaction of local inhabitants. Since public statistical data concerning the satisfaction of inhabitants in different types of urban structures are not available, we gained them from some characteristic localities of the above-mentioned three cities based on a questionnaire survey. Our questions were focused, for example, on the feeling of safety, feeling of privacy, availability of civic

amenities, neighbourly relationships, and perception of aesthetic qualities. We also analysed demographic data from censuses in 2001 and 2011, development of population numbers from 2001 to 2011, share of seniors and children, education and unemployment in 2011 (Czech Statistical Office, 2019). The demographic data served as supporting information for results obtained from the questionnaire survey. Some studies indicate that residential satisfaction increases with higher education that can generate higher income and with higher age. Higher education and higher income could affect the capacity for choosing a place and type of housing; higher age has to do with a long-term affiliation with the place of residence (Buys & Miller, 2012; Campbell et al., 1976; Lu, 1999). Do the wealthier social groups prefer dispersed, low-rise urban structures where inhabitants feel more satisfied as suggested by some studies (e.g., Buys & Miller, 2012; Galster & Hesser, 1981; Lu, 1999)? Answers to this question and to some other related issues are sought in this paper in the analysis of the relationships between urban structure, the detectable demographic parameters of local residents (Czech Statistical Office, 2019), and their satisfaction.

The case studies concerned deliberately three of the four biggest cities in Moravian region— all of them are regional metropolises with regional authorities, important public institutions, and universities, experiencing the postindustrial stage of their development. Nevertheless, the historical development, overall character, and inner urban arrangement of these three cities significantly differ:

1. Brno – a typical concentric city with the compact historical core, circular roads and radial communications,
2. Ostrava – a typical conurbation with no distinct city centre and evenly spread population, a rather an urbanized landscape considerably affected by former mining activities and heavy industries, with important local centres of peculiar history and atmosphere, and with the diffuse street pattern,
3. Zlín – a modern city whose great part is formed of a loose functionalistic structure with large green areas, extensive precincts of the former shoe factory right in the city centre, and a characteristic linear layout in the valley along the main road, railway and river.

Graph 1: Long-term population development in the surveyed cities based on official censuses. Own elaboration



Source: Czech Statistical Office, 2015 (processed by authors)

1. Theoretical background

Overall, residential satisfaction is largely dependent on various management aspects of housing development. To improve residential satisfaction, policymakers, developers, architects, managements, and staff need to understand the driving forces of residential satisfaction and focus on those aspects that are most likely to affect the environment (Mridha, 2015).

Regarding (social) neighbourhood factors, residential satisfaction seems to be higher in rural and more prosperous areas, and in areas with fewer ethnic minorities. Some studies indicate that people seem to value high, particularly social contact, traffic safety, and social safety, an attractive neighbourhood with facilities within the good environment quality for their residential satisfaction (see, for instance Buys & Miller 2012; Galster & Hesser 1981; Lovejoy et al. 2010; Lu 1999). Living in a neighbourhood characterized by economic disadvantage is negatively associated with neighbourhood satisfaction (Chen et al., 2013; Ibem et al. 2019).

Residents tend to be more satisfied with their own suburbs than with other suburbs. New suburban housing areas commonly attract similar people, firstly because moving to any new family dwelling requires a certain level of income, and secondly because suburban settlements are perceived as more idyllic, cleaner, and safer (Atkinson, 2006; Kährik et al., 2012).

Are there any specifics of residential satisfaction in postsocialist cities? Although in Eastern Europe, the revolutions occurred 30 years ago, urban structures show a long-term inertia. The construction of prefabricated housing estates was the only preferred way of creating new residential parts in socialist cities. The prefabricated constructions were built also in Western Europe where they represent a social dwelling. In socialist countries, such a way of residential construction should have contributed to the social levelling of the society and was meant for all social groups of population. Thus, if we are looking for a specific difference of postsocialist countries, we should explore on the satisfaction with housing estates.

Changes of ownership played an important role in the transition period as Górczyńska (2017) shows with the example of Warsaw. Both main drivers of the transitional period (restitution and low-cost privatisation) were out-market tools which together with the regulated rent postponed the onset of real market conditions. Lower residential mobility and disinvestment in the 1990s was the consequence. Therefore, the realization of residential preferences and satisfaction was postponed to the beginning of the 21st century. Due to problems with the provision of housing in big cities (especially Brno in our case), other aspects than the type of urban structure - such as marital status, ownership / rental of the flat, its size, privacy, neighbourhood attachment decide about the residential satisfaction of young people who are more or less decisive for the future prediction (Milić & Zhou, 2018). Heider (2019) discovered that the postsocialist development of ex-GDR cities is negatively correlated with historical growth rates realized during the times of socialism. It is most likely to be true for heavy industry centres (Ostrava in our case).

In the Czech conditions, the question of general evaluation of residential satisfaction and/or preferences is not too frequent. Authors concentrate their attention on the residential quality of special cases like suburbs (Špačková et al., 2017) or inner cities (Kährik et al., 2015) – especially in Prague. Inner structures of cities were studied in multiple cases, but they were focused on various partial problems, e.g., economy (Wittmann & Kopáček 2019), environment

(Hanák et al., 2015, Vaishar & Zapletalová, 2003), quality of life (Andráško et al., 2013), demography – namely ageing (Galčanová & Sýkorová, 2015) etc.

Urbanists assume that the physical framework (material environment) can more or less influence the social situation and residential satisfaction. Clearly, delimited and hierarchically arranged urban spaces create conditions for desirable social interactions, a feeling of safety and solidarity (Gehl, 2011).

2. Methodology - selection of locations and methods of data obtaining

To compare the satisfaction of inhabitants, we chose nine localities in Brno, seven localities in Ostrava, and six localities in Zlín. The localities are characterized below with illustration images.

2.1 Brno

- BR1: historical core – compact block structure of historical core and city centre;
- BR2: Veverí – typical central block structure formed mainly by apartment houses from the 19th century, which is situated right to the north of the historical core;
- BR3: Královo Pole – suburban low-rise blocks of flats, predominantly from the late 19th and the 1st half of the 20th centuries, are situated on the northern outskirts of inner Brno;
- BR4: Masaryk Quarter – loose residential development from the end of the 19th until the turn of the 1970s and 1980s inside Brno;
- BR5: Bystřec II – loose prefab housing estate from the 1970s on the NW outskirts of Brno;
- BR6: Vinohrady – loose prefab housing estate from the 1980s on the eastern outskirts of Brno;
- BR7: Česká – new satellite of family houses in the village closely linking with Brno to the north;
- BR8: Moravany – new satellite of family houses in the village closely linking with Brno to the south;
- BR9: Syrovice – new satellite of family houses in the village closely linking with Brno to the south.

Figure: 1: Map with marked localities in Brno



Source: OpenStreetMap, 2020 (processed by authors)

2.2 Ostrava

- OS1: centre – typical central block structure linked to the historical centre of Moravská Ostrava;
- OS2: Jindřiška – semi-closed blocks of mainly apartment houses from the first half of the 20th century situated on the outskirts of Moravská Ostrava centre;
- OS3: Bieblova – semi-closed block of prefabricated apartment houses from the early 1980s wedged in an older structure on the outskirts of Moravská Ostrava centre;
- OS4: Poruba dvouletky – linear blocks of flats from the turn of the 1940s and 1950s;
- OS5: Poruba sorela – blocks of flats from the beginning of the 1950s on the western outskirts of Ostrava – conservation area;
- OS6: Poruba North – loose prefabricated development from the 1970s on the western outskirts of Ostrava;
- OS7: Nová Bělá – largely new satellite of family houses on the southern outskirts of Ostrava.

Figure 2: *Maps with marked localities in Ostrava*

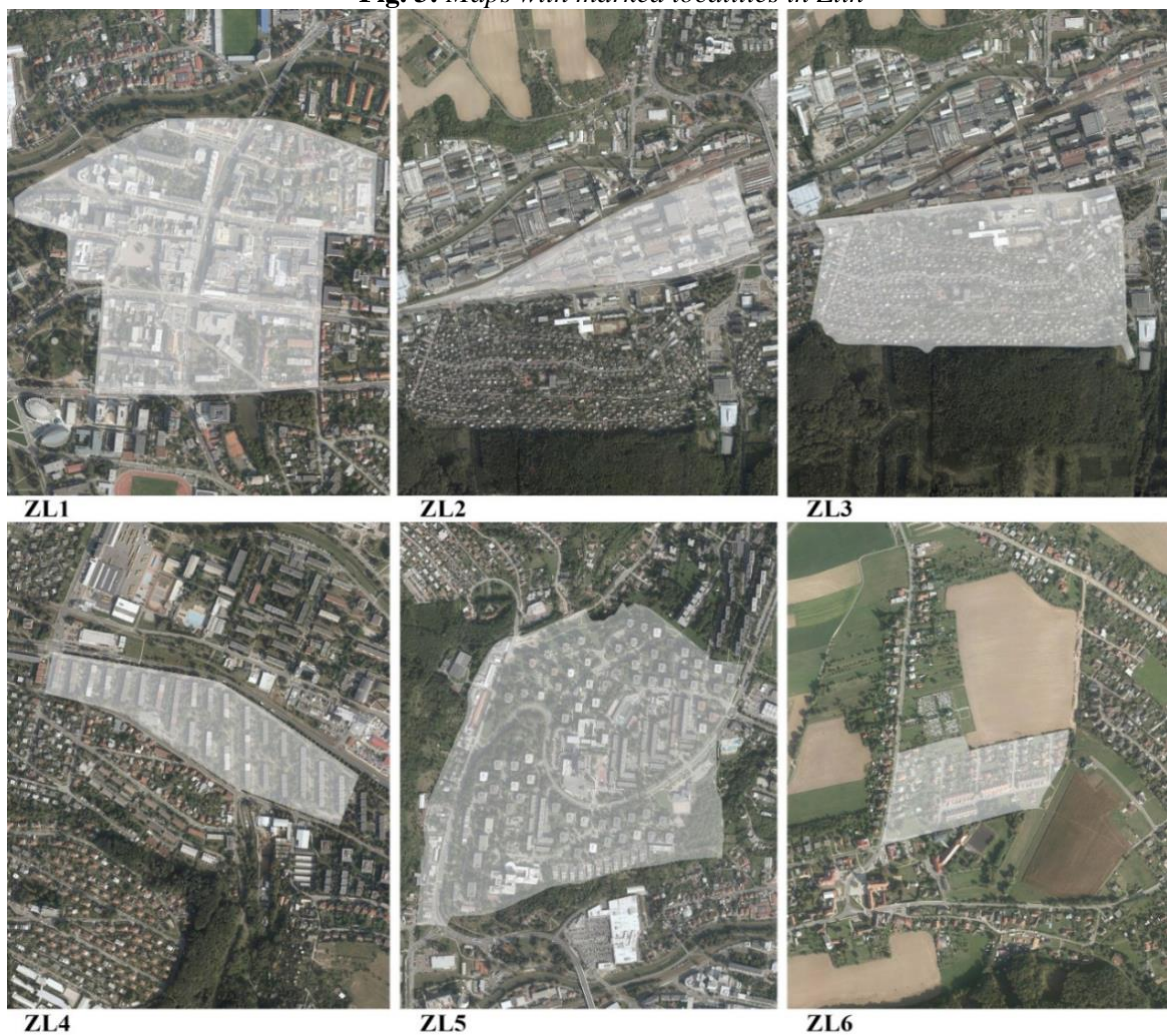


Source: OpenStreetMap, 2020 (processed by authors)

2.3 Zlín

- ZL1: Zlín centre – predominantly compact block structure in the historical core;
- ZL2: Svit rybníky (Ponds) – part of the site of a former manufacturing plant is included in the new city centre and currently under reconversion; since there are hardly any dwellers, the locality is not further mentioned in this paper devoted to the societal issues;
- ZL3: Letná – loose development of two-storey apartment buildings, a functionalistic residential quarter from the period of the 1st Czechoslovak Republic;
- ZL4: Obeciny – linear apartment houses from the end of the 1940s (two-year plan period);
- ZL5: Jižní svahy I (Southern Slopes I) – loose development of prefabricated blocks of flats from the 1960s and 1970s;
- ZL6: Kostelec – predominantly new satellite family houses on the NE outskirts of Zlín.

Fig. 3: Maps with marked localities in Zlín



Source: OpenStreetMap, 2020 (processed by authors)

The above localities were analysed on the basis of data gained from the questionnaires and from the statistical survey.

2.4 Statistical data

The demographic analysis includes statistical data from the 2011 census conducted by the Czech Statistical Office and compares data from the censuses made in 2001 and 2011. As censuses are conducted in 10-year periods, the next one will occur in 2021. Parameters screened include the population development in the chosen localities between 2001 and 2011, the share of residents over 65 and under 15 years of age (so-called index of ageing with a maximally balanced ratio is desirable), the share of residents with higher than basic education (so-called ISCED 3 level and higher; the 2011 average in the Czech Republic was 88 %), the share of residents with academic education (national average 20 %) and the share of unemployed residents in 2011. The obtained data are presented in Tab. 1.

2.5 Questionnaire survey

The analysed localities were subjected to the questionnaire survey. Questions in the questionnaire were answered by residents living in the localities and the answers served to construct a so-called index of residential satisfaction, which is a sum of points acquired for the answers, expressing residential satisfaction – higher scores indicating greater satisfaction. The index of satisfaction reflects answers to questions concerning, for example, the feeling of safety during the day and by night time, aesthetic quality of the environment, neighbourly relationships, feeling of home, or availability of civic amenities. Respondents evaluated each of the answers through points 0 – 10, where 0 points and 10 points represented the worst and the best evaluation of the given phenomenon, respectively. A list of questioned issues is included in Tab. 2. Indices of residential satisfaction are presented in Tab. 2 and Graph 2. Maximum achievable points were 160 (16 questions x 10 points).

In some questions, the points follow out from concrete predefined answers:

Scores for the question “Moving – change of neighbours” dwell on the following possible answers: “Medium change – some residents were changed, some remain” - 10 points; “Small change – nearly the same people stay here” – 7.5 points; “A greater part of neighbours were changed during the last years” – 2.5 points; “The change is great, hardly anybody of old residents remained” - 0 points; “I do not know, I have moved in only recently” – 5.0 points.

In the case of “Long-time residence”, the number of points will correspond to the number of years a person lives in the locality; if less than a year – 0 points; if ten and more than ten years – 10 points.

Scores for the question “Participation in maintaining spaces around the place of residence” dwell with the following possible answers: “Yes, I initiate and promote the enhancement of space within my engagement in the activities of self-government, association of owners or in another organization” - 10 points; “Yes, I respond actively to challenges and participate in the enhancement” – 7.5 points; “Yes, I support the planned enhancements but I am not getting involved” - 5 points; “Rather, I just follow things” – 2.5 points; “No, I am not interested” - 0 points.

We distributed altogether ca. 6 600 questionnaires of which approximately 10 – 25 % were filled in 2-3 weeks (a common case study included ca. 350 questionnaires given out).

3. Empiric results

The below Tab. 1, Tab. 2 and Graph 2 present the results obtained. Important results are characterized in the text.

Table 1: *Demographic data from the census in 2011 and 2001. Source: Czech Statistical Office, 2019*

ZL6	26	49/51	88.9	30.2	3	1971
ZL5	-15.5	62/38	85.8	22.3	4.4	7118
ZL4	-19.3	67/33	92.2	33.6	3.4	1211
ZL3	-11.9	51/49	82.2	16.5	4.8	3148
ZL1	-10.6	74/26	86.1	23.8	4.8	2738
OS7	63.1	37/63	89.1	30.1	4.4	566
OS6	-10.8	70/30	84.7	26.1	4.7	9315
OS5	-16.7	64/36	83.3	22.1	5.3	8794
OS4	-7.9	37/63	72.1	6.2	11.6	2127
OS3	-20.8	52/48	88.5	30.6	6.4	877
OS2	-11.8	65/35	89.5	35.8	4.9	3930
OS1	-14.3	48/52	88.8	41.4	4.7	1965
BR9	41	38/62	86.1	11.4	3.5	1370
BR8	79	31/69	89.5	17.8	2.9	2159
BR7	39	48/52	90.1	23.2	2.5	911
BR6	-13.4	49/51	89.2	29.0	5.2	12 836
BR5	-10.8	45/55	86.2	36.0	4.8	2001
BR4	-1.8	67/33	93.8	25.5	2.9	5402
BR3	-4.9	63/37	92.8	44.9	5.6	3383
BR2	-11.1	66/34	90.1	39.2	4.6	3393
BR1	-7.9	57/43	88.5	33.4	6.5	1544
Demographic data according to the census in 2001 and 2011 (%)						
Change in the number of residents (between 2001 and 2011)						
The ratio of residents over 65 and below 15 years (2011)						
Education - ISCED 3 and higher (2011)						
University education (2011)						
Unemployment (2011)						
Total number of residents (2011)						

Results in Tab. 1 indicate that the smallest population decline between 2001 and 2011 was recorded in Localities BR3 and BR4 (low-rise blocks of flats and residential development in Brno; decline 4.9 % and 1.8 %, respectively). By contrast, the greatest population decline (>15 %) was recorded in Localities OS3 (prefabricated houses in the wider centre of Ostrava), OS5 (Poruba sorela), ZL4 (Obeciny apartment houses in Zlín) and ZL5 (prefabricated housing estate). The greatest population decline in Brno (10.8 % – 13.4 %) occurred in housing estates BR5 and BR6 and in Locality BR2 situated in the wider centre of Brno. All monitored satellites of family houses (BR7, BR8, BR9, OS7, and ZL6) exhibited a considerable population increase in tens of percent.

The number of seniors is distinctly higher than the number of children in older housing areas in Brno (BR1–BR4, block urban structure as well as loose functionalistic residential development), while the ratio in Brno satellites (BR7–BR9) is reversed. Prefabricated housing estates in Brno (BR5, BR6) show a rather even ratio. In Ostrava, most seniors as compared with children live in Localities OS2 (apartment houses from the 1st half of the 20th century), OS5 (Poruba sorela) and OS6 (Poruba prefabricated housing estate); most children live as expected in Satellite OS7, but also in the linear blocks of flats from the 1940s (OS4, Poruba dvouletky), where a different socio-cultural group lives. In Zlín, seniors predominate in the town centre (ZL1) and in Localities ZL4 and ZL5 (Obeciny apartment houses and prefabricated housing estate).

Population with the highest education (ISCED 3 and higher > 90 %) lives in Localities BR2, BR3, BR4, BR7, and ZL4 (central block structure, low-rise apartment houses, residential development and family houses). Localities BR2, BR3, and ZL4 also exhibit a very high share of residents with university education (>33 %). The share of university-educated residents is at the same level or even higher (>33 %) also in Localities BR1 (historical core of Brno) and rather surprisingly BR5 (prefabricated housing estate), as well as in Localities OS1 (central block structure in Ostrava) and OS2 (blocks of flats on the perimeter of the Ostrava centre). Education standard (ISCED3 and higher) of residents in the monitored satellite of family houses in Brno is on average slightly higher than in the prefabricated housing estates (BR7–9 x BR5, BR6: 88.6 % x 87.7 %). In Ostrava (OS7 x OS6) and in Zlín (ZL6 x ZL5) where the principle is the same, the differences in percent are greater, although (by ca. 3 % - 5 %). As compared with the housing estates in Brno, the share of university-educated residents in satellites is almost half (ø 17.4 % x 32.5 %; however, the result may be partly distorted by including older built-up areas in the villages into the data of satellites). In Ostrava and Zlín, the results are reversed and less distinctive. The least educated and on a national scale a very below-average educated population lives in Locality OS4 (Poruba dvouletky) in Ostrava, both in terms of a share of residents with ISCED3 and higher education (72.1 %), and as to the share of university educated residents (6.2 %).

Unemployment is relatively low in all monitored localities except for OS4 (Poruba dvouletky) where it is higher than 11 %. The other highest unemployment values (>6 %) are recorded in Localities BR1 (historical core of Brno) and OS3 (prefabricated houses on the perimeter of the centre of Moravská Ostrava).

Table 2: Questionnaire survey data and satisfaction index. Source: authors

	BR1	BR2	BR3	BR4	BR5	BR6	BR7	BR8	BR9	OS1	OS2	OS3	OS4	OS5	OS6	OS7	ZL1	ZL3	ZL4	ZL5	ZL6
Subjective health condition	8.1	7.3	7.3	7.3	7.2	7.1	8.7	8.0	9.0	7.2	7.5	7.5	5.9	7.2	5.6	8.4	5.0	8.3	7.4	6.3	8.3
Feeling of danger by day	4.5	4.5	4.9	4.9	4.6	4.6	4.9	5.0	5.0	4.5	3.3	4.4	3.6	4.5	4.5	5.0	4.3	4.5	4.2	4.1	4.8
Feeling of danger by night	3.1	3.7	4.5	4.3	4.2	3.8	4.4	4.6	4.6	3.2	2.7	3.0	3.0	3.7	3.2	4.6	3.3	3.8	3.5	3.2	4.1
Untrustworthy strange persons	2.6	3.2	4.3	4.4	3.8	3.3	5.0	4.8	4.8	3.6	2.6	2.9	2.9	3.1	3.5	4.9	3.2	4.1	3.9	2.8	4.7
Good address	8.1	7.9	8.8	8.4	7.6	6.6	8.8	7.6	7.5	8.2	6.9	7.9	6.6	6.4	7.4	8.4	6.8	6.8	8.1	6.4	8.4
Availability of civic amenities	7.0	6.1	6.5	4.6	6.4	6.3	5.7	5.0	5.4	6.3	7.0	6.8	5.7	6.8	5.4	3.8	7.3	6.0	6.2	6.4	5.9
Diversity of using house surroundings	5.4	5.2	7.6	5.1	6.0	6.4	7.3	7.5	7.5	5.7	7.8	4.7	3.6	4.5	4.5	9.0	6.0	8.6	7.6	6.9	8.1
Adaptation to the immobile	5.0	4.3	7.9	5.4	6.5	6.8	8.7	8.2	6.6	5.2	7.0	7.2	4.3	6.3	5.7	7.2	5.3	4.3	6.1	5.9	7.3
Feel of home	6.8	7.5	8.3	8.8	7.4	6.9	8.3	7.4	7.5	7.3	6.7	7.4	6.1	6.1	6.8	8.8	7.5	6.8	8.3	5.4	8.2
Pleasant view	5.1	5.1	6.1	9.0	6.0	5.7	7.1	6.3	6.6	4.3	5.8	7.2	4.3	5.2	5.9	7.5	7.0	7.0	6.9	7.6	6.8
Feel of privacy restrictions	3.0	3.2	3.6	4.0	3.6	3.0	4.1	3.6	4.1	3.3	4.1	3.8	3.2	3.2	3.5	4.3	3.7	3.7	3.4	4.0	3.5
Perception of aesthetic qualities	7.3	6.8	8.3	8.9	7.5	7.2	7.7	7.3	5.9	6.6	6.8	7.0	6.4	7.3	7.0	7.8	7.2	7.6	8.3	6.4	8.2
Moving – change of neighbours	3.9	4.2	7.4	8.1	7.0	6.5	7.7	7.4	6.1	5.5	7.3	6.2	5.7	4.5	5.0	7.5	5.1	8.0	8.4	6.9	7.7
Long-term residence	8.5	7.9	8.7	9.4	9.8	9.6	7.8	8.2	6.4	7.5	6.0	7.8	9.4	9.0	9.5	6.6	7.1	8.8	7.9	8.7	9.3
Neighbourly relationships	7.4	7.0	7.9	7.8	7.1	6.5	7.7	7.9	7.5	7.5	6.7	7.9	6.1	6.8	6.9	8.1	6.8	7.5	8.1	5.8	8.1
Participation in maintaining premises around the residence	4.0	4.0	4.9	4.9	4.2	3.5	3.8	4.0	3.4	5.9	4.6	4.7	5.7	3.5	5.2	5.0	5.8	5.2	7.0	3.0	4.1
Satisfaction index	89.9	87.7	106.9	105.2	98.7	93.8	107.5	102.8	97.7	91.7	92.7	96.4	82.5	87.8	89.7	106.8	91.2	101.1	105.2	89.7	107.4

Subjective feeling of health condition is largely at a good level except for Localities OS4 (Poruba-dvouletky), OS6 (Poruba prefabricated housing estate), and ZL1 (Zlín centre), where the residents gave 5.0 – 5.9 of the 10 points possible.

None of the localities was perceived as distinctly dangerous by the respondents who designated Locality OS2 (blocks of apartment houses on the perimeter of the centre) as the most dangerous by night (3.3 points).

Untrustworthy strangers, homeless persons, and beggars occur particularly in the historical core of Brno (BR1) as well as in Localities OS2, OS3 (wider centre of Ostrava) and OS4 (Poruba dvouletky), where the indicator is below 3.0.

All respondents considered their domicile as a “good address”; a negative evaluation was not given. Localities with the highest scores (≥ 8.0 points) were BR1 (historical core), BR2 (blocks of flats in the wider centre), BR3 (low-rise housing development Královo Pole), BR4 (Masaryk Quarter) and BR7 (satellite Česká) in Brno, and Localities OS1 (centre of Ostrava), OS7 (satellite Polanka nad Odrou) in Ostrava and ZL4 (Obeciny apartment houses) and ZL6 (Kostelec) in Zlín. In the same localities, the respondents most often expressed to perceive a strong feel of home and very good neighbourly relationships.

In all localities, the availability of civic amenities is at a comparable moderate or above average level (5.0 – 7.3 points).

Respondents from Localities BR3 (low-rise development Královo Pole), OS2 (blocks of flats near the centre of Ostrava) as well as those living in the satellites (BR7-9, OS7, ZL6) report very diverse activities in the surroundings of their houses (between 7.5 and 7.8 points). At the same time, the residents consider these localities sufficiently accommodated to immobile. In Zlín, the diversity of using the house surroundings for various activities has high scores in Locality ZL3 (“Letná”) - 8.6 points.

The strongest feel of home (>8.2 points) is reported from Localities BR3 (Královo Pole), BR4 (Masaryk Quarter), BR7 (Česká), ZL4 (Obeciny apartment houses) and ZL6 (Kostelec).

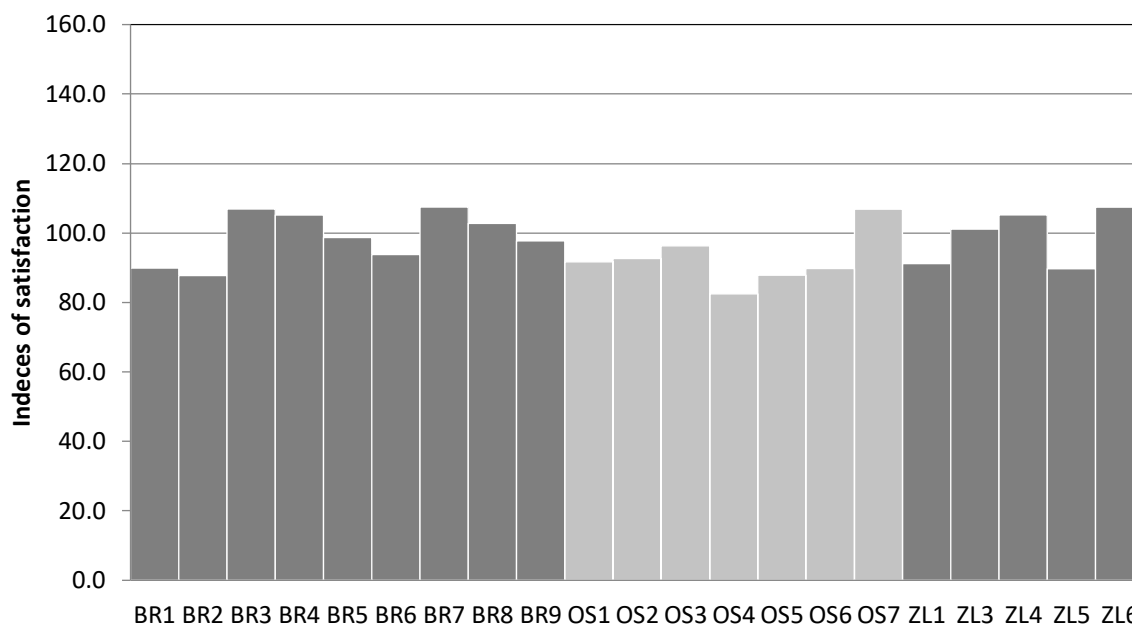
Pleasant view has the far best score in the Masaryk Quarter in Brno BR4 (nearly 9 points), whereas all other localities reach max. 7.5 points (OS7, ZL5).

Considerably restricted privacy is felt largely by respondents living in localities with a higher built-up index (<3.3 points: BR1, BR2, BR6, OS1, OS4, OS5).

Localities with the environment of high aesthetic quality are BR3, BR4, ZL4, and ZL6 (>8.1 points). These localities as well as ZL3 exhibit some other common phenomena: neighbours are changing only rarely, people live there for a longer time – on average more than 8.8 years (\emptyset value of the indicator of “long-term residence” is 8.8 points in these localities) and neighbourly relationships are of above standard nature. Notable is the fact that compared with all the other localities, the housing estates of Bystrc and Vinohrady in Brno (BR5 and BR6) reach the highest points in terms of “long-term residence” (9.8 and 9.6 points, respectively).

Willingness to participate in the maintenance of areas around their houses is the highest in respondents from localities of diverse urban character in Ostrava and Zlín: OS1, OS4, OS6, OS7, ZL1, ZL3 and ZL4 with ≥ 5 points (ZL4 even 7.0 points).

Graph 2: *Indexes of satisfaction in surveyed localities*



Source: authors

Indexes of satisfaction presented in Graph 2 and Tab. 2 reach the highest scores (101.1 – 107.5 points) in localities situated outside the city centre: BR3, BR4, BR7, BR8, OS7, ZL3, ZL4 and ZL6. In the central parts of the cities (BR1, BR2, OS1, and ZL1), the scores range from 87.7 – 91.7 points with even two housing estates in Brno – Bystrc and Vinohrady (BR5 and BR6) reaching higher scores (98.7 and 93.8 points resp.) than the centre of Brno. High scores were given to the already mentioned locality ZL4 (Obeciny - linear apartment houses). However, this locality recorded a distinct population decrease in the period from 2001-2011 (- 19.3 %) and statistical data from 2011 indicate a considerable predominance of seniors over children (67/33). These unfavourable trends can be confirmed or disproved only by the census to be held in 2021. An opposite phenomenon was observed in satellites BR8 and OS7 with high residential satisfaction, in which an extreme increase of population and a distinct predominance of children over seniors were recorded.

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4. Summary of the results

Results of the analysis of residential satisfaction suggest that less satisfied people live in the central parts of the surveyed cities. The highest *Indexes of satisfaction* (101.1 – 107.5 points) occur in the localities (BR3, BR4, BR7, BR8, OS7, ZL3, ZL4, ZL6) with some common characteristics:

- low-rise residential developments beyond the city centre perimeter,
- urban concepts of dispersed city/garden city or low-rise housing developments with gardens and other green areas,

- high scores in these localities were obtained thanks to the aesthetic qualities of the environment, safety, home feeling, and good neighbourly relationships.

Moreover, the overall results (Graph 2) suggest another interesting fact that the position of prefabricated housing estates in Brno (BR5 and BR6) is more favourable than that of housing estates in Ostrava and Zlín (OS6 and ZL5). The housing estates in Brno reach average scores of 96.2 points, a city centre 88.8 points, a satellites 102.6 points (with larger differences between BR7, BR8, and BR9). Residential satisfaction in the surveyed Brno housing estates is higher than in the centre, and at the the same time at approximately same level as in the most remote Brno satellite BR9 (97.7 points). By contrast, residential satisfaction in the housing estate in Ostrava is lower than both in the city centre and in the satellite (89.7 x 91.7 x 106.8). Moreover, in Zlín, the population living in the housing estate is less satisfied than that living in the city centre and in the satellite (89.7 x 91.2 x 107.4). The specific position of housing estates in Brno shows a specific partial factor, too. The level of long-time residence expressed by respondents in the questionnaires in 2018 is still very high, in fact the highest if compared with all other localities.

The surveyed demographic parameters of local populations show that the localities with higher residential satisfaction are inhabited by the above average number of persons with higher than basic education (Tab. 1, index ISCED 3 and higher), with the potential of higher income and lower unemployment. This particularly applies to Localities BR3 and BR4 in Brno (low-rise housing or residential development) with the highest education standard of all localities compared (92.8 %; 93.8 %). An exception from the rule is the Zlín locality from the period of the 1st Czechoslovak Republic (ZL3), where the representation of persons with higher than basic education (ISCED3 and higher) is below the national average (82.2 %) as well as the share of university educated residents (16.5 %). A similarly a low share of residents with academic education lives in the Brno satellite BR8 (17.8 %; BR9 even only 11.4 %); however, these data may be distorted due to the inclusion of older built-up areas in the village into the statistics.

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The overall results further show that the least population loss between the years 2001 and 2011 (4.9 % and 1.8 %) occurred in Localities BR3, BR4 with high residential satisfaction (low-rise housing estates and residential development in Brno). On the other hand, the highest loss of population (>15 %) was as a rule reported from the localities with lower residential satisfaction (OS3, OS5, and ZL5). An exception from this rule is Locality ZL4 (population loss 19.3 %), in which the residents expressed high satisfaction (over 100 points).

Our survey revealed some other interesting facts, too. The Brno localities with the highest residential satisfaction, small population loss, and higher education standards (BR3 and BR4) are inhabited mainly by seniors who distinctly predominate over children. However, the situation in the Brno satellites with high residential satisfaction and moderate or lower (university) education (BR7-9) is the opposite. The share of seniors and children in the Brno housing estates BR5 and BR6 with relatively favourable scores for both residential satisfaction and education is very well balanced. By contrast, the housing estates in both Ostrava and Zlín (OS6 and ZL5) have a greater share of seniors than children.

5. Conclusions and discussion

The results confirmed that there is a relation between the satisfaction of residents and a type of the urban structure as presupposed (section 4. Summary of the results). The satisfaction relates to objective (material) factors which can be statistically defined but also to the subjective feelings of residents. This subjective part of satisfaction could be connected with the residential preferences of individual population slides and groups on the one hand, and with the fashion (general societal feeling about what is “in”) created by media, social networks and similar factors on the other hand.

It was also partly confirmed that the population with higher education prefers most often low-rise and often dispersed residences in green areas where people feel better. People seem to especially value social contact, safety, and attractive neighbourhood within the good quality of the environment in their residential satisfaction (as described by Buys & Miller, 2012; Galster & Hesser, 1981; Lovejoy et al., 2010; Lu, 1999).

A methodological problem may be that due to the availability of statistical data, the education level (a part of the human capital) in our research partly substitutes other categories such as wealth or power position, which is not always the same. According to the investigation of Czech sociologists (Prokop et al., 2019), the two upper social classes differ. The secured middle class disposes of wealth but has typically weaker human capital. By contrast, the cosmopolitan middle class has a high level of capital except for property. In the first mentioned case, the dwelling serves to express prestige, wealth, and power, whereas the cosmopolitan middle class rather looks for the dwelling to be satisfactory for their life and activities including less dependence on their place of living, which can lead to the preference of apartments instead of houses.

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In the past, suburbanization trends were typical of European big and middle size cities. This trend leads to a population decrease in inner cities. However, will this trend continue also in the future? Moos and Revington (2016) show that the generation of millenials (Generation Y) starts to prefer urban dwellings. If the trend is confirmed, it could mean an opposite trend, i.e., population increase in cities where the quaternary sector is sufficiently developed.

A relatively high level of satisfaction has been gained in the housing estates in Brno. It may relate to the general situation of the city's housing market. With a significant shortage of flats, the residents of Brno appreciate housing estates too. This can be attributed to the location of most of the Brno housing estates nearby large forests and with very good public transport. In general, the expected depopulation of Czech prefabricated housing estates has not been confirmed.

Dissatisfaction with the residential milieu can theoretically lead to emigration to better perceived places. The problem is that dissatisfaction with the residential area is not always the main motivation for migration. Next study might be focused on the different motivations of residents for changing their place of living. There are multiple different motivations to be assumed for leaving an urban structure and moving to another one, e.g., economic reasons (especially in Brno, rent and real estate prices), sociological reasons (young people are leaving to break free from their parents' control), change of professional career (moving to Prague, abroad or to rural areas on the other hand) or dissatisfaction with the original residential area (due to environmental, social or reputation reasons). It is evident that apartments are less

migration-stable than detached houses. Additionally, in Ostrava, the structural change of the city's economy might push out people who lost their jobs. Regional peripherality can play a similar role in Zlín.

On the other hand, there are factors defending emigration even if the residents are less satisfied with their urban structures. We can mention economic reasons (missing financial sources), inertia (Czechs are not used to changing their permanent address several times in their lives), and some sentiments (feeling home, social relations etc.). That is why the predicative capacity of the migration indicator is limited.

The research was based on relatively old statistical data originating from the last population census (2011). It is not possible to gain more recent statistical data earlier than after the 2021 census. Therefore, it will be useful to carry out similar research after 2021. The data obtained will reveal longer-term development trends.

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LEADERSHIP CHALLENGES IN PUBLIC SECTOR IN IN A REGIONAL CONTEXT

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Keywords:

Leadership, public sector, management, human resource management

Abstract:

Based on the authors' scientific cooperation, research results and teaching experience, the goal of the article is to analyse different views on leadership in management in public sector in a regional context and to analyse human resource management in public administration in the Czech Republic and compare different approaches and practices in human resource management activities. People in public sector are the most valuable resource. The aim of the article is to present the main findings of the authors' questionnaire survey on leadership and human resource management in selected organizations in public sector in Czech Republic and define the current challenges in leadership. The survey was conducted during the years 2019 - 2020. The respondents were employees of selected organisations in public sector mainly on positions of public servants. The relevant data were obtained from 222 employees. The research questions are concentrated on present opinions on leadership methods in public sector and to the differences in HRM processes for civil servants and other employees in public administration. The results show that in surveyed organisation are many managers not managing and using leadership approaches.

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Introduction

The procedures of leadership and human resources procedures too can be used in a certain modification for public administration. Since 2000, a large number of various declarative and normative documents have been issued in the world, focused on the development of management systems in various areas of business. These documents are usually in the nature of strategic statements and programs; approved and issued by government bodies or institutions; internationally valid standards, most often issued by the International Organization for Standardization ISO, and prescriptive models, recommended especially by various non-profit organizations, whose primary mission is to contribute to the improvement of management systems. (Petrikova, 2010, s. 73)

At present, a key condition for the success of public administration organizations is becoming not only nationally but very often internationally comparable level of leadership and managing skills of employees - including the optimal level of their intercultural maturity, social responsibility, ethical and moral facilities, accompanying any significant climate change in the organization of public administration. In the context of management requirements, it is possible to describe the functions and roles of managers in public administration, who should be active elements, not just the fulfiller of political decisions. Management procedures in public administration contain a number of elements known from the corporate sphere and include

understanding citizens as clients who decide to purchase services, achieving effective results while saving resources, as well as competent and creative approaches with responsibility for results, in the field of services this includes a competitive environment between the public and private sectors, and includes basic methods based on the analogy of organizational management with an emphasis on economy and performance. Public administration systems are more structured and standardized. Managers must work within a strong legal framework and enforce the law rather than performing managerial functions and making managerial decisions.

Many innovations in public administration have been inspired by management and mainly leadership in the private sector. Among the different features of management and leadership in the public and private sectors can be mentioned that the public administration operates on the basis of politically determined needs and the market aspect is only in second place. Both sectors operate in a differently conceived legal environment (ie the public administration has a legitimate definition of what it can do, and the private sector, on the contrary, does what is not legally prohibited). There is also a difference between the two sectors in the decision-making environment (ie the decisions of public administration managers must usually be public). The measurement of performance in public administration cannot be subordinated to the criteria of maximum profit and decision-making in public administration is under the control of the media.

However, it must also be said that there is ever closer cooperation between public and private organizations. Public administration uses a number of management methods developed in the private sector. Both are targeted at the customer and education in public administration is based on experience in the private sector. Management in public administration is a process or form of activity that involves the leadership or management of people (groups and teams) directed to the goals of the organization. Managers in public administration must also develop strategic management. The activities of civil servants are controlled by administrative courts and are therefore independent of politicians.

1. Characteristics of leaders and leadership

Based on the knowledge from theories of leadership the most important features of a leader are the basic features of a leader, just like theorists Kouzes, Posner; Ulrich, Smallwood, Sweetman divided into five categories. The names and content of these categories reflect the findings of the two competency models presented in the theoretical part, namely the Code of Leaders of the author trio Ulrich, Smallwood, Sweetman (2015) and the Leadership Challenge duo by Kouzes and Posner (2014), Armstrong (2008), Pilařová (2016), Jarošová et al (2016).

Model of ruling personal competence

1. Personal championship in order for a leader to lead people effectively and creatively, he must govern effective self-management, have strong personal and moral values and a high level of emotional intelligence (ie, the ability to capture and understand the emotions of himself and others and deal with them effectively). Only in this way will he be able to manage not only himself but also others, prevent stress and be a true role model.

2. Proactive action. The leader constantly learns from successes, failures, tasks, books, courses and life itself, and thus fulfils an active approach to personal development. Thanks to this experience, he is proactive not only in negotiations, but also in thinking.

3. Overview. In addition to proactive thinking, the person of the leader is also associated with clear thinking, which helps him find insight in often confusing situations and problems. Thanks to the overview, the leader finds, defines and expresses common values.
4. Pattern The leader is expected to fulfil what he proclaims himself. The leader connects his actions with common values, emphasizes his own character and integrity. He leads people by example, lives common values and teaches others to create these values.
5. Ignition for the cause. From the actions of a leader, one can feel his zeal for a given thing and radiate personal energy from it. The leader takes his work as a responsibility, not as a privilege or a superiority.

Strategy with a clear vision

6. Visas. The person of the leader is above all connected with the establishment and unwavering proclamation of a convincing vision. This vision represents a future full of exciting and breath-taking possibilities. By communicating and announcing common goals, the leader gains others who follow him.
7. Creativity The leader can look at reality and opportunities in an unconventional way. He is a master of change, who sees further, sooner and more than others. His actions are often attributed to great creativity.
8. Active listening. The leader must master not only effective and masterful communication, but also the skill of active listening. Only in this way can it respond to the needs of the environment and discover the opportunities of the environment. The leader can listen carefully to his surroundings.
9. Coalition. The leader has mastered the art of gaining allies and creating and organizing coalitions of interest, thanks to which a common vision is set in motion.

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Executor and innovator

10. Changes The main task of a leader is the implementation and management of change. In order to truly lead to change, a leader must also be endowed with some managerial skills such as good organizational skills and have a structural approach to problem solving and decision making. In his work, the leader also sets objective goals and either implements them himself or delegates them to co-workers, decides on them and shares responsibility.
11. Innovation. The leader is constantly testing and looking for new and innovative solutions, experimenting and taking risks, generating small victories and gaining valuable experience. In this way, he searches for opportunities and ways of development. In his actions, the perseverance of promoting and implementing his innovative intentions is also evident.
12. Teamwork. The leader places great emphasis on teamwork. He shows great trust to his co-workers, but at the same time pays attention to their responsibility to fulfil the team mission. The leader formulates teams for a goal or process and takes care of management and decision-making, relationship building, and team member training. The leader realizes that in today's world of work, there is a need for a comprehensive view of problems and the generation of new ideas, which goes beyond the capacity of individuals. They can lead people to teamwork, including developing their participation in the successes and mistakes of working together; inspire people around you. Leaders tend to use a consulting and participatory style of leading people.
13. Customer orientation. The behaviour of leaders is very much connected with a strong focus on the customer and satisfying his needs and desires.

Talent manager

14. Talent development. Leaders know how to identify, develop and engage current talent and achieve immediate results, making people willing to develop their skills in the interests of the organization.

15. Trust. Leaders promote collaboration, create an environment of trust, and strengthen relationships to connect individuals with the organization and its vision.

16. Development of collaborators. Leaders strengthen others, support their free decision-making and develop their competencies and talents. They thus fulfil a dynamic approach to the development of co-workers and create a positive work environment where people feel motivated to work. Leaders tolerate mistakes and errors.

It works with the heart and creates human capital

17. Followers. Build a leader for the next generation because it aims at the long-term development of the organization and strategic success. It is not just about fulfilling short-term goals, which it fulfils rather as a talent manager. It forms a corporate and employee brand. The leader thus has successors, followers.

18. Share experience. The leader passes on experience and knowledge that colleagues would have difficulty learning.

19. Appreciates merit. The leader recognizes contributions and appreciates individual achievements and achievements. He can share these merits and make co-workers successful people, even heroes. The leader knows that he is ultimately responsible for the work, so he is not afraid of the strength of his subordinates and co-workers. An effective leader wants to have strong co-workers, which he encourages, helps them to establish and is proud of them. He looks at the successes of his co-workers as his successes, not as threats. He realizes that only in this way can human energy be released and a humane vision created.

20. Loyalty. The leader has the ability to gain the loyalty of co-workers, create a cohesive team and be able to motivate them in a way that inspires and creates an environment for their positive response to the set goals and full willingness to fulfil them. The leader supports the team spirit.

Managing and leading people in organizations, especially the role of managers, the functions of managers, the competencies of managers, the motivation of managers and the characteristics of the current generation of managers; managing and developing of organizations, especially the strategic approach to organization management, organization strategy, organization structure, human resources, organization development, job creation and modern approaches to employment of people.

Managers are responsible for implementing the organization's strategic goals by achieving the desired performance of other people in the organization. Managers contribute to the organization's success by ensuring that other people in the organization use their best abilities and motivation to achieve the organization's success. Managers are also expected to use their best abilities and motivation to achieve the organization's success (Armstrong and Stephens, 2008, p. 38). In management theory and practice, the work of managers is often expressed through so-called managerial functions that are commonly divided into sequence functions

(planning, organization, selection, management, control) and cross-sectional functions (analysis, decision making, implementation).

Simultaneously with these sequential managerial functions, it is necessary to analyse the problems that arise during planning, organization, selection, management or control, to decide on the most appropriate solution to the problem and to implement the chosen variant. Pilařová (2016, p.7) distinguishes within the job role "manager" the role of leader, manager and expert, where the role of leader is the creation of strategy and sales strategy, the role of the manager is the management of people, process management, and the role of an expert is to carry out expert agendas according to the organization's needs and in accordance with the professional focus of the job function. Similarly, according to Urban (2013, p. 11), managers have to master two dimensions of their function, a professional dimension, when deciding on a competitive strategy, organization of work, work processes or resource use, and the human dimension of leadership and leadership. Within the framework of individual human resources management activities, the managers perform the following tasks. (Šikýř, 2016, p. 35)

The ability of the manager also affects the level of responsibility that is related to the position being performed. Generally speaking, five dimensions of managerial work are mentioned.

The difference between a manager and a leading manager lies in the fact that the leadership must do things differently and must constantly invent changes and come up with new approaches.

2. Results and recommendations

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The article presents the original results of the survey of authors from the field of management and organization. The goal of the article is to analyse different views on leadership in management in public sector in a regional context to analyse human resource management in public administration in the Czech Republic and compare different approaches and practices in human resource management activities. People in public sector are the most valuable resource. The goal of the article is to present the main findings of the authors' questionnaire survey on leadership and human resource management in selected organizations in public sector in Czech Republic (mainly Prague region, Brno region, Plzeň region) and define the current challenges in leadership.

The survey was conducted during the years 2019 - 2020. The respondents were employees of selected organisations in public sector mainly on positions of public servants. The relevant data were obtained from 222 employees from mainly three regions from Czech Republic. The research is concentrated on present opinions on leadership methods and selected human resources procedures in public sector. The research was realised in year 2019 -2020, the same sample of 222 respondents from public administration, from this sample 97 respondent was in position of public servants and 125 in position of administrative employees in public administration. Age structure – from 25 to 60 years old. Size of public administration in villages, small and middle size town in Czech Republic. There was realised to 16 interviews with personal managers public administration. (In public administration in Czech Republic work around 500 thousand of employees, part of them - 70 thousand in position of public servants (done by law).

The data analysis was based on the calculation of relative and the evaluation of the dependence of responses on the size of the organisations of public sector using contingency tables and chi-

square tests of independence. In connection with applied human resource management policies and practices and in leadership, respondents strongly agreed, agreed, disagreed, or strongly disagreed that applied human resource management policies and practices help them to achieve defined results of human resource management, including necessary number and structure of employees. The difference between the individual regions did not manifest itself, probably because the approaches to managing people, leadership and human resource management in public administration are very similar.

Civil servant who was respondents in our pilot research concerning to employee's opinions on leadership activities of their line managers are agree, then their line managers in leading activities use mainly sharing experiences (82%), appreciate merit (80%) teamwork (75%), customer orientation (73%), active listening (73%), talent development (72%).

The average rating that allows for improvement and concentration on its use relates to the following competencies of the leader rating I agree was on a scale agree from 35 to 50%.

- Proactive action
- Pattern
- Creativity
- Trust
- Development of collaborators
- Followers
- Loyalty

Because the public administration is sector administrative, the leadership activities as personal championship, ignition for the cause, visas, changes, innovation are not used, the answer has low evaluation from 5 – 15%.

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Management in public administration has other possibilities of development with a focus on using the possibilities of greater involvement of line managers - heads of departments in the proactive management of co-workers.

The next part of research was concentrated to HRM processes for civil servants. The aims to answer the following question: What are the differences in HRM processes for civil servants and other employees in public administration?

The results show that there are differences between human resource procedure in public administration with civil servants, giving by the legislature, and other position of employees of public administration. (Human resources and labour relations in the local government provides for: *Act no. 262/2006 Coll., Labour Code, as amended, Act no. 312/2002 Coll., on Officials of municipalities and amending certain laws, as amended.*)

In HRM procedures are primary the impact of the law on civil servants in the Czech Republic in terms of human resource management. Regulates employment (Sec. 2.2) and education (Sec. 2.3) of local government officials. It applies to employees of territorial self, if they participate in the training of administrative activities and are included in the Office of the unitary authority as officials. It does not apply to employees of territorial self: a) included in its organizational units, b) included only in its special organs – i.e., police c) who carry out auxiliary, service or manual labour or who controls the performance of such work.

Human Resources (HR) can include a broad spectrum of specialities within organizations. human resources planning, job analysis, recruiting, selection methods, training and development, performance management, job evaluations methods, work motivation, salary systems and employee benefits.

When it comes to the question of which of the applied human resource management policies and practices respondents considered most important, they stated employee selection (90%), employee compensation (95%), employee planning, employee evaluation, and employee development (84%), and employee orientation (92%).

3. Conclusion

The authors' findings compared to findings of other researchers in terms of the approach to human resource management and leadership. The modern concept of human resource management implies that management and leadership of employees to perform agreed work, achieve desired performance and meet expected goals should be a fundamental responsibility of all managers in the organization.

The authors' questionnaire survey on the approach to human resource management and leadership in showed that surveyed part of public sector is able to efficiently attract, employ, stabilize and develop enough qualified and motivated civil servants, however they should apply a more conceptual and systematic approach to the human resource management as well as to the staff. Management in public administration has other possibilities of development with a focus on using the possibilities of greater involvement of line managers - heads of departments in the proactive management of co-workers.

The current authors' survey results open up new possibilities for further research in the field of human resource management and dealing with staff managing in view of leading employees.

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