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# ÚVODNÍ SLOVO

Vážení čtenáři,

jsme rádi, že vám můžeme představit druhé vydání časopisu *Littera Scripta* v roce 2013. Věříme, že jste si na elektronické vydávání časopisu již zvykli a zjednodušil se vám tím přístup k novým informacím, které jsou plně využitelné při vaší teoretické i praktické činnosti. Zároveň se těšíme, že brzy přibudou i komentáře k jednotlivým příspěvkům, které budou cenné nejen pro nás, ale zároveň i pro autory příspěvků, kteří tak mohou získat náměty na další práci.

Jako již tradičně vám v tomto vydání představujeme ty nejkvalitnější příspěvky, které jsme obdrželi v průběhu uplynulého půl roku. Jak vám jistě neuniklo, tak od příštího roku budou v časopise *Littera Scripta* publikovány výhradně příspěvky psané v anglickém jazyce. Důvod k tomuto kroku je ten, že se snažíme neustále zvyšovat kvalitu časopisu s cílem zařadit se do některých databází, které by zvýšily povědomí o časopise mezi širší odbornou i laickou veřejností, čímž by se rozšířila i základna potencionálních autorů, kteří by měli zájem přispět do časopisu svým vlastním výzkumem a pohledem na aktuální témata v oblasti ekonomiky a technických věd.

Dovolte mi na tomto místě krátkou vzpomínku na prof. Ing. Milana Dema, Ph.D., dr. h. c., se kterým jsme se bohužel minulý měsíc rozloučili. Pan profesor byl velmi uznávaným odborníkem a člověkem, který nám bude velmi scházet. Vážíme si toho, že byl od roku 2010 v čele redakční rady časopisu *Littera Scripta* a podílel se na jeho zavedení na Seznam recenzovaných neimpaktovaných časopisů vydávaných v České republice.

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Rád bych vám na závěr popřál, aby se náš časopis stal vaším společníkem i v průběhu následujícího roku a aby vás v co nejvyšší míře inspiroval pro vytvoření vaší vlastní práce, kterou velmi rádi uvítáme. Přeji všem čtenářům, autorům, recenzentům i členům redakční rady příjemné prožití vánočních svátků a těším se na další příjemná setkání nad stránkami našeho časopisu i v příštím roce.

České Budějovice, prosinec 2013

Za redakční radu  
prof. Ing. Jan Váchal, CSc.

## INTRODUCTORY WORD

Dear readers,

we are pleased that we can present the second issue of the *Littera Scripta* journal in the year 2013. We believe that you have already got used to the electronic issue of the journal which simplifies the access to new information fully usable for your theoretical and practical activities. At the same time we look forward to adding your comments of individual contributions valuable not only for us but also for the authors who may get further work suggestions.

As traditionally, we introduce you the best contributions received during the last half a year. You certainly noticed, that starting next year, only articles written in English will be published in *Littera Scripta*. The reason for this step is our effort to improve the journal quality constantly; we aim at its assigning to specific databases that would raise awareness of it among professionals and the public. The group of potential authors could be extended this way. Monitoring of current topics in economics and technical sciences, in addition to contributions, would be also very beneficial.

Let me remind the memory of Prof. Ing. Milan Demo, PhD. Dr. h. c., to whom we pay our last respects. Professor Demo was a very acclaimed specialist and a great man so we will miss him so much. We appreciate the fact that he has been the head of the Editorial Board of *Littera Scripta* since 2010. Prof. Demo has participated in *Littera Scripta* assigning to the List of reviewed non-impact journals published in the Czech Republic.

We thank all the authors, regular *Littera Scripta* contributors, who improve the quality of the journal; we also thank reviewers for encouraging the authors to further improvement of their works. Last but not least, we would like to thank you, ie readers, who choose *Littera Scripta* to gain new information and knowledge.

In conclusion, I would like to wish *Littera Scripta* to become your partner during the following year. I wish that you were inspired by *Littera Scripta* to the maximum extent and I hope that our cooperation will be a real asset. I look forward to more pleasant meetings over the pages of our journal in the next year.

Let me wish you all – readers, authors, reviewers and members of Editorial board – Merry Christmas and a successful year 2014.

České Budějovice, December 2013

In the name of the editorial board  
Prof. Ing. Jan Váchal, CSc.

## PRŮBĚH RECENZNÍHO ŘÍZENÍ / REVIEW PROCEEDINGS

Do čísla 2/2013 bylo zařazeno 15 recenzovaných příspěvků od 29 autorů z 10 pracovišť. /

In issue 2/2013 15 reviewed articles written by 29 authors from 10 institutions were included.

### Články / Articles

Počet doručených článků / Number of articles received: 20

Počet článků vyřazených v 1. kole recenzního řízení / Number of articles rejected in 1<sup>st</sup> round of review proceedings: 0

Počet článků vyřazených ve 2. kole recenzního řízení / Number of articles rejected in 2<sup>nd</sup> round of review proceedings: 5

Počet článků přijatých k tisku po dokončení recenzního řízení / Number of articles agreed to be published: 15

### Recenzní rozhodnutí / Review conclusions

Počet zpracovaných recenzí / Number of reviews delivered: 41

- z toho recenzováno recenzentem s titulem doc. nebo prof. / from which was reviewed by reviewer with Doc. or Prof. degree: 28 (68,3 %)

	Recenzenti s doc. či prof. Reviewers with Doc. or Prof. degree	Ostatní Other	Celkem In total
Přijato beze změn Published without changes	8	5	13
Přijato, doporučeno zohlednit navrhované úpravy Published, suggested considering some remarks	12	6	18
Přijato po celkové revizi příspěvku Published after over-all revision	3	2	5
Odmítnuto Denied	5	0	5

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Jaroslav Vrchota

# Development Evaluation of Enterprises in Czech Agriculture

Jaroslav Homolka, Jiří Fábera  
Czech University of Life Sciences Prague

## Abstract

The paper deals with evaluation of economy of selected trade companies operating agricultural basic production in the period from 2008 to 2011. The evaluation stems from results of economic analyses of enterprises which are further monitor in context with development of external influences affecting the whole branch of agriculture and development of economic decisions of the evaluated companies. Further, the evaluation is based on real possibilities of companies stemming from resources of which they dispose, and on facts that happen in the monitored period in both companies. In the first part the paper introduced development of important factors influencing the whole branch of agriculture and their real state, further methods used in financial analysis of enterprises are introduced. In the second part of the work, two companies are evaluated of which the first operates plant and animal production and the second one is focused purely on plant production. In both companies machinery was modernized with contribution of supports from European Union funds and both the companies were competitive in the monitored period. The first company had problems with liquidity, while an unused capital cumulated in the second one.

**Keywords:** trade company, common agricultural policy, subsidies, yields, costs, operating result, financial stability, profit of enterprise, liabilities

## Introduction

In the Czech Republic, there is a Law in force No. 252/1997 Col., on agriculture subsequently amended (further only “Law on agriculture”). According to §1, the purpose of the Law on agriculture is to create conditions ensuring ability of Czech agriculture to provide basic nutrition, food safety and needed non-food raw materials, to create background supporting non-production function of agriculture which contribute to protection of components of the environment like land, water and the atmosphere, and to maintenance of populated and cultural landscape, to create conditions for carrying out of the common agricultural policy and the policy of rural development of the European Union,

to create conditions for development of various economic activities and improvement of quality of life in rural areas and for village development.

For maintenance of production agricultural potential and for development of rural space, the law on agriculture in §2 defines state measures, dealing with structural support, support of activities financed from national resources and implementation of collection of measures resulting from regulations of the European Community (Further only “EC”). Further measures which concern provision of tax releases in consumption of fuels by persons operating agricultural production, creation of unified rules for trade with agricultural products, further creation of measures within common organization on the market with agricultural and food products. According to §2b of the Law on agriculture, the State Agricultural Intervention Fund (further only “SAIF”) is set as an authority of common market organization and direct supports. SAIF deals with structural support and support of rural development according to EC regulations. The Law on agriculture defines principles of financing of subsidiary programmes guaranteed exclusively from national resources. For some provided supports the Ministry of Agriculture constituted as an entrusted person the Support and Guarantee Rural and Forestry Fund, Inc. (further only “SGRFF”). SGRFF provides supports to entrepreneurs in the area of agriculture, forestry, water management and processing industry, further to municipalities and voluntary municipality associations in rural areas.

Enterprise in agriculture, characteristics of agricultural entrepreneur and a definition of agricultural production are contained also in the Law on agriculture. A person operating the given activity has to be entered in an agricultural entrepreneur register according to law.

Table 1: Prices of agricultural producers in selected commodities in CZK

Average purchase price of agricultural commodities [CZK/t]				
Commodity/year	2008	2009	2010	2011
Food wheat	3284	2663	4649	4155
Feed wheat	2713	2419	3702	3797
Winter oilseed rape			6668	8768
Malt barley	4975	3336	4147	5056
Slaughter cows q.c. A+B in live	26462	25243	25554	29048
Slaughter pigs q-c- I. + V. in live	30432	26930	26146	31655
Slaughter pigs q.c. I.+III. in JUT	38995	34533	34353	40224
Cow milk Q q.c. 2	7207	6443	7975	8462
Weaned piglets	57224	52611	51570	47869

Source: CzSO 2013; MoA 2011

The reached economic results in agricultural enterprises are influenced by many factors acting inside enterprises and in outside environment of the businesses. Some of them can influence enterprises, for example a level of reached production intensity, a level of reached labour productivity, and others. Most external effects can not be influenced by the enterprise, for example height of agricultural producer prices, an amount of financial support, an amount of levies

and so on. It can just use them in a suitable way. As an example the table 1 shows fluctuating realization prices of selected commodities in the evaluated period and a view of financial support for agrarian sector.

Structure of supports flowing in the agricultural sector after accession in the European Union:

- direct and subsidiary payments
- market measures
- national payments
- Rural Development Programme

From a viewpoint of extent of financial supports within the EU CAP, the biggest significant is a system of direct payments in the form of unified payment per area. A rate per 1 ha of managed agricultural land amounted already to 4686 CZK in 2011. Other specific support is a separated payment for sugar, and a support of cows with market milk production.

In the framework of subsidiary national payments it is dealt with a support of hop growing, a support of breeding of ruminants, and a support to growers of potatoes for starch production.

The above mentioned factors project themselves in the economic situation of agricultural branch and thereby also in the economy of particular entrepreneurial subjects. Therefore, development of some indicators characteristic for creation of the entrepreneurial environment in this branch will be introduced.

A share of agriculture in the total gross added value in the CR has a decreasing trend. From 2004 to 2010 it felled from 2.63 % to 1.63 %. A share of employees decreased from 2004 (3.46 % from the total number of employees in the national economy) to 2010 by 0.76 % to the total number c. 114 thousand of employees. In 2010, 46 477 subject carried business in agriculture, of it 92 % were businesses of individuals managing c. one third of all agricultural land fund and 8 % businesses of legal entities managing the remaining two thirds of agricultural land fund (Rosochatecká 2006).

Since 2008, the area of main grown crops has changed in favour of wheat; the area has increased by 7 % to 863 thousand hectares; of oilseed rape, its acreage has increased by 4 % to 373 thousand hectares; the area of sugar beet has raised by 1.6 % to 58 thousand hectares, the area of maize by 10 % to 197 thousand hectares. Vice versa the area of barley has decreased by 23 % to 373 thousand hectares and also the area of potatoes has decreased by 13 % to 26 thousand hectares; the area of rye by 41 % to 25 thousand hectares. In the period 2008 to 2011, any more significant variations were not recorded in yields per hectare in main crops, that moved in wheat at the level 5 t/ha, in barley a decrease in yields was recorded in 2008 when it was below the margin 4 t/ha; usual values are at the level of 4.5 t/ha; the average yields of sugar beet moves from 55–60 t/ha, potatoes yields about 25 t/ha, and a yield of oilseed

rape was about 3 t/ha. According to the table 1, which compares prices of agricultural production, the year 2009 was the worst and prices of plant production moved at the level of 67 % of the year 2008. Since 2010, the prices of main crops have shown growing trend; already in 2011 there was a growth in prices by c. 30 % against the year 2010.

Development in animal production is characteristic by decrease in numbers of cows raised on the purpose of market milk production, and decrease in numbers of pigs, vice versa breeding of meat cattle has slightly increased. The number of dairy cows decreased from the year 2008 by 24 thousand animals, e.i. a decrease by 6 %. However, milk yields increased by about 2 % to 6 903 litres/piece, in spite of that the milk production decreased by 4 %. The number of meat cattle increased from 2008 to 2010 by 4 thous. animals and it amounted 167 thousand pieces. In the same period, the number of pigs decreased by 21 % to 1909 thousand pieces. A change in prices of products in animal production recorded smaller fluctuations throughout the years than a change in plant production. A decrease in prices of animal production was in 2009 against 2008 by 14 % and in 2010 the price index grew again; the prices reached the level of 2008 in 2012.

Interest rates of provided credits decreased in the long term; in the period 2008 to 2010 the decrease amounted to 1 % from 5.4 % to 4.04 %. The level of prices of material inputs shows a long-term trend (CzSO 2013; MoA 2011).

For evaluation of economic situation, the base is created by an economic analysis a part of which is a financial analysis. The economic analysis creates a picture of a state of entrepreneurial subjects and a development of its economic results between accounting periods. Financial analysis and work of financial analysts were in detail studied e.g. by Bildstein-Hagberg (2003). By a choice of suitable methods it is possible to reach also an output which can be compared among the enterprises mutually. Methods of financial analysis are frequently used by all users, both by the external and the internal. For the external users, the most frequent reasons are possibilities of investments or also a general evaluation of economic activity for informative purposes of the wide public. For the internal users, the output of financial analysis serves in planning, a check and evaluation of particular kinds of business activities. In creation of economic analysis it is suitable to use all available resources, both published openly and the internal, however it is necessary to monitor arising phenomena in the context with other important facts which only the management of entrepreneurial subject can provide. On economic and financial analysis as the main topic of work was focused also research carried out by Liang and van Dijk (2011).

The aim of carried out analysis is naturally the most important point of view influencing the choice of suitable method of financial analysis for a concrete case. However, any method itself does not give absolutely the best or absolutely the worst results, therefore it is useful to combine the methods.

According to Vochozka et al. (2012), two basic techniques of analysis are used, i.e. a percentual analysis and a ratio analysis. In both cases, the base is absolute indicator, i.e. state and flow magnitudes.

For evaluation of the management level selected ratio indicators will be used in the further practical part.

## **Materials and methodology**

The aim of the paper is to analyze and evaluate development of economy of selected agricultural enterprises and to determine factors that influenced their economy in the period from 2008 to 2011. Selected enterprises are typical representatives of certain groups of production agricultural businesses that are a subject of monitoring in the selective collection.

The introductory part is focused on delimitation of entrepreneurial environment in which the agricultural enterprises are situated. The main external factors that creates a structure of the agrarian sector in the Czech Republic are introduced there. Further, a price development on the market of agricultural commodities is introduced there. For needs of evaluation of the enterprises, a theory of financial analysis and its methods is delimited briefly.

The matter of investigation has a character of qualitative approach in the form of case study of two typical companies for czech agriculture. Also quantitative points of view are included in the research in the form of financial analysis indicators.

The second part of paper deals with the own evaluation of economy of the selected enterprises. Always an enterprise is characterized at first according to a form and production factors that has at disposal, and further the financial analysis follows. The financial analysis is composed of an analysis of liquidity, indebtedness and profitability. The paper also explains an influence of subsidies on a financial situation of the enterprises and their operating result. Data needed for calculations and information necessary to explain found out phenomena were obtained from publicly available resources (Justice 2013), so final accounts of the enterprises and consultations with responsible employees in the businesses. Further, a brief comparison of the reached operating result of both enterprises with average values of enterprises in the Czech Republic found out on the base of investigation of the Agricultural Accounting Data Network was carried out. For comparability, values are recounted per one hectare of agricultural land here.

### **Characteristics of evaluated companies**

As an example for evaluation of development of business economy in agriculture in 2008–2011 two trade companies that operate its activity in the Central Bohemian region were chosen. The first company (further the company A) operates plant and animal production and manages c. 2 800 hectares of agricultural land. The second company (further the company B) focuses only on plant production and manages c. 1 100 hectares of agricultural land.

The company A was chosen as a representative of group of trade companies with acreage of agricultural land over two thousand hectares with universal field production and with breeding of farm animals. The company B was

chosen as a representative of group of trade companies managing agricultural land in range of 1000–2000 ha and operating an universal field production. The mentioned groups of companies are delimited in the framework of network of testing agricultural businesses monitored by IAEI Prague.

In the company A, machinery is being modernized still and also crop pattern has been adjusted. Growing of cereals, oilseed rape and mustard prevails. A small part of managed area is created by grass growths. The company realizes so called minimization procedures (without tillage) regarding a low annual rainfall. For the company it is important a careful management of soil humidity, but the so called “minimization” is also saving of time, fuels, and the soil is less stiffened. Throughout the years in the company A an inhibition in cattle breeding happened as well as re-building of stables to pig feedlots. The company concentrates on pig breeding with close herd turnover. In 2008 a herd recovery started with the help of European funds. The company has a herd of 200 pieces of meat cattle without market milk production. The machinery passed the most significant change and demanded a significant volume of investment, therefore is noted for a considerable degree of progress in the area of saving of labour forces, time, cost for repairs, and fuels. The purchase of machines was financed by means of long-term bank credits with use of supports of interest from credits by means of the SGRFF.

The company B is at present focused only on plant production. Already for ten years it has used the minimization technology of land cultivation (without tillage), however, the land is aerated. The plant production is operated on the whole area. Grown crops are winter and spring wheat, spring barley, oilseed rape, opium poppy and sugar beet. The acreage of sugar beet was reduced owing to allotment of sugar quota and instead of sugar beet opium poppy growing started. The company is able to store all wheat production of c. 2500 tonnes and barley production c. 1200 tonnes in its newly modernized stores equipped with an active ventilation for keeping the production in a good quality. Further the production is sold at time of the most favourable prices. Oilseed production is sold at time of harvest and the sugar beet harvest is realized by the help of use of services at time agreed with a consumer. The company employs yearly 5 employees, two of them are managers, and at harvest time it takes some temporary employees. The main machines are changed after longer time intervals.

## **Results**

### **Analysis of solvency**

A basic presumption for long-term functioning enterprise is to keep good relations (payment ethics) with its suppliers and for a potential development of the business from external resources of financing (loans from banks) it is essential to secure liquidity of the enterprise. The liquidity represents a summary of all liquidity means that the enterprise has disposable for covering its payable liabilities. Solvability is a preparedness to pay its debts when its maturity came (Sedláček 2007). Usually three levels of liquidity are distinguished,

an immediate liquidity, quick liquidity and current liquidity.

*Calculation of liquidity:*

Current liquidity = current assets/(current liabilities + short-term credits)

Immediate liquidity = (short-term financial property + short-term debts)/(current liabilities + short-term credits)

Quick liquidity = short-term financial property/(current liabilities + short-term credits)

Table 2: Indicators of solvency of the company A

Solvency indicators				
	2008	2009	2010	2011
Current liquidity	1.71	1.90	2.22	1.29
Immediate liquidity	1.03	0.74	0.76	0.42
Quick liquidity	0.32	0.10	0.08	0.00

Source: Intraplant statements, own calculations

Results of solvency analysis in the company A indicate that there was a risk of nonpayment of the liabilities in the company. From the immediate liquidity indicator, which corresponds with a recommended value only in 2008, it is obvious that the company would not be able to pay its liabilities immediately from money on a bank account. The liquidity indicator is a state magnitude counted to one date, so it is not possible to tell that the company was not able to cover its liabilities all the year. The critical period according to the management is on the turn of year and in spring when the stored production is sold and owing to long payback period, often longer than 3 months, the company wrestle with a lack of financial means to cover its monthly liabilities (for employees, cost interests, from trade relations). This fact is evidenced by values of the quick liquidity in which besides financial means also short-term receivables are shown. The values of quick liquidity moved in the recommended height again only in 2008, however, it is not a key factor of decision making because in 2010, neither the indicator of quick liquidity nor of immediate liquidity reached the recommended values, but the current liquidity indicator reached the recommended values. The values of current and quick liquidity evidence that the company lost its payment ability partially in possession of reserves and predominantly in a high amount of receivables and bank credits. In the reserve structure, the biggest items were unfinished production and animals, items that are closely connected with the character of production and the management of the enterprise can influence them just a little, with a requirement of maintenance of the current production. A positive phenomenon is decreasing reserve of material. The material for pig fattening in animal production has to stay constant, however, the material in plant production can be decreased. The company buy in advance this material only in case of advantageous offer with discounts provision. The high amount of bank credits results from a renewal of machinery and also from spending of overdrafts by which the company solves temporary deficiencies of financial means. Other

of steps to solve the liquidity was that the company asked for prolongation of the payback period of some liabilities in the main supplier which pay off some of its liabilities towards the company in a period longer than usual. Therefore, the request was accepted.

Table 3: Indicators of solvency if the company B

Solvency indicators				
	2008	2009	2010	2011
Current liquidity	8.06	13.04	7.59	6.53
Immediate liquidity	4.98	7.39	5.17	4.20
Quick liquidity	4.46	6.49	3.96	3.56

Source: Intraplant statements, own calculations

According to the results of indicator, the company B was liquid in a long-term, mainly thanks to a proportion of high short-term financial assets and short-term liabilities. Because the short-term financial assets that are noted for high liquidity created at average 34 assets and short-term liabilities amounted at average 8 %, the company was able to pay off its liabilities immediately only by the help of its financial means. Adding other components of assets with lower liquidity (short-term, receivables and reserves) in indicators of quick and current liquidity, only ability to pay its liabilities increased further. High values of liquidity found out already from financial means gave the company possibility to use a part of these means for development of entrepreneurial activity also in other business area without significant jeopardy of solvency and thereby also the activity in the main area.

### Analysis of financial stability

A financial stability of enterprise is characterized by a structure of financial resources, appropriate composition of its operating results. In case of problems in this area, heavy indebtednes can happen and subsequently bankruptcy of the enterprise. The financial instability of enterprise usually means a decrease in creditors' confidence (Rosochatecká 2006).

#### *Indicators of financial stability:*

Creditor risk = foreign resources/total assets

Debt ratio = foreign resources/own resources

Coefficient of self-financing = own resources/total assts \* 100

Interest coverage = (net profit + paid interests)/paid interests

Time of return on loan = total credits/(net profit + depreciations)

Indicator of rate of interest = paid interests/average state of credits \* 100

Table 4: Indicators of financial stability of the company A

Indicators of financial stability				
	2008	2009	2010	2011
Indicator of creditor risk	0.69	0.66	0.61	0.60
Indicator of debt ratio	2.52	2.00	1.68	1.62
Coefficient of self-financing	27.17 %	32.86 %	36.31 %	37.19 %
Interest coverage	2.93	0.62	2.95	4.24
Time of return on loan	2.62	2.82	1.84	1.21
Indicator of rate of interest	6.90	5.80 %	4.07 %	5.37 %

Source: Intraplant statements, own calculations

According to the analysis, the financial stability in the company A has improved in the long-term. The coefficient of self-financing (a share of own resources in the total assets) has increased by 10 % throughout years what is a positive phenomenon, however, values represent higher dependence of the company on foreign resources without which the company would not be able to acquire assets. Other indicators of financial stability have also improved in the long-term, only in indicators of interest coverage and time of return on loans deterioration was recorded in 2009 because the indicator influences an operating result from the current period and the company reached a loss in this year which was revised by height of depreciations mainly from newly purchased machines and also building. However, the indicator of interest coverage documents that the company was able to cover payments of credits. It is necessary so that the management takes into account possible fluctuations in gaining a profit in the following years. The indicator of creditor risk has decreased to a value 0.6. A possible liquidation of the enterprise would represent a loss for creditors because the indicator of debt ratio exceeds the margin 100 % and receivables of creditors would not be satisfied to full extent.

Table 5: Indicators of financial stability of the company B

Indicators of financial stability				
	2008	2009	2010	2011
Indicator of creditor risk	0.17	0.12	0.14	0.14
Indicator of debt ratio	0.22	0.15	0.16	0.16
Coefficient of self-financing	78.06 %	84.66 %	84.86 %	86.47 %
Interest coverage	23.59	7.24	13.77	33.09
Time of return on loan	0.43	0.92	0.56	0.23
Indicator of rate of interest	8.20 %	8.20 %	8.54 %	9.20 %

Source: Intraplant statements, own calculations

The coefficient of self-financing in the company B has grown in the long-term what was positive and the company's assets became less dependent on foreign resources. The indicator of debt ratio has a similar trend like the indicator of creditor risk which predicates about financing of the company mainly from own resources. Payment of annual interests was fully covered from the reached net profit, only in 2009 a fall happened owing to a decrease in net profit, however, it did not affected the payment of interests. Generally it can

be said that development of the company is secured predominantly from good economic results.

### Analysis of profitability and costs

Profitability represents achievement of profit. The most often it is expressed as a profitability rate, i.e. a ratio of profit to a base by help of which the profit was achieved (e.g. to assets, costs, revenues, outputs). The assets are a state magnitude while outputs, revenues and costs are flow magnitudes (Sůvová 2008).

#### *Indicators of profitability and costs:*

Profitability of Assets = profit before interests and taxation/total assets \* 100

Profitability of own capital = profit after taxation/own property

Profitability of revenues = net profit/revenues

Costs of revenues = costs/revenues

Table 6: Indicators of profitability and costs of the company A

Indicators of profitability and costs				
	2008	2009	2010	2011
Profitability of Assets (ROA)	4.59 %	-0.85 %	2.61 %	5.47 %
Profitability of own capital (ROE)	16.88 %	-2.57 %	7.18 %	14.72 %
Profitability of revenues	9.00 %	-1.63 %	4.05 %	8.53 %
Costs of revenues	1.30 %	1.51 %	1.35 %	1.23 %

Source: Intraplant statements, own calculations

From the indicators of profitability and knowledge of price development of agricultural commodities it is possible to estimate that an ability of the company A to reach a profit unwinds just from the price development of agricultural commodities if the production stays steady. Because in 2009 and 2010 the commodity prices were significantly lower than in the margin years, also the capital profitability decreased. For the company it would be beneficial to diversify structure of its incomes and secure incomes independent on development of the market of agricultural commodities. The development of costs of revenues is to some extent documented by the fact that the main activity of the company was, without endowment supports flowing from the state budget and the European Union, unprofitable because in each period more than one cost unit was expended per a unit of revenues. In the weakest year 2009, subsidies (other operational revenues) shares with 28 % on the total revenues; in the following year they created already only 20.5 %. A comparison of ROA indicator and interest rate in 2009–10 is documented by a negative fact that the total capital of the company was less profitable than the borrowed capital, so for the company the bank loans were a burden. However, the necessity of use of bank loans resulted from an intensive investment policy of the company. It must be added that in 2011 in spite of new investment covered by the help of bank loans, the profitability of the total capital exceeded the average inte-

rest rate and the borrowed capital started to pay off to the company.

Table 7: Indicators of profitability and costs of the company B

Indicators of profitability and costs				
	2008	2009	2010	2011
Profitability of Assets (ROA)	17.21 %	3.56 %	5.73 %	8.50 %
Profitability of own capital (ROE)	22.05 %	4.56 %	6.76 %	9.83 %
Profitability of revenues	29.62 %	8.39 %	9.73 %	16.13 %
Costs of revenues	1.07 %	1.35 %	0.97 %	1.15 %

Source: Intraplant statements, own calculations

From the results it is obvious that the profitability of total capital in the company B showed similar values as the profitability of own capital owing to a high share of self-financing. The profitability was the highest in 2008 when the company showed the highest profit. In the following year the profitability decreased c. by 75 % mainly owing to a decrease in revenues from sale by 25 %. The decrease in revenues was caused more by the decrease in prices of sold commodities than by the decrease in crop yields, and also by the fact that a part of harvest was sold in the next year. The profitability of revenues from sale predicated about an ability of the company to reach even a net profit from the total revenues under the average conditions. From a comparison of ROA with the indicator of interest rate it is obvious that for the company it is not advantageous to use foreign resources for financing of investments. From the indicator of profitability of revenues it results that also for this successfully managing company the financial supports are necessary to secure the financial stability.

### Activity analysis

“Activity indicators measure ability to use invested financial means and linking of particular capital component in particular kinds of assets and passives; the most often they express a number of turns of particular components of resources or assets. Their analysis serve above all for looking for answers to a question how we manage assets and their particular components” (Šůvová 2008).

#### *Activity indicators:*

Asset turnover = revenues/assets

Fixed asset turnover = revenues/fixed assets

Current asset turnover = revenues/ current assets

Reserve turnover = revenues/reserves

Debt turnover = revenues/ debts

Liability turnover = revenues/ liabilities

Turnover can be converted into a time of turnover in days.

**Activity analysis of the company A**

Table 8: Activity indicators

Activity indicators				
	2008	2009	2010	2011
Asset turnover	0.51	0.52	0.64	0.64
Fixed asset turnover	0.87	0.78	1.09	1.09
Current asset turnover	1.24	1.59	1.59	1.57
Time of fixed asst turnover (in days)	418	470	336	335
Time of current asset turnover (in days)	294	229	230	233
Time of reserves turnover (in days)	116	140	151	156
Time of debt turnover (in days)	123	78	70	76
Time of liability turnover (in days)	196	122	105	133

Source: Intraplant statements, own calculations

A change of the total asset value in the revenue value fastened in the company A, so the company used its assets more efficiently in creation of revenues. The value of fixed and current assets increased, so a time when particular assets projected in the revenue value decreased. The decrease of time of current asset turnover caused decrease of time of debt turnover; customers paid off their liabilities faster and the company had its financial means bind in the form of debts for a shorted time. Vice versa, the time of reserve turnover increased, generally by 34 % which slowed down the time of turnover of disposable financial means. The company had possibility to buy reserves with a more significant reduction in price before the year end, and thereby also a base of income tax from ordinary activities decreased. From the time of debt turnover it is possible to read that the company paid its liabilities in a period longer than 3.5 months and in 2008 the period was longer than 6 months.

**Activity analysis of the company B**

Table 9: Activity indicators

Activity indicators				
	2008	2009	2010	2011
Asset turnover	0.58	0.46	0.59	0.53
Fixed asset turnover	0.61	1.36	1.89	1.88
Current asset turnover	0.94	0.72	0.90	0.76
Time of fixed asst turnover (in days)	227	268	193	194
Time of current asset turnover (in days)	389	506	405	482
Time of reserves turnover (in days)	149	219	129	172
Time of debt turnover (in days)	25	35	65	47
Time of liability turnover (in days)	13	3	32	42

Source: Intraplant statements, own calculations

The company B used more efficiently fixed assets in achievement of revenues; their time of turnover decreased to 194 days. The current asset turnover indicates that a part of current assets were not used; it was dealt mainly with fi-

financial means on bank account. It confirms a presumption from liquidity evaluation that it would be economically beneficial for the company to use a part of these resources for investment activity. The time of debt turnover increased c. by 25 days and the company had bound its financial means for a longer time in the form with lower liquidity. The time of reserve turnover develops from when and in what intervals reserves are bought and consumed.

### **Influence of subsidies on operational result of a company**

The table 10 introduces what would be the operational result of economy, if no endowment payments were paid to the enterprises. The main endowment payments are payments for area of managed lans SAPS which purpose is to secure a sufficiently big income of agricultural enterprises so that their activity would not be unprofitable for a long time, so that they would enable modernization and increase of production efficiency, contribute to diversification of the production according to demand, and secure a sufficient income of employees in agriculture.

From the table it results that except 2008 when the company B reached a positive operating economic result without subsidies, both enterprises would manage with a loss in all other years. It would mean that if there were no endowment payments, they could not under the current market conditions produce in the long term. A general development of both companies in the given period was characterized by considerable investment in the machinery (in both companies almost all used machines were bought as new). The companies during the monitored period dealt also with purchase of new production capacities. The operating economic result after deduction of subsidies would express with what results the companies would be managed, if they passed the current development.

Introduction of subsidies unambiguously contributed in both enterprises to modernizing of production and improvement of work conditions of employees. It can be stated that the paid subsidies encourage development of Czech agriculture.

Table 10: Operating economic result

Operating economic result of the company A		
	current operating ER	OER after deduction of subsidies
2008	8 089	-14 317
2009	1 267	-16 772
2010	4 321	-11 908
2011	7 655	-8 041
Operating economic result of the company A		
	current operating ER	OER after deduction of subsidies
2008	13 593	6 806
2009	2 913	-4 443
2010	4 528	-2 348
2011	6 664	-254

Source: Intraplant statements, own calculations

## Conclusion and discussion

The aim of this paper was on base of a case study to analyze and evaluate economy of selected agricultural subjects and to determine factors, which influenced their level of economy in 2008–2011. For this purpose, two trade companies were selected as representatives of typical groups of agricultural enterprises in the Czech Republic.

The assessment of the Czech Republic in the European Union was significant for both the companies; it brought availability of financial supports from the Union funds. The supply of new capital in the company A enabled modernizing of machine equipment and renewal of capacities for pig breeding. A negative side of this development was a high indebtedness of the company caused by a considerable height of bank credits. The company paid off the credits, however, it had problems with liquidity which it solved by the help of a bank overdraft. Binding of financial means in long-term debts for partners and daughter company was unfavourable, too. For more fluent obtaining of financial means, also a more steady sale of plant products with use of storage in the enterprise can contribute, as well as a reduction of time of debt turnover and a mutual credit of debts and liabilities from the business contact.

The company B also invested in modernizing of machine equipment and storage spaces in the monitored period. The company maintained a low level of indebtedness for a long time. A high liquidity was secured thank to savings in bank accounts.

From the viewpoint of rate of profit in both the companies, the year 2000 was risky; prices of agricultural commodities decreased on the market while prices of purchased material grew. In the company A, the low realization prices were the main cause of loss in the given year. In the company, it is necessary to continue in economical spending of operational costs and to try to reach a reduction in cost share in revenues. It would be advantageous for the company to reach also a certain diversification on the side of incomes also outside the agricultural production.

The company B, despite the decrease in realization prices, managed successfully to reach a significant profit in 2009. The structure of grown crops in the company showed a high profitability.

The companies differ in use of their capital because the company A uses more efficiently all input capital. In the company B, the unused financial means cumulate. This capital could be used, with willingness of management of both the companies, to diversification of activities, eventually for purchase of land in order to become independent on lessors of managed pieces of land.

Both the companies manage with a smaller ratio of assets per one hectare against the comparable average in the Czech Republic in spite of that they are able to reach a comparable profit. In comparison of the reached level of operational profit in re-count per hectare of managed land with average values found out in a network of testing authorities for Czech agriculture (IAEI, FADN 2013), their level was following. The company A for the category of enterprises with acreage above 2000 ha reached slightly under-average

values in the monitored year except 2009 when it was only 26 %. An opposite situation was shown by the company B which in year 2008–10 was in this indicator high above the average values. Only the year 2011 was slightly under the average, 92 %. Also in creation of added value, except the year 2009, better than average results were achieved.

Střeleček et al. (2011) introduced in a collection of monitored agricultural enterprises negative values of profit before taxation for 2009. It is in accordance with found out results in both companies when the height of this profit was negative in the company A and in the company B in 2009 it showed the lowest values over the whole monitored period.

Matošková (2011) points out a considerable volatility of prices of agri-food products on the world markets which shows also in fluctuation of prices of these products on the domestic market. This price fluctuation significantly affected also the achieved economic results in the evaluated companies in the monitored period.

Both the companies have passed a wide modernizing in recent years and achieved very good economic results. They trade with a steady base of suppliers and customers. On base of the carried out analysis it is possible to state that both the companies have a background for further development and applying on the market.

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## Hodnocení vývoje českých zemědělských podniků

Příspěvek se zabývá hodnocením hospodaření vybraných obchodních společností provozujících zemědělskou prvovýrobu za období trvající od roku 2008 do roku 2011. Hodnocení vychází z výsledků ekonomických analýz podniků, které jsou dále sledovány v kontextu s vývojem externích vlivů působících na celé odvětví zemědělství a vývojem hospodářských rozhodnutí hodnocených společností. Dále se hodnocení opírá o reálné možnosti společností vycházející ze zdrojů, jimiž disponují a o skutečnosti, které za sledované období v obou společnostech nastaly. V první části práce je uveden vývoj důležitých faktorů ovlivňujících celé odvětví zemědělství a jejich současný stav a dále jsou zde uvedeny metody používané při finanční analýze podniků. Ve druhé části práce jsou hodnoceny dvě společnosti, z nichž první provozuje rostlinnou a živočišnou výrobu a druhá společnost je zaměřena výhradně na rostlinnou výrobu. V obou společnostech probíhala, za přispění podpor z fondů Evropské Unie, modernizace strojového vybavení a ve sledovaném období byly obě společnosti konkurenceschopné. První společnost měla problémy s likviditou, zatímco ve druhé společnosti se hromadil nevyužitý kapitál.

**Klíčová slova:** obchodní společnost, společná zemědělská politika, dotace, výnosy, náklady, výsledek hospodaření, finanční stabilita, ziskovost podniku, závazky

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# Methodology of Introduction and Utilization of Talent Management in the Organization

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## Abstract

The desire of every organization is to achieve predetermined objectives and successfully accomplish its tasks. A key element in the fulfilment of objectives stated in advance and achieving the organization's required performance efficiency are human resources, primarily talented individuals. These employees contribute, to a large extent, to the implementation of strategy and the organization's economic goals. Therefore, there is a need for the organization to pay an increased attention to them, concentrate on complex and systematic work with them and applies the system of talent management within the organization. Despite the proven benefits of talent management, the fear of its time and organizational performance often result that in the end organizations will not apply talent management in spite of making a decision on the implementation of this approach. The aim of this article is to introduce the methodology of implementation and utilization of talent management in the organization as an instrument for the implementation of this approach in practice. To meet the target of this article the analytic-synthetic cognitive process was used. By the method of synthesis from the known knowledge of this approach, a mind map of talent management was created. On its basis, practically usable and into steps structured methodology for the implementation and utilization of talent management in the organization was made by means of the methods of induction and deduction.

**Keywords:** talent management, mind map, methodology, practice

## Introduction

The system of talent management consists of several areas, and of a number of interconnected partial activities. Its complex application, both introduction of its use and the actual implementation of all its processes in everyday functioning of the organization is certainly time-consuming and organizationally demanding (Cannon and McGee 2007). Despite the demonstrable benefits of talent management this 'fear' of time and organizational performance

often results that in the end organizations will not apply talent management in spite of making a decision on the implementation of this approach in case they have a sufficient amount of financial and other means and also further prerequisites of the implementation and utilization are met. This fact was confirmed by the survey of talent management use by organizations in one of Czech Republic's regions, in organizations of the Moravian-Silesian Region, where as the reason for failure to use talent management in some of organizations stated organizational demands of the application of this approach in practice (Horváthová and Mikušová 2011). Some kind of instructions or a method used by organizations for this approach of practically putting into practice and a consequent use of all its benefits for the organization would certainly help organizations to overcome this barrier.

The **methodology of the introduction and utilization of talent management in the organization** might serve as such suitable instrument, instructions, or a certain aid for practical materialization of that approach. And the description of such methodology and its use is the objective of this article.

## Materials and Methodology

In the first phase, a mind map of talent management in the organization was created by the method of synthesis from the known knowledge of the talent management. Such a mind map allows us to look at talent management issues from all angles, to identify its structure, not only to give us an idea of all sub-areas and the various activities of this systematic approach but also of the procedure of their implementation, their complexity and interdependence.

A **talent management mind map in the organization** depicts talent management as a complex of six basic areas. Each of these areas is further dividing into activities when the individual activities included for example in the "Basic concepts of talent management" area are "Talent" and "Talent management". Only in one case, which is the "Talent management processes" area, the area is divided into **sub-areas** and these further into **activities** where the individual activities of the "Acquisition" sub-area are "Key roles", "The need and resources of talents", "Key competences", "Performance" etc. (see Diagram 1).

In the second phase, this schematic illustration of a logical sequence, continuity and interconnection of areas, sub-areas and also activities of talent management in the form of mind map was used as the basis for a proposal of the **methodology of introduction and utilization of talent management** by the application of methods of induction and deduction.

## Results

A form of the created methodology of introduction and utilization of talent management in the organization is based on the structure of a talent management mind map. Its particular steps "copy" a logical sequence of partial

areas and sub-areas of that approach as well as their particular activities. The methodology was devised in such a way so that its structure and contents would offer the organization that decided on talent management introduction and use as precise as possible **directions** for steps of implementation as well as for a consequent implementation of this complex and systematic approach to work with talented individuals.

After the summary of **methodology** of the introduction and utilization of talent management in the organization which is given in Table 1, the detailed description of some (due to the limited scope of the article) **areas** and possibly **sub-areas** and **activities** will follow. Description of remaining areas and activities can be found in the publication HORVÁTHOVÁ, Petra. Talent management. Praha: Wolters Kluwer ČR, 2011. ISBN 978-80-7357-665-3.

**Area 1 Basics concepts of talent management**

The main objective of any organization that will decide to pay attention to systematic work with talents is defining not only its own conception of talent management but in particular who will actually be considered as talent and into which groups of their employees it will look for talents (Berger and Berger 2003).

**Activity: Talent**

There are quite a number of definitions relating to the concept of talent, the most common one describes a talented individual as a person who gives both a high performance and shows a high potential (Cannon and McGee 2007). Similarly, there are several views on how to and in which groups of employees to search for talent. Organizations may identify their talents only among employees holding managerial positions or also among specialists or only among specialists or among all employees (Goldsmith and Carter 2010). To ensure that with regard to achieving organization’s business objectives, the organization devotes its effort to the “right” talent it is necessary regularly to review the definition of the talent in the organization.

Objective:	Definition of a talent
Benefits:	Understanding of the definition of talent in the organization.
Realization:	Introductory (preparatory) stage of talent management application in the organization.
Participating roles: <sup>1</sup>	Top management of the organization. <sup>2</sup>
Materials needed: <sup>3</sup>	None.

<sup>1</sup>This is not a list of all participating roles, only mentioning the main ones.

<sup>2</sup>Most often CEOs and directors of functional areas (HR director, production and technical director, financial one, etc.).

<sup>3</sup>This is not a list of all materials needed, only of the main ones.

**Activity: Talent management**

Talent management is mostly perceived as a system of acquisition, retention, and developments of talents, as a process by which the organization identifies, leads and develops its employees at present and for the future (Cannon and McGee 2007).

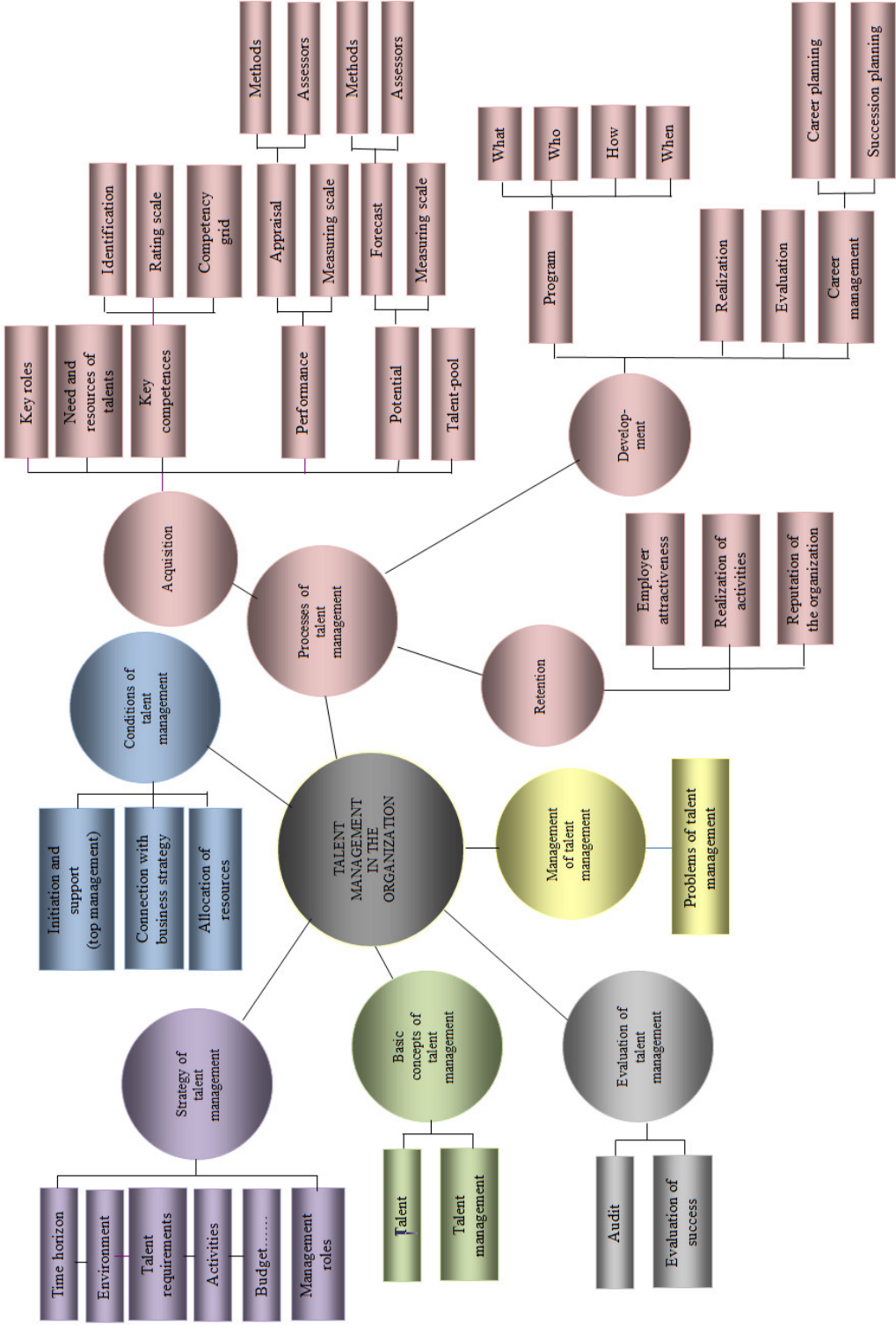
Objective:	Form of work with talented employees design.
Benefits:	Activities constituting the talent management system identification.
Realization:	Introductory (preparatory) stage of talent management application in the organization.
Participating roles:	Top management of the organization.
Materials needed:	Budgets.

Tab.1: The summary of methodology of the introduction and utilization of talent management in the organization (own processing)

No.	Area	Sub-area	Activities
1	Basic concepts of talent management		Talent Talent management
2	Strategy of talent management		Time horizon
			Environment
			Talent requirements
			Activities
			Budget
			Management roles
3	Conditions of talent management		Initiation and support (top management)
			Connection with business strategy
			Allocation of resources
4	Processes of talent management	Acquisition	Key roles
			Need and resources of talents
			Key competences
			Performance
			Potential
			Talent-pool
		Development	Program
			Realization
			Evaluation
		Retention	Career management
			Employer attractiveness
			Realization of activities
5	Management of talent management		Reputation of the organization
			Problems of talent management
6	Evaluation of talent management		Audit
			Evaluation of success

Source: Own processing

Pic. 1: Talent management mind map



## Area 2 Strategy of talent management

A prerequisite to the efficient working of talent management in the organization is its initiation and support not only a declaration of understanding talent management as one of organization's priorities but also providing a commitment of time investments and a real involvement in the implementation of this approach by the organization's top management and its interrelation with the organization's business strategy. In order to use time and other resources as efficiently as possible a strategy of talent management should be developed in the organization (Mathis and Jackson 2008).

### **Activities: Time horizon, Environment, Talent requirements, Activities, Budget . . . . .**

Talent management strategy takes the form of a document organized into several sections; each section addresses the certain specific key issue such as e.g. a time horizon of talent management system application, the environmental impact, demands for talents, talent management activities, budget and so on.

Objective:	Specification of expectations and demands made on all individuals taking part in the implementation of talent management strategy.
Benefits:	Determination of individuals' responsibility and demands made on them in putting talent management strategy into effect.
Realization:	Initial stage of talent management application strategy creation.
Participating roles:	Top management of the organization.
Materials needed:	Descriptions and specifications of job roles. Talent management strategy.

## Area 3 Conditions of talent management

If the introduction and use of the talent management system in the organization is to be beneficial then it requires from the top management not only a declaration of understanding talent management as one of organization's priorities but also providing a commitment of time investments and a real involvement in the implementation of this approach. In order to use time and other resources as efficiently as possible a strategy of talent management should be developed in the organization (Cannon and McGee 2007).

### **Activity: Initiation and support**

Initiation and support of talent management by a management team is one of key criteria for achieving talent management success. Programs in the field of talents supported by the top management are usually more successful. By acting as an example, managers demonstrate a support and define what is important for their organization.

Objective:	Declaration of talent management as a priority in the organization.
Benefit:	Fulfilment of condition for successful implementation of talent management.
Realization:	Introductory (preparatory) stage of talent management application in the organization.
Participating roles:	Top management of the organization.
Materials needed:	None.

### Activity: Linking with business strategy

The efficient work with talent is based on building talent management strategy that will be in line with the organization's philosophy and business strategy. Only from that strategy and through the strategy of human resources management the key decisions can originate suggesting whether and which activities of talent management should be implemented (Horváthová and Durdová 2010).

Objective:	Linking talent management strategy with business strategy of the organization.
Benefits:	Fulfilment of condition for successful implementation of talent management.
Realization:	Introductory (preparatory) stage of talent management application in the organization.
Participating roles:	Top management of the organization. Talent manager.
Materials needed:	Business strategy. Talent management strategy.

### Activity: Allocation of sources

The organization that will decide on the introduction and use of talent management strategy has to earmark a required quantity of resources for this pre-designed activity and this concerns not only the funds. It is necessary to answer a question how large and how structured a budget for talent management will be.

Objective:	Ensuring resources for talent management application.
Benefits:	Specification of resources needed for the application of talent management. Determination of the amount and structure of the budget for the application of talent management.
Realization:	Introductory (preparatory) stage of talent management application in the organization.
Participating roles:	Top management of the organization. Financial director.
Materials needed:	Business strategy. Talent management strategy. Budgets.

## Area 4 Processes of talent management

Talent management as a systematic and complex approach to work with talented individuals consists of three basic processes – acquisition, development and retention of talents. Each of these processes includes in itself quite a number of related activities (Horváthová 2010).

### Sub-area: Acquisition

First, the organization has to identify key roles, to assess whether there are employees with key competences who will be needed in the future in dependency on business strategy. As long as there are not sufficient existing resources in the organization then it has to find these talents either from internal resources or from external resources (Horváthová and Mikušová 2011).

#### Activity: Key roles

The key roles are such positions in the organization which, if they are not filled, may seriously disturb the working of the organization as these roles are the most crucial for achieving its success. It is not only a need to identify these key roles, but also individuals suitable for holding these roles. Consequently, succession planning is aimed at planning to meet the need of having employees in these key roles (Goldsmith and Carter 2010).

Objective:	Key roles identification in the organization.
Benefits:	Identification of roles to which attention should be paid in succession planning. Identification of roles to which the attention does not have to be paid in succession planning.
Realization:	Introductory stage of talent acquisition process. Part of the process of succession planning.
Participating roles:	Top management of the organization.
Materials needed:	Organizational chart. Descriptions and specifications of job roles.

#### Activity: Need and resources of talent

If the organization has not got sufficient existing resources then it has to find these talents. It may identify talents among its present employees, from internal resources or obtain them from external resources, from the labour market, by their transferring from competitive firms, from other branches, among students, graduates, by searching for talents among holders of research fellowships, by direct addressing of suitable individuals, and so on (Koubek 2007).

Objective:	Determination the need of talents and their coverage.
Benefits:	Creating the plan of the need of talents and possibilities of its coverage.
Realization:	Introductory stage of talent management acquisition.
Participating roles:	Top management of the organization. Talent manager.
Materials needed:	Business strategy. Key roles. Performance evaluation and potential forecast.

#### Activity: Key competences → Identification, Rating scale, Competency grid

An organization has to identify its key competences, which are competences crucial for the success of every employee and thus of the whole organization.

There are several ways to identify these key competences. Each of key competences is judged (scored) in dependency on its relative contribution to the organization and the rating scale is created for that purpose. To each position in the company is then assigned a level of competence necessary for performing the job. Subsequently, a competency grid is created – for each position in the organization the level of all key competences is determined.

Objective:	Identification of key competences. Determining the rating scale. Competency grid creation.
Benefits:	Determination of key competences needed to ensure organization's success in the future. Evaluation of individual levels of competences according to benefits for the organization. Determination of levels of all competences for each position in the organization.
Realization:	Introductory stage of talent management acquisition.
Participating roles:	Top management of the organization. Direct supervisors.
Materials needed:	Business strategy. Key roles. Organization scheme. List of competences. Descriptions and specifications of the job roles. Performance evaluation and potential forecast.

**Note:** In the same way all remaining areas, sub-areas and activities are included in the methodology of implementation and utilization of talent management. As mentioned above, due to the limited extent of the article only some of them are described.

## Discussion

A complex and systematic approach to work with talented individuals, the system of talent management consists of several areas and of quite a number of interconnected partial activities. A mind map of talent management compiled by the author of this article gives an idea of all individual areas and various activities of this approach, of the procedure of their implementation, their mentioned complexity and interdependence of these areas and activities. It enables us to look at talent management issues from all sorts of angles, to learn its structure.

The author of this article used this mind map of talent management in the organization as a starting point for developing the methodology of introduction and utilization of talent management in the organization. The methodology is in the form of schematic representation and description of each area, sub-areas and activities including the indication of the goal, benefits of the certain activity and the period of its putting into practice. Moreover, major (not all) involved roles are specified for every activity as well as major materials (again not all) needed for putting a certain activity into practice.

A concrete form of talent management application will always depend on an organization's specific situation – on the level of human resources management, on the amount of sources, on the approach and involvement of not only organization's management but also of all its employees, whether to use or not to use all ideas and practices of the methodology or whether it will

implement further sub-steps. A similar situation arises in case of determining the times for performing each activity or a horizon of complex implementation of talent management in the organization – it is not possible exactly to determine either of them. Benefits resulting from the appropriate implementation and realization of talent management may be delayed for several years. Even so, the application of talent management will pay off. Organizations that do not use talent management should certainly consider the use of that approach (Horváthová and Davidová 2011).

## Conclusion

For its demonstrable benefits, organizations should increasingly use the talent management system. Management of a number of organizations would welcome the use of talent management, but fear of certain financial, personnel and organizational demands prevent them from doing it. The presented methodology of introduction and utilization of talent management in the organization could become the instrument for overcoming this "barrier".

The approach to the talent management use in human resources management has been carefully verified by practice abroad, organizations consider it as a valid, credible, and useful instrument of systematic work with talented individuals (Kinley and Ben-Hur 2013). They really apply this system to the management of their human resources. For example, the results of the survey 2010 State of Talent Management carried out by the world's largest association of experts in the area of talent management by the New Talent Management Network in January 2010 can serve as proof. The system of talent management was implemented and is successfully used in 67% of respondents participating in the survey.

There is no doubt that talent management should be certainly applied also in our conditions. Beliefs can be expressed that in the near future the level of our experts' work – human resources experts will approach the standard level of work of human resources experts in advanced economies and the system of talent management will become the integral part and the essential link of instrumentation in the field of human resources management in most Czech organizations.

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## Metodika zavedení a využívání talent managementu v organizaci

Přáním každé organizace je dosáhnout předem stanovených cílů, úspěšně splnit své úkoly. Klíčovým prvkem při plnění předem stanovených cílů, dosahování požadované výkonnosti organizace, jsou lidské zdroje, zejména talentovaní jednotlivci. Tito zaměstnanci velkou měrou přispívají k realizaci strategie a ekonomických cílů organizace, je tedy potřeba, aby jim organizace věnovala zvýšenou pozornost, aby se věnovala komplexní a systematické práci s nimi, aby byl v organizaci uplatňován systém talent managementu. Přes prokazatelné přínosy talent managementu velmi často vede obava z jeho časové i organizační náročnosti k tomu, že talent management, i přes rozhodnutí o realizaci tohoto přístupu, organizace nakonec neaplikují. Cílem článku je představit metodiku zavedení a využívání talent managementu v organizaci jako vhodného nástroje pro realizaci tohoto přístupu v praxi. Pro splnění cíle článku byl využit analyticko-syntetický poznávací postup. Metodou syntézy byla ze známých poznatků o tomto přístupu vytvořena myšlenková mapa talent managementu, z ní pak za použití metod indukce a dedukce byla vytvořena prakticky využitelná, do jednotlivých kroků strukturovaná, metodika zavedení a využívání talent managementu v organizaci.

**Klíčová slova:** talent management, myšlenková mapa, metodika

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# Analysis of Key Topics in the Research on Nonprofit Organizations: From Efficiency to Hybrids

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## Abstract

Research in the nonprofit sector is a relatively young discipline. Nonetheless, a number of research schools of thought and movements have formed over several decades, several outstanding research institutions have come into existence, and many books, articles and studies dealing with the nonprofit sector have been written. The first social science to try and understand the nonprofit phenomenon through its research methods was economics. This article analyses the causes of the interest that economists started paying to the nonprofit sector and the nonprofit form of companies. It examines how the areas of interest of the research have been changing, trying to identify causes of such changes. It demonstrates that, since its very beginning, this research has been very strongly influenced by actions taken by interest groups and has been significantly interconnected with the public policy towards the nonprofit sector. Its primary objective is to demonstrate significant shifts in the research emphases and to articulate the author's view of the tendencies in the development of the area studied.

**Keywords:** nonprofit sector, public policy, interest groups, research trends

## Introduction

*Theory is not value-neutral. It is inevitably appropriated, constructed, or appealed for purposes related to the configuration of institutional power and the interests of stakeholders.*

*Hall (1995)*

The nonprofit (also third) sector refers to the sphere between the state and the market where the following two principles meet: private voluntary activities and non-profitability. This article analyses the transformation of the pillars which the research in this specific area has been based on. It provides

an overview of the progress in the understanding of the phenomenon as facilitated by leading figures in the nonprofit research, identifying the causes of changes in the orientation of the research and, last but not least, it is a critical analysis of the influence of interest groups on this research.

The terminology of the area we have been dealing with herein is still inconsistent, and probably will remain so. In the literature written in Czech, the overview of terminology is best compiled in (Skovajsa 2010). It should be noted that terminology may pose one of the biggest risks of incomprehension in discussions about the nonprofit sector, especially in the situation when the multidisciplinary approach has been growing in importance. Each of the social sciences has its own terminology, yet different meanings are assigned to the same concepts (Muukkonen 2000) points out that the terminology refers to the sector on the one hand and to actors, entities operating in this sector, on the other hand, and that it also reflects different cultural and historical experience. The terms as used throughout this paper are private nonprofit organizations and the private nonprofit sector or just nonprofit organizations and the nonprofit sector. For the rationale see for example Rosenmayer and Pospisil (2006).

## Materials and Methods

The article is not based on any ad hoc executed empirical research; on the contrary, it examines the background of researches in the order in which they gradually emerged. Therefore, the secondary analysis has been selected as the main method. To draw up the sections of this paper that analyze the principles of individual theories, the author followed from his own research methods applied in the following two grant projects where the author served as principle investigator: Podíl nestátních neziskových organizací na zabezpečování veřejných služeb /The Share of Non-Governmental Nonprofit Organisations in Securing Public Services/(GA402/05/0974) and Revize teorií neziskového sektoru jako východisko formulace veřejné politiky vůči neziskovému sektoru /Review of the Theories of the Nonprofit Sector as the Basis for the Formulation of Public Policy towards the Nonprofit Sector/(GA402/09/0941).

This contribution does not aspire to be an exhaustive analysis; accordingly, it cannot contain the proposal section either. It rather has a theoretical and conceptual as well as summarizing character. At the same time, it defines the space for another of the author's planned activities, specifically for an in-depth research in the links between sources of research funding and the themes or issues comprising the agenda of the research.

Of course, this article utilizes mostly the American research tradition and derives some results from it. It can be the limiting factor and it can be challenged by rights. Yes, European, or even the Czech, research tradition is different. But the main problem remains the same – government and interest groups, very often the nonprofit ones, influence the “independent” research strongly and con-

tinually. And such influence doubtlessly deserves our attention and critical analysis.

## Results

### Economic Research of the Nonprofit Sector

With a certain amount of exaggeration, it may be stated that economics was really the first social science which started exploring the space “between the state and the market” in a systematic manner. The statement is characterized as a slight exaggeration because economics has a lead of no more than ten years at the maximum. Political scientists, sociologists and, naturally, historians come up with their theories as soon as in the course of the 1970s. They are primarily general theories, political macro theories, organizational theories, etc. Of course, emphases in these sciences were also shifting, most significantly during the late 1980s when international comparative studies became the priority, exploring differences in terminology, legislation and cultural and religious backgrounds.

Economics, however, was the first one, mainly due to the strong impulses of economic nature, which culminated at the turn of the 1960s and the 1970s in the USA, where the nonprofit sector has a rich and strong tradition. In the American context, the nonprofit sector can be understood primarily as a tax-exempt field. It was the potential threat that the government posed to this space which became the most significant impetus launching the economic research in the nonprofit sector.

#### *Quantitative expansion and a change in the structure of incomes*

Before we proceed to analyse the above specified impetus, it is necessary to mention some other, though probably not as substantial, impulses. The first was undoubtedly the quantitative expansion of nonprofit organizations, which already started in the 1950s. As an illustration, it may be stated that the number of tax-exempt nonprofit organizations grew from 50,000 in the 1950s to about 300,000 in the mid-sixties and 700,000 in the mid-seventies (Muukkonen 1999).

Another impetus launching serious researches was a change in the nature of some significant types of U.S. nonprofit organizations, mainly in the field of health care services. While in the 1950s, the health care sector consisted mainly of organizations working on traditional principles of charity, significant changes occurred in the next decade, mainly because the Medicare and Medicaid systems had been deployed. This, as Hansmann points out, entailed liberation of nonprofit hospitals from their dependence on charitable contributions (Hansmann 1987), allowing them to become potentially profitable (in terms of cost-effectiveness, see Vaceková 2013) institutions that receive most of their income from patient payments. With a substantial change in the structure of incomes, changes in the economic behaviour of organizations can also be expected, so this fact can be considered to be one of the causes underlying the interest of economists.

Both of these impulses were significant: the numbers of entities of the clearly defined institutional type became more significant; therefore the need to explore the causes of the growth and for example also the fields where the institutions were operating, was self-evident. Medicare and Medicaid in turn significantly changed the structure of incomes, hence also the fundraising and marketing strategies of the organizations concerned.

*The Tax Reform 1969 and its impacts on the subject-matter of the research*

But there was yet another impetus that caused the boom of the economically-oriented research. And it can be assumed that this was the major impetus. It was a tax reform which would have far-reaching consequences for the tax-exempt space. Specifically, they were consequences for endowed entities, enjoying the comparatively largest benefits among all charity entities.

**Private foundations** became subject to regulation, specifically so called operating foundations, often founded by wealthy individuals. Regulators, legislators came to believe that these entities pursued interests of their founders rather than public interests, all this with intensive support in the form of indirect (tax) public aid. The introductory part of the text of a voluminous report of the U.S. Congress is telling (United States, Congress 1970):

*Increasingly in recent years, taxpayers with substantial incomes have found ways of gaining tax advantages from the provisions that were placed in the code primarily to aid limited segments of the economy. In fact, in many cases these taxpayers have found ways to pile one advantage on top of another. The House and Senate agreed that this was an intolerable situation. It should not have been possible for 154 individuals with adjusted gross incomes of \$200,000 or more to pay no Federal income tax on 1966 income. Ours is primarily a self-assessment system. If taxpayers are generally to pay their taxes on a voluntary basis, they must feel that these taxes are fair. Moreover, only by sharing the tax burden on an equitable basis is it possible to keep the tax burden at a level which is tolerable for all taxpayers (United States, Congress 1970, 1–2).*

As a result, for the first time, the Tax Reform Act 1969 imposed restrictions on private foundations. Under the Tax Reform Act 1969, private foundations are required to make minimum contribution. For example, 5% of assets must be distributed in a qualifying distribution each year at the present time. The minimum distribution rule replaced a system where foundations could lose their exempt status for excessive accumulations (Agard 2010).

According to Agard, *The Tax Reform Act of 1969 defined the fundamental social contract offered to private foundations. In exchange for exemption from paying most taxes and for limited tax benefits being offered to donors, a private foundation must (a) pay out at least 5% of the value of its endowment each year, none of which may be to the private benefit of any individual; (b) not own or operate significant for-profit businesses; (c) file detailed public annual reports and conduct annual audits in the same manner as a for-profit corporation; (d) meet a suite of additional accounting requirements unique to nonprofits (Agard 2010, 409).*

The response by the foundation sector representatives to the measures was very fast. Two special commissions were set up in sequence: The so-called Peterson Commission (Commission on Foundations and Private Philanthropy) was formed by John D. Rockefeller III in 1969, and its activities had rather limited impacts, largely because they released their report as late as after the tax reform measures became effective. The declared aim of the Commission was an unbiased research into endowed entities and their role in the society. Neither the government nor foundations themselves were to influence the research. This independence was to lend credibility to the Commission, which was undoubtedly necessary for potential influencing of the Congress in its decision-making about foundation activities.

However, more recognized today are the outputs of the Filer Commission (Commission on Private Philanthropy and Public Needs). It was established in 1973 to explore private philanthropy and its role in the American society. These researches and the insight into the inherent laws of the philanthropic sector were intended to help formulate recommendations on the ways leading to an increased level of private giving. The composition of the Committee then reflected the efforts to achieve diversity of opinions and diversity resulting from professional experience. Hence, its members were for example leading representatives of significant endowed entities, universities, but also people with a political background, etc. Let us touch on the fact that approximately \$2,330,000 was spent on the activities of the Commission, which were officially completed in 1975 (Dunbar 1976). The Commission produced over 80 studies and articles; however the most important is their final report (Commission on Private Philanthropy and Public Need 1975).

In addition to the formulation of a number of recommendations, mostly aimed at encouraging donations and philanthropic institutions, the Commission's activities also had other impacts. For example the Program on Nonprofit Organizations (also known as PONPO) of the Yale University was launched thanks to its scholarship fund. The project, which involved approximately 150 scientists not only from Yale but also from other institutions, brought among other important works such as *The Economics of Nonprofit Institutions* collection issued in 1986 and edited by Susan Rose-Ackerman (Rose-Ackerman 1986).

#### *The impulse for research: partial summary*

Initiation of the Independent Sector, an umbrella organisation bringing together endowed entities, other nonprofit organizations, and representatives of companies, i.e. representatives of the private market sector, may be then seen as the effort to institutionalize the influence of interest groups. It can be concluded that the five-year operation of the Filer Commission especially had a long-term effect, not only on the US nonprofit sector, but it also became a source of inspiration and information for interest groups in various parts of the world. It is an extraordinary example of how a sense of threat and regulatory measures introduced by the government can stimulate private activities,

both in terms of significant expenditures and scientific and research activities. As a matter of fact, a base was created and stabilized for mutual contacts between researchers and academics on the one side, and non-governmental entities on the other. It can be perceived both positively and with a certain critical detachment, to say the least.

Peter D. Hall (1995) makes the following observation on that: *“Although a few scholars studied philanthropy, voluntarism, and nonprofit organizations simply because they found them interesting, most members of the research community were attracted to the field by the incentives provided by nonprofit leaders as they sought to defend the charitable tax-exempt universe against legislative attack.”* (Hall 1995, 9). This suggests that research questions began to be asked “to order” in a way, with representatives of powerful interest groups standing on the customer side. Although the quality of a wide range of researches from that period has been time-proven, there are prominent authors who have not lost their critical perspective such as Barry D. Karl (1987) in the second half of the 1980s: *“In some cases it is questionable if the word “research” had the same meaning for foundation leaders and scholars. Many times it was a question of advocacy and evaluative nonprofit justification.”* (Karl 1987, 984).

Karl further points out that the current terminology will be gradually amended. For example, hired theorists involved in the field substituted the term “charity” with the term “nonprofit organization” because the term “carries an organizational conception modelled on business enterprise, which is presumably efficient, subject to cost accounting standards of performance and principles of effective management” (Karl 1987, 984).

### **American Micro-Economic Approach: Principles**

In any case, these efforts to research the nonprofit sector have been successful and have grown to considerable proportions. A whole stream of theoretical concepts has been formed which we call the **American micro-economic approach** today. Its essence is an analysis of the “nonprofit company”, based on the principle of non-distribution constraint, specifically the analysis of the ways in which this condition affects behaviour and fulfilment of the functions of an organization.

This approach emphasizes the issues related to costs and efficiency, for example studies of public, for-profit and nonprofit service providers are very important. The main feature of these theories is that they are trying to be **universal**, valid under all conditions, i.e. in different countries and in different times.

As regards terminology, Hansmann’s distinction between the *donative nonprofits* and *commercial nonprofits* can especially be considered to be inspirational (Hansmann 1987). This division, as well as further elaboration of this principle, caused very contradictory reactions. On the one hand, recognition from the side of the academic and professional community, on the other hand, not very friendly and disapproving reactions from the side of some NGOs. The reason is that Hansmann’s distinction clearly refers to the heterogeneity

of the nonprofit sector and theoretically justifies the regulation of the sector and the selective approach of the government towards its individual parts. It was, of course, often perceived as a threat to the autonomy of nonprofit entities.

Two basic streams of economic research in the nonprofit sector had been profled by the end of the 1980s. The first primarily examined **the causes underlying the existence** of nonprofit organizations, the second dealt with the **behaviour** of these organizations, i.e. their functioning and how their operations were influenced by the non-distribution constraint condition. A typical representative of the first approach is the heterogeneity theory (also called the public goods and government failure theory), mostly associated with the name of Burton Weisbrod (Weisbrod 1987). The behaviour of nonprofit entities is then a subject-matter for example of the supply side theory (also called entrepreneurship theory), a representative of this approach is for example the above mentioned Hansmann.

### **Further Transformations of the Subject-Matter of the Research**

As compared to the previous detailed section of the paper, the following part is slightly less detailed. One of the reasons is that, starting from the second half of the 1980s, economic research in the nonprofit sector stops being more or less coherent and becomes more fragmented, and especially multidisciplinary. In addition, as noted by Anheier, the period from 1985–1995 was not the decade of any major theoretical innovations; this work was carried out mainly from 1975–1985. Rather, they are two different developmental traits that characterize the later period. First, previous theories were further refined and developed. Second, a substantial pool of empirical works that either test theoretical approaches, or supply evidence about correctness and key aspects of this or that theory has been gathered (Muukkonen 1999).

Anheier formulated transformations of the research agenda in a very precise manner (Anheier 2013). It is evident that the research agenda is closely linked to the prevailing public policy:

#### *Initial Agenda (– 1990s)*

This phase of the research encompassed a range of absolutely crucial issues, which the economy of the nonprofit sector could not do without in the subsequent years. We can say that fundamentally new topics have appeared only rarely since then, and when they have done so, they have often taken the form of variations on the themes of this initial period. Typical for this phase is especially the following:

- focus on organization and organizational behaviour,
- alternative ways of providing services,
- formulation of several fundamental theories,
- emphasis on the role of values shared by individual types of organizations,

- analysis of the issues related to multiple stakeholders, multiple revenue sources,
- efforts to identify comprehensive impacts of activities implemented by non-profit organizations.

According to the quoted resource (Anheier 2013), the key findings include especially the following:

- There are good reasons why nonmarket firms exist in market economies.
- They require an adequate legal and policy framework to bring their advantages to the forefront (direct contributions, positive externalities), and avoid shortcomings and failures.

#### *1995 – 2005 Agenda*

This phase of research was very popular among researchers in particular and showed to good advantage a number of interesting analyses based on the principles of New Public Management. The main objective was to make use of nonprofit organizations not only for market reforms but also in the efforts to redefine the social state system. Generally, it may be stated that the research concentrated on the role of the nonprofit sector in remedying some of the shortcomings of the other systems, but also on the possibilities of partnerships established among organisations in individual sectors. Briefly, the following became the main research themes:

- Privatisation and PPP: efficiency, efficient delivery of public services;
- Social Capital, Civil Society: cohesion, self-organization;
- Social Accountability.

The key findings of this phase include especially the following:

- Nonprofits are useful tools of government reforms (Privatization).
- Nonprofits can be used for market reform as well (quasi-markets).
- They are also good partners in PPP.

#### *Since 2005 until today*

This phase is mainly based on the welfare state crisis. The basic idea is that the problems of modern states can be addressed only in the context of all three sectors. These problems are nevertheless quite serious because the current governments have been losing their ability to meet their – previously typical – roles. The following especially have become the main issues:

- How do societies invest in their own future when governments are no longer able or willing to take either leading or primary roles?

- Deployment of entities from all sectors in addressing socio-economic issues, and their cooperation. Exploration of the effects and forms of this cooperation.
- Establishment and operation of so called hybrid organizations, entailing characteristics typical for various institutional types.

## Conclusion

The above outlined transformation of the agenda shows, among other things, that we have been getting away from the initially relatively clearly defined topics to issues that are rather fragmented and problems which are much less clear-cut. We can come up to the assumption that the future belongs to hybrid types of organizations. For researchers, this means a much greater challenge than that they used to face over the last decades. It seems that the only way how to come up with new knowledge and understand the changes that have been taking place is to implement methods of interdisciplinary research. This, of course, is sure to entail complications resulting from a combination of individual methodological approaches and specifics.

And in conclusion a minor reflection. The research in nonprofit organizations was supposedly launched by private finance initially, however the situation today is fundamentally different, especially in the European environment. Of course, research still partially relies on private donors, particularly large foundations, today as it did in the past. More often, we however encounter with other sources, primarily in the academic environment. They are public budgets, or rather – more and more frequently – supranational budgets.

The subject-matter of the research has also been changing. In particular, if the entity providing the funds is the government, including the supranational one, its priority is to solve problems of contemporary welfare states. These problems can be very diverse, from the plight of the poor, throughout the problem of high and long-term unemployment, to for example an inflexibly functioning system of the providing of public services. In any case, it seems that we have recently witnessed researchers and nonprofit organizations themselves increasingly concentrating on the priorities of governments, national or supranational, in order to obtain funds. This, among other things, is also a reason why social innovation and social economy are prominent themes today. They are the topics that have not got very crystallized so far and are seemingly new. The public and private sectors have been blending into each other in an interesting manner, and so are research methodologies and political interests, with the applied terminology having been affected too.

This conclusion, although hypothetical, is certainly debatable. However, it can become the springboard for a new perspective on the reality of nonprofit organizations. For example, there already exist researches proving how European funds have been distorting missions, activities and organizational structures of NGOs (Škarabelová et al. 2008).

In any case, one more, again somewhat speculative conclusion can be drawn. The beginnings of the economic research into the nonprofit sector are asso-

ciated with the sense of a threat to institutional freedom and independence. Fears of regulation launched a very prolific creative process. Today, this sense of threat is missing. In general, nonprofit organizations are not in a situation when they would have to justify their “place in the sun”, on the contrary, they have been gradually becoming an integral part of the social and political system that is respected by the public policy. The research itself has then been increasingly dependent on public funds and thus must reflect the topics preferred by the government/state. Can any substantial or even ground-breaking theories be expected to come to existence in such an environment? Can the research on the concerned issues be still characterized as free and independent? Let us conclude this reflection with the hypothesis that ground-breaking or substantial findings, theories and concepts are consigned to history for the reasons outlined at the end of this paper.

Researchers will probably always reflect the expectable and ongoing legislative and institutional changes, the effectiveness and efficiency of alternate institutional forms and settings. But they shouldn't resign to offer both general and partial concepts and theories, they should still try to broaden our knowledge and they should do it regardless of whether or not it reflects current government's or interest groups' demand. In this context, this article strived to prove that the government can influence the nonprofit sector both directly (financial subsidies/tax exemption or other types of the support) and indirectly (by such a legislative change which can cause similar reaction as in the case of the US Tax Reform Act). Both of those ways can influence the essence of the research too. That's why the government, public policy and regulation ought to be permanently examined as well – and it is not the challenge only for economics itself. Such a complex issue must be closely and regularly examined multidisciplinary. The importance of independent and critical research is even much more important in the situation where the nonprofit sector and related legislation are still very much in flux. This is undoubtedly the Czech case, where we witness the efforts to completely change the nature and structure of many nonprofit institutions. And, as an acknowledgement of above concluded, we cannot be sure how the political and special-interest factors will finally influence the “space between the state and the market”.

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## **Analýza klíčových témat výzkumu neziskových organizací: od efektivnosti k hybridům**

Výzkum neziskového sektoru je relativně mladou disciplínou. Přesto se za několik desetiletí vyprofilovala řada výzkumných proudů a směrů, vzniklo několik významných výzkumných pracovišť a bylo vyprodukováno mnoho knih, článků a studií zkoumajících neziskový sektor. První společenskou vědou, jež se pokusila uchopit neziskový fenomén pomocí svého aparátu, byla ekonomie. Tento článek analyzuje příčiny toho, že se ekonomové začali o neziskový sektor a neziskovou formu firmy zajímat. Zkoumá, jak se měnily oblasti zájmu tohoto výzkumu a snaží se identifikovat příčiny těchto změn. Prokazuje, že tento výzkum je od počátku velmi výrazně ovlivněn působením zájmových skupin a že je výrazně spjat s veřejnou politikou vůči neziskovému sektoru. Jeho základním cílem je prokázat výrazné posuny v akcentech výzkumu a artikulovat autorovu představu o směřování zkoumané oblasti.

**Klíčová slova:** neziskový sektor, veřejná politika, zájmové skupiny, nonprofit organization theory

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# Use of Cluster Analysis for Classification of Tourism Potential

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## Abstract

The aim of the research was to prove the methods of the cluster analysis, which have already been used by a number of scientific disciplines, are usable also in tourism. The cluster analysis is a mathematical statistical method which allows a set of objects of input data matrix to be divided into several clusters. Measures of distance are used to evaluate similarity of the objects. Euclidean distance can be used for quantitative variables. Tourism potential has been studied by a number of authors here and abroad, see bibliography. A district (Czech: okres) has been chosen as basic spatial unit in our research. The advantage of this approach is the possibility of using a public database of CZSO (Czech Statistical Office) which is the most important source of input data. Furthermore the data published by the Institute for Spatial Development in Brno have been used, the tourism potential of individual districts has been specified by the methods of cluster analysis, and the districts have been divided into six groups. Conformity of these groups with reality proves the appropriateness of the method used.

**Keywords:** Regionalization, Cluster Analysis, Tourism Potential, Qualitative Differentiation of the Czech Republic

## Introduction

The aim of the research was to prove whether the methods of cluster analysis, which have been commonly used by a number of social and natural sciences, are also applicable to territory regionalization in terms of tourism potential. Different regions can be abstracted from a specific very complex geographical spatial object by different experts, not only if they approach the issue from different perspectives but even if they define it in the same perspective. However, this does not mean such subjectively defined regions do not exist objectively (Demek 1980). After all, for such regions we have chosen objectively existing parts, properties or relations from the given particular

geographical object. If we proceeded earnestly, from that perspective the defined regions would exist objectively. However, they do not exist with a finite number of elements and separately but only in a specific geographical object we have abstracted them from. Yet if necessary, we can define the exact boundaries of each region thanks to the fact we have chosen only a finite number of constituents, elements and links into it. The definition also applies in the case that the region has been abstracted from such geographical spatial object whose specific boundaries are completely featureless (the majority of cases). Of course, in the case that different people have abstracted different regions from the same specific geographical object, different boundaries may be defined (For example: Bauhalis 2000; Fisher 1982; 1987; Hübelová 2010; Kober 2006; Lauko 1982).

## **Materials and Methodology**

### **Tourism Potential**

Tourism potential has been studied by a number of authors here and abroad, see bibliography. (For example: Horník, Chalupa and Rux 1992; Klapka, Nováková and Frantál 2013; Vepřek 2002). For our purposes we consider works of Institute of Spatial Development in Brno (see Bina 2002; 2010a; 2010b) as a basis. For the first time the tourism potential for all municipalities in the Czech Republic was determined in 2001 using 24 constituents. An update has been made in April 2010.

Segments of the tourism potential are grouped into two following sub-potentials:

- a) Tourism attractions potential
- b) Potential of areas and lines affecting tourism

#### **Ad a) point**

Tourism attractions are e.g. châteaux, castles, botanical gardens, golf courses, spa locations and others, as well as natural sights such as caves, rock formations, etc. Other attractions consist of a certain reputation (e.g. municipalities renowned for winegrowing or brewing). Inclusion of a site into UNESCO World Heritage List creates significant added value of attraction (Chalupa, Janoušková and Hübelová 2013).

#### **Ad b) point**

This sector expresses broader territorial preconditions for tourism development. It is based on the fact that different areas have different general importance for tourism.

What is a part of the tourism potential and what is its attribute is discussed in the Institute of Spatial Development report. Statement that it is not possible to quantify all the constituents of tourism potential (e.g. genius loci) is correct

and essential. Authors of the report claim that when determining the breadth of the potential they took a golden mean. As an example they state that the existence of the castle is a part of the given site's potential, but services and attractions for visitors in the castle vicinity does not belong there. They do not consider also the existence of accommodation facilities, observation towers, nor downhill ski resorts as a part of the potential. We think such concept is too narrow. Surely nobody visits certain site in order to spend the night in a hotel. However, quality and price of accommodation can play a decisive role in the choice of tourist's destination.

**The aim of our work is not in examining the definition of tourism potential at all but verification of suitability of the cluster analysis methods for its examination.**

In 2010 (see Bína 2010b) an evaluation of utilizing the tourism potential by municipalities with extended powers (MEP) has been made. From Bína's work we took over numerical evaluation of the attractions potential recalculated for the districts. His evaluation of areas and lines is not appropriate for us and in this section we used data from the public database of CZSO.

As a criterion for utilizing the potential we used data about accommodation facilities visit rate from the public database of CZSO. We think that it is a basic factor which the tourism industry is interested in.

At the same time we once again remind that our work is not about a new detection of potential or evaluation of its utilization, but only about evidence that the cluster analysis methods that have been used in a number of disciplines are also suitable for tourism.

This method allows distribution of input data matrix objects set into several clusters. Both objects and variables can be clustered. We start from  $n \times p$   $X$  data matrix where  $n$  is the number of objects and  $p$  is the number of variables. We mark the number of clusters as  $k$ . We consider different explosions of  $n$  objects sets into  $k$  clusters. The aim is to achieve a situation where the objects within a cluster are similar as possible and objects from different clusters are least similar as possible (Jarkovský and Littnerová 2002).

To evaluate the quality of decomposition (see Hebák 2007) various criteria are used, e.g. Ward's criterion:

$$G = stE = \sum_{h=1}^k \sum_{i=1}^{n_h} \sum_{j=1}^p (x_{hij} - \bar{x}_{hj})^2,$$

where  $E$  is the matrix of intra-cluster variability

$$E = \sum_{h=1}^k \sum_{i=1}^{n_h} (x_{hi} - \bar{x}_h) (x_{hi} - \bar{x}_h)^T,$$

$x_{hi}$  is the observation vector for  $i$ th object in  $h$ th cluster,  $\bar{x}_h$  is the average vector for  $h$ th cluster, and  $n_k$  is the number of objects in  $h$ th cluster. Creation of the most distant compact clusters occurs at minimum total sum of squared deviations of all the values from the respective cluster averages.

Measures of distance are used to evaluate similarity of the objects. Mutual distances for all the  $n$  object pairs are calculated,  $n \times n$  type symmetrical square matrix of distance is created.

Euclidean distance can be used for quantitative variables.

$$D_E(x_i, x_{i'}) = \sqrt{\sum_{i=1}^p (x_{ij} - x_{i'j})^2}.$$

The most common method of cluster analysis is **hierarchical clustering**, i.e. creation of hierarchical sequence of decompositions. Result of the hierarchical clustering can be best shown in a tree diagram, dendrogram. The distances between clusters are derived from the distances between objects. For example the smallest, the largest, or average distance can be used. Therefore there are several agglomerative methods. The Ward's method based on the aforementioned Ward's criterion  $G$  of decomposition quality is often considered the best of these methods.

The criterion for joining clusters is the increment of total intergroup sum of observations squared deviations from the clusters average as follows:

$$\Delta G = \sum_{i=1}^g \sum_{j=1}^p (x_{gij} - \bar{x}_{gj})^2 - \sum_{i=1}^h \sum_{j=1}^p (x_{hij} - \bar{x}_{hj})^2 - \sum_{i=1}^{h'} \sum_{j=1}^p (x_{h'ij} - \bar{x}_{h'j})^2,$$

where this increment is expressed as the sum of squares in the emerging cluster reduced by the sum of squares in the dissolving clusters. The expression can be simplified to the following form:

$$\Delta G = \frac{n_h n_{h'}}{n_h + n_{h'}} \sum_{j=1}^p (\bar{x}_{hj} - \bar{x}_{h'j})^2.$$

Increment is expressed as the product of the Euclidean distance between the centroids of clusters considered for coupling and a coefficient dependent on the size of clusters. The coefficient value increases with increasing cluster size and for a fixed  $n_h + n_{h'}$  is the maximum at clusters with the same size of  $n_h = n_{h'}$ . A coupling which ensures minimization of the  $\Delta G$  criterion is performed; Ward's method therefore tends to remove small clusters. When using Euclidean distance, the following relationship can be used to convert distance matrix at each step of the clustering algorithm:

$$D_{gg'} = \frac{1}{n_h + n_{h'} + n_{g'}} [(n_h + n_{g'}) D_{hg'} + (n_{h'} + n_{g'}) D_{h'g'} - n_{g'} D_{hh'}],$$

where  $D_{gg'}$  is considered the distance between  $g$ th and  $g'$ th cluster.

## Results

We consider necessary to emphasize the importance and status of certain tourism region within hierarchically higher regional system, in our case the macro space of the Czech Republic.

The area is examined either as a unit mainly taxonomic, rather homogeneous, or as an area mainly complex with a complicated internal structure of the core (nodal) concentration and its background, which more accurately reflects the present geographical reality.

The tourism region can therefore be defined using the following system theory:

- The system ("*region*") is a set consisting of a finite set of  $P$  elements and  $k$  final set –  $R$  local predicates.
- One sided predicates are called properties and/or characteristics. Two sided and multi-sided predicates are called relations and/or relationships.
- The set of all elements that lie outside the system but affect the system, forms the system surroundings.

So the open and closed systems are distinguished. In open systems there are relations between the system and its surroundings.

**The tourism regions are always open systems.** The set of elements consists of territorial units. One sided predicates are e.g. size of the area, number of workers in tourism, precipitation, and/or temperature. Two sided predicates are spatial interactions between territorial units.

Different regions can be abstracted from a specific very complex geographical spatial object by different experts, not only if they approach the issue from different perspectives but even if they define it in the same perspective (Mičian 1982). However, this does not mean such subjectively defined regions do not exist objectively. After all, for such regions we have chosen objectively existing parts, properties or relations from the given particular geographical object. If we proceeded earnestly, from that perspective the defined regions would exist objectively. However, they do not exist with a finite number of elements and separately but only in a specific geographical object we have abstracted them from. Yet if necessary, we can define the exact boundaries of each region thanks to the fact we have chosen only a finite number of constituents, elements and links into it. The definition also applies in the case that the region has been abstracted from such geographical spatial object whose specific boundaries are completely featureless (the majority of cases) (Lauko 1982).

Of course, in the case that different people have abstracted different regions from the same specific geographical object, different boundaries may be defined. We have chosen the cluster analysis method which seeks to identify the object clusters in a multidimensional space and subsequently reduce the multidimensional issue by categorizing the objects into identified clusters. Research data of D. Hübelová (2010) was used in the evaluation procedure.

The input matrix contains a total of 46 data representing potential attractiveness, potential infrastructure (capacity and occupancy rate of accommodation, transport availability), landscape potential, (national parks, protected landscape areas, national nature monuments, nature monuments, nature reserves, national nature reserves), basic information on population and settlements, pollution and crime rate.

## Characteristics of Defined Groups

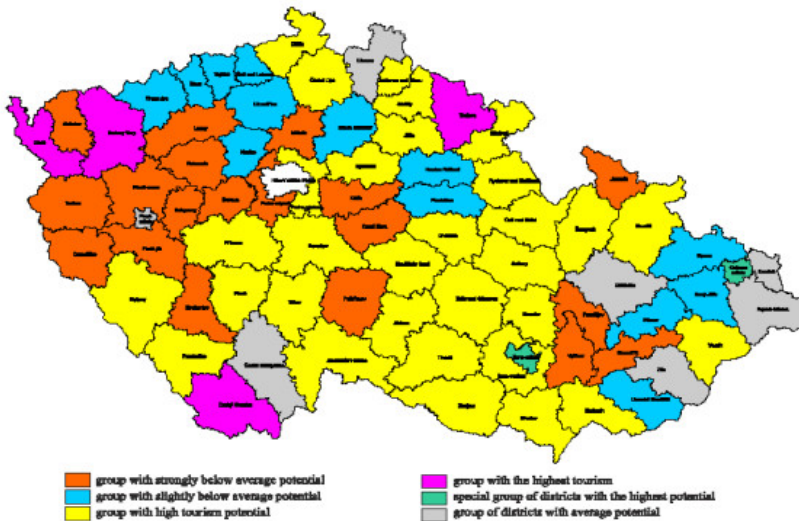
- **Strongly below average type of potential** in this group is based on the low number of monuments attractions and also the low attraction of the landscape. This is related to low level of infrastructure, particularly few accommodation facilities. The group has the lowest visit rate of tourists. Even these territories have tourism potential which must be utilized by perfect work of destination management.
- **A group with slightly below average potential** which is based (as in the first group) by small number of attractions, low potential of landscape, and weak infrastructure. In comparison with the first group there are districts with a larger number of inhabitants, population density twice as high, and higher air pollution. Visit rate is also below average but higher than in the first group.
- **A group with high tourism potential.** It is pleasant that this group includes most of the territory of the Czech Republic, proving that the republic as a whole has really high potential which has not been sufficiently utilized yet.
- **A group with the highest tourism potential** in the Czech Republic. The group has the highest attractions potential, landscape potential, and the best infrastructure facilities. Number of accommodation facilities is more than three times higher than national average. The national average for the number of visitors is exceeded even slightly higher (3.6 times). Trutnov District excels in both summer and winter tourism, Český Krumlov registered on the UNESCO List has a number of cultural attractions (Český Krumlov Château, Rožmberk Castle, Zlatá Koruna and Vyšší Brod Monasteries), water sports resort on Lipno Dam and Vltava River. The high potential of Karlovy Vary and Cheb Districts (Františkovy Lázně) is based on spa industry and it forms the following separate group.
- **A special group of districts with the highest potential** are the urban districts of Brno and Ostrava. Most tourists coming belong to a group called Business Tourists. These are the participants of congresses, fairs, workshops, etc. Such tourists are very welcome. Their expenditures are above average, estimated as three times greater than expenditures of ordinary tourists who travel because of recreation or knowledge. This kind

of tourism is necessary to expand into other regions. The problem is the highest crime rate in the Czech Republic and high air pollution.

- **A group of districts with average potential.** Coincides with the previous group in high air pollution (almost twice the national average) and high crime rate. It has a lower level of infrastructure. The number of visitors is slightly above average indicating a good utilization of the potential.

**In the Czech Republic there is no territory without tourism potential. However, there are considerable differences in its type, size, and utilization.**

Map No. 1 Tourism Potential in the Czech Republic



## Discussion and Conclusion

We are aware of the fact that there are many different methods for data clustering which differ by:

- Distance measurement between objects
- Algorithm for linking objects into clusters
- Interpretation of outputs

The meaningfulness of the clustering results depends both on the objective existence of clusters in the data and on arbitrarily set criteria of clusters definition (Mundt 2001). The aim of the analysis can be either to determine links

between objects (dendrogram is a sufficient output) or to identify clusters in the data that will be used in further analysis as a simplification of multidimensional issue. In the process of clustering the most similar objects are gradually clustered until all the objects are merged into one cluster connecting all the objects in the analyzed file.

- The aim of this work was **to prove whether the methods of the cluster analysis, which have already been used by in a whole number of scientific disciplines for many years, are usable also in tourism.**
- The work was not preceded by a field research, all the data used are taken from official sources – the public database of the Czech Statistical Office and the data of the Institute of Spatial Development in Brno.
- The district has been selected as the basic unit because there are sufficient data in the CZSO for this unit. The high amount of input data could not be objectively processed and evaluated by classical methods.
- According to the user needs the input data matrix can be adjusted for other territorial units and also for other input data. Publicly available software has been used for the evaluation.
- Our method of cluster analysis allowed identifying that the republic can be divided into 6 groups of districts differing in characteristics of tourism potential. The achieved distribution is in accordance with reality which proves the suitability of using the cluster analysis.

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# Features of the Labour Market in Russia

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## Abstract

The paper deals with the features of the labour market in Russia. The Russian labour market is neither quantitatively nor qualitatively balanced, there are significant disparities in pay for various categories of employee and regional labour markets differs significantly from each other. The labour market is developing in the context of the general crisis, marked by recession, structural deformities, a gap of commercial and technological linkages, over employment, illegal migration, depopulation, poor infrastructure of the labour market and a large share of the shadow economy. All these features are discussed in detail.

**Keywords:** labour market, average salary, unemployment

## Introduction

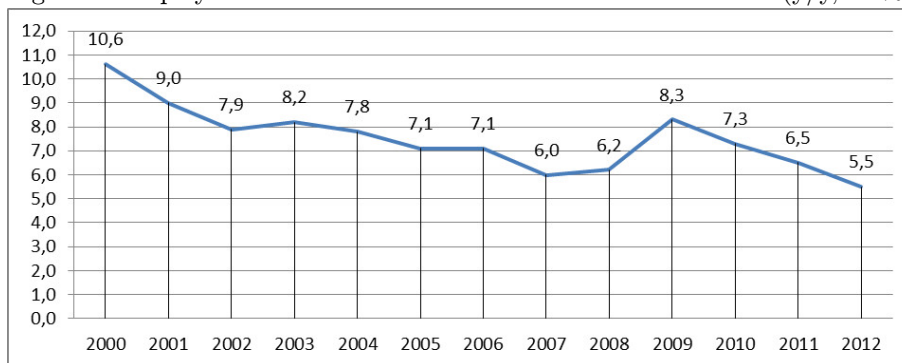
Nowadays, when globalization processes take place, providing the free movement of goods, services, capital and labour, the problem of the further development and regulation of market relations becomes the burning issue of the Russian labour market. Today the economically developed countries emphasize the development of human capital through investment in human resources, which must ensure the survival and competitiveness on the world markets in the 21<sup>st</sup> century. Amid slowing world population growth, the relative increase in the number of people in developing countries, as well as the ongoing process of “aging” (particularly in developed countries) there are the quantitative and, above all, qualitative changes in the workforce. Already, most of it falls on developing countries with lower levels of education and health care. In spite of high mobility and low-cost labour resources of these countries they have low qualifications and can rather answer to the purposes of the extensive (cost) than intensive (efficient) economy. While an absolute growth of labour force is still going on internationally, trends to reduce it have already occurred in some countries. Thereupon, the study of mechanism of the formation, operation and regulation of the labour market in Russia becomes the issue of paramount importance.

## Methodology and objective

The aim of the paper is to discuss the development of the labour market in Russia and its characteristic feature. The paper is trying to respond to the question: “How is the development of labour market dependent on structural changes in the economy and pay system reforms?” The data based on which the paper was carried out was obtained from the Russian State Committee on Statistics RF database and other public sources.

The establishing of a civilized labour market in Russia is in its infancy. During the Soviet period, its development was hampered by, on the one hand, high monopolization of the economy, stringent government regulation of wages, with its little differentiation depending on the results of labour, a lack of housing market, administrative constraints to moving to other cities. On the other hand, employees adhered to the enterprises via high proportion of services and benefits derived from social funds of enterprises, which were primarily provided to persons who had a great work experience. In particular, workers of large enterprises received housing, could arrange their children in day care, camp, got free or discounted trips to rest homes, health centres, etc.

Fig. 1 Unemployment rate in Russian Federation in 2000 – 2012 (y/y, in %)



Source: Rosstat (2013)

The scenario of market transformations of the social and labour sphere during the reforms of the 90's of the last century included a contraction of traditional activities in connection with structural changes in the economy, as well as the closure of inefficient industries that produced low-quality products. The actual release of workers (mainly of manual labour) was to be 18–20%, followed by their use in the non-productive sector. However, as a result of ill-conceived financial and credit policy of the State (issue of vouchers, default of 1998) the Foundation of most businesses, including manufacturing competitive products had been undermined. Effective demand was beginning to decline due to the devaluation of population's money savings. The practice of non-payment and delays of salary exacerbated the situation. Reducing or stopping production gave rise to unemployment, which further reduced the standard of living of the population and decreased effective demand

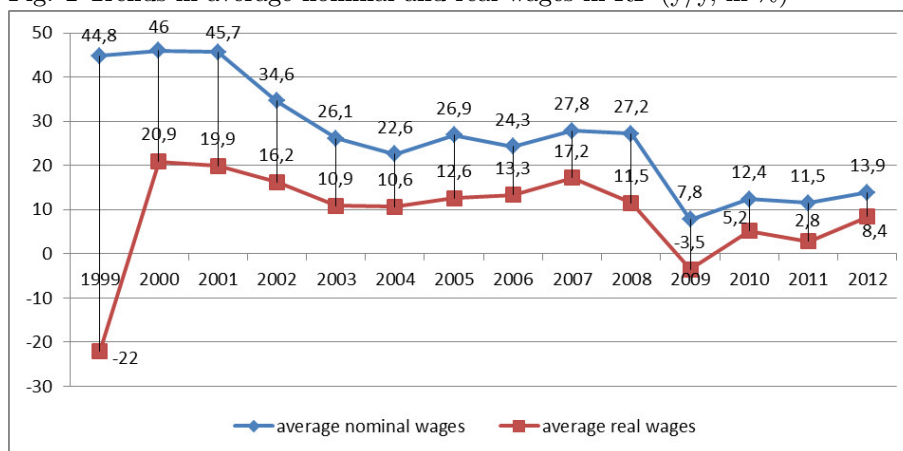
to a minimal set of goods and services. Many scientific organizations and defence enterprises were closed or subject to conversion, which was carried out in barbarous manner with the loss of modern equipment and high technologies, but the main loss was much of the elite of personnel employed in these enterprises. In many regions of the country the vocational qualification of the unemployed was higher than the requirements for the vacant jobs. The problem worsened thanks to socio-psychological factors: a decline in social status, loss of qualification when changing jobs (Odegov, Rudenko and Luneva 2007).

The pay system reforms were based on the rejection of State regulation of the differentiation of wages and restrictions on its growth. It was necessary to overcome the levelling out of the pay process, put wages in dependence on the actual qualifications of the employee, the efficiency and quality of their work, the demand for their products. In 1991–1997 there was an increase of wages, provoked market conditions affecting only some areas of employment (for example, a fast-growing financial-credit sector of the economy where wages have acted as a competitive tool, and does not reflect the real labour costs of employees). Self-regulation of the labour market has led to significant disparities in pay for various categories of employees.

## Results and discussion

The labour market cannot be regarded as an independent system; it is integrated into the economy of the entire country and is actively cooperating with other markets (consumer, monetary and financial, innovation, etc.). It is a sophisticated multi-functional system with a high degree of uncertainty and characteristics caused by the specificity of product, which is sold in this market.

Fig. 2 Trends in average nominal and real wages in RF (y/y, in %)



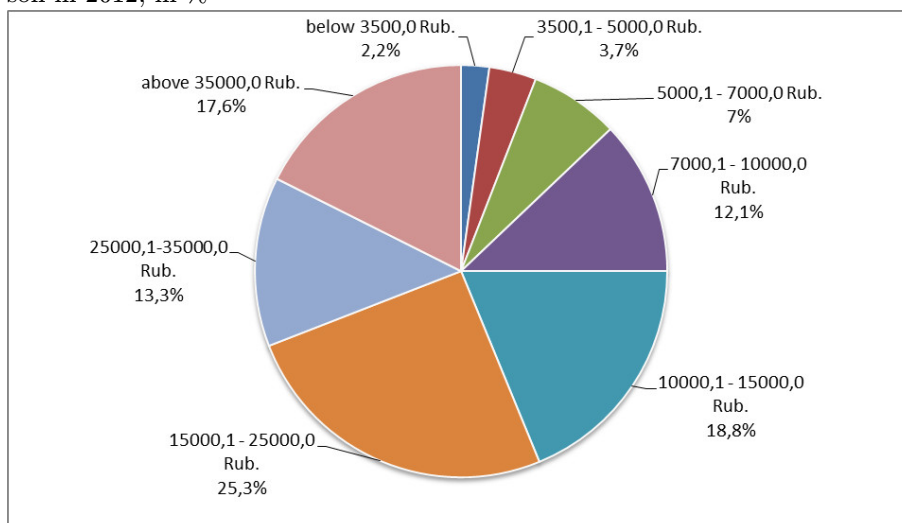
Source: Rosstat (2013)

According to N. Tonkov, Executive Secretary of the Russian Union of Industrialists and Entrepreneurs, by the end of the first quarter of the 21<sup>st</sup> century Russia will have a working population of 17% less than today, which is the same as the loss of each sixth worker. In view of this, nowadays the competition for a person's knowledge and skills is flaring up; it takes the form of encouragement or restriction of immigration and emigration, various preferences and social guarantees, development of education and training, involving the most gifted young people from other countries, etc.

In State Committee on Statistics RF data, in 2012, the average accrued salary of the employed in agriculture, forestry and hunting economy amounted to 13808 roubles, in education – 18236 roubles, in the financial sphere – 55981 roubles, production of energy minerals – 54849 roubles. The income gap is even more lamentable: the amount of the most affluent citizens income is 16.4 times higher than the income of the poorest people; every eighth Russian is below the poverty line (minimum subsistence is 6705 roubles when minimum wage – 5205 roubles) (Russia, Federal law N 232-FL 2012, Russian Federation Government resolution N 227 2013).

In official statistics. According to sociological research, 13.0% of citizens of the Russian Federation have official monthly income up to 3 thousand roubles, 27.8% – up to 7 thousand roubles. The income of wealthy Russians is 100 times higher than those of the poor. In Russia there are 101 billionaires, 160 thousand people with annual income of more than 1 million dollars; 440 thousand people get more than 100 thousand dollars a year (Domcheva 2012). Overall, the situation remains critical with wages. Wages today have neither the reproductive nor incentive function.

Fig. 3 Distribution of population by amount of average monthly income per person in 2012, in %



Source: Rosstat (2013)

The situation is exacerbated by the fact that the labour market develops in the context of the general crisis, marked by recession, structural deformities, a gap of commercial and technological linkages; over employment (hidden unemployment is 10–25% of employees); illegal migration; depopulation; poor infrastructure of the labour market and a large share of the shadow economy. Despite the fact that positive trends have recently emerged, the real situation is considerably different from those for which the reform has been initiated.

The status of regional labour markets differs significantly from each other. This is due to both natural-climate conditions and the economic state of the regions. Despite the continuing migration from the Northern, Eastern, Southern regions in the European part of the country, the level of their registered unemployment is above the average (1.5%) by 2 times. The maximum level is observed in the Republic of Ingushetia (48.9%), the Chechen Republic (35.3%), the Republic of Tuva (21.7%), Altai Krai (17.2%) (State Committee on Statistics RF 2013). These figures show that the deficit of labour does not automatically solve the problem of unemployment, and the combination of high unemployment with labour shortages is possible. For the next 20 years, the main problems of labour supply in the regions will be a potential labour reduction, combined with its aging and growing territorial disparities.

Nowadays the Russian labour market is neither quantitatively nor qualitatively balanced. Under the unemployment level (2012 – 4.0 million people or 5.3%) the number of vacancies by early 2013 totalled 1.3 million jobs. However, the structural mismatch between supply and demand did not allow filling the vacancies in the correct time, consequently the tension coefficient was 0.91<sup>1</sup>. There is a lack of maintenance workers, drivers, cooks, bricklayers, carpenters, seamstresses, salespeople; as well as doctors, teachers and engineers in the labour market.

And no wonder, in the post-reform period vocational schools has been halved<sup>2</sup>; training of personnel in occupations of the chemical, food, textile, footwear industry virtually stopped (RosBusinessConsulting 2012). Training of personnel for agricultural, construction, transportation and service occupations has been reduced. Jobs in this sector are filled by either non-professionally trained employees or those trained in other professions (including graduates). There is an overabundance of specialists in economics and management. The difficulties with providing personnel in working professions will increase especially in the period 2013–2020, when the number of the working-age population shrinks with the more intensity (for that period two thirds of total losses of occupational workforce are expected).

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<sup>1</sup>Tension coefficient is the ratio of the number of citizens registered at the employment service bodies in order to find suitable employment, the number of available jobs and vacancies.

<sup>2</sup>In the Soviet Union there were about ten vocational schools at one University, now – no more than two (<http://top.rbc.ru/economics/25/05/2012/652070.shtml>).

## Conclusions

The whole conception of the reforming of the labour market strategy calls for a complex approach, which include a succession of wide spectrum of macro-economic factors. According to the forecast, the transition from an industrial economy to an innovative type will cause the structural shifts in the professional qualification of employees:

- redistribution in favour of the contingent of non-manual workers (from 41.4% in the reference period up to 50% in 2025);
- increase of the proportion of middle-level specialists and officials involved in the preparation of information, documentation, registration and maintenance (current ratio in the number of senior and middle-level professional qualification specialists is heavily deformed to the detriment of the latter);
- change of the composition of the working staff in favour of skilled workers of the industrial sectors (from 36% in the reference period up to 43% in 2025);
- slowdown of the growth rate of the share of the service sector, housing and communal services, trade and related activities – the main reasons: a significant reduction of the size of the population and the adoption of new, more efficient forms of their employees work (Chizhova 2006).

In such circumstances, balance between supply and demand can be achieved either by reducing labour requirements via output reduction, or by improving the effectiveness of labour based on innovative technologies. No doubt, we need to choose the second way.

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## Charakteristické rysy trhu práce v Rusku

Příspěvek se zaměřuje na charakteristiku hlavních rysů trhu práce v Rusku. Ruský trh práce není kvantitativně ani kvalitativně v rovnováze, existují signifikantní disparity v odměňování různých kategorií zaměstnanců a trhy práce v jednotlivých regionech se od sebe výrazně liší. Tento trh práce se rozvíjí v kontextu celosvětové krize provázené recesí, strukturálními deformacemi, nedostačnou provázaností ekonomických a technologických faktorů, nezaměstnaností i přezaměstnaností, ilegální migrací, snižováním počtu obyvatel, špatnou infrastrukturou trhu práce a vysokým podílem stínové ekonomiky. Tyto faktory jsou v článku podrobněji diskutovány.

**Klíčová slova:** trh práce, průměrná mzda, nezaměstnanost

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# Municipal Area as a Criterion of the Czech Tax Assignment System

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## Abstract

This paper deals with municipal area defined by urban area of a municipality, counted area of municipality and total area of municipality. The aim of this paper is to determine whether the municipal area or the number of inhabitants of the municipality affect the expenditure associated with municipal area, how significant is this effect and what is the progress of a possible dependence. The influence of these variables is studied in this paper through correlation and regression analysis between the municipal area or population of municipality and municipal expenditure associated with the municipal area and revaluated to 1 ha. This paper assesses whether it is appropriate to use the municipal area as a criterion for the Czech tax assignment system. The analysis is performed on the example of the Zlín Region municipalities.

**Keywords:** tax assignment system, Czech Republic, Zlin region, municipality, municipal area, urban area of municipality, counted area of municipality, total area of the municipality, population of municipality, municipal expenditure

## Introduction

The most important source of income to municipal budgets in the Czech Republic is tax revenue. Currently (2013), on average, municipal tax revenue forms more than half of their total revenue. The allocation of the national tax revenue (or rather gross revenue of the income taxes and VAT) between municipalities depends on the Act No. 243/2000 Coll., Tax Assignment System. When this law was applied in 2001, the gross revenue of income taxes and VAT was distributed only through a single criterion (simple number of inhabitants of municipality), which over the time has been expanding and thus increasing the complexity of the set tax sharing system (the “System”).

Currently (2013), this law states four criterion on which is gross revenue of income taxes and VAT is distributed between the municipalities. They are: simply number of municipality inhabitants, converted number of municipality

inhabitants, number of pupils in nursery and primary schools funded by the municipality and counted area of municipality. The listed tax assignment system is further complicated by motivational components.

The complexity of the system is increased since the beginning of 2013, when the number of pupils in nursery and primary schools funded by municipalities was added to redistribution criterion and municipal area criterion was limited to a 10 ha counted area per inhabitant. It was also considered to using urban area of municipality as a criterion within the tax assignment system. Urban area of municipality, in certain aspects, may better reflect the field for the management, operation and financing managed by the municipalities (e.g. public green, pavements, municipal roads and other roads, public transport, street lights) and which do not relate to the entire municipality, respectively artificially set counted area of municipality, but mostly just an urban area. The area of urban area is closer to the actual area, which is managed by municipalities in reality and has greater information capability than the total area of the municipality or counted area of the municipality.

## Methodology

The paper investigates the dependence between the municipal area (expressed by total area, counted area and urban area), respectively the number of inhabitants of municipality and municipality expenditure per 1 ha of the municipal area (expressed by total area, counted area and urban area). The dependence between the given variables, its intensity and process is examined through correlation and regression analysis. Correlation analysis investigates the level of relationship between municipal area, respectively number of inhabitants and municipality expenditure converted on 1 ha of municipal area, when level of the relationship is measured by correlation coefficient. The regression analysis investigates if the change of municipal area, respectively number of inhabitants (in role of causes) by one unit will influence the municipal expenditure converted on 1 ha (in role of consequences) and how significant is this change. This will enable to define the definition of regression coefficient.

For purpose of verifying the possibility of application of conclusions of the analysis carried out by the example of Zlín Region municipalities in terms of all municipalities in the Czech Republic, confidence intervals of correlation coefficients are constructed and the statistical significance of these correlation coefficients as well as statistical significance of limits of their correlation coefficients are verified. For the same reason, confidence intervals for regression coefficients are constructed and the statistical significance of regression coefficients are verified; the statistical significance of limits of confidence intervals for regression coefficients aren't investigated due to their character.

The total area of municipality is defined by the area of all cadastral parts of municipality defined by the Czech Office for Surveying, Mapping and Cadastre (2012).

For the purpose of this paper the counted area of a municipality is defined as area of all cadastral parts of a municipality defined by the Czech Office

for Surveying, Mapping and Cadastre, although it is reduced to 10 ha per one inhabitant.

In determining the term urban area it may be used Decree No. 97/1966 Coll., which was implemented certain provisions of Act No. 53/1966 Coll., The protection of Agricultural Land. This decree is no longer valid, however, of any legislation in the Czech Republic it is the only one which defines the term urban area, as a continuously built-up area or otherwise technically adapted for municipality needs, while it includes an agriculture area into the area of urban area, but it does not create the agricultural land fund coherent whole (they are separated by a continuous built-up area or they are entering to the urban areas and they are not suitable for mechanical cultivation). In connection with the above, definitions the urban area for the purposes of the paper, was defined as the sum of the areas of gardens, built-up areas, water surfaces and other areas; other areas include plantation of trees, tracks, highways, roads (roads of I. to III. category), other roads (local, special-purpose and paved forest roads), other transport areas, green areas, sports facilities and recreation area and the cemetery and urn grove, cultural and educational area, handling area (not-built-up area between buildings of the same owner), mining area, landfill, barren soil and other surfaces). Agricultural areas (see definition of urban area of municipality) are not included in the urban area for purpose of this paper on the grounds that the other areas comprise green areas, which include street and the housing greenery, parks, etc.

Table 1 Budget subsections to determine the expenditure for this paper

221	Roads
222	Public Transport
233	Watercourse and water management works
234	Water in the agricultural landscape
251	Business Support
363	Municipality services and regional development
371	Protection of atmosphere and climate
373	Protection and remediation of soil and groundwater
374	Protection of Nature and Landscape
521	Protection of Population
527	Crisis Management
531	Security and Public Order
551	Fire Protection
617	Regional and Local Government (under this budgetary subsection are recorded financial expenses associated with public management executed by the municipalities, while the grant amount from the general cash administration was deducted with the exception of subsidies for construction authorities, whose expenses to a certain extent depend on the area of the municipality).

Source: own elaboration on the basis of dates of Decree No 323/2002 Coll.

Expenditure for the purpose of this paper is divided into the current expenditure, capital expenditure and total expenditure (in terms of kind classification

of budgetary structure). Within these expenditures are defined expenditures in the budget subsections (in terms of sector classification of budgetary structure), where there is an assumption that their value is primarily influenced by the municipal area. These budget subsections are defined in the following Table 1. The budget subsections do not include the three budget subsections; 372 (Waste Management) due to the significant revenues associated with this area; 231 (Drinking Water) and 232 (Sewage and Waste Water Treatment) because of the assurance of this area in small municipalities by themselves and in large municipalities and towns by authorized external parties.

The expenditures deducted for the paper are subsequently converted by the corresponding municipal area in order to utilize them further.

The aim of this paper is to determine whether the municipal area (expressed as total area, counted area, intravilan), respectively the number of inhabitants, has the impact on municipal expenditures depending on the municipal area and how significant is the impact and what is the progress of a possible dependence.

The paper has analyzed data considering Zlín Region municipalities. There were 304 municipalities in the Zlín Region within the monitored period 2009–2011, which represents less than 5 % of the municipalities of the Czech Republic, an average of about 589 thousand population, which represents less than 6 % of the population of the Czech Republic and is located on 396 thousand ha, which represents a 5 % share of Czech Republic's area.

## Results

### Urban area of the municipality versus the municipal expenditure

Expenditure for this part of the paper is converted by urban area and subsequently correlated with the urban area and number of inhabitants in the municipality. It is also examined the average change in expenditure converted into the urban area when changing the urban area by one hectare and changing population by 1 person. Specific values of the coefficients of correlation (CC) and regression (CR) are shown in Table 2. Note statistically significant (SS) or statistically insignificant (SI) near the examined values of coefficients of correlation and regression and near the limits of confidence intervals for correlation coefficients are mentioned.

From Table 2 it is evident that the dependence of urban area respectively population and current expenditure converted to urban area is strong to very strong, in case of capital expenditure is dependence weak and in the case of total expenditure is dependence moderate to strong. Then, with 95 percent of probability, correlation and regression coefficients calculated for all municipalities of Czech Republic are situated in the above intervals. Limits of confidence intervals for correlation coefficients are statistically significant too. The lower limits of confidence intervals in case of capital expenditures are the exception, they are statistically insignificant; there is a possibility that some municipalities in the Czech Republic have different conclusions in capital expenditures.

However, capital expenditures don't show some tendency, but they are dependent on individual decisions of councils and therefore, certain independency on urban area of municipality and number of citizens of municipality isn't surprising.

Table 2 Average values of correlation and regression coefficients for indicator urban area of Zlín Region municipality for the years 2009 – 2011<sup>1</sup>

	Current Expenditure	Capital Expenditure	Total Expenditure
CC "intravilan" × "expenditure/intravilan"	0.61 SS	0.17 SS	0.45 SS
Confidence intervals for CC "intravilan" × "expenditure/intravilan"	0.53 SS < CC < 0.68 SS	0.06 SI < CC < 0.28 SS	0.37 SS < CC < 0.60 SS
CC "population" × "expenditure/intravilan"	0.75 SS	0.17 SS	0.52 SS
Confidence intervals for CC "population" × "expenditure/intravilan"	0.70 SS < CC < 0.80 SS	0.06 SI < CC < 0.28 SS	0.46 SS < CC < 0.69 SS
CR "intravilan" × "expenditure/intravilan"	0.0601 SS	0.0232 SS	0.0833 SS
Confidence intervals for CR "intravilan" × "expenditure/intravilan"	0.0523 < CR < 0.0680	0.0112 < CR < 0.0352	0.0672 < CR < 0.0995
CR „population“ × „expenditure/intravilan“	0.0030 SS	0.0010 SS	0.0040 SS
Confidence intervals for CR "population" × "expenditure/intravilan"	0.0028 < CR < 0.0033	0.0005 < CR < 0.0015	0.0034 < CR < 0.0047

Source: own elaboration and calculation on the basis of data from Czech Office for Surveying, Mapping and Cadastre 2012; Decree No. 276/2009 Coll.; Decree No. 245/2010 Coll.; Decree No. 259/2011 Coll.; Ministry of Finance of the Czech Republic 2012a, 2012b.

The table also shows the values of regression coefficients, e.g. if the urban area changes by 1 ha, the current expenditure changes by an average of 60 CZK/1 ha of urban area and if the number of inhabitants changes by one it will change current expenditure in average by 3 CZK/1 ha of urban area. Analogously data may be derived from other values of the regression coefficient.

### **Counted area of the municipality versus municipal expenditure**

Expenditure for the purpose of this part of paper is converted by counted area and subsequently correlated with the counted area and the number of inhabitants in the municipality. Also it is examined the average change in expenditure converted by area of counted area in case of change of area of counted area by 1 ha and in case of change in population by 1 person. Particular values of the coefficients of correlation and regression are shown in Table 3.

<sup>1</sup>CC = correlation coefficient, CR = regression coefficient.

Note statistically significant (SS) or statistically insignificant (SI) near the examined values of coefficients of correlation and regression and near the limits of confidence intervals for correlation coefficients are mentioned.

Table 3 Average values of correlation and regression coefficients for indicator counted area of Zlín Region municipalities for the years 2009 – 2011

	Current Expenditure	Capital Expenditure	Total Expenditure
CC "counted area" × "expenditure/counted area"	0.39 SS	0.08 SI	0.30 SS
Confidence intervals for CC "count. area" × "expenditure/counted area"	0.29 SS < CC < 0.48 SS	-0.03 SI < CC < 0.19 SS	0.19 SS < CC < 0.40 SS
CC "population" × "expenditure/counted area"	0.79 SS	0.30 SS	0.62 SS
Confidence intervals for CC "population" × "expenditure/count. area"	0.74 SV < CC < 0.83 SV	0.19 SV < CC < 0.40 SV	0.55 SV < CC < 0.68 SV
CR "counted area" × "expenditure/counted area"	0.0019 SS	0.0006 SS	0.0024 SS
Confidence intervals for CR "count. area" × "expenditure/counted area"	0.0014 < CR < 0.0023	0.0001 < CR < 0.0010	0.0016 < CR < 0.0033
CR „population“ × „expenditure/counted area“	0.0008 SS	0.0003 SS	0.0011 SS
Confidence intervals for CR "population" × "expenditure/counted area"	0.0008 < CR < 0.0009	0.0002 < CR < 0.0004	0.0010 < CR < 0.0013

Source: own elaboration and calculation on the basis of data from Czech Office for Surveying, Mapping and Cadastre 2012; Decree No. 276/2009 Coll.; Decree No. 245/2010 Coll.; Decree No. 259/2011 Coll.; Ministry of Finance of the Czech Republic 2012a, 2012b.

Table 3 shows that the dependence of counted area, respectively population and current expenditure converted to counted area is medium, respectively very strong, in the case of capital expenditures is very weak, respectively medium, in case of the total expenditure is medium dependency, respectively stronger. On the basis on data from table 3, correlation and regression coefficients are statistically significant. With 95 percent of probability, their values for all municipalities in Czech Republic are situated in intervals specified in table 3. Also, limits of confidence intervals for correlation coefficients are statistically significant, with the exception of the lower limits of confidence intervals for correlation coefficients in case of capital expenditures; they are statistically insignificant. This finding isn't surprising considering that capital expenditures don't show the tendency to a certain indicators but they are rather dependent on the individual decisions of councils.

The given table also shows the values of regression coefficients, e.g. if the area of the counted area change by 1 ha, it will change the current expenditure by an average of 2 CZK/1 ha of counted area and in case of change of the number of inhabitants by one will change current expenditure an average of about

1 CZK/1 ha of counted area. Analogously the data may be derived from other values of the regression coefficients.

**The total area of the municipality versus municipal expenditure**

Expenditure for the purpose of this part of the paper is converted by total area and subsequently correlated with the total area and the number of inhabitants in the municipality. It is also examined the average change in expenditure converted on the total area with the change in the total area by one hectare and change in population by 1 person. Particular values of the correlation and regression coefficients are shown in Table 4. Note statistically significant (SS) or statistically insignificant (SI) near the examined values of coefficients of correlation and regression and near the limits of confidence intervals for correlation coefficients are mentioned.

Table 4 Average values of correlation and regression coefficients for indicator total area of Zlín Region municipalities for the years 2009 – 2011

	Current Expenditure	Capital Expenditure	Total Expenditure
CC “total area” × “expenditure/total area”	0.39 SS	0.12 SI	0.30 SS
Confidence intervals for CC “total area” × “expenditure/total area”	0.29 SS < CC < 0.48 SS	0.01 SI < CC < 0.23 SS	0.19 SS < CC < 0.40 SS
CC “population” × “expenditure/total area”	0.80 SS	0.30 SS	0.62 SS
Confidence intervals for CC “population” × “expenditure/total area”	0.76 SS < CC < 0.84 SS	0.19 SS < CC < 0.40 SS	0.55 SS < CC < 0.68 SS
CR “total area” × “expenditure/total area”	0.0019 SS	0.0006 SS	0.0024 SS
Confidence intervals for CR “total area” × “expenditure/total area”	0.0014 < CR < 0.0023	0.0001 < CR < 0.0010	0.0016 < CR < 0.0033
CR „population“ × „expenditure/total area“	0.0008 SS	0.0003 SS	0.0011 SS
Confidence intervals for CR “population” × “expenditure/total area”	0.0008 < CR < 0.0009	0.0002 < CR < 0.0004	0.0000 < CR < 0.0011

Source: own elaboration and calculation on the basis of data from Czech Office for Surveying, Mapping and Cadastre 2012; Decree No. 276/2009 Coll.; Decree No. 245/2010 Coll.; Decree No. 259/2011 Coll.; Ministry of Finance of the Czech Republic 2012a, 2012b.

From Table 4 it is evident that the dependence of the total area, respectively population and current expenditure converted on the total area is medium, respectively very strong, in the case of capital expenditure is rather weak, respectively medium, in case of the total expenditure is dependent medium, respectively stronger. On the basis of calculation it can be concluded that correlation and regression coefficients are statistically significant; with regard

to the results of analysis, correlation and regression coefficients for all municipalities in Czech Republic are situated in intervals stated in table 4 (with 95 percent of probability). Again, capital expenditures create the exception; lower limits of confidence intervals for correlation coefficients are statistically insignificant due to character and irregularity of investments; investments aren't dependent on particular factor.

The table also shows values of the regression coefficients, e.g. if the total area changes by 1 ha, it will change the current expenditure by an average of 2 CZK/1 ha of the total area and if the number of inhabitants changes by one it will change current expenditure an average of about 1 CZK/1 ha total area. Analogously the data may be derived from other values of the regression coefficients.

Comparing the values of the coefficients of correlation and regression in Table 3 it can be seen that their values are almost identical.

### **Population of the municipality versus municipal area**

It is reasonable that the population of the municipality is a very important element. To what extent the number of inhabitant is interconnected with municipal area (expressed as the total area, counted area and urban area) is also important.

Table 5 contains the values of the coefficients of correlation and regression between the number of inhabitants and the municipal area (expressed as the total area, counted area and urban area), and other way around the values of the coefficients of correlation and regression between the municipal area (expressed as the total area, counted area and urban area) and population. Note statistically significant (SS) or statistically insignificant (SI) near the examined values of coefficients of correlation and regression and near the limits of confidence intervals for correlation coefficients are mentioned. Table 5 examines whether the dependence exists between these variables, how significant it is and how the municipal area will in average change in case of change of the population by one person and how much population will change if the municipal area will change by 1 ha.

Based on the table 5 it can be concluded that the dependency between population and urban area is almost absolute, dependence between the population and counted area or a total area is also strong, but not as significant as in the case of intravilan.

Values of regression coefficients indicate that with the change in population by one person, urban area will change in average 0.0363 ha, counted area will change by 0.1486 hectares of counted area and total area by 0.1485 hectares of the total area. On the contrary, the change urban area by 1 ha will change an average population by about 21 people, in the case of counted area and the total area that are on average about 3 citizens.

Correlation and regression coefficients are statistically significant. Then, with 95 percent of probability, correlation and regression coefficients calculated for all municipalities in the Czech Republic are situated in the above

intervals; limits of confidence intervals for correlation coefficients are statistically significant too.

Table 5 Average values of the coefficients of correlation and regression between population and area municipalities (and vice versa) for the years 2009 – 2011

CC „urban area“ × „population“	0.87 SS
Confidence intervals for CC „urban area“ × „population“	0.84 SS < CC < 0.89 SS
CC „counted area“ × „population“	0.68 SS
Confidence intervals for CC „counted area“ × „population“	0.61 SS < CC < 0.74 SS
CC „total area“ × „population“	0.68 SS
Confidence intervals for CC „total area“ × „population“	0.61 SS < CC <
CR „urban area“ × „population“	21.0340 SS
Confidence intervals for CR „urban area“ × „population“	19.7084 < CR < 22.3593
CR „counted area“ × „population“	3.0849 SS
Confidence intervals for CR „counted area“ × „population“	2.7056 < CR < 3.4655
CR „total area“ × „population“	3.0858 SS
Confidence intervals for CR „total area“ × „population“	2.7065 < CR < 3.4650
CR „population“ × „urban area“	0.0363 SS
Confidence intervals for CR „population“ × „urban area“	0.0340 < CR < 0.0386
CR „population“ × „counted area“	0.1486 SS
Confidence intervals for CR „population“ × „counted area“	0.1303 < CR < 0.1668
CR „population“ × „total area“	0.1485 SS
Confidence intervals for CR „population“ × „total area“	0.1303 < CR < 0.1668

Source: own elaboration and calculation on the basis of data from Czech Office for Surveying, Mapping and Cadastre 2012; Decree No. 276/2009 Coll.; Decree No. 245/2010 Coll.; Decree No. 259/2011 Coll.

## **Evaluation and conclusions**

From 1 January 2008, the Czech system of tax assignment was adjusted, among others, the redistributive criteria of the total area of the municipality was introduced. Three percent of the gross revenue of the income taxes and VAT began to be distributed in accordance with the total area of each municipality. This criterion should give an advantage to the municipalities with lower population density and those who were prevented in conjunction with neighbouring municipalities by geographic conditions or it should offset the increased costs associated with the repair and maintenance of local roads and transport services. Already in 2007, due to the high variability of population density in the Czech Republic there were assumed significant differences not only between small and large communities, but also between different communities within a certain size category. The system worked unchanged until the end of 2012, when, with effect from 1 January 2013 there was limited criterion of total area to 10 ha per person. The reason for this provision was just criticism of existing extremes in tax revenues of municipalities with large rural areas (extravilan). On the contrary, this is criticized by municipalities with a small population with reasonable size of area, because this step will significantly reduce their revenue and consequently the extent of expenditure. The professional public is questioning the logic of linking the criteria of the total area and population, and they are proposing to use urban area (or its modification in the form of built-up area or residential area).

The purpose of this paper was to determine whether the municipal area (expressed as total area, counted area, urban area), eventually the number of inhabitants has the impact on municipal expenditure depending on the area of the municipality and how significant is the impact and what is the progress of a possible dependence (influence).

When calculating expenditure on 1 ha of municipal area and their subsequent correlation with the municipal area shows that dependency is the strongest in the case of urban area, nearly one-third higher than in the case of dependence counted area and the total area; in the case of current, capital and total expenditure.

When calculating expenditure on 1 ha of municipal area and their subsequent correlation with the number of inhabitants in the municipalities it shows that the dependency is slightly higher in the case of the counted area and the total area, but only very slightly; namely for current, capital and total expenditure. There is not any really noticeable difference.

The values of regression coefficients also show that changes in urban area have a much greater impact on expenditure than the changes of counted area and total area of municipality. E.g. the growth of the urban area by 1 ha will increase current expenditure by about 60 CZK/1 ha, capital expenditure by 23 CZK/1 ha and the total expenditure by about 83 CZK/1 ha. In contrast, the growth in the counted area and the total area by 1 ha will increase current expenditure by about 2 CZK/1 ha, capital expenditure by about 1 CZK/1 ha and a total expenditure by less than 3 CZK/1 ha.

The values of regression coefficients also show that changes in population have a much greater impact on expenditure converted by urban area than on the expenditure converted by counted area and by total area. E.g. population growth by 1 person will increase the current expenditure converted to 1 ha of urban area by CZK 3, capital expenditure converted to 1 ha of urban area by 1 CZK and total expenditure calculated on 1 ha of urban area by CZK 4. In contrast, population growth by 1 person will increase current expenditure calculated on a 1 ha of counted area and total area by less than 1 CZK, capital expenditures calculated on a 1 ha area of counted a total area by 0.30 CZK and total expenditure converted on 1 ha of counted area a total area by about CZK 1.

These differences in the values of regression coefficients are given by the extent of area, which is registered in each type of area municipalities, but even so the difference is significantly large.

The dependency between population and municipal area is strongest when it is given to the urban area of the municipality, the dependence is very strong, almost absolute and almost one-fifth higher than in the case where a municipal area is given by the counted area and total area. Looking at the regression coefficients between population and municipal area can see that on the 1 residents it is on average of 0.0363 ha urban area, the counted area of 0.1486 ha and 0.1485 ha of the total area. Regression coefficients between municipal area and population again shows that on 1 ha of urban area it is on average about 21 residents, on 1 ha of counted area a total surface area it accrues in average for 3 people. This demonstrates that the dependency ratio is much higher among the urban area and the population and vice versa.

Statistically significant correlation and regression coefficients and their confidence intervals, in the case of confidence intervals for correlation coefficients supplemented by statistical significance their limits, show that the results of the analysis and subsequently conclusions drawn from this analysis can be applied with respect to all municipalities of the Czech Republic.

Based on the analysis, it was determined that municipal area in terms of the urban area, counted area or total area, the most associated with the expenditure connected with the area is just urban area. Thus, in terms of use municipal area criterion within a tax assignment system it could be more suitable just urban area than previously used total area or currently used counted area. However, just the urban area depends the most on the population from the given criterions. The reason for the inclusion of criteria in the tax assignment system would not be its dependence but it is its "independence" so it could reflect to a certain extent other differences and specificities of individual municipalities. The remaining two kinds of municipal area would be the best to use, but even here the relationship between population and counted a total area is very strong, and thus raises a similar problem as in the case of urban area.

Looking at the results from the analysis point of view it can be seen that in the case of the dependency between expenditure and the population; values of correlation coefficients are relatively high and higher than in the area. These

correlation coefficients are similar to those exceptions, the current expenditure has been estimated in a very strong dependency.

Based on the above it can be stated that municipal area expressed by the urban area, counted area or total area has a certain impact on expenditure and it has great significance for municipal management. If, however, it will be considered adjustment of the tax assignment system in terms of need to modify the municipal area as criteria for redistribution, then urban area would be the most appropriate criterion. Not only that, the urban area has the greatest impact on the expenditure of municipalities in terms of different expression of area of the municipality, in some respects, better reflects the area of the administration and financing under the municipalities responsibility, and more so it corresponds to the area about which the municipality really cares, and may also have more appropriate ability than the counted area and the total area of the municipality.

However, the urban area (slightly less counted area and total area) and population are very strongly linked to each other. At the same time it can be seen that the dependence between population and expenditure converted to the area in all cases is greater than the correlation between municipal area and expenditure converted to the municipal area. In addition, tax revenue attributable to the municipality according to the criteria of the total area is on average about 31 thousand CZK/1 km<sup>2</sup> (Tománek 2011). In terms of expenditure related to the area, for 1 km<sup>2</sup> of total area accounts for the total expenditure of about 1 million CZK, on 1 km<sup>2</sup> of urban area, which is on average, about 7.5 million CZK. From this point of view is not very logical argument to interconnect the revenue side with the expenditure side.

In relation to the facts mentioned above, it can be stated that from broader context view, the results of the analysis and its conclusions and in terms of simplicity, clarity and comprehensibility of the Czech tax assignment system it is more suitable to abandon the criterion of area (in whatever terms) and retain its influence only through criteria of population.

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## Rozloha obcí jako kritérium českého systému rozpočtového určení daní

Tento příspěvek se zabývá rozlohou obce vyjádřenou intravilánem, započtenou plochou a celkovou rozlohou. Cílem příspěvku je zjistit, zda rozloha obce, resp. počet obyvatel v obci, mají vliv na obecní výdaje spojené s rozlohou obce, jaký je tento vliv a jaký je průběh případné závislosti. Vliv těchto proměnných je v příspěvku zkoumán prostřednictvím korelační a regresní analýzy mezi rozlohou obce nebo počtem obyvatel obce a obecními výdaji spojenými s rozlohou obce a přepočtenými na 1 ha rozlohy obce. Příspěvek tak hodnotí, zda je vhodné použít rozlohu obce jako přerozdělovací kritérium v českém systému rozpočtového určení daní. Analýza je provedena na příkladu obcí Zlínského kraje.

**Klíčová slova:** rozpočtové určení daní, Česká republika, Zlínský kraj, obec, rozloha obce, intravilán obce, započtená plocha obce, celková rozloha obce, počet obyvatel obce, výdaje obcí

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# Selected Characteristics of Family Business in the Construction Industry of the Czech Republic

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## Abstract

The aim of this paper is to identify and outline the characteristics that distinguish family businesses from non-family businesses in the construction industry of the Czech Republic. The paper presents the results of the research that was carried out in the construction market of the Czech Republic in the years 2007–2011 and that indicated some connections with the current knowledge from the field of family business. Characteristics that distinguish family businesses from non-family businesses were defined by means of literary sources – Orientation to maintaining the business; Tendency to centralization; Orientation to local markets, Customer Orientation, Applied Business Strategy and Number of employees. In accordance with the theoretical concept, it was found out that family businesses have on average a smaller number of separate establishments than non-family businesses. It was found out that the observed family businesses slightly better manage to adapt their offer to customer requirements and also that they pay more care to customers, which supports the hypothesis of higher orientation of family businesses to customers. Business strategies of family businesses are focused on the strategy of differentiation. The tendency to employ a lower number of employees was also confirmed at both family and non-family businesses. In contrast, quality of production was slightly lower in family businesses.

**Keywords:** family business, strategy, centralization, customer orientation, employees

## Introduction

Family business is an important part of business activities with impacts on the national economy. Family businesses contribute significantly to GDP, for example, International Enterprise Research Academy states in 2008 that family businesses make up 85% of all enterprises in the EU. The most famous researchers in the field of family business (Koiranen 2007) describe family businesses as “the backbone of the European economy.” In geographical terms,

the largest share of family businesses is in Italy, where 95% of all enterprises are based on family businesses. In the Czech Republic the issue of family businesses is currently presented on the basis of issues related to small and medium-sized enterprises (SMEs). It is particularly because of the defined support of the state itself as well as representatives of public authorities. It turns out that there are differences among regions in drawing of subsidies related to the support of SMEs and thus family businesses (Váchal et al. 2010). This can lead to negative consequences that affect family businesses mainly in times of economic instability. Some surveys suggest that small business owners know the business environment; however, their preparation to solve the problems linked to the external environment (financial crisis of 2009) is insufficient (Mikušová 2010).

With regard to the described facts, it would be interesting to find out how family businesses behave in confrontation with the effects of the crisis, coming from the external environment. Is it possible to confirm some findings related to the essential characteristics of family businesses? Conducted surveys (Strážovská 2004; Hanzelková 2006; Koráb et al. 1998) indicate that family businesses do not concentrate on short-term profit, but they concentrate on the future; it is rather the question of long-term sustainability. Far more than non-family businesses they are able to sacrifice profits to further running of the company, becoming thus more resistant to critical situations. Family businesses are then becoming relatively reliable business partners. Also progressivity of family businesses lies in the fact that they provide jobs for risk groups of population.

The aim of this paper is to find out whether the identified characteristics related to family business in the developed world also apply to family businesses in the Czech Republic. As the aim of the survey is to find out how family businesses behave when influenced by external negative factors (financial crisis), it is the construction sector from which family businesses are deliberately chosen. Basic characteristics are examined on a sample with the character of family and non-family businesses and their mutual comparison between the years 2007 and 2011.

## **Theoretical Foundations**

Characteristics that distinguish family businesses from non-family businesses can be defined on the basis of available literature sources. With regard to the scope of the conducted research and the possibilities of interpretation of the results the following characteristics are chosen based on their frequency in the literature.

### **Orientation to the long-term existence of the business**

A long-term plan or long-term orientation is one of the strengths of family businesses, which represents a substantial competitive advantage (Kets de Vries 1996). Orientation to maintaining the business instead of maximizing profit is typical for family businesses. It is closely related to risk aversion and confidence.

Particularly, risk aversion, which was confirmed by the surveys on Swedish family businesses conducted in 2007 by Naldi et al, can be considered as one of the characteristics that allowed family businesses to survive the economic crisis between the years 2008 and 2013. Confidence seen in family businesses reinforces the belief of stakeholders that liabilities of family businesses will be met. The more intimate environment in the family business is, the longer term prospects the family business has (Sundaramurthy 2008). Confidence also reinforces mutual cooperation, relations among people, reduces the risk of conflict, reduces transaction costs, facilitates the effective solving of conflicts and supports the running of the business (Sundaramurthy 2008; according to Rousseau et al. 1998), for example in terms of sales achieved.

The long-term prospects of family businesses are particularly true when shares of profits obtained from the business meet needs of the family and there is no reason for further business growth (Koráb 2005). The stability of the business has priority over maximum profit, which is not the case of non-family businesses. The long-term vision of family businesses is particularly reflected in setting long-term goals. Plans of long-term goals in family business tend to be more efficient (Koráb et al. 1998) and can lead to maintaining businesses in difficult economic conditions.

### **Centralization of management**

Centralization towards the family results probably from the awareness of business ownership (Koiranen 2007). Directors of the company are thus very reluctant to give up power over the company that they built. They want to know everything that is going on in the company, and often quite a long time after they left their leading post to their successor. The low autonomy of family businesses is also mentioned in works of (Huovinen and Tihula 2008). They justify centralization of the management of family businesses in the hands of families by the fear of losing control over the business and also losing independence of other managers. The centralization of decision-making towards the family is also supported by demonstrated nepotism and paternalism, through which the power is concentrated into the hands of the family. Distribution of power in the family business expects that the business owner surrenders a certain degree of responsibility in favour of a new employee – manager. This step, however, requires a certain degree of confidence. A typical feature of paternalism seen in the management of the family business is for example the tendency to autocracy, strong need for control, distrust of other co-workers, the need for recognition and the inability of the delegation (Kets de Vries 1996; Hanzelková 2004).

### **Orientation to local markets**

Orientation of family businesses to local markets and higher customer care was proved by the research which was carried out by Gallo and Svein in 1991. Such strategies of family businesses may be hard to change because of the influence of the family on business. The founders of family businesses try to build

good relationships with their stakeholders through values transferred to business. Good relationships with stakeholders are closely related to the quality of work and attitudes of staff and families. Kets de Vries (1996) even states that the management of the family business often identifies itself with products, and that is why they pursue high quality of the products. In family businesses, family values are transmitted on business environment which has a positive impact on the quality of the product (Schein 1995; Taguiri and Davis 1996). Good relations maintained by the founders of family businesses require responsible and solid approach, which is time-consuming. Therefore, family businesses focus more on local markets, where such relationships are easy to maintain with relatively low transaction costs. The result is that far fewer family businesses expand abroad than non-family businesses (Gallo and Sveen 1991). This fact also results from their conservatism and poor orientation to growth (Doncles and Fröhlich 1991), even in sectors that are otherwise quite dynamic. It may also relate to orientation of family businesses to maintaining the business and aversion to risk (Doncles and Fröhlich 1991). Penetrating foreign markets is linked with uncertainty, which is in conflict with the strategy of maintaining the business.

### **Customer orientation**

Customer orientation is related to the emphasis on tradition and quality that characterize family businesses. For family businesses, customers are one of the most important stakeholders (Pricewaterhouse Coopers 2007; Strážovská 2002); therefore they try to get their utmost satisfaction.

### **Business strategy**

The results of empirical surveys (Odehmalová 2008) show that family businesses apply more the strategy of differentiation i.e. focusing on the specific nature of products with the option to demand higher prices, combined with a wide range of products and a wide range of customers.

### **Number of employees**

A typical feature of family businesses is also a small number of employees (IFERA Fact and Figures 1996; the National Study of Family Business 1997; Lussier 2004). A small increase in the number of employees is related to paternalistic behaviour of the founder (Dyer 1988; Dyer, Hilburt – Davis 2003), as well as to characteristic directive management, hierarchical relationships, centralization of management and distrust of other workers. It is particularly the paternalistic behaviour with the aim of keeping the business in the “founder’s own hands” that leads the reluctance of the founder to employ more employees. A higher number of employees requires a more professional approach, in particular formalization of procedures and delegation of management. Through delegation of tasks, the responsibility for the company is partly transferred to lower level employees. Founders of companies, however, are well aware

of the fact that managers can't play the role of entrepreneurs, because of other preferences and the low level of responsibility associated with the risk of possible failure (Říkovský 2002).

## Methodology

The database of the survey "Competitiveness of Enterprises", which was carried out between the years 2007 and 2011 (Blažek et al. 2007), was used for investigation of the different characteristics of family and non-family businesses.

421 companies from manufacturing and construction industries took part in the survey of Masaryk University. Within this group, 81 companies were identified that fall according to the sectoral classification CZ – NACE in category F – the construction industry. What year? And what economic results – until when?

In this category, 21 family businesses were found, defined on the basis of the assumption: "Family business is an enterprise in which at least two members of one family work and who have a direct influence on the management of the company" (by Odehnalová 2011; Lukeš, Nový et al. 2005; Sten 2007; Taguiry and Davis 1996). The remaining 60 companies can be considered as businesses that do not meet the basic definition of family business.

The construction sector was, like many other industries, hit by the economic crisis. Within the sector the first signs of the crisis appeared already in 2008, when a slight drop in building construction was seen, while a decrease in civil engineering appeared about two years later (Czech Statistical Office). Construction production index has been declining year on year since 2009; between the years 2010 and 2011 it declined by 3.5%. In 2012, construction output fell by 6.5% year on year. Building authorities issued by 8.8% fewer building permits and their orientation value declined by 6.3%. The total value of new construction orders in the Czech Republic fell by 18.4% year on year. The number of flats whose construction began was lower by 13.4% in 2012 than in 2011. The number of completed flats grew by 3.0%. One reason for this unfavourable situation in the construction sector is ongoing weak demand due to the continued careful approach of private investors, combined with limited state budget (Czech Statistical Office 2013).

In 2012 construction output declined by 6.5% year on year. Building construction recorded a decline of 3.4% year on year and civil engineering fell by 13.6%. Construction output fell by 17.0% in 2012 in comparison with the year 2008 (Czech Statistical Office 2013). Construction declined year on year for the fourth year. In the last two years it was below the level of the years 2007 and 2008, when it peaked (Czech Statistical Office 2013).

These facts have a major impact on the competitiveness and even the very existence of businesses. Many companies did not manage to overcome the critical decline in the sector of construction production and had to terminate the business. The fact whether there are differences in the behaviour of family and non-family businesses during the economic crisis was also surveyed within the examined sample of companies.

Characteristics of family businesses were surveyed on the given sample of companies by means of questionnaires. The questionnaires included the following types of questions covering the examined characteristics.

Orientation to maintaining the business: The survey that identifies businesses that survived the economic crisis lasting from the year 2008 was carried out in 2013.

Centralization of management is related to the question: “Give the number of separate establishments including the headquarters.”

Orientation to local markets is related to the question: “Express in percentage opinions of customers from the region and outside the region.”

Customer orientation is related to a set of questions: “What care, in comparison with competitors, is paid to customers of your company?” “How do you rate, in comparison with competitors, the ability of your company to tailor products to customer requirements?” “How do you rate, in comparison with competitors, the quality of products of your company?”

Applied business strategy of management is related to the question: “What business strategy does your company apply?”

The number of employees is related to the question: “Give the total number of employees of your company.”

To identify the characteristics of the studied group of companies, the method of descriptive statistics, namely absolute and relative frequency, comparison of averages and standard deviation, with the use of software IBM SPSS Statistics 20 was used.

## Results

### Orientation to maintaining the business

All family businesses successfully coped with the economic crisis and their existence was also confirmed in 2013. Out of 81 family and non-family businesses, 5 non-family businesses did not survive the economic crisis.

Tab. 1: Orientation to maintaining the business

		Existence	Absence	Total
Non-family businesses	Number	55	5	60
	%	91.70%	8.30%	100%
Family businesses	Number	21	0	21
	%	100%	0%	100%

Source: author

### Centralization of management

Tendency toward centralization was identified on the basis of responses to the question: “Give the number of separate establishments including the headquarters.” The question was not answered by 4 non-family businesses. Family businesses report a lower number of separate establishments than non-family

businesses. The standard deviation points out the fact that non-family businesses tend to have greater decentralization in the form of autonomous units.

Tab. 2: Centralization of management

	Number of separate establishments (average)	Standard deviation	Number
Non-family businesses	2.39	3.15	56
Family businesses	1.71	1.14	21
In total	2.21	2.74	77
No answer			4

Source: author

### **Orientation to local markets**

Orientation to local markets was measured on the basis of answers to the question: “Express in percentage opinions of customers from the region and outside the region.” The question was answered by all 81 surveyed companies. On average, family businesses reported slightly lower orientation to local markets measured by the percentage of customers from the region. The fact is in contrast to the theoretical concept mentioned in the research that was published by Gallo and Sveen (1991) and Doncles and Fröhlich (1991).

Tab. 3: Orientation to local markets

	Average percentage of customers from the region	Average percentage of customers out of the region but from the CR
Non-family businesses	58.10%	40.00%
Family businesses	57.30%	40.30%

Source: author

### **Customer orientation**

The level of customer orientation was investigated by asking questions: “What care, in comparison with competitors, is paid to customers of your company?”, “How do you rate, in comparison with competitors, the ability of your company to tailor products to customer requirements?” and “How do you rate, in comparison with competitors, the quality of products of your company?” Respondents used a 5-point scale, where 1 meant significantly lower and 5 meant significantly higher. The first two questions were answered by all 81 surveyed companies; the question relating to the quality was not answered by 1 family business.

Tab. 4: Customer care

	Customer care	Standard deviation	Number
Non-family businesses	3.6	0.8	60
Family businesses	3.91	0.83	21
In total	3.68	0.82	81

Source: author

Tab. 5: Ability to tailor to customer requirements

	Ability to tailor to customer requirements	Standard deviation	Number
Non-family businesses	3.79	0.9	60
Family businesses	3.6	0.65	21
In total	3.8	0.84	81

Tab. 6: Quality of product

	Quality of product	Standard deviation	Number
Non-family businesses	3.79	0.63	59
Family businesses	3.76	0.7	21
In total	3.78	0.65	80
No answer			1

Source: author

### Applied Business Strategy

The question “What business strategy does your company apply?” was answered by all 81 surveyed companies. Family businesses were more focused on the strategy of differentiation, compared to non-family businesses, which more applied the strategy cost leadership.

Tab. 7: Applied business strategy

	Differentiation	Cost leadership	Dif. focus	Cost focus
Non-family businesses	35%	25%	20%	20%
Family businesses	28.80%	32.70%	25%	13.50%

Source: author

### Number of employees

The size of the business and the tendency towards a higher or lower number of employees in family and non-family businesses was investigated by means of answering the question: “Give the total number of employees of your company.” The answers show a clear difference between family and non-family businesses in the average number of employees. The tendency to employ a higher number of employees in non-family businesses is demonstrated not only by the average number of employees, but also by the standard deviation of the answers.

Tab. 8. Number of employees

	Total number of employees – average	Standard deviation	Number
Non-family businesses	217.26	383.64	60
Family businesses	183	141.19	21
In total	208.37	337.8	81

Source: author

## Discussion

Theoretical assumptions mentioned in the introduction of this paper were subjected to investigation in the group of 81 construction companies. On the basis of the conducted analysis, the following conclusions can be drawn. The group of family businesses was able to survive the economic crisis between the years 2008 and 2013. It happened in accordance with the assumptions on the sustainability. On the other hand, there were 5 non-family businesses that were closed down. This fact supports the theoretical concept that family businesses are more focused on sustainability, risk aversion as it is mentioned in the surveys carried out by Kets de Vries (1996), Sundaramurthy (2008), Koironen (2007), Koráb et al. (1998), Garcia-Álvarez and Lopey-Sintas (2001). The centralization of family businesses was another area of research. In accordance with the theoretical concept, it was found out that family businesses have on average a smaller number of separate establishments than non-family businesses. The findings thus correspond with the surveys carried out by Koironen (2007), Huovinen and Tihula (2008), Koráb et al. (2008).

The characteristic describing the orientation of family businesses to customers was surveyed by means of several variables; in particular, the care paid to customers, the ability to tailor products to customer requirements, quality of production. It was found out that the surveyed family businesses could tailor their products to customer requirements a little better and also that they pay higher attention to customer care, which supports the hypothesis of a higher orientation of family businesses to customers. The business strategy of family businesses is also in accordance with the previous theoretical findings. The strategy of differentiation is more applied by family construction companies than by non-family businesses. Non-family businesses are more focused on the strategy of cost leadership. The tendency to employ fewer employees, as it is mentioned in conclusions of many studies on family business (Romano, Tanewski and Smyrniotis 2001; Kets de Vries 1996; Lin and Hu 2007; Nelton 1998) was confirmed in the surveyed group of family and non-family businesses. By contrast, quality of production was slightly lower in family businesses. This finding is in contrast to studies carried out by Kets de Vries (1996), Doncles and Fröhlich (1991), Schein (1995), Taguiri and Davis (1996), Romano, Tanewski and Smyrniotis (2001). Similarly, the finding relating to family orientation to local markets is in contrast to the theoretical concept. The results showed that slightly fewer customers of the surveyed group of family businesses were from regions or from other parts of the country. The assump-

tion that family businesses choose more conservative strategy for their business can be drawn from the above mentioned conclusions. Their efforts to maintain long-term business may result in a lower number of employees, focusing on good customer relations, and applying the strategy of differentiation. The question remains whether the findings of the quality and orientation to local markets are influenced by the nature of the study branch, or the ownership structure.

## Conclusions

The survey of the group of companies from the construction sector reveals some findings which are known in economically developed countries with a long-term development and support of family business. With regard to the limited sample of businesses and related non-representativeness, the achieved results cannot be generalized. However, there are some aspects which deserve greater attention in future surveys. The achieved results show differences in observed characteristics of family and non-family businesses in the period of the economic crisis in the construction sector, which is still going through a difficult situation caused by the external environment. On the basis of the achieved findings, it can be said that family businesses in confrontation with the effects of the crisis which comes from the external environment, behave differently in the selected characteristics. Family businesses have a lower number of establishments, pay more attention to their customers and are able to adapt better to customer requirements. In addition, they are more focused on the strategy of differentiation and tend to employ a smaller number of employees. Other characteristics such as greater emphasis on the quality and orientation to local markets were not confirmed.

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# Accounting of Internally Generated Intangible Assets at Public Universities in the Czech Republic

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## Abstract

Public universities in the Czech Republic register every year hundreds of internally generated patents for inventions, utility models or industrial designs, prototypes or functional. Internally generated intangible assets are the subject of evaluation and accounting. As such, it should be recorded in the balance sheet of the entity in the category of intangible assets and depreciated progressively. The aim of this work is to determine whether the internally generated intangible assets are recognized in the balance sheets of universities. Executed comparison of the research' results of universities reported to the Council for Research, Development and Innovation with the balance sheet of universities in 2011, it was found that 95% of universities does not show in their balance sheets internally generated intangible assets, which are however presented to the Council for research, development and innovation as the research results of public universities. It is evident, that public universities dispose with large amount of intangible assets whose existence is not declared in the financial statements. Their accounting doesn't provide the true picture of the assets of these economic entities.

**Keywords:** intangible assets, universities, accounting, balance sheet

## Introduction

Public universities in the Czech Republic register every year hundreds of internally generated patents for inventions, utility models or industrial designs, prototypes or functional. The universities report these intangible assets to the Ministry of education in the Information system of research, experimental development and innovations as the results of their research activities and their number has a direct impact on the amount of funds, which are universities receiving every year, to finance their activities.

Internally generated intangible assets are the subject of evaluation and accounting. As such, it should be recorded in the balance sheet of the entity in the category of intangible assets and depreciated progressively.

The aim of this paper is to find out whether these internally generated intangible assets are reported not only for the purpose of financing the universities research from public sources, but also in the balance sheets of universities, in order to respect the principle of significance and true and fair view of the assets of the entity.

## Material and Methods

### Intangible assets

For the purpose of this paper it is necessary to define intangible assets. Assets are embedded resources controlled by the entity, which are a result of the past events and which are expected to generate future economic benefits to the company, the future profits. Fixed assets are proprietary ingredients that are used in the company in the long-term and the majority of these assets wear and tear gradually. Long-term assets include fixed assets of long-term nature, intangible assets and financial assets (Kovanicová 2009). Intangible assets differ from tangible assets in that it has no physical substance, they are mainly the rights, which property results (or is expected to result) in economic benefit (Kovanicová 2003).

Intangible assets have the following characteristics:

- the intangible nature,
- operating time is longer than one year,
- reaches a certain level of appraisal (Kovanicová 2009).

Intangible assets should be classified according to their nature and by the way of acquisition. The method of the acquisition determines the content of acquisition costs. Depending on the nature of intangible assets it is possible to distinguish between identifiable and unidentifiable assets.

Specifically identifiable intangible assets:

- patents: are exclusive right to use the invention for a period of time;
- copyright: they are exclusive rights to reproduce and sell books, music, film and other similar cases;
- trademark: Is the exclusive right to use a particular symbol that is protected by law. It may take the form of names, symbols, slogans, logo or emblems;
- concession and licenses: Concessions privileges are transferred to the State or other public corporations for the use of certain equipment or to perform certain trades, occupations and activities. License means the right to use patents, trademarks, etc. in specific circumstances.

Identifiable asset is for example goodwill (Kovanicová 2003).

Intangible assets can be obtained and recognized in the balance following ways:

- purchase,
- acquisition of rights to results of intellectual activity,
- own activity,
- non-monetary contribution from any other person,
- transfer of the legal conversions / mergers,
- gratuitous transfer (gift), or transfer of personal use to business (Svačina 2010).

### **Evaluation of intangible assets**

The most common reasons for the valuation of intangible assets include:

- non-monetary contribution of intangible assets to capital company,
- valuation for accounting purposes,
- the use of intangible assets as collateral subject,
- transformation of companies,
- sale of intangible assets,
- intangible assets of the company in the event of bankruptcy or liquidation,
- settlement of inheritance,
- rights owners often want to know the value of their property, only as an input to various subsequent business meetings (Mařík 2011).

For the purpose of this article is relevant reason for the valuation of intangible assets valuation for accounting purposes.

### **Accounting of public universities**

Public universities are in the Czech Republic ranked among non-profit organizations, whose accounting is subject of Act No. 563/1991 Coll., About Accounting, Decree 504/2002 Coll., Implementing certain provisions of Act No. 563/1991 Coll., about accounting for non-profit entities and Czech accounting standards for entities that do their accounts according to Decree No. 504/2002 Coll., as amended.

From an accounting point of view, according to Decree 504/2002 Coll. Intangible assets are defined as:

- research and development, which were internally generated and held for trading or are acquired from other persons,
- software, that has been developed internally and used for trading or has been acquired from other persons,
- appreciable rights – to industrial property and similar property, to the results of intellectual creative activities and other Appreciable rights under specific legislation,
- other intangible assets – which by their nature can't be included in other items of fixed assets (e.g., emission allowances and preferential limits).

Accounting Act allows following valuation methods:

- purchase cost – it means the price at which the assets were acquired at the time of its acquisition (e.g. the price of a trade mark when buying from an independent third party)
- replacement cost – means here the price at which the assets were acquired at the time of record (e.g. a value determined by an expert in case of contribution of a utility model in the company)
- own expense – for internally generated intangible assets it means direct costs of production or other activity, and indirect costs that relate to production or other activity (e.g. internal development software designed for repeat business) (Svačina 2010).

Internally generated intangible assets can be under the Accounting Act only appreciated on the level of own expenses. Own expenses are direct costs of production or other activities, and indirect costs that relate to production or other activities, as defined in accordance with the accounting methods (Svobodová 2012).

Accounting can contain information about the valuation of intangible assets that is determined in the case of buying on market principles and for internally generated intangible assets on principles of Accounting Act, that means on own expenses, which in most cases represent different price levels (Čada 2007).

## Methods

There are 26 public universities in the Czech Republic, one of them is not included among the research organizations of the Czech Republic and another one was accepted among research organizations first in 2012, therefore its research results are not disclosed for the previous period. Public universities, which are in the same time research organizations longer than since 2011, will be for the purposes of this article an examined sample. It is therefore 24 entities.

The research results of all research organizations in the Czech Republic for 2012 and 2011 are available on the website operated by the Council for Research, Development and Innovations. Results are listed for each organization according to the applicable evaluation methodology of research organizations and evaluation of completed programs (valid for the years 2010, 2011 and 2012). According to this methodology there are research results, which were applied by research organizations within last 5 years period. For 2012, therefore, there are research results presented since 1<sup>st</sup> January 2007 till 31<sup>st</sup> December 2011 and for 2011 research results presented since 1<sup>st</sup> January 2006 till 31<sup>st</sup> December 2010. As it isn't possible to determine exactly in which year within the five-year period these results incurred, it's necessary to use the difference between the sum of results presented in 2012 and the sum of results presented in 2011 for the purpose of this article. If the difference of these values will be positive it can be determined with certainty, that in 2011 the university produced at least this number of intangible assets. It is probably that the number of research results created in 2011 was even higher than considered difference, because our difference represents in the reality difference between number of research results created in 2011 and number of research results created in 2006. For the purposes of this study, however, this value is sufficient, because it is possible to verify whether there was recorded adequate increase in the value of the corresponding item among intangible assets in the balance sheet for the year 2011.

The results are classified according to the methodology by the type of result. For the purpose of this Article, will be used following types of results:

- P – patent
- F – utility model, industrial design
- G – functional prototype or sample (Information system of research, experimental development and inovations, 2013)

The reason, why those tree types were chosen, is that those types of results can be clearly classified for accounting purposes, and also it is evident that they belong to the group of long-term intangible assets, that their owner plans to sell or use for own activity in the future. This intention is proved by the act of legal protection of ownership of the property.

All selected types of results fall into accounting entries Assessable rights in the balance sheet. The balance sheet is part of the annual management report. Annual Financial Reports are posted on the universities websites.

Each research result should be evaluated by universities at the level of their own costs and recorded as an increase in fixed assets in 2011, as due to their nature it is not to be disputed that it they are internally generated intangible assets. The exception is the case when the valuation of a particular research outcome doesn't reach 60 thousand CZK, in which case the costs associated with the acquisition of intangible assets are considered as costs of actual accounting year.

A prerequisite for the verification of the financial records of internally generated intangible assets by universities is that the value of this property will in most cases exceed 60 thousand CZK.

Comparing changes of item assessable rights for 2011 and the number of research results registered by the Council for Research, Development and Innovation, will be verified that universities do accounting reports of internally generated intangible assets.

## Results

Table 1 shows the difference in number of research results in selected categories reported in 2012 and 2011. It is evident that public universities reported substantial number of targeted species of research results to the Council of research, Development and Innovations. The total number of selected research results for all of the monitored institutions amounted to 1734 of which 1227 were functional prototypes or samples, 404 utility models and industrial designs and 104 patents. The difference in number of research results reported in 2012 and 2011 was zero for four of the monitored institutions. These institutions were therefore excluded from further verification. The research sample of monitored institutions decreased therefor at 20.

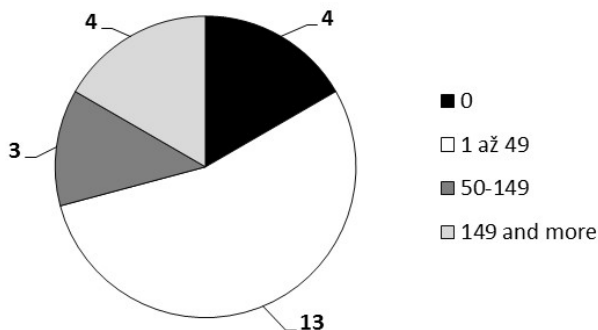
Tab. 1: Numbers of research results realized in 2011

Public university	Type of result		
	P	F	G
Academy of Performing Arts in Prague	0	0	4
Academy of Fine Arts in Prague	0	0	0
Czech Agricultural University in Prague	6	62	21
Czech Technical University in Prague	31	71	294
Janáček Academy of Music and Performing Arts in Brno	0	0	0
University of South Bohemia in České Budějovice	6	7	0
Masaryk University	5	2	5
Mendel University in Brno	1	22	4
University of Ostrava	0	2	0
Silesian University in Opava	0	0	0
Technical University of Liberec	11	43	56
University of Hradec Králové	0	2	0
Jan Evangelista Purkyně University in Ústí nad Labem	0	0	2
Charles University in Prague	5	8	4
Palacký University in Olomouc	13	7	6
University of Pardubice	1	1	12
Tomas Bata University in Zlin	4	67	36
University of veterinary and pharmaceutical sciences Brno	0	0	0
VŠB - Technical University of Ostrava	5	28	253
University of Economics in Prague	0	2	1
Institute of chemical technology Prague	7	11	23
Academy of Arts, Architecture and Design in Prague	0	0	2
Technical University Brno	7	28	370
University of West Bohemia	1	42	134

Source: Office of the government 2013

In Figure 1 are the surveyed institutions divided by the total number of research results registered in 2011.

Figure 1: Institutions classified according to the total number of research results



Source: Own

Tab. 2: The increments of appreciable rights in balance sheet in 2011

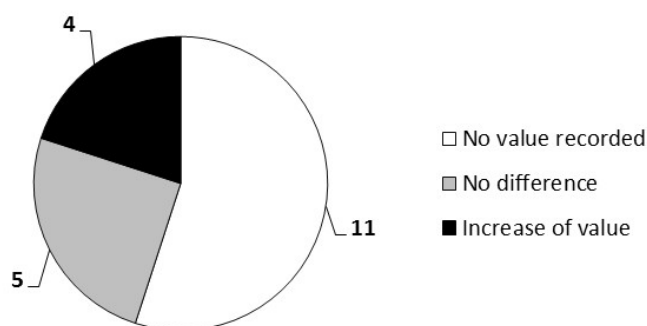
Public university	2011	2010	Difference
Academy of Performing Arts in Prague	1223.15	1223.15	0
Academy of Fine Arts in Prague			
Czech Agricultural University in Prague	0	0	0
Czech Technical University in Prague	0	0	0
Janáček Academy of Music and Performing Arts in Brno			
University of South Bohemia in České Budějovice	0	0	0
Masaryk University	8611.94	7377.1	1234.84
Mendel University in Brno	250	250	0
University of Ostrava	0	0	0
Silesian University in Opava			
Technical University of Liberec	0	0	0
University of Hradec Králové	0	0	0
Jan Evangelista Purkyně University in Ústí nad Labem	0	0	0
Charles University in Prague	97	97	0
Palacký University in Olomouc	0	0	0
University of Pardubice	7600	440	7160
Tomas Bata University in Zlín	5382	4670	712
University of veterinary and pharmaceutical sciences Brno			
VŠB - Technical University of Ostrava	13200.88	12085.82	1115.06
University of Economics in Prague	0	0	0
Institute of chemical technology Prague	0	0	0
Academy of Arts, Architecture and Design in Prague	0	0	0
Technical University Brno	0	100	-100
University of West Bohemia	504.63	504.63	0

Source: Own

There are the increments of appreciable rights in balance sheets in 2011 in Table 2. Of the monitored institution that demonstrably registered in year 2011 patents, utility models or industrial or functional prototypes or samples only four institutions recorded in the same year growth of appreciable rights in the balance sheet.

Figure 2 shows the results listed in Table 2. The monitored organizations are grouped according to changes in the value of the item appreciable rights in balance sheet in year 2011.

Figure 2: Monitored institutions grouped according to changes in the value of item appreciable rights



Source: Own

From figure 2 it is clear that from total number of monitored institutions more than half records no appreciable rights, five institutions did not change state of appreciable rights during 2011 and only four institutions increased state of item appreciable rights in 2011.

## Discussion

From the total number of monitored universities, which reported chosen types of research results, 11 institutions doesn't record in their accounting any intangible assets of this kind, five institutions records some intangible assets, but its state didn't change within the year 2011, although those institutions reported this type of research results.

Only four from the monitored institutions has increased value of monitored item. Detailed analysis of the annual accounting reports of these four institutions shows, that only in one case this increase represents internally generated intangible assets.

Only one university from four, which reported in 2011 the largest number of research results, recorded in the same time in its accounting the increase of item appreciable rights. The annual financial report of this university doesn't give any additional information, which would enable to identify this increase.

The result shows that only 5% of public universities record the internally generated intangible assets in their accounting.

## Conclusion

Public universities in the Czech Republic register every year hundreds of internally generated patents for inventions, utility models, or industrial designs, prototypes of functional samples.

The executed research shows that almost every public university in the Czech Republic is the owner of this type of internally generated intangible assets, however, if we look at the balance sheets of those universities, there are no intangible assets to be found. Their accounting doesn't provide a true picture of property of those economic entities.

In conclusion, it is obvious that although the examined subjects routinely work with the concept of intangible assets, they are considering exclusively purchased intangible assets. In regards of internally generated intangible assets the performed research has proven that the examined subjects do not record the internally generated intangible assets in their accounting reports.

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## Účetní evidence nehmotných aktiv vytvořených vlastní činností na veřejných vysokých školách v ČR

Veřejné vysoké školy v České republice každoročně registrují stovky patentů k vynálezům, užitečných nebo průmyslových vzorů, prototypů nebo funkčních vzorků vytvořených vlastní činností. Nehmotná aktiva vytvořená vlastní činností jsou předmětem ocenění a účtování. Jako taková by měla být evidována v rozvaze ekonomického subjektu v kategorii dlouhodobá nehmotná aktiva a postupně odepisována. Cílem této práce je zjistit zda jsou nehmotná aktiva vytvořená vlastní činností vykazována v rozvahách vysokých škol. Provedeným porovnáním výzkumných výsledků vykazovaných vysokými školami Radě pro výzkum, vývoj a inovace s rozvahami vysokých škol za rok 2011 bylo zjištěno, že 95 % vysokých škol v rozvahách nevykazuje nehmotná aktiva vytvořená vlastní činností, která jsou prezentována Radě pro výzkum, vývoj a inovace jako výsledky výzkumné činnosti veřejných vysokých škol. Veřejné vysoké školy prokazatelně disponují velkým množstvím dlouhodobých nehmotných aktiv, o jejichž existenci se nedozvíme z účetních výkazů. Jejich účetnictví tak neposkytuje věrný obraz hospodaření těchto ekonomických subjektů.

**Klíčová slova:** nehmotná aktiva, vysoké školy, účetnictví, rozvaha

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# Analýza klíčových skupin stakeholderů komerčních subjektů v České republice

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## Abstrakt

Analýza stakeholderů je v současné době, zejména v zahraniční literatuře, považována za velice důležitý aspekt managementu i marketingu současné turbulentní doby. V České republice analýze stakeholderů není však doposud věnována dostatečná pozornost. Tento článek se zabývá právě problematikou analýzy stakeholderů. Cílem tohoto článku je provedení identifikace a detailní analýzy stakeholderů komerčních subjektů v České republice. Veškeré podniky budou rozděleny do skupin mikro, malých, středních a velkých podniků. V rámci těchto kategorií podniků budou zkoumány skupiny stakeholderů, na něž se podniky nejčastěji zaměřují. Dále pomocí analýzy rozptylu a F-testu bude zkoumáno, zda se odpovědi jednotlivých skupin podniků statisticky významně liší, či nikoliv.

**Klíčová slova:** stakeholder, analýza stakeholderů, identifikace stakeholderů, podniky

## Úvod

Analýza stakeholderů se stává stále více populární (Brugha, Varvasovszky 2000) zejména v současné době, která je ještě stále ovlivněna dopady globální finanční a ekonomické krize. Dle Hubera se stakeholder management, jehož nedílnou součástí je analýza stakeholderů, prokázal jako velice užitečný nástroj i v ekonomicky obtížných obdobích, jelikož výkon podniku je ovlivňován celou řadou různých zájmových skupin, jako jsou zákazníci, akcionáři či dodavatelé (Huber et al. 2004). Všechny podniky jsou ovlivňovány nepřeborným množstvím rozličných skupin stakeholderů, které představují jak jednotlivci, tak celé skupiny, jež mají obrovský vliv na výkon vlastní organizace (Reed 1999). Stakeholderi představují entitu jakéhokoliv druhu, která se objevuje v přirozeném prostředí organizace. Jedná se tedy o různé jiné osoby, skupiny, organizace, instituce či společnosti (Mitchel et al. 1997). Stakeholderi představují nejen jednotlivce a skupiny, kteří ovlivňují aktivity organizace, ale jsou to také všichni, kdo jsou konáním organizace ovlivněni. Někteří stakeholderi mají dle Chinyia et al. (2010) tak nesmírný význam pro veškeré činnosti organizace, že mohou až

zmařit aktivity organizace (disponují power to kill). Z tohoto důvodu je nutné provádět důkladnou analýzu všech skupin stakeholderů, které podnik ovlivňuje, nebo těch, jež jsou činností podniku ovlivněny. Neméně důležité je provádět prioritizaci klíčových skupin stakeholderů pro stanovení nejdůležitějších stakeholderů, na něž by se měla organizace zaměřit. Identifikace základních skupin stakeholderů je považována za první krok analýzy stakeholderů, na který navazuje určení klíčových skupin stakeholderů (Bourne 2009).

V zahraniční nalezne celou řadu odborných publikací, statí, článků a výzkumů, které se problematiky analýzy stakeholderů týkají – například v dílech Freemana, který je považován za jednoho z nejvýznamnějších představitelů strategického přístupu k analýze stakeholderů a jeho začlenění do strategického managementu (Freeman 2010; Freeman et al. 2010), Johnsona, Scholese a Whittingtona (2008) či Lindy Bourne (2009), jež se zaměřuje zejména na analýzu stakeholderů, ovlivňujících projektové činnosti. Dále můžeme nalézt problematiku analýzy a mapování stakeholderů, stejně tak jako stakeholder management v oblasti projektů v díle Chinyia (2010). Ačkoliv otázka stakeholderů a jejich analýzy je v zahraničí považována za velice důležitou – viz Freeman (2010); Brugha, Varvasovszky (2000); Huber (2004) a mnozí další, v České republice této oblasti není věnována prozatím dostatečná pozornost, což je jedním z hlavních důvodů výběru tohoto tématu jako základního výzkumného problému autorky. V České republice můžeme nalézt pouze jeden empirický výzkum, který se zabývá touto oblastí, a to je výzkum docentky Šimberové (2008), který je zaměřen na oblast stakeholderů průmyslových trhů.

Analýzy stakeholderů, s ohledem na identifikaci klíčových skupin stakeholderů, je možné definovat jako nástroje, které vedou právě k identifikaci, popisu a stanovení priorit stakeholderů na základě jejich atributů, vztahů a zájmů, které se týkají daného problému (Buckles 1999).

Cílem příspěvku je analyzovat výsledky realizovaného výzkumu, který je zaměřen na identifikaci klíčových skupin stakeholderů komerčních subjektů v České republice. Jednotlivé podniky budou rozděleny do skupin dle velikosti na mikro, malé, střední a velké podniky. Na základě statistických analýz výsledků provedeného marketingového výzkumu bude provedena komparace jednotlivých skupin podniků a stanoveny odlišnosti.

## **Materiál a metodika**

Jak již bylo výše uvedeno, cílem tohoto článku je provést analýzu skupin stakeholderů podnikatelských subjektů v České republice. Nejprve však bylo nutné zpracovat důkladnou literární rešerši zahraničních odborných zdrojů, ale i různých výzkumů, odborných článků, případových studií a statí publikovaných na různých konferencích, na jejímž základě byly určeny hlavní skupiny stakeholderů, které budou prověřeny prostřednictvím vlastního výzkumu autorky. Celkový seznam vytipovaných skupin stakeholderů byl upraven a přizpůsoben potřebám českého trhu a finálně bylo vybráno 15 základních skupin stakeholderů. Stanovené skupiny byly předmětem výsledného marketingového výzkumu autorky. Aby nebyla vynechána některá významná skupina, byla v dotazníku

ponechána otevřená možnost doplnit ostatní nezahrnuté skupiny stakeholderů, které respondenti považují za důležité pro své podnikání.

Pro vlastní výzkum byla použita metoda elektronického dotazování, a to prostřednictvím dotazníku umístěného na serveru surveymonkey.com, kdy byli osloveni představitelé podniků všech velikostí dle níže uvedené kategorizace podniků (podrobněji viz tabulka č. 1: Kategorizace podniků).

Tabulka 1: Kategorizace podniků

Kategorie	Počet zaměstnanců	Roční obrat	Roční bilanční suma
Mikro	< 10	≤ € 2 miliony	≤ € 2 miliony
Malý	10–49	≤ € 10 milionů	≤ € 10 milionů
Střední	50–249	≤ € 50 milionů	≤ € 43 milionů
Velký	≥ 250	> € 50 milionů	> € 50 milionů

Zdroj: Ecorys 2012, European Commission 2003

Základními indikátory pro kategorizaci podniků je počet zaměstnanců a z hlediska financí je řešen buď roční obrat, nebo roční bilanční suma. V provedeném výzkumu byla kategorizace podniků provedena na základě počtu zaměstnanců a ročního obratu.

V rámci dotazníkového šetření byla řešena oblast stakeholderů, na něž se podniky zaměřují, s cílem stanovit klíčové skupiny stakeholderů jednotlivých kategorií podniků.

S ohledem na výše uvedená fakta je možné základní výzkumné problémy tohoto článku shrnout následovně:

- identifikace klíčových skupin stakeholderů komerčních subjektů na českém trhu,
- analýza klíčových skupin stakeholderů s ohledem na kategorii podniku,
- analýza rozdílů v odpovědích jednotlivých kategorií podniků prostřednictvím testování vícerozměrné analýzy rozptylu,
- stanovení výsledných 5 hlavních skupin stakeholderů pro každou kategorii podniku.

Pro výchozí hodnocení dat budou použity základní matematicko-statistické metody, zejména pak absolutní a relativní četnosti a střední hodnoty.

Pro podrobnou analýzu rozdílů v odpovědích jednotlivých kategorií velikosti podniků (mikro, malých, středních a velkých podniků) bude využita vícerozměrná analýza rozptylu (ANOVA). Dále bude zkoumáno, zda se ve výše uvedených skupinách mezi sebou i uvnitř skupin liší střední hodnoty zkoumaných veličin. Pro testování shody středních hodnot bude využito testování shody rozptylů prostřednictvím F-testu.

## Výsledky

Dotazníkového šetření se celkem zúčastnilo 120 respondentů, 14 dotazníků muselo být vyloučeno pro jejich nekompletnost. Z výše uvedených 14 případů

v šesti případech respondenti uvedli odpověď, že se nezaměřují na žádné, resp. konkrétní skupiny stakeholderů (jednalo se o 4 mikro podniky a 2 malé podniky). Ostatní dotazníky musely být vyloučeny pro nevyplnění identifikačních údajů pro kategorii podniku, nebo neúplného zodpovězení některé jiné otázky. Struktura dotazovaných subjektů dle kategorie podniku je shrnuta v tabulce č. 2.

Tabulka 2: Kategorie podniku

Kategorie	Absolutní četnost	Relativní četnost (v %)
Mikro podniky	50	47,1
Malé podniky	36	34
Střední podniky	14	13,2
Velké podniky	6	5,7

Jak je z výše uvedené tabulky vidět, ve výzkumu převládaly mikro, malé a střední podniky s celkovým počtem zaměstnanců do 250 a ročním obratem do 50 milionů Eur. Tyto podniky jsou někdy souhrnně nazývané jako malé a střední podniky (MSP). Celkově malé a střední podniky tvoří v rámci české ekonomiky 99 % (Mulačová 2012) a jsou dominantní skupinou v rámci celé produkce České republiky. Situace je obdobná však i v rámci celé Evropy, kde malé a střední podniky tvoří 98 % celé produkce (Ecorys 2012). Proto ani struktura respondentů není nijak zarážející, velkých podniků, které se výzkumu zúčastnily, bylo pouze 6. Nejdominantnější zkoumanou skupinou jsou mikro podniky – s více než 45% zastoupením, následované malými podniky (34 %) a 13 % středních podniků.

V následujícím textu budou podrobně rozebrány jednotlivé výsledky dotazování. Respondenti měli nejprve označit skupiny stakeholderů, které pro ně představují zájmové skupiny. V tabulce č. 3 jsou vyjádřeny četnosti jednotlivých skupin stakeholderů zastoupené v rámci odpovědí dané kategorie podniků v České republice.

Z níže uvedené tabulky vyplývá, že všechny podniky bez rozdílu kategorie velikosti se zaměřují na **zákazníky**, které označili všichni respondenti. V některých případech jsou odpovědi podniků více či méně shodné bez ohledu na jejich velikost, v jiných případech se odpovědi výrazně liší. Variantou, kdy je možné na první pohled spatřit jasné rozdíly v odpovědích respondentů, je například skupina **akcionářů**. U skupiny MSP je to naprosto logické, protože podniky zpravidla nepreferují akciovou společnost jako právní formu podnikání. Dále se vyskytují rozdíly mezi mikro, malými a středními podniky a velkými podniky v oblasti zaměření na dodavatele, kde mikro, malé a střední podniky uváděly dodavatele v cca 58 %, zatímco z velkých podniků tuto skupinu uvedlo 83 % dotázaných respondentů. Z hlediska zaměření na **konkurenci** uvedly tuto skupinu všechny velké podniky a nejméně mikro podniků, které na konkurenci nekladou tak velký důraz. Podobná situace je i u médií či orgánů státní správy či vzdělávacích institucí. **Média** byla vybrána všemi velkými podniky a 20 % malých podniků. V ostatních skupinách se odpovědi poměrně výrazně liší. Média uvedlo pouze 36 % malých podniků, ale více než 50 % podniků středních.

Obdobná situace je i u **orgánů státní správy**. Z provedeného výzkumu je zřejmé, že mikro podniky se zaměřují více na **orgány místní správy** (uvedeno v 40 %), méně však na orgány státní správy (uvedeno pouze v 28 %). Odpovědi velkých podniků jsou však v tomto případě opačné. Na orgány státní správy se zaměřují všechny velké podniky, ale na orgány místní samosprávy pouze 67 % z nich. Podobné odpovědi, kdy se více zaměřují na danou skupinu stakeholderů velké podniky než mikro, malé a střední podniky, se vyskytly jak u vlastníků, tak u managementu. V případě **finančních institucí a bank, dopravců** či **zaměstnanců** se odpovědi výrazně neliší.

Tabulka 3: Skupiny stakeholderů v České republice

Skupina stakeholderů	Absolutní četnost / Relativní četnost (v %) v rámci kategorie			
	Mikro podniky	Malé podniky	Střední podniky	Velké podniky
Akcionáři	0/0	0/0	2/14	5/83
Dodavatelé	29/58	21/58	8/57	5/83
Dopravci	20/40	12/33	4/29	2/33
Finanční instituce, banky	13/26	9/25	5/36	2/33
Konkurence	31/62	26/72	12/86	6/100
Management	5/10	6/17	4/29	4/67
Média	10/20	13/36	8/57	6/100
Místní komunita	15/30	11/31	4/29	3/50
Orgány státní správy	14/28	19/53	8/57	6/100
Orgány místní samosprávy	20/40	24/67	6/43	4/67
Poradenské společnosti (daňové, finanční a další poradenství)	19/38	14/39	2/14	1/17
Vlastníci	10/20	5/14	4/29	4/67
Vzdělávací instituce	12/24	9/25	7/50	4/67
Zákazníci	50/100	36/100	14/100	6/100
Zaměstnanci	42/84	27/75	12/86	5/83
Ostatní	0/0	0/0	0/0	0/0

Pro podrobnou analýzu rozdílnosti odpovědí jednotlivých kategorií podniků dle velikosti byla použita analýza rozptylu ANOVA.

Tabulka 4: ANOVA analýza pro jednotlivé kategorie podniků

	Analysis of Variance				
	Sum of Squares	Df	Mean Square	F-Ratio	P-Value
Between groups	8737,38	3	2912,46	4,03	0,0115
Within groups	40508,3	56	723,362		
Total (Corr.)	49245,6	59			

Dle provedených statistických analýz je možné konstatovat (při P-hodnotě F-

testu, která je menší než 0,05), že existuje statisticky významný rozdíl mezi jednotlivými kategoriemi podniků na hladině významnosti 95 %. Pro bližší určení, které skupiny se od sebe liší, byl dále využit Multiple Range Test, na jehož základě byly identifikovány 3 páry kategorií podniků, jejichž odpovědi se mezi sebou statisticky významně liší. Jak je vidět i z tabulky č. 3, významné rozdíly jsou zejména u velkých podniků. Také na základě Fisher's Least Significant Difference testu (LSD testu) byly jako skupiny se statisticky významnými rozdíly odpovědí (na hladině významnosti 95 %) stanoveny následující dvojice kategorií podniků – malé a velké podniky, dále mikro a velké podniky a střední a velké podniky.

Více než 50 % malých, středních a velkých podniků označilo orgány státní správy jako jednu ze skupin stakeholderů, na něž se zaměřují, téměř 70 % malých a velkých podniků uvedlo i orgány místní samosprávy. Jelikož orgánů státní správy a místní samosprávy existuje celá řada, byli dále respondenti požádáni o specifikaci konkrétních orgánů státní správy a samosprávy, se kterými komunikují nejčastěji.

Tabulka 5: Orgány státní správy a samosprávy

	<b>Absolutní četnost</b>	<b>Relativní četnost (v %)</b>
Celní správa	45	43
CzechInvest	30	29
Česká správa sociálního zabezpečení	0	0
Český statistický úřad	0	0
Finanční úřad	76	72
Hospodářská komora	0	0
Městský (obecní) úřad	32	30
Ministerstvo dopravy	0	0
Ministerstvo financí	46	43
Ministerstvo práce a sociálních věcí	30	28
Ministerstvo pro místní rozvoj	15	14
Ministerstvo průmyslu a obchodu	47	44
Ministerstvo zahraničí	0	0
Ministerstvo zdravotnictví	0	0
Ministerstvo zemědělství	16	15
Ministerstvo životního prostředí	0	0
Úřad práce	31	29
Zdravotní pojišťovny	31	29

Jak je vidět z výše uvedené tabulky, 72 % dotázaných podniků uvedlo jako důležité orgány státní správy a samosprávy **finanční úřady**. Z ministerstev bylo nejčastěji uváděno **Ministerstvo průmyslu a obchodu** (uvedlo 44 % dotázaných), Ministerstvo financí (43 % dotázaných), Ministerstvo práce a sociálních věcí a Ministerstvo zemědělství (uváděno především podniky, které se dle klasifikace ekonomických činností CZ-NACE nachází v sekci A – Zemědělství, lesnictví a rybářství). Ostatní ministerstva neuvedl žádný z dotázaných.

43 % respondentů uvedlo také **Celní správu** a 30 % podniků, které spadají z více než 50 % do kategorií mikro, malých a středních podniků, také označilo městské (či obecní) úřady.

## Diskuse

V rámci provedeného výzkumu byly identifikovány základní klíčové skupiny stakeholderů podle jednotlivých kategorií podniků (klasifikace mikro, malých, středních a velkých podniků). Pro každou kategorii bylo určeno 5 nejčastěji uvedených skupin stakeholderů, které jsou shrnuty v tabulce č. 6. V některých případech byly stejné četnosti platné pro více skupin stakeholderů. Jedná se např. o pátou nejčastější skupinu stakeholderů mikro podniků a skupiny stakeholderů velkých podniků. Tyto skupiny byly v následující tabulce sloučeny na stejnou pozici, a proto je v některých případech uvedeno více než 5 skupin.

Tabulka 6: Hlavní skupiny stakeholderů pro jednotlivé kategorie podniků

Sk.	Mikro podniky	Malé podniky	Střední podniky	Velké podniky
1	Zákazníci	Zákazníci	Zákazníci	Zákazníci, konkurence, média, orgány státní správy
2	Zaměstnanci	Zaměstnanci	Zaměstnanci	
3	Konkurence	Konkurence	Konkurence	
4	Dodavatelé	Orgány místní samosprávy	Dodavatelé, média, orgány státní správy	Akcionáři, dodavatelé, zaměstnanci
5	Dopravci, orgány místní samosprávy	Dodavatelé		

Z výše uvedené tabulky je jasné, že nejčastěji uváděnými skupinami stakeholderů, na které se podniky zaměřují bez ohledu na velikost (kategorii), jsou: zákazníci, zaměstnanci, konkurence a dodavatelé. Mikro a malé podniky dále uváděly orgány místní samosprávy, zatímco střední a velké podniky do skupiny, na něž se zaměřují, zahrnuly i orgány státní správy a média. Je jasné, že čím větší a známější podnik je, tím spíše se objeví pod hledáčkem médií, která jsou schopna významně ovlivnit vnímání podniku očima veřejnosti i další skupiny stakeholderů.

Skupinu zákazníků uvedlo celkem logicky 100 % všech dotazovaných. Všechny velké podniky navíc uvedly konkurenci, média a orgány státní správy, skupina akcionáři, dodavatelé a zaměstnanci byla uvedena 83 % dotázaných velkých podniků. Akcionáři jsou specifickou skupinou, která je typická právě pro větší podniky, které mají právní formu akciové společnosti. Druhou nejčastěji zmiňovanou skupinou stakeholderů jsou zaměstnanci, které uvedlo v případě mikro, středních a velkých podniků více než 80 % respondentů, malé podniky pouze v 75 %. Střední podniky stejně často uváděly i konkurenci, která se celkově stala třetí nejčastěji jmenovanou skupinou stakeholderů.

Jak již bylo v úvodu zmíněno, v České republice byl prozatím proveden pouze jeden empirický výzkum stakeholderů, a to v oblasti průmyslových trhů.

Šimberová (2008) ve svém výzkumu identifikovala jako nejčastěji uváděné skupiny stakeholderů následující (v níže uvedeném pořadí):

- zákazníci, dodavatelé, orgány státní správy, orgány místní samosprávy, zaměstnanci, konkurence.

Zákazníci jsou opravdu nejdůležitější skupinou stakeholderů, která byla potvrzena jak výzkumem autorky, tak výzkumem docentky Šimberové. V současné době je však jako další velice významná skupina uváděna konkurence, která se v hodnocení nejhůře objevila jako třetí skupina stakeholderů. Hlavním důvodem je rostoucí konkurenční boj ve všech odvětvích a také dopady globální hospodářská krize, která ovlivnila všechny světové ekonomiky. V prvních pěti nejčastěji uváděných skupinách stakeholderů se v obou výzkumech shodně objevily skupiny zaměstnanců, dodavatelů a orgánů státní správy a samosprávy.

Při bližší analýze prováděné prostřednictvím analýzy rozptylu a F-testu bylo zjištěno, že je nutné brát v úvahu kategorii podniku s ohledem na rozdělení na mikro, malé, střední a velké podniky, jelikož na hladině významnosti 95 % byla prokázána rozdílnost odpovědí respondentů v rámci těchto kategorií.

## Závěr

Dle význačných zahraničních autorů, jako jsou např. Bourne (2009), Freeman (2010), Huber (2004), význam stakeholder managementu a analýzy stakeholderů neustále roste, zejména pak v silně konkurenčním či jinak problémovém okolí podniku (Huber 2008). Z provedeného výzkumu je jasné, že třemi nejčastějšími skupinami stakeholderů, na něž se veškeré podniky bez ohledu na jejich velikost zaměřují, jsou **zákazníci, konkurence a zaměstnanci**. Střední a velké podniky se častěji zaměřují na orgány státní správy, zatímco malé a mikro podniky na orgány místní samosprávy. Rozdíly mezi odpověďmi respondentů byly identifikovány v dalších skupinách, jako jsou např. média či vzdělávací instituce. Proto je důležité, přestože základní skupiny stakeholderů jsou pro všechny kategorie podniků shodné, se zaměřit i na podrobnější analýzu jednotlivých kategorií podniků. Na základě vícerozměrné analýzy rozptylu a F-testu bylo prokázáno na hladině významnosti 95 %, že odpovědi jednotlivých kategorií podniků se významně statisticky liší. Po podrobnějším zkoumání prostřednictvím tzv. LSD testu byly jako skupiny se statisticky nejvýznamnějšími rozdíly odpovědí na hladině významnosti 95 % stanoveny následující dvojice kategorií podniků – malé a velké podniky, dále mikro a velké podniky a střední a velké podniky. Z provedené statistické analýzy tedy vyplývá, že je více než vhodné provádět samostatně analýzu velkých podniků a zvláště mikro, malých a středních podniků. Mezi mikro podniky, malými a středními podniky nebyl na základě LSD testu prokázán statisticky významný rozdíl v odpovědích respondentů.

Pro další výzkum autorky v oblasti skupin stakeholderů komerčních subjektů v České republice je vybrán další krok analýzy stakeholderů, jenž, jak bylo uvedeno v úvodu tohoto článku, následuje po identifikaci stakeholderů, a je jím prioritizace stakeholderů. Prioritizace bude použita pro specifikaci pěti

nejdůležitějších skupin stakeholderů jednotlivých kategorií podniků. V tomto článku byly určeny nejčastější skupiny stakeholderů a v některých případech – jako např. u středních a velkých podniků – byly shodné četnosti u více skupin, a proto bylo určeno více skupin než výše avizovaných pět. Prioritizace by měla napomoci pro konkretizaci pěti klíčových skupin pro každou kategorii. Při výzkumu prioritizace bude autorka zkoumat jak prioritizaci na základě profesionálního úsudku dotazovaných respondentů, tak objektivní prioritizaci na základě Metodiky Stakeholder Circle.

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## Analysis of Key Stakeholder Groups of Commercial Entities in the Czech Republic

Currently the stakeholder analysis, mainly in foreign literature, is considered as a very important aspect of management and marketing in the present turbulent times. There is not enough attention paid to the stakeholder analysis in the Czech Republic. This article deals with the problem of stakeholder analysis. The aim of this article is the stakeholder identification and the detailed analysis of stakeholders of commercial entities in the Czech Republic. All enterprises will be divided into groups of micro, small, medium and large-sized enterprises. In these categories of enterprises stakeholder groups, on which enterprises focus on mostly, will be examined. Further through the analysis of variance and F-test it will be examined if there are statistically significant differences among respondent's answers in each category of enterprises.

**Keywords:** stakeholder, stakeholder analysis, stakeholder identification, enterprises

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# The Position of Organic Farming within the European Union's Agriculture (Selected Differences Existing Among Individual Countries)

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## Abstract

This paper analyzes basic development trends in European Union's organic farming during the period 2005–2011. The analysis is based on data provided by EUROSTAT, IFOAM and FAOSTAT. Individual time series are analyzed through basic index, chain index, geomean, correlation analysis and elasticity analysis and logarithmical regression. The aim of this paper is to identify basic development trends in the following areas: organic land development; the number of organic farms; and the value of organic market development. Research also identifies existing differences among individual EU countries in the area of organic farming development. A part of the paper is also devoted to the relationship that exists between organic farming development and agricultural subsidies/supports in individual EU countries. The size of organic farmland increased significantly and also the number of producers increased. The significant organic farming growth can be demonstrated in majority of analyzed countries. It should be emphasized that high growth of organic farming size was obvious especially in the new EU countries. In general, it is clear that organic farming represents a specific market niche in the European agricultural market. Organic farming development is connected especially with the new consumption trends and also with the growth of individual countries economies and especially with the growth of income per capita in individual countries. The growth of organic farming is stimulated especially by the demand side of economy rather than by government subsidies. The conducted analysis proved much higher correlation and elasticity of organic farming sector performance in relation to individual countries' economy development than it is in relation to individual countries' government expenditures.

**Keywords:** organic farming, European Union, development, trend, GDP/cap, government expenditures, correlation, elasticity, characteristics, differences

## Introduction

Organic farming is a form of agriculture that relies on techniques such as crop rotation, use of green manure, compost and biological pest control. Organic farming uses fertilizers and pesticides but excludes or strictly limits the use of manufactured (synthetic) fertilizers, pesticides (which include herbicides, insecticides and fungicides), plant growth regulators such as hormones, livestock antibiotics, food additives, genetically modified organisms human (European commission 2013) sewage sludge, and nanomaterials (Paull 2011a).

According to the International Federation of Organic Agriculture Movements – "Organic agriculture is a production system that sustains the health of soils, ecosystems and people. It relies on ecological processes, biodiversity and cycles adapted to local conditions, rather than the use of inputs with adverse effects. Organic agriculture combines tradition, innovation and science to benefit the shared environment and promote fair relationships and a good quality of life for all involved..." (Paull 2010; IFOAM 2008).

Since 1990, the market for organic products has been significantly growing and in 2011 its value reached almost \$60 billion. This demand has driven a similar increase in bio-managed farmland which has grown over the years 2001–2011 at a compounding rate of 8.9% per annum (Paull 2011b). As of 2011, approximately 37 million hectares worldwide were farmed organically, representing approximately 0.9 percent of total world farmland (Willer and Kilcher 2011).

While taking into account, the distribution of organic agricultural land by region, it can be claimed that the leader is Oceania – especially Australia. In this region we can find about 12.2 million hectares of organic land. Other regions have this hectarage: Europe 10.6 million hectares, Latin America 6.9 million hectares, Asia 3.7 million hectares, North America 2.8 million hectares and Africa 1.1 million hectares. With respect to Europe, it should be emphasized that the share of European Union on total European organic land area is over 93% (cc 9.5 million hectares) (IFOAM 2012).

The markets for organic products are strongest in North America and Europe, especially then in the European Union. North America participates in global organic food market by 49% and the share of Europe is about 47% (IFOAM 2012).

European Union's share in global organic food market is about 41%. This means that European Union represents one of the most important players on global organic food market. In general, it can be said that Oceania has almost one third of the global organic agricultural land, but its relative importance is decreasing. Europe, a region that has had a very constant growth of organic land over the years, has more than one quarter of the world's organic agricultural land and it is possible to expect that the growth of organic agricultural land areas will be much higher in the future especially because of EU's agricultural policy (Willer and Lernoud 2013).

During the last two decades the European Union changed the priorities of its Common agricultural policy (CAP) and, nowadays, the CAP is focused especially on multifunctional agriculture (Svatoš 2008). The important part

of this concept is also environmental protection (Boháčková and Hrabánková 2011). A part of this idea is also to support organic farming development. European agriculture and especially its organic part are heavily subsidized not only by individual EU members, but also through the EU budget (Gay and Offermann 2006; Margareta and Penteleseu 2005; Basek and Kraus 2011).

The result of applied policies together with changes in economy and life style is the constantly increasing share of organic farming in total EU's agriculture and also constantly increasing share of organic farming in EU's agricultural market (Park and Lohr 1996; Gilg and Battershill 1998; Haering, Vairo, Dabbert, et al. 2009). The paper analyzes basic development trends in the European Union's organic farming during the period 2005–2011. The aim of this paper is to identify basic development trends in the following areas: organic land development; the number of organic farms; and the value of organic market development. Research also identifies existing differences among individual EU countries in the area of organic farming development. A part of the paper is also devoted to the relationship that exists between organic farming development and agricultural subsidies/supports in individual EU countries.

## Methodology

In this paper, period from 2005 to 2011 is analyzed. The analysis is based on data provided by EUROSTAT, IFOAM and FAOSTAT (data is conducted in current EUR prices). The analysed variables are the following: the organic land for agricultural purposes development (IFOAM), the number of organic farms development (IFOAM and EUROSTAT), the value of organic food market development (IFOAM), the value of organic products consumption per capita (EUROSTAT, IFOAM). Also, organic market development in the European Union is analyzed. For the purpose of this paper the EU is represented by 27 following countries: Austria, Belgium, Bulgaria, the Czech Republic, Cyprus, Denmark, Estonia, France, Finland, Germany, Greece, Hungary, Ireland, Italy, Latvia, Lithuania, Luxemburg, Malta, the Netherlands, Poland, Portugal, Romania, Slovakia, Slovenia, Spain, Sweden and the United Kingdom. Individual time series are analyzed through basic index, chain index, geomean, correlation analysis (Pearson's correlation coefficient) and elasticity analysis (Hindls et al. 2007). The correlation analysis provides basic information about the relationship existing between government expenditures (EUROSTAT) and GDP per capita (EUROSTAT) on one hand and selected above mentioned variables representing organic market development on the other hand. The elasticity of individual countries' organic agriculture in relation to government expenditures and GDP per capita is analyzed through the logarithmical regression. The advantage of this approach is the very easy calculation of elasticity values. Government expenditures in agriculture are analyzed in relation to organic market development especially because they are supposed to be one of main stimuli influencing organic farming development. Government expenditures in agriculture provide a basic overview about the level

of agricultural sector support in individual countries. The main idea is to identify if there exists a direct relation between the value of government expenditures and organic farming development. GDP per capita development is analyzed in relation to organic market characteristics especially because organic market is very dependent on the level of economy development and also it is dependent on the income and living standards of population. GDP per capita in this case is a well chosen factor, especially because of its ability to provide basic information about the economy growth and also about economic power of individual consumers (the growth or decline of GDP value is usually connected with positive or negative changes in available income per capita).

## Analysis and discussion

The European Union is a large consumer and producer of organic foods. Organic farming accounts for 5.4% of farmland within the EU. The organic farms area is constantly growing. While in 2005, the size of organic agricultural area was 6.24 million hectares, in 2011 it was more than 9.5 million hectares. The number of producers increased during the same period from 163510 to 236042 (the average size of organic farm in the EU increased from 38 hectares to more than 40 hectares). The share of organic farmland on total agricultural area in the EU increased from 3.5% to 5.4% (for details see table 1). Specific figure characterizing organic farming development in the EU is the value of organic market development. While in 2005 the value of organic market in the EU was about 11.8 billion EUR, in 2011 it was already 19.7 billion EUR. The value of realized organic products sales per capita increased from 23.6 EUR to about 39.4 EUR (for details see table 2).

However, it is necessary to emphasize that significant differences in organic farming development exist among individual EU members. The highest share of organic farmland on total agricultural area is in Austria, Estonia, Sweden, the Czech Republic, Finland, Italy and Slovakia. The share of organic farm area in individual countries' available agricultural land is between 8%–20%. On the other hand the lowest share, less than 3%, can be found in Hungary, Luxemburg, the Netherlands, Romania, Ireland, Bulgaria and Malta. The following countries control majority of registered areas: Spain (17.05%), Italy (11.63%), Germany (10.67%), France (10.25%), United Kingdom (6.71%), Poland (6.40%), Austria (5.7%), Sweden (5.05%), the Czech Republic (4.84%) and Greece (3.26%). The mentioned countries share in total organic farmland is 81.46%. The share of other countries is lower than 3%. Nevertheless, it is necessary to emphasize that between individual countries huge differences exist with respect to average farm size (for details see table 5). The largest farms are in Slovakia (over 450 hectares), while the smallest farms are in Malta (2.5 hectares).

Looking at the growth rate of organic farming development in individual countries, we can see that during the analyzed period the size of organic farmland increased by 53% and the number of producers making business in organic

Table 1: Selected characteristics of organic farming in the EU in period 2005–2011

Country	2005		2011		Basic		Chain		2005		2011		Basic		Chain		2005		2011		
	Area (ha)	Area (ha)	Basic	Chain	Producers	Producers	Basic	Chain	Producers	Producers	Basic	Chain	% Organic farmland in total available agricultural land	% Organic farmland in total available agricultural land	% Organic farmland in total available agricultural land	% Organic farmland in total available agricultural land	% Organic farmland in total available agricultural land	% Organic farmland in total available agricultural land	% Organic farmland in total available agricultural land	% Organic farmland in total available agricultural land	
Austria	479817	542553	1.13	1.02	20391	21575	1.06	1.01	1669	1966											
Belgium	22996	59220	2.58	1.17	733	1274	1.74	1.10	1.66	4.31											
Bulgaria	2432	25022	10.29	1.47	111	978	8.81	1.44	0.05	0.82											
Czech Republic	254982	460498	1.81	1.10	829	3904	4.71	1.29	5.99	10.84											
Denmark	134129	162173	1.21	1.03	3036	2677	0.88	0.98	5.18	6.09											
Estonia	59742	133779	2.24	1.14	1013	1431	1.41	1.06	7.21	14.75											
Finland	147587	188189	1.28	1.04	4359	4114	0.94	0.99	6.68	8.21											
France	550488	975141	1.77	1.10	11402	23135	2.03	1.13	2	3.55											
Germany	807406	1015626	1.26	1.04	17020	22506	1.32	1.05	4.74	6.08											
Greece	288737	309823	1.07	1.01	14614	21274	1.46	1.06	3.46	3.74											
Hungary	128576	124402	0.97	0.99	1553	1433	0.92	0.99	3.01	2.94											
Ireland	35266	54122	1.53	1.07	957	1400	1.46	1.07	0.84	1.31											
Italy	1069462	1096889	1.03	1.00	44860	42041	0.94	0.99	8.42	8.61											
Latvia	104235	184096	1.77	1.10	2873	3484	1.21	1.03	6.11	10.38											
Lithuania	64544	152305	2.36	1.15	1811	2623	1.45	1.06	2.31	5.75											
Luxembourg	3243	3720	1.15	1.02	72	96	1.33	1.05	2.51	2.84											
Malta	14	23	1.63	1.08	6	9	1.50	1.07	0.14	0.22											
Netherlands	48765	47205	0.97	0.99	1468	1672	1.14	1.02	2.54	2.45											
Poland	159709	609412	3.82	1.25	7182	23430	3.26	1.22	1.08	3.94											
Portugal	211501	201054	0.95	0.99	1479	2434	1.65	1.09	5.75	5.79											
Romania	92770	229946	2.48	1.16	2920	9471	3.24	1.22	0.67	1.67											
Slovakia	90206	166700	1.85	1.11	196	365	1.86	1.11	4.8	8.61											
Slovenia	23499	32149	1.37	1.05	1718	2363	1.38	1.05	4.84	6.58											
Spain	622762	1621898	2.60	1.17	15693	32195	2.05	1.13	2.51	6.52											
Sweden	222738	480185	2.16	1.14	2951	5508	1.87	1.11	6.98	15.4											
United Kingdom	612996	638528	1.04	1.01	4263	4650	1.09	1.01	3.84	3.96											
EU27	6238603	9514659	1.53	1.07	163510	236042	1.44	1.06	3.50	5.39											

Source: EUROSTAT 2013

farming increased by 44%. The most progressive trend in organic farming development, both from the point of view of area and number of producers exist in the following countries: Bulgaria, Poland, Spain, Belgium, Romania, Lithuania, Sweden, Estonia, Slovakia, France, the Czech republic, Latvia, Malta and Ireland.

In this case it should be emphasized that especially in Bulgaria, Poland, Spain, Belgium, Romania, Lithuania, Sweden and Estonia the size of organic farmland more than doubled during the analyzed time period. The growth of farming area was accompanied by the significant growth in number of producers. In general all, analyzed countries experienced significant growth of organic farming area (except for the Netherland, Hungary and Portugal) and number of producers active in organic farming (except for Finland, Italy, Hungary and Denmark).

Quite specific characteristic of organic farming development in the European Union is the value of organic market. The value of organic farming products sold on EU market increased during the analyzed time period by 67%. The inter-annual growth rate of realized sales reached almost 9%. The most developed markets for organic products can be found for 2011 especially in Germany (33.48%), France (19.08%), United Kingdom (9.56%), Italy (8.74%), Austria (5.41%), Spain (4.9%), Denmark (4.58%), Sweden (4.50%), the Netherlands (3.87%) and Belgium (2.21%). The cumulative share of above mentioned countries on European organic products' market is over 96%.

Another important finding related to organic market development is the fact, that on the basis of the conducted analysis it is possible to say that organic products' market is quite stable and the shares of main players are more or less stable (the European market is controlled by the specific group of players). When talking about the main players, only the United Kingdom significantly reduced its share in organic market during the analyzed period – while in 2005 the share of United Kingdom was almost 20% in 2011 it was only 9.56%.

While analyzing organic products' market development, it is also necessary to mention that among individual countries huge differences exist with respect to per capita sales – for details see table 2. While in Denmark total spending for organic products is about 162 EUR per capita, in Slovakia it is only 0.74 EUR per capita a year. Based on organic market development we can say that the most progressive value development was, during the analyzed time period, recorded in Romania (+85% a year), Slovenia (+45% a year), Bulgaria (+40% a year), the Czech Republic (+30% a year), Hungary (+27% a year), Poland (+26% a year), Spain (+20% a year), Denmark (+19% a year), Lithuania (+23% a year) and Estonia (+20% a year). Those countries increased their share in European organic market value from 5.67% to 11.24%. The most progressive consumption (both in total value and in per capita value expression) can be allocated in Denmark (+105 EUR/cap), Austria (+72 EUR/cap), Sweden (+46 EUR/cap), Luxembourg (+43 EUR/cap), Germany (+33 EUR/cap), France (+26 EUR/cap), the Netherlands (+20 EUR/cap), Belgium (+17 EUR/cap) and Slovenia (+16.5 EUR/cap).

Table 2: Organic products market development in the EU in period 2005–2011

	Domestic sales/ capita value in EUR				Domestic sales value in mil. EUR			
	2005	2011	Basic	Chain	2005	2011	Basic	Chain
Austria	54.69	126.43	2.31	1.15	450.00	1065.00	2.37	1.15
Belgium	21.95	39.37	1.79	1.10	230.00	435.00	1.89	1.11
Bulgaria	0.13	0.95	7.37	1.40	1.00	7.00	7.00	1.38
Cyprus	1.94	1.79	0.92	0.99	2.00	2.00	1.00	1.00
Czech Republic	1.17	5.62	4.79	1.30	12.00	59.00	4.92	1.30
Denmark	56.65	161.74	2.86	1.19	307.00	901.00	2.93	1.20
Estonia	2.97	8.96	3.01	1.20	4.00	12.00	3.00	1.20
Finland	15.25	22.27	1.46	1.07	80.00	120.00	1.50	1.07
France	31.66	57.46	1.81	1.10	2000.00	3756.00	1.88	1.11
Germany	47.29	80.56	1.70	1.09	3900.00	6590.00	1.69	1.09
Greece	4.50	5.13	1.14	1.02	50.00	58.00	1.16	1.03
Hungary	0.59	2.51	4.21	1.27	6.00	25.00	4.17	1.27
Ireland	15.87	21.63	1.36	1.05	66.00	99.00	1.50	1.07
Italy	18.77	28.33	1.51	1.07	1100.00	1720.00	1.56	1.08
Latvia	0.87	1.94	2.24	1.14	2.00	4.00	2.00	1.12
Lithuania	0.59	1.98	3.38	1.23	2.00	6.00	3.00	1.20
Luxembourg	88.14	131.19	1.49	1.07	41.00	68.00	1.66	1.09
Malta	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Netherlands	25.67	45.59	1.78	1.10	419.00	761.00	1.82	1.10
Poland	0.79	3.11	3.96	1.26	30.00	120.00	4.00	1.26
Portugal	0.69	1.99	2.88	1.19	7.29	21.00	2.88	1.19
Romania	0.09	3.74	40.47	1.85	2.00	80.00	40.00	1.85
Slovak Republic	0.74	0.74	1.00	1.00	4.00	4.00	1.00	1.00
Slovenia	2.00	18.51	9.26	1.45	4.00	38.00	9.50	1.46
Spain	6.91	20.90	3.02	1.20	300.00	965.00	3.22	1.21
Sweden	47.95	93.66	1.95	1.12	433.00	885.00	2.04	1.13
United Kingdom	38.74	29.99	0.77	0.96	2333.00	1882.00	0.81	0.96
Total	23.57	39.37	1.67	1.09	11785.29	19683.00	1.67	1.09

Source: IFOAM 2013

The results of per capita consumption value development provide interesting findings about the willingness of European consumers to spend money for organic products. In general it is possible to say that the majority of consumers in all analyzed countries spend for organic products only limited (insignificant) amount of their income. It can be concluded that there is a positive trend in per capita consumption development. Except for Slovakia, Cyprus and United Kingdom in all countries growth of individual consumers spending for organic products can be observed.

Organic farming and organic market development are heavily influenced by economic development and agricultural policy of the European Union. During the monitored time period, the economy of individual European countries shows significant growth and that growth was also transformed into agricultural policy development. Also, income per capita increased significantly. The value of government expenditures for agricultural activities in the EU reached over 42 billion EUR a year and GDP per capita in the EU reached

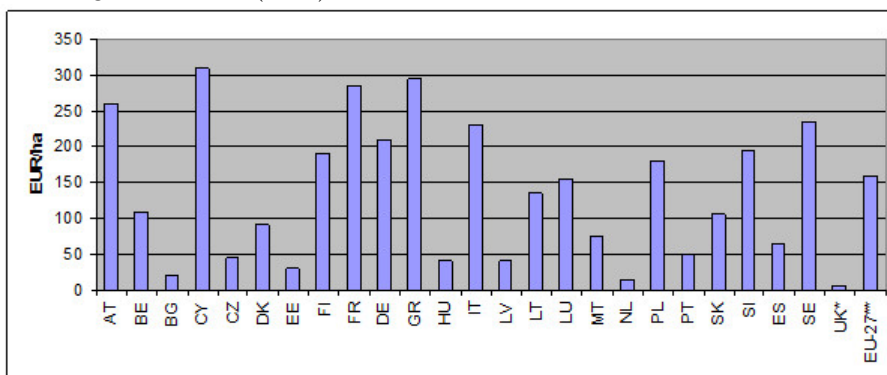
Table 3: Government agricultural expenditures and GDP/cap value development in the EU in period 2005–2011

Agricultural expenditures in mil. EUR	2005	2007	2009	2011	Basic	Chain	GDP in Euro per inhabitant	2005	2007	2009	2011	Basic	Chain
Austria	1436.3	1317.3	1510.2	1423.2	0.991	0.998	Austria	29800	33000	33100	35700	1.198	1.031
Belgium	705.3	741.0	737.9	718.0	1.018	1.003	Belgium	29000	31600	31600	33700	1.162	1.025
Bulgaria	225.5	217.4	248.0	211.1	0.936	0.989	Bulgaria	3000	4000	4600	5200	1.733	1.096
Cyprus	189.8	172.9	147.5	152.5	0.803	0.964	Cyprus	18400	20700	20900	21100	1.147	1.023
Czech Republic	626.5	837.0	1074.7	817.3	1.305	1.045	Czech Republic	10200	12800	13600	14800	1.451	1.064
Denmark	249.3	243.9	420.8	393.9	1.580	1.079	Denmark	38300	41700	40500	43200	1.128	1.020
Estonia	64.0	129.0	184.2	127.4	1.991	1.122	Estonia	8300	12000	10300	11900	1.434	1.062
Finland	1940.0	1941.0	1904.0	1995.0	1.028	1.005	Finland	30000	34000	32299	35000	1.167	1.026
France	6618.0	7121.0	7883.0	8031.0	1.214	1.033	France	27300	29600	29300	30700	1.125	1.020
Germany	5990.0	5440.0	5370.0	5920.0	0.988	0.998	Germany	27000	29500	29000	31900	1.181	1.028
Greece	50.0	198.0	816.0	69.0	1.380	1.055	Greece	17400	19900	20500	18500	1.063	1.010
Hungary	1139.7	1191.7	755.2	522.2	0.458	0.878	Hungary	8800	9900	9100	10000	1.136	1.022
Ireland	1063.4	1274.5	1107.7	859.3	0.808	0.965	Ireland	39200	43100	35800	35500	0.906	0.984
Italy	6084.0	6286.0	5907.0	5839.0	0.960	0.993	Italy	24500	26200	25200	26000	1.061	1.010
Latvia	167.4	188.0	294.6	261.0	1.559	1.077	Latvia	5800	9600	8600	9800	1.690	1.091
Lithuania	230.5	381.5	365.6	327.2	1.420	1.060	Lithuania	6300	8900	8400	10200	1.619	1.084
Luxembourg	133.9	139.2	175.5	189.6	1.416	1.060	Luxembourg	65000	78000	72300	82100	1.263	1.040
Malta	54.3	47.5	49.2	43.9	0.808	0.965	Malta	12200	13700	14400	15900	1.303	1.045
Netherlands	1086.0	1180.0	1408.0	1433.0	1.320	1.047	Netherlands	31500	34900	34700	35900	1.140	1.022
Poland	1743.0	3047.8	2636.1	2265.9	1.300	1.045	Poland	6400	8200	8100	9600	1.500	1.070
Portugal	779.4	629.1	646.7	623.1	0.799	0.963	Portugal	14600	16000	15900	16100	1.103	1.016
Romania	485.6	683.9	562.8	468.9	0.966	0.994	Romania	3700	5800	5500	6100	1.649	1.087
Slovakia	360.4	404.7	634.3	562.0	1.559	1.077	Slovakia	7100	10200	11600	12800	1.803	1.103
Slovenia	218.8	243.6	267.9	203.7	0.931	0.988	Slovenia	14400	17100	17400	17600	1.222	1.034
Spain	5599.0	6460.0	6026.0	5318.3	0.950	0.991	Spain	21000	23500	22800	23100	1.100	1.016
Sweden	707.2	567.0	593.8	706.7	0.999	1.000	Sweden	33000	36900	31500	41000	1.242	1.037
United Kingdom	4755.8	3783.2	2947.4	3271.2	0.688	0.940	United Kingdom	31000	34200	25700	28200	0.910	0.984
EU27	42703.1	44866.2	44674.1	42753.4	1.001	1.000	EU27	22600	25000	23500	25200	1.115	1.018

Source: EUROSTAT 2013

more than 25 thousands EUR (for details about government expenditures and GDP/cap value – see table 3). Except for usual subsidies connected with agricultural sector development in the European Union, organic farming is subject to specific subsidies supporting only its own development. In 2011, the value of organic farming subsidies provided by individual EU governments represented more than 1.5 billion EUR, which accounts for 3.5% of total government agricultural expenditures in the EU. Nevertheless, it is necessary to emphasize the existence of significant differences among individual countries in organic farming financing – for details see figure 1.

Figure 1: Average government spending for organic support payments per certified organic hectare (2011)



Source: European Commission 2011

Note: \* Without England, \*\* Without England, Ireland and Romania

While in Cyprus, subsidies for one hectare of organic farmland reached more than 300 EUR, in the Netherlands it was only about 15 EUR. Organic farming enjoys different priority in individual countries. In many countries organic farming is a natural part of their agricultural sector, in some countries it is something completely new. Organic farming can be perceived as a new segment of agricultural sector especially in the new EU members, while in the case of old EU members, organic farming maintains its stable position within economy. While in the case of new EU members organic farming represents an alternative to conventional agriculture and consumers and farmers only slowly move forward, in the old EU members, organic farming is already established on agricultural and food market. Its position is stabilized and organic farm producers are able to address specific group of consumers. It is also necessary to emphasize much higher purchasing power of old EU members' consumers compared to consumers in new EU countries. Limited purchasing power is one of the main reasons why consumers in new EU countries do not consume organic products to such an extent as consumers in old EU countries.

Organic farming development within the European Union is influenced by government subsidies and GDP development. It is also obvious, that change in GDP value and government subsidies or expenditures has different impact on organic agriculture and market development in individual analyzed coun-

Table 4: Correlation and elasticity existing between GDP/cap and government expenditures on one side and selected organic farming characteristics on the other hand

	GDP per inhabitant						Government expenditures							
	Area (ha)		Producers		Sales, total [Mio €]		Organic Products sales per		Area (ha)		Producers		Sales, total [Mio €]	
	C	E	C	E	C	E	C	E	C	E	C	E	C	E
Austria	0.762	0.728	0.536	0.353	0.951	5.299	0.952	5.168	0.371	0.537	0.431	0.441	0.114	0.632
Belgium	0.905	5.887	0.880	3.493	0.881	4.303	0.879	3.966	-0.188	-0.749	-0.239	-1.155	-0.230	-1.202
Bulgaria	0.925	4.234	0.830	3.380	0.902	4.463	0.903	4.537	0.237	0.863	-0.151	-0.029	0.275	1.297
Cyprus	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Czech Rep.	0.835	1.407	0.793	3.821	0.940	4.458	0.939	4.387	0.569	0.903	0.487	2.428	0.853	3.551
Denmark	0.763	1.387	-0.783	-0.823	0.857	7.873	0.860	7.687	0.796	0.295	-0.752	-0.164	0.808	1.403
Estonia	0.562	1.274	0.711	0.621	0.600	2.473	0.601	2.483	0.419	0.441	0.524	0.204	0.549	0.973
Finland	0.485	0.825	-0.586	-0.349	0.413	1.582	0.396	1.462	0.119	0.371	-0.059	-0.075	0.120	0.082
France	0.665	3.893	0.696	5.138	0.735	5.499	0.728	5.226	0.855	2.386	0.910	3.156	0.919	3.171
Germany	0.887	1.434	0.877	1.746	0.951	3.104	0.950	3.156	-0.060	-0.179	-0.109	-0.355	-0.287	-1.428
Greece	0.512	0.420	0.792	2.264	0.792	0.717	0.806	0.655	0.507	0.021	0.332	0.088	0.313	0.028
Hungary	-0.456	-0.332	-0.229	-0.221	0.438	3.786	0.439	3.819	-0.223	-0.023	-0.232	-0.026	-0.664	-0.740
Ireland	-0.705	-1.154	-0.761	-1.229	-0.693	-2.146	-0.678	-1.908	-0.136	-0.080	-0.220	-0.109	0.260	0.172
Italy	-0.110	-0.218	-0.152	-0.212	0.268	1.919	0.249	1.637	0.547	0.258	0.520	0.179	-0.437	-0.816
Latvia	0.797	0.738	0.609	0.441	0.673	1.332	0.689	1.417	0.703	0.543	0.179	0.134	0.796	1.582
Lithuania	0.866	1.530	0.857	0.748	0.828	1.755	0.796	1.902	0.718	1.328	0.825	0.700	0.425	1.161
Luxembourg	0.646	0.436	0.861	1.353	0.628	1.787	0.585	1.390	0.725	0.236	0.710	0.542	0.946	1.411
Malta	0.492	1.616	0.088	1.445	N/A	N/A	N/A	N/A	-0.192	-0.678	-0.358	-3.140	N/A	N/A
Netherlands	-0.047	-0.047	0.492	0.506	0.726	3.251	0.730	3.130	-0.012	-0.006	0.698	0.326	0.909	1.799
Poland	0.815	2.634	0.860	2.523	0.652	1.987	0.655	1.977	0.053	0.578	0.157	0.658	-0.086	0.267
Portugal	-0.164	-0.542	0.767	4.004	0.547	8.099	0.546	8.043	0.158	0.181	-0.699	-1.390	-0.484	-2.699
Romania	0.681	1.214	0.271	0.526	0.387	3.381	0.387	3.397	-0.412	-0.482	-0.399	-0.868	-0.611	-4.603
Slovakia	0.911	0.951	0.951	0.996	-0.042	0.003	-0.090	-0.006	0.841	0.830	0.897	0.864	-0.093	-0.016
Slovenia	0.902	1.119	0.775	0.938	0.433	6.172	0.432	6.088	0.004	0.007	-0.191	-0.132	-0.417	-3.604
Spain	0.457	4.844	0.380	2.874	0.163	2.902	0.150	2.497	-0.328	-0.968	-0.447	-1.110	-0.556	-3.249
Sweden	0.560	1.783	0.386	1.232	0.530	1.706	0.522	1.599	0.130	0.154	0.279	0.978	0.277	0.800
UK	-0.446	-0.364	0.052	0.008	0.832	1.052	0.835	1.155	-0.697	-0.345	-0.558	-0.315	0.525	0.450
EU 27	0.575	2.250	0.617	1.936	0.628	2.992	0.630	2.866	-0.261	-0.979	-0.210	-0.606	-0.177	-0.664

C = Correlation; E = Elasticity

Source: own calculations, 2013

tries. In case of some countries there is significant correlation and high level of elasticity between organic farming development and government expenditures. There is also a group of countries which can be characterized by the significant correlation and elasticity between organic farming performance and GDP value development. On the other hand there are also many countries, where the level of mutual correlation and elasticity existing between organic farming and government expenditures respectively GDP value development is limited (For details about correlation and elasticity existing between organic farming and government expenditures and organic farming and GDP/cap value development – see table 4).

Table 5: Average organic farm size in individual European Union countries in hectares

	2005	2006	2007	2008	2009	2010	2011	Basic index	Chain index
Austria	23.5	23.7	24.2	24.5	24.7	24.6	25.1	1.069	1.011
Belgium	31.4	36.5	38.3	39.6	40.6	43.0	46.5	1.482	1.068
Bulgaria	21.9	21.5	56.9	65.6	27.6	35.8	25.6	1.168	1.026
Cyprus	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
CR	307.6	292.4	237.4	186.3	148.2	127.4	118.0	0.383	0.852
Denmark	44.2	49.4	50.3	54.5	58.1	60.9	60.6	1.371	1.054
Estonia	59.0	62.1	65.7	69.4	74.5	83.3	93.5	1.585	1.080
Finland	33.9	36.5	37.5	37.7	40.7	42.1	45.7	1.351	1.051
France	48.3	47.5	46.5	43.9	41.2	41.0	42.2	0.873	0.978
Germany	47.4	47.0	46.3	45.8	45.0	45.2	45.1	0.951	0.992
Greece	19.8	12.6	11.8	13.2	13.8	14.6	14.6	0.737	0.950
Hungary	82.8	79.1	88.0	76.1	86.8	80.9	86.8	1.049	1.008
Ireland	36.9	37.4	36.1	38.2	36.0	35.0	38.7	1.049	1.008
Italy	23.8	25.4	25.4	22.6	25.8	26.6	26.1	1.094	1.015
Latvia	36.3	36.5	36.6	38.5	39.9	46.3	52.8	1.456	1.065
Lithuania	35.6	41.2	51.3	43.7	48.7	54.8	58.1	1.629	1.085
Luxembourg	45.0	50.4	41.7	41.6	46.9	38.8	38.8	0.860	0.975
Malta	2.3	2.0	0.4	0.4	2.2	2.2	2.5	1.087	1.014
Netherlands	33.2	33.4	32.1	34.2	34.9	29.8	28.2	0.850	0.973
Poland	22.2	24.8	24.0	21.1	21.5	25.4	26.0	1.170	1.026
Portugal	143.0	138.2	117.9	111.0	91.7	82.6	82.6	0.578	0.913
Romania	31.8	35.5	58.7	50.5	54.7	61.2	24.3	0.764	0.956
Slovakia	460.2	431.6	421.1	402.2	400.8	480.6	456.7	0.992	0.999
Slovenia	13.7	13.7	14.7	14.4	14.0	13.8	13.6	0.995	0.999
Spain	39.7	42.8	44.2	53.1	52.6	52.3	50.4	1.269	1.041
Sweden	75.5	94.7	108.2	91.3	81.3	84.2	87.2	1.155	1.024
UK	143.8	130.6	123.9	137.0	140.0	141.4	137.3	0.955	0.992
EU27	38.2	37.4	38.5	38.9	39.8	41.2	40.3	1.056	1.009

Source: own calculations

Based on the conducted analysis it is possible to see that government expenditures do not represent the main stimuli for organic farming growth in majority of EU countries. If we analyzed the EU as a group of countries, it is obvious that government expenditures have only limited impact on organic farmland size development and also their impact on the number of producers and value of realized sales is limited. Government expenditures represent important

stimuli for organic farming development especially in the new EU countries. In general, government expenditures as one of important factors influencing organic farming development are seen especially in the Czech Republic, Denmark, France, Greece, Italy, Lithuania, Latvia, Estonia, Luxemburg, Slovakia and the United Kingdom.

In case of government expenditures impact on organic farming and market development, it is possible to see that government expenditures are not probably the main stimuli for organic farming growth. Much more significant stimulus supporting organic farming development is probably economy development and especially the growth of income (economy and purchasing power) both in total and in per capita expression. For mutual relationship, it can be argued that there is an existing relationship between GDP/cap and selected organic farming's characteristics in individual countries. We can see that high level of mutual relations (correlation and elasticity) between GDP and organic farming development exist in the majority of analyzed countries: Austria, Belgium, Bulgaria, the Czech Republic, Denmark, Estonia, France, Germany, Ireland, Latvia, Lithuania, Luxemburg, Poland, Slovakia and Slovenia. Limited if not non-existent relationship or correlation can be found in the case of Finland, Hungary, Italy, Malta, the Netherlands, Portugal, Spain, Sweden and the United Kingdom.

## Conclusion

Based on the results, it is possible to say that during the analyzed time period organic farming and organic products market had significant growth in the European Union. The size of organic farmland increased significantly and so did the number of producers increase. Very important factor influencing and stimulating the growth of organic farming is the increase of organic market value and especially the growth of demand for organic products in the majority of European countries. The significant organic farming growth can be found in majority of analyzed countries. In this case, it should be emphasized that high growth of organic farming size was seen especially in the new EU countries. In the case of the old EU members, it is possible to see that organic farming is already a stable part of their agricultural sectors. Organic farming grows especially in those countries which make a decision to specialize themselves (i.e. Spain, France, Sweden, Belgium) in their organic markets.

In general it is obvious that organic farming represents a specific market niche in the European agricultural market. Its development is linked especially to the new consumption trends and also to the growth of individual countries economies and especially to the growth of income per capita in individual countries. The growth of organic farming is stimulated especially by the demand side of economy rather than by government subsidies or expenditures. The conducted analysis proved much higher correlation and elasticity of organic farming sector performance in relation to individual countries' economy development than it is in relation to individual countries' government expenditures.

It is also necessary to emphasize that organic market in the European Union is controlled by the limited number of countries. Also the willingness of consumers to pay higher prices for organic products is limited. Among individual countries we can see huge differences both in total realized consumption value, and in per capita consumption value.

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# Výkonnost jako klíčová kompetence

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## Abstrakt

Manažerské kompetence v době globální ekonomické krize získávají na významu, neboť pouze schopní a výkonní manažeři dokáží podniky aktivně udržet konkurenceschopné. Síla podniku není dána jen jeho finančním zázemím, ale stále více na významu nabývá lidský kapitál. K hodnocení a měření potenciálu pracovníků proto podniky využívají školení a kurzy, díky kterým vybírají ty nejschopnější. Z celé škály kompetencí je pro vrcholového pracovníka asi nejvýznamnější kompetencí rozhodující o úspěchu, či neúspěchu manažerů jejich výkonnost, proto je cílem této studie konfrontovat výkonnost manažerů se studenty.

**Klíčová slova:** manažer, kompetence, výkonnost

## Úvod

Kompetence (Kubeš 2004, Hroník 2008, Boyatzis 1982, McClelland 1973) jsou v rámci práce chápány jako schopnost vykonávat určitou činnost nebo práci. Např. definice Armstronga (1999), který vidí kompetence jako „základní schopnosti, způsobilosti potřebné k dobrému výkonu práce“, je velmi podobná s výkladem autorů C. K. Prahalad a G. Hamel (1994), jež je spatřují jako „*co-koliv, co je požadováno od člověka, aby se mohl efektivně zhostit pozice nebo role s důrazem na nadstandardní výkon*“. Definici ještě více rozšiřuje Woodruffe (1990) „*Kompetence je jakýkoliv osobnostní rys, vlastnost nebo dovednost, která může být považována za bezprostředně související s efektivním nebo mimořádným pracovním výkonem.*“, která už úzce navazuje na pracovní výkonnost. Čeští autoři chápou kompetence rozdílněji, napří. Bedrnová (2002) dává kompetence do souvislosti s pojmy pracovní způsobilost, kvalifikace, pracovní síla a zabývá se vzájemným propojením těchto kategorií. Za kompetenci pak považuje optimální doladění pracovní způsobilosti člověka na míru jím vykonávané profese a daného konkrétního pracovního zařazení. Schopnost zůstat sám sebou a současně být schopen reflektovat konkrétní požadavky právě zastávaných pozic a vykonávaných rolí lze podle autorky chápat také za určitou kompetenci. Oproti tomu Plamínek (2005) vykládá kompetence na pozadí teorie MbC (Management by Competencies). Tato teorie získává zdroje z jeho vlastní teorie vitality, z přístupu zaměřeného na klienta, z představy učící se organizace a především teorie omezení. Pojem kompetence vztahuje autor jen ke

konkrétním úlohám, které mají lidé vykonat: „Kompetence je souhrn dosaženého výkonu (tedy lidské práce) a přinášeného potenciálu (tedy lidských zdrojů). Chybí-li jedno, chybí i kompetence jako celek.“

Spojení mezi kompetencemi a výkonností vystihl již v roce 1973 McClelland (1973), který napsal: „Nejlepší způsob, jak porozumět výkonu, je pozorovat, co lidé právě dělají, aby byli úspěšní (tj. kompetence), než se spoléhat na předpoklady o hlubších vlastnostech či attributech, jakými je například inteligence.“

Pracovní výkonnost v rámci tohoto výzkumu není totožně chápána s Wagnerelem (2009) jako „charakteristika, která popisuje způsob, respektive průběh, jakým zkoumaný objekt vykonává určitou činnost, na základě podobnosti s referenčním způsobem vykonání (průběhu) této činnosti“, ale je zde kladen větší důraz na širší spektrum výkonnosti, jak uvádí Randhawa (2007), který ji definuje jako: „Splnění daného úkolu za dodržení očekávaných standardů přesnosti, úplnosti, nákladů a rychlosti.“ Jak dodává Houldsworth (2006), „lze ji hodnotit pomocí přístupu ke klientům, organizaci práce (své i ostatních), motivaci dosahovat cílů, ochoty rozhodovat“. Tuto definici doplňuje studie Austin Peay University (2012) o přístup ke kvalitě a financím. Pracovní výkonnost dle Hroníka (2008) bezprostředně souvisí s motivací. Takový vztah lze definovat pomocí Yerkes-Dodsonova zákona, jehož stručné schéma je na obrázku č. 1.

Obrázek 1: Vztah motivace a výkonnosti



Zdroj: Hroník (2008)

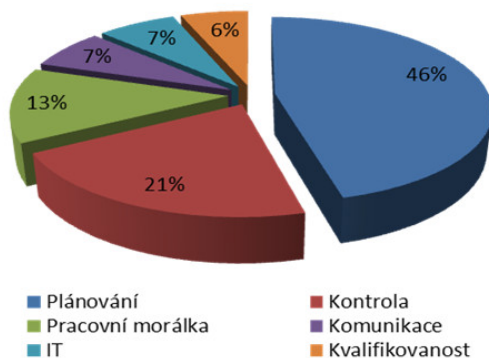
Křivka znázorňuje, že s rostoucí měrou motivace roste také výkonnost až do určité maximální výkonnosti, poté už má motivace opačný efekt. Z toho důvodu je velmi důležité udržovat motivaci a s ní spojenou výkonnost pracovníků v tzv. aktivačním optimu, které je znázorněno na obr. č. 1. Představuje ideální intenzitu zatížení pracovníka tak, aby bylo dosaženo nejlepšího výkonu. Pracovník, který je „přemotivován“ a pociťuje velkou míru zatížení a s ním spojenou úzkost, nedosahuje optimálního výkonu, stejně tak jako při nízké motivaci. Aktivační optimum má každý pracovník položené jinde, z toho důvodu je důležité, aby vedoucí byl schopen správně analyzovat a vycítit tento bod.

Je zde vidět, že motivace je velmi účinnou podporou výkonu, ale není snadnou záležitostí a musí respektovat mnoho okolností. Vrcholový manažer by se měl naučit uplatňovat tyto aspekty nejen na tým, ale také sám na sebe. Pro-

tože sebmotivace je úzce spojena s úspěchem. „*Sebmotivace je možná pouze, pokud dosáhneme dostatečné míry vlastní inspirace a vůle k aplikaci. Největším zdrojem inspirace je úspěch, který nám dodává sebevědomí a odvahu k vyšším cílům. Aplikace oproti tomu představuje schopnosti, jako je plánování vlastního času, získávání nadšení pro to, co děláme a stanovování vlastních cílů*“ (Koubek 2003).

Vážnost nízké výkonnosti práce dokládá také studie předložená společností Czipin & Proudfoot Consulting (Peníze.cz 2007; Frejtichová 2004). Výzkum byl prováděn v deseti zemích ve firmách s více jak pěti sty zaměstnanci. Česká republika zaostává za západní Evropou pouze o dvě procenta, přesto je ztráta 40 % produktivity alarmující. Z průzkumu mimo jiné vyplývá, že zaměstnanci ročně odpracují 1906 hodin, z nichž je neproduktivních 724 hodin. Zároveň průzkum informoval o tom, že jen díky špatnému plánování a vedení průměrný zaměstnanec promarní 85 pracovních dnů v roce. Proto prvním nedostatkem bylo stanovení manažerské plánování, na druhém místě je nedostatečná kontrola a dohled, dále potom pracovní morálka a přibližně sedmiprocentní podíly mají: nedostatečná komunikace, informační technologie a nízká kvalifikovanost lidí, jak je patrné z obrázku č. 2 znázorňujícím hlavní překážky růstu produktivity práce ve světě.

Obrázek 2: Hlavní překážky růstu produktivity práce ve světě



Zdroj: Frejtichová 2004

## Metodika a cíl

Cílem studie je statisticky ověřit, zda je správný předpoklad, že manažeři dosahují stejné, případně vyšší úrovně výkonnosti oproti studentům. Výkonností se v tomto významu myslí schopnost kombinovat více dílčích činností, vysoká pracovní morálka, obecná schopnost dotahovat započaté úkoly do konce a další aspekty, které byly zohledněny v dotazníkovém šetření, kde byli respondenti formou otázek testováni na základě vlastního uvážení. Dotazníkové šetření bylo

zaměřeno na větší spektrum kompetencí (komunikace, kooperace, výkonnost, zodpovědnost, samostatnost a jiné), ke každé kompetenci směřovalo minimálně 7 otázek (tvrzení), které byly v rámci testu přeházené, aby nedocházelo k předjímání výsledků. Souhlasné stanovisko s jednotlivými tvrzeními v rámci dotazníku bylo možné hodnotit pomocí pětibodové škály. Otázky v dotazníku byly formulovány na základě doporučení odborníků z praxe a následně ještě upravovány dle výsledků pilotního ověření. Oběma skupinám (manažeri i studenti) byly předloženy identické dotazníky, aby bylo možné přistupovat k výsledkům jednotně. Výkonost je zde hodnocena na základě otázek směřujících na oblasti: přístup ke klientům, organizace práce své i ostatních a motivace dosahovat cílů, jak uvádí Houldsworth (2006). Z hlediska struktury výkonnosti bylo po konzultaci s psychologem doporučeno směřovat tři otázky do oblasti osobní motivace k dosažení výsledku, která je klíčová z hlediska nejsilnější vazby na budoucí úspěch (výzkum Masjuan 2008). Dvě otázky směřovaly do oblasti vztahu s klientem a byly zaměřeny na schopnost efektivní a asertivní komunikace s ohledem na míru ochoty poskytnout klientům přidanou hodnotu. Dále bylo zařazeno po jedné otázce zaměřené na interní a externí organizaci práce, které se týkaly schopnosti delegovat a kontrolovat úkoly a osobního time-managementu.

V rámci výpočtu byla položena nulová hypotéza, že kompetence manažerů a studentů se shodují na základě analyzovaných dat, a alternativní hypotéza, že kompetence manažerů dosahují vyšší úrovně výkonnosti než kompetence studentů. Získávání dat probíhalo v rámci disertační práce od 221 manažerů pomocí dotazníkového šetření za spoluúčasti Jihočeské hospodářské komory a společnosti CzechInvest a následně od 376 studentů vysokých škol. Data byla testována pomocí dvouvýběrového Wilcoxonova testu (Freund 2010; Friedrich 2010) a jeho asymptotické varianty. Jedná se o neparametrický dvouvýběrový test, který se nejčastěji používá tehdy, pokud není splněn předpoklad normality dat. Jelikož mírné porušení normality u vzorků větších než 30 nemá zásadní dopad na výsledky testu.

Necheť  $X_1, \dots, X_n$  a  $Y_1, \dots, Y_m$  jsou dva nezávislé náhodné výběry ze dvou spojitých rozložení, jejichž distribuční funkce se mohou lišit pouze posunutím.  $x_{0,50}$  a  $y_{0,50}$  jsou označeny jako medián prvního a druhého rozložení. Vždy je testována hypotéza, že distribuční funkce obou rozložení jsou shodné, jinými slovy, že mediány se rovnají. Oproti alternativě, že první z mediánů  $x_{0,50}$  manažerů je větší než druhý jmenovaný (Budíková et al. 2010; Freund 2010; Friedrich 2010).

$$H_0 = x_{0,50} - y_{0,50} = 0 \quad \text{proti} \quad H_A = x_{0,50} > y_{0,50}$$

(Friedrich 2010)

V první fázi jsou všechny  $(n + m)$  hodnot  $X_1, \dots, X_n$  a  $Y_1, \dots, Y_m$  uspořádány vzestupně podle velikosti. Jelikož celý proces testu probíhá elektronicky pomocí softwaru Statistika ver. 10, není tento krok v práci zapisován, jelikož se jedná pouze o lapidární operaci.

Dále jsou zjištěny součty pořadí hodnot  $X_1, \dots, X_n$  a označeny jako  $T_1$ . Součet hodnot v pořadí studentů  $Y_1, \dots, Y_m$  bude značen  $T_2$ .

Dalším krokem je vypočtení testované statistiky pro  $U_1$  a  $U_2$ , přitom stále platí, že  $U_1 + U_2 = mn$  (Friedrich 2010):

$$U_1 = mn \frac{n(n+1)}{2} - T_1, U_2 = mn \frac{m(m+1)}{2} - T_2$$

(Friedrich 2010)

Pokud platí, že statistika  $\min\{U_1, U_2\} \geq$  tabletované kritické hodnotě pro zvolené rozsahy obou výběrů a zvolenou hladinu významnosti, pak nulovou hypotézu o totožnosti porovnávaných skupin zamítneme na hladině významnosti  $\alpha = 0,05$ . Jelikož pro oba vzorky ve všech testovaných případech platí, že  $n, m$  jsou větší než 30, je přistoupeno k asymptotické variantě Wilcoxonova testu (Mann-Whitneyův test), který se využívá pro  $n$  a  $m$  větší třiceti. Kde  $U'1 = \min\{U_1, U_2\}$  (Budíková et al. 2010; Wonnacot 1995).

$$U_0 = \frac{U'_1 \frac{mn}{2}}{\sqrt{\frac{(m+n+1)}{12}}}$$

(Friedrich 2010)

Kritický obor hodnot pro pravostrannou alternativu  $W = \langle k_2, n \rangle$  nezáporné hodnoty  $k_1$  a  $k_2$  jsou přesně dány v odborné literatuře.  $H_0$  zamítáme na hladině významnosti  $\alpha$ , pokud  $U_0 \in W$  (Freund 2010; Friedrich 2010).

Výsledky testu dokládají rozdíly v posunutí křivek jednotlivých kompetencí manažerů a studentů.

## Výsledky

Stanovení hypotéz:

$$\begin{aligned} X &= \text{výkonnost u manažerů} & H_0 &= x_{0,50} - y_{0,50} = 0 \\ Y &= \text{výkonnost u studentů} & H_A &= x_{0,50} > y_{0,50} \end{aligned}$$

Testová statistika:

Dvouvýběrový Wilcoxonův test (Mann-Whitneyův U test)

Zvolená hladina významnosti:  $\alpha = 0,05$

Nejprve byla veškerá  $n + m$  hodnot  $X_1, \dots, X_n$  a  $Y_1, \dots, Y_m$  uspořádána vzešupně podle velikosti. Z důvodu velkého množství dat byl tento krok prováděn elektronicky.

Byl zjištěn součet pořadí hodnot  $X_1, \dots, X_n$  a označen  $T_1$ . Součet pořadí hodnot  $Y_1, \dots, Y_m$  značím  $T_2$ .

$$\text{Výpočet statistiky } U_1 = mn \frac{n(n+1)}{2} - T_1, U_2 = mn \frac{m(m+1)}{2} - T_2$$

$$\begin{aligned} T_1 &= 11358,00 & U_1 &= 2856,00 \\ T_2 &= 8742,00 & U_2 &= 7080,00 \end{aligned}$$

Tabulka č. 1 vytvořená v softwaru Statistica ver. 10 ukazuje nejdůležitější zjištěné hodnoty u výkonnosti. V prvních dvou sloupcích jsou uvedeny součty obou skupin.  $U$  značí požadovanou min. hodnotu z  $U_1$  a  $U_2$ .  $Z$  je hodnota asymptotické testové statistiky v metodice značené jako  $U_0$ .  $P$ -hodnota je již vypočtená požadovaná hodnota, která je porovnávána s  $\alpha$  a rozhoduje o zamítnutí, či nezamítnutí nulové hypotézy.  $P$ -hodnota je upravena pro jednostrannou alternativní hypotézu a opět konfrontována s  $\alpha$ . V obou případech je  $p$ -hodnota blízká nule.

Tabulka 1: Mann-Whitneyův U test

Označené testy jsou významné na hladině $p < 0,05000$					
	Součet manažerů	Součet studentů	$U$	$Z$	$p$ -hodnota
Výkonnost	2819355	3597798	1051902	14,85040	0,00000

$$0,00000 < 0,05$$

$$p\text{-hodnota} < \alpha$$

Jelikož konečná  $p$ -hodnota je blízká nule a je menší než zvolené  $\alpha$ , zamítám nulovou hypotézu na hladině významnosti 0,05.

$$p\text{-hodnota} / 2 < \alpha$$

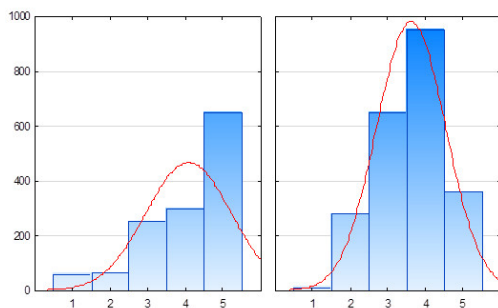
$$0,00000 < 0,005$$

Na základě analyzovaných dat se alternativní hypotézu nepodařilo zamítnout, jelikož polovina z  $p$ -hodnoty je stále menší než zvolené  $\alpha$ . Proto můžeme nadále tvrdit, že manažeři dosahují vyšší úrovně výkonnosti než studenti.

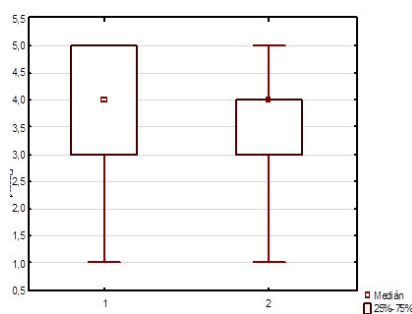
Výsledek testu dokládá také obrázek č. 3, kde je znázorněno, že vrchol pravé křivky studentů je o 0,5 bodu posunutý vůči levé křivce manažerů. Také nejčastější výskyt je u hodnoty 4 a 3 oproti hodnotě 5 u manažerů.

Na obrázku č. 4 je sice patrné, že hodnota mediánu je u obou skupin shodná, ale procentuální výskyt hodnot v rozmezí 25–75 % je u levého krabicového diagramu posazen až k hodnotě 5, zatímco u studentů (diagram č. 2) je v rozmezí od 3 do 4 bodů.

Obrázek 3: Výkonnostní křivky



Obrázek 4: Výskyt hodnot



## Diskuze

V odborné literatuře dle zjištění nebyly zatím komparovány výsledky studentů s manažery z hlediska výkonnosti, ale lze vycházet z Johna Shieldse (2007), který ve své knize popisuje studie prováděné ve Spojených státech amerických na státních úřednících a jejich vedoucích, kde byla prokázána vyšší výkonnost právě u manažerů. Podobná problematika je také okrajově zmíněna v knize zaměřené na performance management (Williams 1998), kde je uváděna studie v soukromém sektoru. Zde byl srovnáván management dle úrovně řízení, přičemž nejvyšší výkonnosti opět dosáhli vrcholoví manažeři vůči manažerům liniovým. Z hlediska úspěšnosti podniku je důležitý také vztah mezi výkonností manažera a jeho vztahem k inovacím a jejich podpoře, který zkoumal P. Moren (2005) ve farmaceutickém průmyslu, kde se na 120 manažerech podařilo prokázat pozitivní závislost mezi mírou osobní výkonnosti a mírou podnikových inovací.

Výkonností vysokoškolských studentů se zabývá také Andrew T. Roach (2006), který zkoumal rozdílnost výkonnosti z hlediska ročníku studia, samotná výkonnost roste s dobou studia, kde největší nárůst je mezi třetím a čtvrtým rokem. Další studií z hlediska výkonnosti studentů je výzkum zaměřený na vztah mezi úspěchem a výkonností, kde Josep M. Masjuan (2008) ve svém více jak 7letém výzkumu navazuje na výsledky Cryera a Eltona (1992), kteří zde prokázali silnou vazbu. Vztah této vazby se právě Masjuan (2008) pokouší ve svých výzkumech blíže specifikovat a diferencuje výkonnost a úspěšnost studentů: úspěch při studiu, v osobním životě a v profesním. Měřítky jsou definované ukazatele a subjektivní vnímání tazatelů. Výkonnost zde rozlišuje na výkonnost spjatou s vlastní motivací, která prokazuje nejsilnější vazbu s úspěchem, a výkonnost každodenní, kterou lze vnímat jako opak prokrastinace.

## Závěr

V práci se podařilo zamítnout hypotézu, že výkonnost manažerů je shodná s výkonností studentů, a zároveň se nepodařilo zamítnout alternativní hypotézu, která tvrdila, že manažeři dosahují lepších výsledků než studenti na hladině významnosti  $\alpha = 0,05$ . Oba tyto výsledky dokládá také grafické znázornění výskytu středních hodnot a zastoupení četností v jednotlivých skupinách, odkud je zřejmé, že manažeři dosahovali vyšších hodnot.

Lze se domnívat, že tento výsledek je zapříčiněn převážně nízkou měrou zkušeností a praxe studentů, právě tyto faktory nejvíce zvyšují výkonnost, neboť odbourávají strach z neúspěchu, chybovat a pomáhat pracovníkovi zaměřit se pouze na podstatné, důležité body a převzít zodpovědnost. Určitý podíl také může mít motivace, kterou lze na základě dotazníku obtížně definovat, zde by bylo vhodnější provést případové studie. Vliv ostatních faktorů, jako jsou fyziologické předpoklady a prostředí, na výsledek je zanedbatelný. Fyziologické předpoklady jsou podobné a vliv prostředí na výkonnost v tomto případě není významný, pro obě skupiny jsou vnější podmínky co nejvíce optimalizovány pro efektivní práci.

Doporučení pro zvýšení výkonnosti studentů je pokusit se získat pracovní praxe a stáž, které pomohou načerpat cenné zkušenosti, které přispějí k budoucímu zvýšení jejich výkonu. A odbourat prokrastinaci (Ferrari 1995; Gabrhelík 2006) – chorobné odkládání povinností na pozdější termín. Řešení souvisí s rozložením práce během semestru, kdy studenti práci odkládají, protože je netlačí termín. Bylo by vhodné koncipovat výuku do kratších bloků, ve kterých by studenti měli povinnost plnit zadané úkoly, aby si navykli na pravidelnou činnost, a usilovat o průběžnou práci studentů během celého semestru. Klíčem k překonání prokrastinace je totiž především stanovování si menších dílčích cílů, které studentům pomohou s prací vůbec začít a navyknout si tak na určitý režim, který pro ně nebude tak stresující. Pozitivem tohoto faktu je i pozitivní motivace, kterou budou zažívat při splnění dílčích úkolů a povinností (Belz 2001). Pracují-li totiž na studijních povinnostech pouze v závěru semestru, jejich dlouhodobá výkonnost je poměrně nízká, zároveň se cítí stresováni množstvím úkolů, které se jim za celý semestr nakupí.

Další doporučení se týká hlavně metod, které lze aplikovat na obě skupiny, a dle literatury (Covey 2004; Forster 2006; Redcliffe 2012) se jedná například o systém dlouhodobého a denního plánování, které se skládá z více drobných úkolů, což nám pomáhá rozdělovat ty větší. Zároveň, jak píše Foster (2006), je podstatné vybrat vždy maximálně tři nejdůležitější úkoly v rámci dne a stručně vymezit čas potřebný na každý úkol. Tato činnost by měla zabrat přibližně 15 minut každé ráno. Zároveň se doporučuje pro zachování motivace a energie rozdělovat práci do bloků s více krátkými přestávkami. Redcliffe (2012) spatřuje jako největší ohrožení naší produktivity komunikaci (emaily, telefonáty, kolegy), z tohoto důvodu doporučuje nevyřizovat emaily dříve než po obědě a zároveň při plnění prioritních denních úkolů vypínat telefon.

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## Performance as a Main Competence

In times of global economic crisis managerial competence is coming into prominence because only competent and high-performance managers are able to hold companies actively competitive. The strength of the company does not come from a finance background but human capital is becoming more important. That is why companies use the competency model to evaluation and finding potential of the employees. Thanks to this model they can choose the most capable ones. From the whole scale of competencies for the top managers the most important competence determining the success of the manager is his/her performance. Therefore the aim of this study is to confront performance of managers with students.

**Keywords:** manager, competence, efficiency

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# Projevy vodní eroze v drahách soustředěného povrchového odtoku

Katarzyna Drongová, Veronika Sobotková

Vysoké učení technické v Brně

## Abstrakt

Na pozemcích, kde dochází vlivem morfologie terénu k soustředování povrchového odtoku, mohou vznikat tzv. hluboké efemérní rýhy. Jedná se o rýhy, které jsou každoročně zaorávány, a při jarním tání a přívalových srážkách dochází k jejich opětovnému vzniku. Hluboké efemérní rýhy jsou v České republice jedním ze zatím málo popsaných projevů vodní eroze. Užitečným nástrojem pro identifikaci lokalit s možností vzniku efemérních rýh jsou hydrologické analýzy s využitím nástrojů geografického informačního systému ArcGIS. Za předpokladu určení vhodných okrajových podmínek je možné pomocí těchto nástrojů uspokojivě identifikovat potenciální místa vzniku efemérních rýh. Na základě přímého měření efemérních rýh byl stanoven statisticky významný vztah použitelný pro predikci ztráty půdy z těchto rýh. Provedená měření ukázala, že ztráta půdy z efemérních rýh často dosahuje, nebo i výrazně převyšuje ztrátu půdy predikovanou dostupnými modely sloužícími pro výpočet plošné ztráty půdy. Výstupy těchto modelů jsou však v praxi mnohdy interpretovány jako hodnoty celkového odnosu půdy z dané plochy.

**Klíčová slova:** vodní eroze, hluboká efemérní rýha, plošná eroze, soustředěný povrchový odtok, ztráta půdy

## Úvod

Hluboké efemérní rýhy vznikající v drahách soustředěného povrchového odtoku (dále také „DSO“) na orné půdě jsou v České republice jedny ze zatím málo popsaných projevů vodní eroze. Název je převzat z anglického slovního spojení „ephemeral gully“. Pojem efemérní je vykládán jako „pomíjející“ či „prchavý“. V důsledku zemědělské výroby totiž dochází každoročně k zaorávání těchto rýh a k následnému znovuoobnovení v období jarního tání a přívalových srážek. Koncentrovaný odtok z pozemku může vytvářet poměrně hluboké rýhy, které poté dopravují směs vody a erodovaného materiálu (splavenin) do vodotečí či do zastavěného území obce.

Tato problematika je v poslední době velmi diskutovaná v zahraničí. V cizojazyčné odborné literatuře je uváděno, že tyto rýhy mohou vést ke ztrátám půdy, jež výrazně převyšují ztráty vzniklé při plošné či rýhové erozi (Vandaele

1996). V Belgii (Nachtergaele et al. 2002) bylo závěrem rozsáhlého výzkumu konstatováno, že eroze způsobená efemérními rýhami je dominantní složkou celkového odnosu půdy z povodí. Náklady na likvidaci škod způsobených takovou událostí pak bývají značné.

Z výše uvedených důvodů nastala potřeba výzkumu těchto rýh a kvantifikace objemu odnosu půdy jimi způsobeného. Dle studie „Vymezení přispívajících ploch nad závěrovými profily erozně ohrožených drah odtoku na orné půdě pro potřeby Rámcové směrnice pro vodní politiku 2000/60/ES“ bylo v zemědělské krajině ČR identifikováno přes 33 000 erozně ohrožených drah soustředěného povrchového odtoku o celkové délce téměř 12 000 km (Ekotoxa 2011). Bylo ověřeno, že v případě pěstování širokořádkových plodin a jsou-li tyto pozemky do jednoho měsíce po zasetí plodiny postiženy přívalovou srážkou, pak mají erozně ohrožené dráhy vzniklé na těchto pozemcích velký potenciál k tvorbě hlubokých efemérních rýh.

Níže uvedený obrázek (č. 1) ukazuje dráhy soustředěného povrchového odtoku měřené v roce 2012 v obci Domašov v Jihomoravském kraji. Na pozemku byla pěstována širokořádková plodina – čirok. Srážka, která rýhy iniciovala, dosáhla denního úhrnu pouze 20 mm. Přesto byl způsoben značný odnos půdy. Srážka přišla v období, které je Wishmeierem charakterizováno jako doba od přípravy pozemku k setí do jednoho měsíce po zasetí nebo sázení (dále nazýváno také druhé období C faktoru) (Janeček et al. 2012). V tomto období má půda nižší objemovou hmotnost a hodnota kritického smykového napětí s ní související je pro daný povrch menší.

Obrázek 1: Erozní projevy v drahách soustředěného povrchového odtoku měřené v roce 2012 v Domašově v Jihomoravském kraji

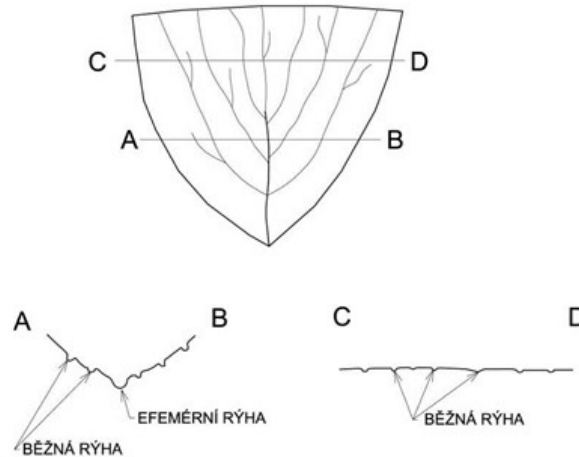


Zdroj: Vlastní

Na hluboké efemérní rýhy je možné pohlížet jako na zvláštní typ rýh. Rozdíl mezi běžnými rýhami a hlubokými efemérními rýhami dokumentuje obrá-

zek č. 2. Běžné rýhy se na zemědělském pozemku objevují ve větším množství a jejich každoroční výskyt je velmi závislý na konkrétních zemědělských praktikách, jako je směr orby a setí plodin. Oproti tomu hluboké efemérní rýhy se znovuobjevují na stejných místech – v drahách soustředěného povrchového odtoku.

Obrázek 2: Znázornění rozdílu mezi klasickými rýhami a efemérními rýhami



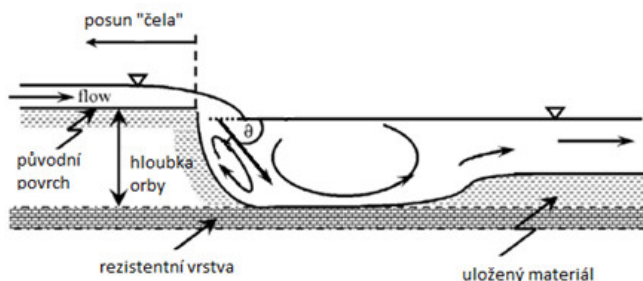
Zdroj: U.S. Department of Agriculture – Soil Conservation Service 1992

Hluboké efemérní rýhy mívají průřezovou plochu větší než 1 čtvereční stopa (0,093 m<sup>2</sup>) (Vandaele 1996). Efemérní rýhy v DSO bývají obvykle větší než klasické rýhy a zároveň menší než permanentní strže.

Vlivem soustředěného povrchového odtoku může docházet k tvorbě depresí v místech s nedostatečným půdním pokryvem. Nastává koncentrace proudící vody v těchto depresích a tím dochází k jejich zvětšování. Eroze se začíná tvořit na počátku deprese, kde vznikají téměř svislé stěny a projevuje se zde bystřinné proudění. V malé míře dochází k odnosu materiálu z plochy stěny. Odnosem materiálu ze dna deprese dochází k prohlubování rýhy a „poddolování“ svislé stěny na začátku deprese, čímž dochází k oslabení její stability a finálně zborcení do prostoru erozní rýhy. Tím se svislé čelo posouvá dál proti proudu (Gordon 2007; Morgan 2005) (obrázek č. 3).

Ve chvíli, kdy eroze dosáhne hloubky orby, tj. narazí na více rezistentní vrstvu půdy, redukuje se odnos materiálu ze dna rýhy. Dále dochází ke zvětšování šířky rýhy, a to v důsledku eroze bočních stěn rýhy. Měření provedená na jihovýchodě Sydney v Austrálii prokázala, že eroze bočních stěn (bočnic, břehů) je mnohem významnější co do množství oderodovaného materiálu (Morgan 2005). V České republice zatím eroze v drahách soustředěného povrchového odtoku nebyla kvantifikována.

Obrázek 3: Schéma vytváření a „aktivní migrace“ svislých stěn v podélném profilu efemérní rýhy



Zdroj: Gordon 2007

U nás se v praxi pro dimenzování protierozních opatření používá univerzální rovnice USLE Wischmeier-Smith (Wischmeier a Smith 1978), která počítá dlouhodobou průměrnou ztrátu půdy v ploše svahu (plošná eroze) v závislosti na šesti faktorech ovlivňujících hodnotu ztráty půdy. V této rovnici však není (mezi jinými) zahrnuta bilance odnosu zeminy, kterou způsobují efemérní rýhy. Vztah totiž neuvažuje účinek povrchového odtoku, zejména soustředěného povrchového odtoku jako erozního činitele, ale zahrnuje pouze vliv kinetické energie kapek dopadajících na povrch půdy.

Řada zahraničních autorů popisuje smykové napětí způsobené povrchovým odtokem jako hlavní faktor tvorby hlubokých efemérních rýh. Jako první popsal význam smykového napětí pro vznik rýh Horton (1945). Uvádí vztah pro výpočet smykového napětí:

$$\tau_b = \rho \cdot g \cdot d \cdot s \quad (1)$$

- kde:  $\tau_b$  smykové napětí od povrchové odtékající vody [ $\text{N}\cdot\text{m}^{-2}$ ],  
 $\rho$  objemová hmotnost vody [ $\text{kg}\cdot\text{m}^{-3}$ ],  
 $g$  tíhové zrychlení [ $\text{m}\cdot\text{s}^{-2}$ ],  
 $d$  výška odtékající vody [m],  
 $s$  sinus úhlu svírající povrch svahu s vodorovnou rovinou [-].

## Materiál a metodika

Za účelem porovnání výpočtu plošné eroze z plochy svahu a rýhové eroze vzniklé v efemérních rýhách byla vybrána lokalita v katastru obce Šardice na Hodonínsku v Jihomoravském kraji, kde byl na základě geodetického měření zhotoven přesný výškopis. V prostředí ArcMap byl z výškopisu pomocí topografických nástrojů interpolační metodou vygenerován hydrologicky korektní digitální model terénu (dále „DMT“). Na základě DMT a s použitím patřičných hydrologických nástrojů dostupných v prostředí ArcMap (např. Flow Accumulation) byla vygenerována vrstva akumulace odtoku. Vrstva akumulace odtoku sloužila

jako podklad pro identifikaci potenciálních míst vzniku efemérních rýh v dráhách soustředěného povrchového odtoku. Akumulace odtoku byla klasifikována tak, aby zobrazila takové efemérní rýhy, které mají velikost přispívající plochy nad 3 ha (Ekotoxa 2011).

Následně byl proveden výpočet objemu těchto hlubokých efemérních rýh. Objem efemérních rýh byl přepočten na hmotnost odnesené půdy z rýhy. Níže jsou podrobněji popsány postupy měření a výpočty ztráty půdy způsobené plošnou erozí, volumetrické kvantifikace objemu efemérních rýh přímo v terénu a predikce objemu eroze v efemérních rýhách na základě empirického vztahu.

### **Výpočet ztráty půdy způsobené plošnou erozí**

Pro stanovení dlouhodobé průměrné ztráty půdy byla použita univerzální rovnice USLE Wischmeiera-Smitha (1978). Výpočet byl proveden v prostředí Arc-Map pomocí hydrologických a topografických nástrojů. Do rovnice vstupovaly níže uvedené faktory.

Použitý R faktor byl zvolen  $40 \text{ MJ}\cdot\text{ha}^{-1}\cdot\text{cm}\cdot\text{h}^{-1}$ , což je průměrná hodnota R faktoru převažující na většině ploch zemědělské půdy v České republice (Janeček et al. 2012). Pro stanovení LS faktoru byl použit výpočet pomocí programu USLE2D (Govers a Van Oost 2000). Pro stanovení K faktoru bylo využito údajů z celostátní databáze BPEJ. Na základě hlavní půdní jednotky byla přiřazena každému elementu vektorové vrstvy BPEJ hodnota K faktoru. Pro stanovení C faktoru byl použit celostátně dostupný registr půdních bloků LPIS. P faktor vstupoval do výpočtů jako konstanta ( $P = 1$ ). Stanovení K, C a P faktoru bylo provedeno v souladu s metodikou „Ochrana zemědělské půdy před erozí“ (Janeček et al. 2007).

### **Volumetrická kvantifikace objemu efemérních rýh**

Za účelem získání skutečných údajů o objemu efemérních rýh došlo k vývoji mechanického zařízení, tzv. erodoměru pro zaměřování příčných profilů rýh přímo v terénu. Zařízení bylo navrženo a je dále vyvíjeno na Ústavu vodního hospodářství krajiny Fakulty stavební VUT v Brně. Erodoměr umožňuje pomocí kovových jehlic umístěných v rámu zaměření příčných profilů povrchu půdy v efemérních rýhách. Pro zaměření průběhu terénu ve vybraném zaměřovaném příčném profilu je erodoměr posunován v délkově regulovatelném nosném profilu, čímž dojde k zaměření celého příčného profilu efemérní rýhy (od jedné hrany efemérní rýhy k druhé).

Pomocí výše popsaného zařízení došlo během let 2009 až 2012 k zaměření 25 hlubokých efemérních rýh v krajích Olomouckém, Moravskoslezském, Jihomoravském a Vysočina, mezi nimi i dvou rýh DSO1 a DSO2 (obrázek č. 5) v zájmovém území obce Šardice. Pěstovanou plodinou na pozemcích, kde byly prováděny měření pomocí erodoměru, byla širokořádková erozně nebezpečná plodina. Měření probíhalo koncem měsíce srpna, případně začátkem září, tj. krátce před sklizní plodiny pěstované na daném zemědělském pozemku. Výsledky 25 měřených efemérních rýh jsou základem pro testování možných metodických postupů pro predikci parametrů efemérních rýh (především jejich

objemu) za předpokladu přítomnosti širokořádkové plodiny a výskytu srážky během druhého Wischmeierova období. Pomocí tohoto zařízení se získá skutečná hodnota objemu oderodovaného materiálu z konkrétní efemérní rýhy.

Obrázek 4: Zaměřování příčného profilu efemérní rýhy erodoměrem

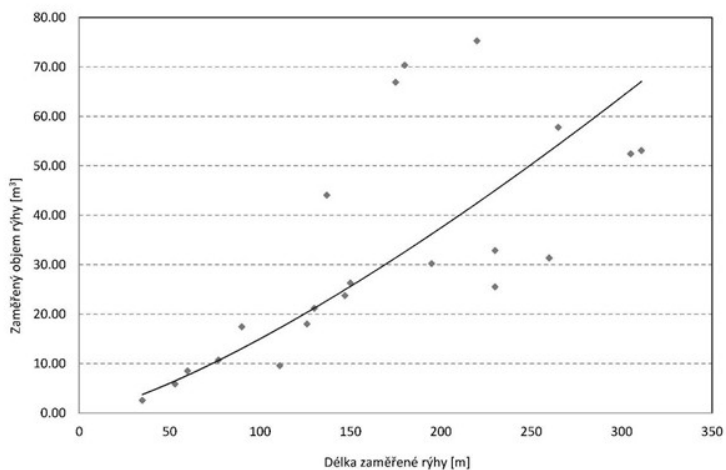


Zdroj: Vlastní

### Predikce objemu eroze v efemérních rýhách

Na základě souboru terénních měření byl vytvořen statisticky významný regresní vztah (koeficient determinace  $R^2 = 0,787$ ) sloužící pro výpočet objemu rýhy na základě predikované délky rýhy. Vzhledem k přítomnosti odlehlých bodů byly do testování závislosti zahrnuty měřené rýhy kratší než 350 m. Byl zvolen mocninový typ regresní funkce (viz graf č. 1).

Graf 1: Závislost délky rýhy na jejím objemu – rýhy kratší než 350 m



Zdroj: Vlastní

Pro měřené DSO kratší jak 350 m má regresní vztah tvar:

$$V = 0.0342 \cdot L^{1.3208} \quad (2)$$

kde: L délka rýhy [m],  
V objem rýhy [m<sup>3</sup>].

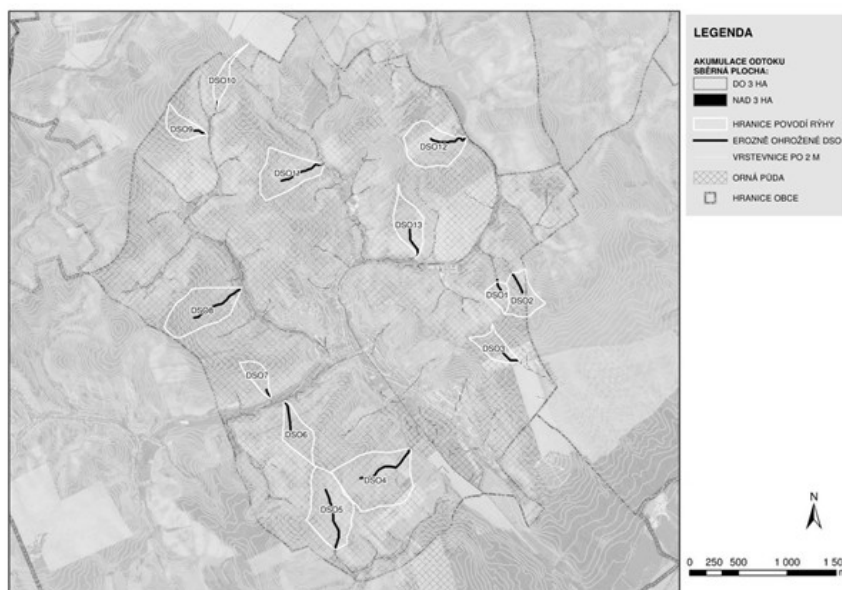
Vztah platí pro širokořádkové plodiny za předpokladu výskytu přívalové srážky v druhém období C faktoru.

Podobný vztah publikoval Capra et al. (2009). Na velkém vzorku téměř 200 rýh měřených v Itálii během let 1995 až 2007 zjistil silný vztah mezi objemem a délkou rýhy.

Délka rýhy, která vstupuje do výše uvedeného vztahu, byla predikována na základě závěrů uvedených ve studii „Vymezení přispívajících ploch nad závěrovými profily erozně ohrožených drah odtoku na orné půdě pro potřeby Rámcové směrnice pro vodní politiku 2000/60/ES“ (Ekotoxa 2011). V této studii byly identifikovány erozně ohrožené rýhy na ploše celé ČR a bylo konstatováno, že dochází k jejich vzniku nejčastěji od velikosti přispívající plochy 3 ha. Dále pomocí funkce Flow Accumulation (akumulace odtoku) dostupné v prostředí ArcMap byly v zájmovém území lokalizovány potenciální efemerní rýhy a odečteny jejich délky. Podle vztahu (2) a následného přepočtu objemu oderodované zeminy na hmotnost byla vypočtena ztráta půdy z hlubokých efemerních rýh.

## Výsledky

Obrázek 5: Identifikace erozně ohrožených drah soustředěného povrchového odtoku v k. ú. Šardice



Zdroj: Vlastní

V tabulce č. 1 jsou uvedeny všechny identifikované erozně ohrožené DSO včetně vyčíslení jejich přispívající plochy a predikované délky a ztráty půdy.

Na základě postupů popsaných v předchozí kapitole bylo pomocí nástroje akumulace odtoku na blocích orné půdy v katastru Šardic identifikováno 13 erozně ohrožených drah soustředěného povrchového odtoku (obrázek č. 5), kde by v případě pěstování širokořádkových plodin a příchodu přívalové srážky v období krátce po zasetí plodiny vznikly efemérní rýhy.

Tabulka 1: Výsledné parametry a ztráta půdy z efemérních rýh

Označení DSO	Velikost přisp. plochy rýhy [ha]	Predik. délka efemérní rýhy [m]	Objem efemérní rýhy [m <sup>3</sup> ]	Ztráta půdy z efemérní rýhy [t]
DSO1	4,7	150,0	25,6	41,0
DSO2	11,8	189,0	34,7	55,6
DSO3	8,1	214,0	40,9	65,5
DSO4	37,6	870,0	260,9	417,5
DSO5	26,7	651,0	177,9	284,7
DSO6	11,5	314,0	67,9	108,7
DSO7	5,7	112,0	17,4	27,8
DSO8	24,9	583,0	153,8	246,1
DSO9	7,6	254,0	51,3	82,1
DSO10	4,8	100,0	15,0	24,0
DSO11	20,0	478,0	118,3	189,3
DSO12	20,5	451,0	109,6	175,3
DSO13	12,5	344,0	76,6	122,6

Pro přispívající plochy jednotlivých erozně ohrožených DSO byla vypočtena ztráta půdy způsobená plošnou erozí. Dále bylo vyčísleno procentuální navýšení plošné eroze z přispívajících ploch predikovanou erozí z efemérních rýh. Jak je vidět v tabulce č. 2, pohybuje se toto navýšení od 11,9% po 103,3%.

Tabulka 2: Procentuální vyjádření navýšení plošné eroze z přispívající plochy erozních rýh o erozi z efemérních rýh

Označení DSO	Roční ztráta půdy z přispívající plochy rýhy – plošná eroze [t·rok <sup>-1</sup> ]	Ztráta půdy z efemérní rýhy [t]	Procento navýšení predikované eroze v případě zahrnutí eroze z efemérních rýh [%]
DSO1	92,8	41,0	44,1
DSO2	123,6	55,6	45,0
DSO3	63,4	65,5	103,3
DSO4	2052,1	417,5	20,3
DSO5	1296,8	284,7	22,0
DSO6	467,7	108,7	23,2
DSO7	234,3	27,8	11,9
DSO8	772,1	246,1	31,9
DSO9	340,1	82,1	24,1
DSO10	102,7	24,0	23,3

Označení DSO	Roční ztráta půdy z přispívající plochy rýhy – plošná eroze [t·rok <sup>-1</sup> ]	Ztráta půdy z efemérní rýhy [t]	Procento navýšení predikované eroze v případě zahrnutí eroze z efemérních rýh [%]
DSO11	1009,6	189,3	18,7
DSO12	1196,6	175,3	14,6
DSO13	466,3	122,6	26,3

## Diskuse a závěr

Jak ukazují závěry provedených měření, mohou ztráty půdy způsobené vznikem hlubokých efemérních rýh dosahovat, nebo i převyšovat ztráty půdy udávané dostupnými modely sloužícími pro výpočet plošné ztráty půdy. Zde prezentované závěry potvrzují i zahraniční výzkumy. Např. Vandaele (1996) v rámci rozsáhlého výzkumu dospěl k závěru, že efemérní rýhy jsou často dominantní složkou celkové půdní eroze na zemědělských pozemcích. Z důvodu významu problematiky a velkého rozšíření erozně ohrožených drah soustředěného povrchového odtoku v České republice je nutný další výzkum těchto hlubokých rýh.

V rámci tohoto článku byla popsána metoda pro lokalizaci erozně ohrožených DSO. Hydrologické analýzy v rámci geografických informačních systémů mohou v praxi sloužit pro prvotní analýzu řešeného území. Zjednoduší a urychlí se následný průzkum lokalit, kde je nutné navrhnout stabilizaci drah soustředěného povrchového odtoku. Korektní návrh stabilizace DSO a vhodný management půdy pak slouží jako účinné opatření proti vzniku efemérních rýh. Tato opatření se projeví snížením celkové ztráty půdy ze zemědělských pozemků a poklesem objemu povrchového odtoku při přívalových srážkách.

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## The Assessment of Soil Losses by Ephemeral Gully Erosion

Small channels attend to be created due to concentrated runoff from fields. These are named ephemeral gullies. Ephemeral gully can be easily filled by normal tillage and then reform again in the same location by additional runoff events. Therefore ephemeral gully disappears due to tillage and appears again after rainfall during the growing season. This issue has been discussed widely abroad. The problematic of ephemeral gully was not yet described in conditions of Czech Republic. Hydrologic analyses in geographic information system ArcGIS are useful tools for identifying sites with potential for creation of ephemeral gullies. A statistically significant relationship was determined on the basis of ephemeral gully direct measurements. The relationship can be used to predict ephemeral gully soil loss. The measurements had shown that the ephemeral gully soil loss can significantly exceeds the predicted soil loss by available models witch calculates interrill soil erosion. The models outputs are often interpreted as a value of the total soil loss from the surface.

**Keywords:** water erosion, ephemeral gully, sheet erosion, concentrated surface runoff, soil loss

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# The Surface Quality of the Deep Hole Drilling

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University of Defence

## Abstract

Deep hole drilling by gun-barrel drill influences properties of the drill hole by a number of factors. Attendant phenomena in deep hole drilling influence both mechanical properties and the quality of the hole, as well as the efficiency of the drilling process. This paper concentrates on the analysis of the surface quality of the deep hole after deep hole drilling. This work provides differences in the parameters of surface roughness and waviness at different diameters of gun barrels and at different pressures of plasma nitriding. The results point out changes in the parameters of surface roughness and waviness along the whole length of the barrel. The paper also focuses on the surface imperfection of the hole. Defects in the bore of the gun barrel are analysed in more detail.

**Klíčová slova:** parameters of surface roughness, deep hole, gun barrel

## Introduction

Deep hole drilling is a technological process for producing a semi-produced material for gun barrels. The quality of deep hole in deep hole drilling depends on many factors, which influence the production process. The main influencing factors are methods and system of the drilling, accuracy of machines, cutting conditions, material the gun barrel is made of, cutting fluid and also concomitant phenomena caused by the deep hole drilling process. The attendant phenomena of deep drilling include misalignment between the tool and the workpiece, dynamical disturbance; bell mouth formation at the beginning of drilling and better quality surface of the bore (Dend 2001, 1165–1188).

This article focuses on changing parameters of surface roughness among various diameters of barrels and with different pressures of plasma nitriding. Imperfections come into being and they decrease the overall quality of the surface due to the cutting process.

## Materials and Methods

A carbon alloy steel 32CrMoV12-10 in the form of bars was used as workpiece material. Chemical composition of this steel is displayed in Table 1. Four barrels were prepared with different diameters: two barrels with diameter 5.5 mm and next two with diameter 6.5 mm. These barrels were drilled by a gun drill. All barrels were plasma nitrided to increase surface hardness. Pressures of plasma nitriding were 400 Pa and 700 Pa (Pokorný 2011, 69–76).

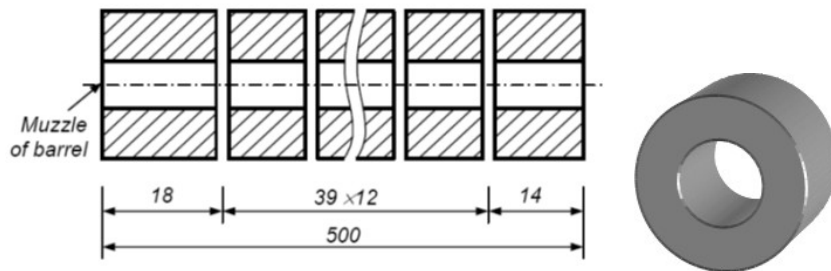
Tab. 1 Chemical composition of steel 32CrMoV10-12

	C	Mn	Si	Cr	Ni	Mo	Cu	P	S
Content [%]	0.35 ÷ 0.40	0.6 ÷ 0.80	0.17 ÷ 0.37	0.9 ÷ 1.2	max. 0.5	0.15 ÷ 0.2	max. 0.3	max. 0.03	max. 0.03

### Preparing of samples

Gun barrels were cut off into parts (rings) after plasma nitridation as shown in Figure 1. The length of the barrels was 500 mm and the barrels were cut off into 41 samples. The length of the first sample was 17 mm, the others were 10 mm (39 samples); 2 mm were reserved for the cutting disk. The lengths of the samples from the muzzle of the barrel were 18, 30, 42, 54, 66, 78, 90, ..., 450, 462, 474, 486 and 500 mm. The length of the last sample was 13 mm.

Fig. 1 Scheme of cutting samples



All of these ring samples were axially cut into two parts in that way the cutting plane passed through the axis of the bore (the axis of the bore was lying in the plane of the cut, it is shown in Figure 2). One part of the samples was used for measurement of the quality of the surface and the second part of samples was used for the other experiments (Pokorný 2011, 717–720).

### Measurement method

Measuring surface roughness of the bore barrel was implemented by relative methods (2 dimensional) and the Surtronic 25 machine was used. Parameters of surface roughness were measured on the surface of the bore in the direction of the axis; there were 5 places along the perimeter (Figure 3). For results of the profile, Talyprofile Platinum was used. Single points in Figures 4 to 7,

mean values from five measurements shown on each of the samples.

Fig. 2 Sample after axial cutting

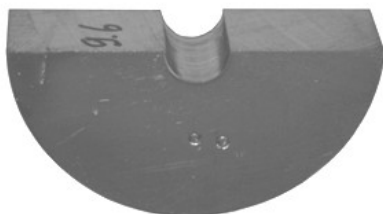
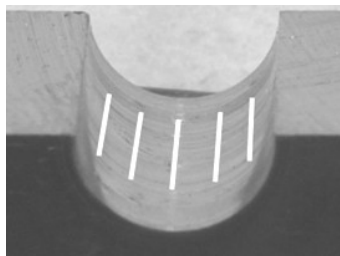


Fig.3 Places for measurement of surface roughness



## Results and discussion

### Barrel with diameter of 5.5 mm; pressure of plasma nitridation 400 Pa and 700 Pa

Values of surface roughness  $R_a$  of the gun barrel in drilling length are shown in Figure 4. Parameter of surface roughness  $R_a$  of the barrel with diameter of 5.5 mm: pressure of plasma nitridation 700 Pa obtains values from  $0.33 \mu\text{m}$  up to  $0.85 \mu\text{m}$ . In the case of the barrel with pressure of plasma nitridation 400 Pa, lower values of surface roughness from  $0.21 \mu\text{m}$  up to  $0.61 \mu\text{m}$  were detected. Parameters of surface roughness of the barrels were higher at the beginning of drilling the barrels and successively deep 50 mm go down. Values of surface roughness of the barrel with diameter of 5.5 mm with pressure of plasma nitridation 700 Pa in length from 50 mm up to 400 mm were about  $0.5 \mu\text{m}$ . Values of surface roughness of the barrel with diameter of 5.5 mm: pressure of plasma nitridation 400 Pa were lower about  $0.27 \mu\text{m}$ . The exception was higher surface roughness of the bore in drilling length of 240 mm, 252 mm and 264 mm from the muzzle of the barrel with a pressure of plasma nitridation 700 Pa. The next exception was surface roughness of the bore in drilling length of 156 mm by the barrel with diameter of 5.5 mm with pressure plasma nitridation 400 Pa. The parameter of surface roughness increased at the end of drilling in the case of both barrels; the barrel with diameter of 5.5 mm and pressure of plasma nitridation 400 Pa had the value  $0.6 \mu\text{m}$ ; the barrel with pressure of plasma nitridation 700 Pa had the value  $0.84 \mu\text{m}$ .

Values of surface waviness in the drilling length of the barrel are shown in Figure 5. Parameters of surface waviness  $W_a$  of the barrel with diameter of 5.5 mm: pressure of plasma nitridation 400 Pa was achieved from  $0.18 \mu\text{m}$  up to  $0.38 \mu\text{m}$ . In the case of the barrel with pressure of plasma nitridation 700 Pa higher values of surface waviness were found out  $W_a$  from  $0.3 \mu\text{m}$  up to  $0.7 \mu\text{m}$ . Values of surface waviness were higher at the beginning of drilling of the barrel but after that they successively went down in the drilling length 45 mm.

Fig. 4 Values of surface roughness Ra of a plasma nitrided barrel with diameter of 5.5 mm

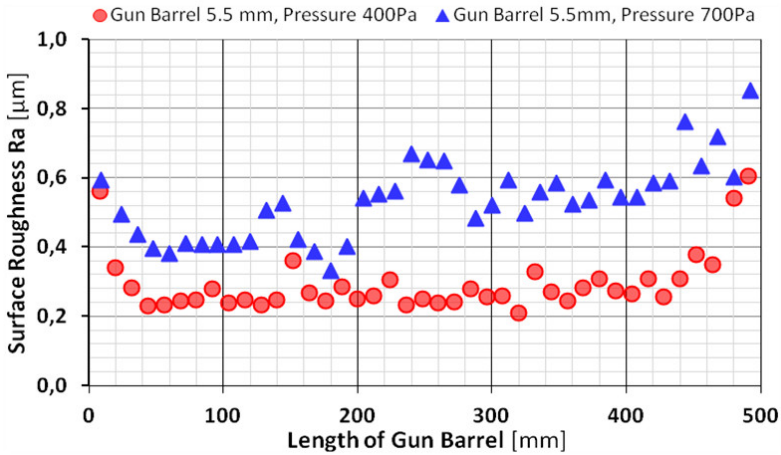
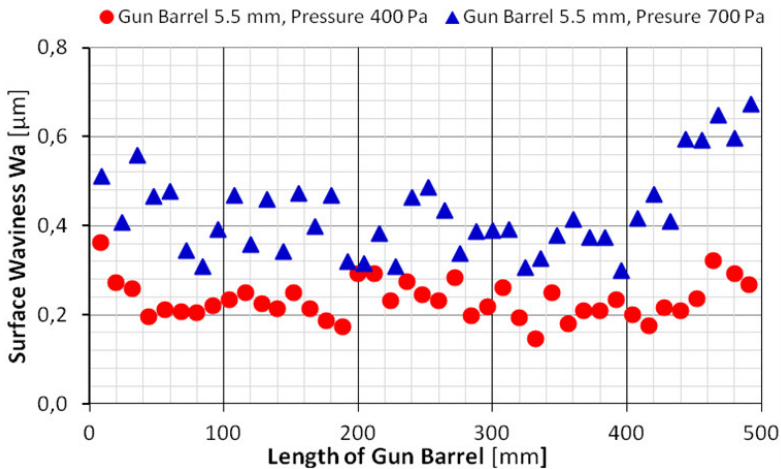


Fig. 5 Values of surface waviness Wa of a plasma nitrided barrel with diameter of 5.5 mm



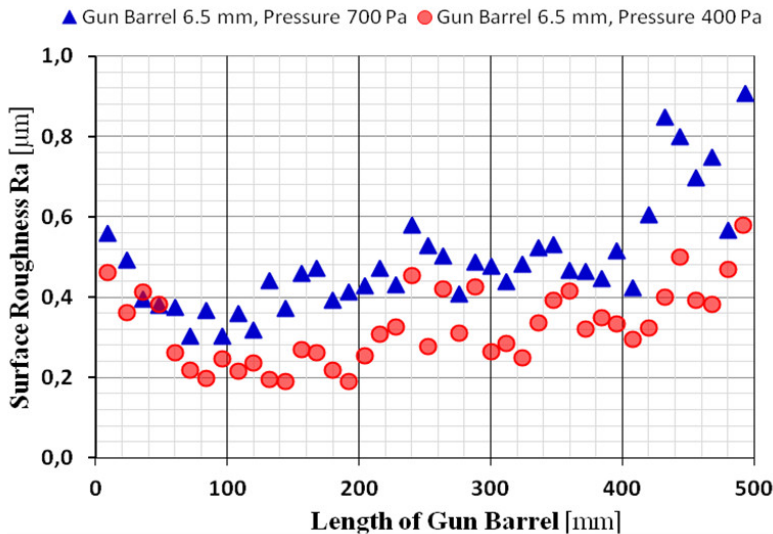
Parameters of surface waviness of the barrel with diameter of 5.5 mm: pressure of plasma nitridation 700 Pa from the drilling depth 50 mm up to 400 mm were in the range from 0.3  $\mu\text{m}$  up to 0.5  $\mu\text{m}$ . The range of values for the barrel with a pressure of plasma nitridation 400 Pa was lower from 0.14  $\mu\text{m}$  up to 0.30  $\mu\text{m}$ . Values of surface waviness increased at the end of the barrel; the parameter of the barrel with pressure of plasma nitridation 400 Pa was 0.32  $\mu\text{m}$ ; parameter of plasma nitridation 700 Pa was 0.72  $\mu\text{m}$ .

### Barrel with diameter of 6.5 mm: pressure of plasma nitridation 400 Pa and 700 Pa

Process parameters of surface roughness  $R_a$  in the drilling length of the barrel with diameter 6.5 mm with different pressure of plasma nitridation are shown in Figure 6. Values of surface roughness of the barrel with pressure of plasma nitridation 700 Pa were from about  $0.3 \mu\text{m}$  up to  $0.93 \mu\text{m}$ . In the case of the barrel with pressure of plasma nitridation 400 Pa, parameters of surface roughness were lower; from  $0.19 \mu\text{m}$  up to  $0.58 \mu\text{m}$ .

Process values of surface roughness  $R_a$  of the barrels were similar to values  $R_a$  of plasma nitrided barrels with diameter 5.5 mm. The values of surface roughness were higher at the beginning of drilling but then they went down in the drilling length from 60 mm up to 80 mm. Parameters of surface roughness on the barrel with pressure of plasma nitridation 700 Pa fluctuated around  $0.45 \mu\text{m}$  in the drilling length from 60 mm up to 400 mm from the muzzle of the barrel. Values were lower and fluctuated around  $0.3 \mu\text{m}$  on the barrel with pressure of plasma nitridation 400 Pa.

Fig. 6 Values of surface roughness  $R_a$  of a plasma nitrided barrel with diameter of 6.5 mm

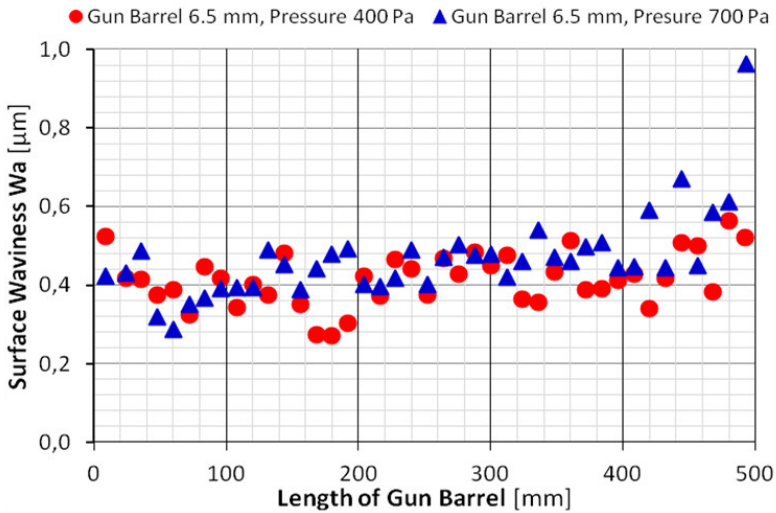


Exceptions were higher values of surface roughness in the middle of the barrels. Parameters of surface roughness were  $0.58 \mu\text{m}$  in distance 240 mm from the muzzle of the barrel in the case of the barrels with pressure of plasma nitridation 700 Pa.

Parameters of surface roughness were  $0.45 \mu\text{m}$  in the drilling length 240 mm from the muzzle of the barrel on the barrel with pressure of plasma nitridation 400 Pa. Measured values of surface roughness increased at the end of drilling in the case of both barrels; the barrels with a pressure of plasma nitridation

400 Pa had values  $0.58 \mu\text{m}$ , the barrels with pressure of plasma nitridation 700 Pa had values  $0.92 \mu\text{m}$ .

Fig. 7 Values of surface waviness  $W_a$  of a plasma nitrided barrel with diameter of 6.5 mm



Values of surface waviness of the barrel are shown in Figure 7. Values of surface waviness  $W_a$  of the barrel with diameter of 6.5 mm: pressure of plasma nitridation 400 Pa achieve from  $0.26 \mu\text{m}$  up to  $0.56 \mu\text{m}$ . In the case of the barrel with pressure of plasma nitridation 700 Pa, values of surface waviness were higher at the beginning of drilling of the barrel but after that they successively went down up to the length 50 mm. Parameters of surface waviness of the barrel with diameter of 6.5 mm: pressure of plasma nitridation 700 Pa in the drilling length 50 mm to 420 mm were in the range from  $0.33 \mu\text{m}$  up to  $0.52 \mu\text{m}$ . Process values of the barrel with pressure of plasma nitridation 400 Pa were lower from  $0.26 \mu\text{m}$  up to  $0.48 \mu\text{m}$ . Values of surface waviness increased at the end of the barrel; the parameter of the barrel with pressure of plasma nitridation 400 Pa was  $0.56 \mu\text{m}$ ; the parameter of plasma nitridation 700 Pa was  $0.92 \mu\text{m}$ .

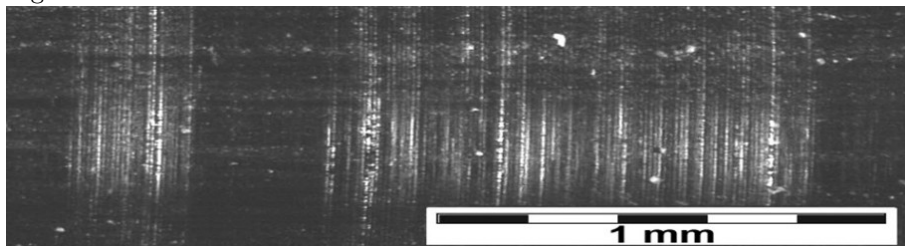
### Imperfection surface of drilling bore

There are imperfections on the surface of the bore. Imperfections of this type (Geometrical product specification):

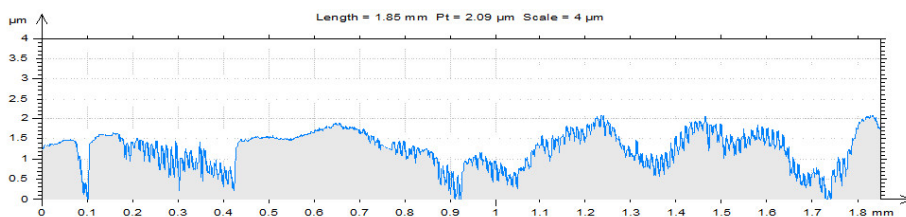
- scratch – track after the drilling tool on the surface of the bore
- impaired quality of the surface
- hollows or elevation on the surface of the bore

The scratch on the surface of the bore could be caused by vibration of the drilling tool. There are places with a smaller range of high deviation and subsequent surface with increased deviation of unevenness on the profile of the surface where a change of surface roughness is obvious. Hollows reach depth of up to  $1.8 \mu\text{m}$ . Parts of surface, caused during drilling with unstable moving of the tool, have higher deviation of unevenness on the surface in comparison with places where there is a stable process of drilling.

Fig. 8 Scratches on the surface of the bore

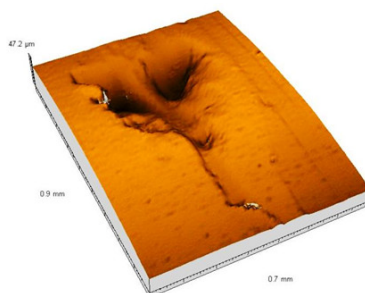


Surface of the bore with scratches



The other examples of imperfection which exist on the surface of the bore are hollows or elevation.

Fig. 9 3D projection with a hollow on the surface of the bore



In general, the hollows appear in the shape shown in Figure 9. These types of hollows were probably created due to pulling out material from the surface of the bore. This can happen due to the imperfections in the material of the gun barrel or because the hollow is connected with the process of drilling

with improper cutting conditions. These hollows are about 30  $\mu\text{m}$  deep, 0.6 mm long and about 0.4 mm wide (it is shown in Figure 10). There can be problems with the removal hollows because it is necessary to enlarge the diameter of the bore up to about 0.06 mm. In the case of some technological processes carried out after drilling of the bore they may not be fulfilled and that is why the type of the defect can affect the quality of the bore surface.

Fig. 10 Profile with a hollow on the surface of the bore



If defects are not removed the range of the defects will have an effect on the future function of the hole.

## Conclusion

It has been experimentally demonstrated that there is a change in the quality of surface in different lengths of the barrels. Values of surface roughness were lower in the middle of the barrel in case of the barrels with pressure of plasma nitridation 400 Pa, then in case of barrels with pressure of plasma nitridation 700 Pa. Parameters of surface roughness were lower in case of the barrel with diameter of 6.5 mm at the beginning of drilling, but on the other hand values of surface roughness were higher at the end of drilling. This trend of changing of surface roughness is shown in Table 2.

Tab. 2: Limit values of surface roughness of barrels after drilling bore

Diameter of barrel [mm]	Pressure nitridation [Pa]	Surface roughness Ra [ $\mu\text{m}$ ]		
		At the beginning of barrel	In the middle of barrel	At the end of barrel
5.5	400	0.56	<b>0.22 ÷ 0.32</b>	<b>0.60</b>
	700	<b>0.60</b>	<b>0.38 ÷ 0.65</b>	0.85
6.5	400	<b>0.45</b>	<b>0.20 ÷ 0.40</b>	<b>0.58</b>
	700	0.58	0.30 ÷ 0.60	<b>0.90</b>

Process values of surface roughness in drilling length of the barrel have a very similar trend, but one value of surface roughness is different at the beginning and at the end of the bore. Values of surface roughness reach very similar values in the middle of the barrel and these values are lower on the barrel with diameter of 5.5 mm and pressure of plasma nitridation 400 Pa.

Tab. 3: Limit values of surface waviness of barrels after drilling bore

Diameter of barrel [mm]	Pressure nitridation [Pa]	Surface roughness $W_a$ [ $\mu\text{m}$ ]		
		At the beginning of barrel	In the middle of barrel	At the end of barrel
5.5	400	0.36	0.14 ÷ 0.30	0.32
	700	0.52	0.30 ÷ 0.48	0.66
6.5	400	0.52	0.28 ÷ 0.48	0.56
	700	0.48	0.28 ÷ 0.54	0.96

The barrel with diameter of 5.5 mm has a lower range of values of surface roughness in the middle of the barrel than the barrel with the diameter of 6.5 mm. Parameters of surface waviness  $W_a$  are lower in case of the barrel with diameter of 5.5 mm. Surface waviness generally shows a higher range of values than the surface roughness in the drilling length of the bore. Values of surface waviness are very similar in the case of barrels with diameter of 6.5 mm with pressure of plasma nitridation 400 Pa and 700 Pa. On the other hand, values of surface waviness are higher on barrels with diameter of 5.5 mm with a pressure of plasma nitridation 700 Pa. The comparison of surface waviness between different diameters and pressures of plasma nitridation are shown in Table 3.

Based on experimental results, it can be seen that drilling and following plasma nitridation have an influence on the values of surface roughness and surface waviness along the length of the barrel. The depth of the nitriding process can have an influence on surface roughness in the way that during nitridation with small diameter discharge it is able to reach only certain depth of the bore.

Surface roughness changes and surface imperfections in the form of scratches, hollows and elevations have to be eliminated by following technological operations during surface barrel finishing to ensure required quality of the hole surface.

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## Kvalita otvoru povrchu po hlubokém vrtání

Vrtání hlubokých otvorů hlavňovým vrtákem ovlivňuje vlastnosti vrtaného otvoru celou řadou faktorů. Průvodní jevy při vrtání hlubokých otvorů mají vliv na mechanické vlastnosti, kvalitu povrchu vrtaného otvoru a efektivnost procesu vrtání. Příspěvek je zaměřen na analýzu kvality povrchu otvoru po hlubokém vrtání. Jsou uvedeny změny parametrů drsnosti a vlnitosti povrchu u různých průměrů hlavní při různých tlacích plazmové nitridace. Výsledné hodnoty parametrů drsnosti a vlnitosti povrchu vývrtu jsou vyhodnocovány po celé délce hlavně. Dále příspěvek pojednává o nedokonalostech povrchu vývrtu hlavně. Jsou zde podrobněji analyzovány defekty v otvoru vývrtu hlavně.

**Keywords:** parametry drsnosti povrchu, hlaveň, hluboké vrtání

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# Sledování průběhu infiltrační schopnosti půdy v trvalém travním porostu a v porostu rychle rostoucích dřevin během vegetačního období roku 2011

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## Abstrakt

Cílem příspěvku je zhodnotit průběh infiltrační schopnosti půdy na vybraných lokalitách Vysočiny, konkrétně v městské části Bystřice nad Pernštejnem – Domanínec a v k. ú. Sazomín 7 km jihovýchodně od Žďáru nad Sázavou. Pro stanovení a vyhodnocení infiltrační schopnosti půdy na zájmové lokalitě bylo prováděno měření výtopové infiltrace půdy pomocí dvouválcové metody. Pro vyhodnocení výtopové infiltrace byly použity graficko-empirické rovnice dle Kostjaka. Současně s každým měřením infiltrace byl prováděn odběr neporušených půdních vzorků pomocí Kopeckého válečku z hloubek 10, 20 a 30 cm pro laboratorní stanovení fyzikálních vlastností půdy a porušených půdních vzorků z povrchové vrstvy pro stanovení obsahu humusu. Naměřené hodnoty se dále zpracovávaly tabulkově a graficky. V průměru rychlejší vsak vody do půdy ve vegetačním období 2011 byl prokázán na pozemku s trvalým travním porostem. Jako rozhodující činitel ovlivňující infiltrační rychlost v trvalém travním porostu se ukázala okamžitá vlhkost půdy. V porostu rychle rostoucích dřevin nebyl prokázán rozhodující vliv konkrétní fyzikální charakteristiky půdy na rychlost infiltrace.

**Klíčová slova:** půda, infiltrační schopnost půdy, fyzikální vlastnosti půdy, trvalý travní porost, rychle rostoucí dřeviny

## Úvod

Vstup vody do půdy (infiltrace) závisí na řadě půdních vlastností a charakteristik, které jsou s vodou navzájem spjaty. Vzájemné ovlivňování půdy s vodou závisí na podmínkách pohybu vody v půdně-horninovém prostředí a na schopnosti půdy po určitou dobu poutat či trvale zadržovat vodu (Vopravil, Khel a Holubík 2011). Zrychlený odtok vody v důsledku snížené infiltrační schopnosti půdy ve spojitosti se stále častějším nerovnoměrným rozdělením srážek během roku má za následek nevyrovnanost vláhových poměrů půdy se všemi ekologickými důsledky. Proto výzkum a následně podpora infiltrační schopnosti půd,

jakožto prostředí sehrávajícího významnou roli v hydrologickém cyklu krajiny a rozhodujícího o velikosti povrchového odtoku, má své opodstatnění.

Cílem příspěvku je zhodnotit průběh infiltrační schopnosti půdy během vegetačního období roku 2011 v porostu rychle rostoucích dřevin (RRD) a v trvalém travním porostu (TTP).

## Materiál a metodika

### Popis zájmového území

Lokalita Domanínky – pozemek „Pod letištěm“, na kterém bylo prováděno měření infiltrace, patří do městské části obce Bystřice nad Pernštejnem. Město se nachází na jihovýchodním okraji Českomoravské vrchoviny, asi 20 km východně od Žďáru nad Sázavou. Pozemek leží v nadmořské výšce 530–544 m n. m. Zájmové území je mírně svažitého charakteru. Plantáž rychle rostoucích dřevin je založena na orné půdě, kde byly dříve pěstovány převážně obiloviny a brambory. Jedná se o monokulturní plantáž v ČR nejpoužívanějšího rychle rostoucího topolového klonu J-105 (*P. nigra* x *P. maximowiczii*). Porost na pozemku Pod letištěm je desetiletý.

Zájmová lokalita „U Jasana“ s trvalým travním porostem se nachází na Českomoravské vrchovině 7 km jižně od Žďáru nad Sázavou na jižní hranici CHKO Žďárské vrchy, mezi obcemi Vatín a Sazomín v katastrálním území Sazomín. Pokusný pozemek je mírně svažitého charakteru s všesměrovou expozicí. Experimentální plocha se nachází v nadmořské výšce 560 m n. m.

Dle *Atlasu podnebí Česka* (Tolasz 2007) se průměrná roční teplota vzduchu na obou lokalitách pohybuje v rozmezí 6–7°C a roční úhrn srážek činí v dlouhodobém průměru 600–650 mm.

Zájmové pozemky jsou charakterizovány kódem bonitované půdně-ekologické jednotky (BPEJ) 7.29.11. Podle vyhlášky Ministerstva zemědělství č. 327/1998 Sb., kterou se stanoví charakteristika bonitovaných půdně ekologických jednotek a postup pro jejich vedení a aktualizaci, ve znění vyhlášky č. 546/2002 Sb. vyjadřuje tento kód následující charakteristiky:

- *klimatický region*: MT 4, mírně teplý, vlhký,
- *hlavní půdní jednotka*: kambizemě modální eubazické až mezobazické, středně těžké až středně těžké lehčí, bez skeletu až středně skeletovité, s převažujícími dobrými vláhovými poměry,
- *sklonitost*: mírný sklon (3–7°),
- *expozice*: všesměrová expozice,
- *skeletovitost*: bezskeletovitá s příměsí, slabě skeletovitá
- *hloubka půdy*: hluboká, středně hluboká.

TTP byl na jaře roku 2011 přihnojen síranem amonným (6. 4.) a ve dvou dávkách močovkou (13. 4., 18. 6.). Pokos porostu byl proveden 18. 5., 14. 6.

a 31. 8. následovaný druhý den sklizní senáže. V porostu RRD nebyly uplatňovány žádné agrotechnické operace.

## Metodika

Pro stanovení a vyhodnocení infiltrační schopnosti půdy na zájmové lokalitě byla prováděna měření výtopové infiltrace půdy pomocí dvouválcové metody dle standardní metodiky (Kutílek 1988). Kvůli statistické průkaznosti byly použity tři soupravy soustředných válců s průměrem vnitřního válce 30 cm a vnějšího 55 cm. Pro vyhodnocení výtopové infiltrace byly použity empirické rovnice dle Kostjaka. Z polních měření byla stanovena závislost rychlosti infiltrace v na čase  $t$ . Vyjádření této závislosti pomocí empirických rovnic Kostjaka podrobně uvádí Kutílek, Kuráž a Císlarová (1993), Vališ a Šálek (1970), Velebný a Novák (1989) aj. Výsledky infiltračních pokusů jsou prezentovány v podobě grafů s logaritmickým měřítkem s proložením hodnot mocninnou funkcí a výpočtem rovnice regrese.

Současně s infiltračními pokusy byly na experimentálních plochách z půdního profilu z hloubek 10, 20 a 30 cm prováděny pomocí Kopeckého fyzikálních válečků dle metodiky Pokorného a kol. (2007) odběry neporušených půdních vzorků. Půdní vzorky byly z každé hloubky odebírány ve třech opakováních. Z výsledků získaných v laboratoři byly dle Zbírala a kol. (2004) provedeny výpočty vybraných fyzikálních parametrů půdy, jako jsou objemová hmotnost redukovaná, okamžitá vlhkost půdy, pórovitost, kapilární, semikapilární, nekapilární póry a provzdušněnost. Proveden byl také zrnitostní rozbor. Z odběru porušených půdních vzorků byl dle Zbírala a kol. (2004) stanoven obsah humusu. Rozbor neporušených i porušených půdních vzorků byl proveden v laboratoři Ústavu agrochemie, půdoznalství, mikrobiologie a výživy rostlin Agronomické fakulty Mendelovy univerzity v Brně.

## Výsledky

Za účelem posouzení infiltrační schopnosti půdy na zájmových lokalitách byla v roce 2011 v období od května do října uskutečněna celkem čtyři měření, a to vždy ve třech opakováních. Infiltrační pokusy spolu s odběrem půdních vzorků byly v porostu RRD provedeny 11. 5., 29. 6., 23. 8. a 20. 10. a v TTP 12. 5., 28. 6., 24. 8. a 19. 10. 2011.

### Základní charakteristiky půdy

Půda na plantáži RRD na lokalitě „Pod letištěm“ byla dle Novákovy zrnitostní klasifikace (Jandák, Pokorný a Prax 2009) vyhodnocena jako půda písčitohlinitá. Podíl jílnatých částic ( $< 0,01$  mm) byl v hloubce 10 cm 25,2 %, ve 20 cm 25,5 % a ve 30 cm 25,3 %. Půda s TTP byla v celém sledovaném profilu vyhodnocena také jako písčitohlinitá s obsahem jílnatých částic v 10 cm 23,7 %, ve 20 cm 27,1 % a v hloubce 30 cm 26,5 %.

Ze základních charakteristik půdy byl sledován také obsah humusu, který se s rostoucí hloubkou snižoval. Na pozemku RRD byl obsah humusu v 10 cm

1,43 %, ve 20 cm 0,99 % a ve 30 cm 0,59 %, dle Jandáka, Pokorného a Praxe (2009) se jedná o půdu slabě humózní. V TTP byl zjištěn obsah humusu v 10 cm 3,26 %, ve 20 cm 0,76 % a ve 30 cm 0,19 %, což značí půdu v 10 cm středně humózní a v hloubkách 20 a 30 cm slabě humózní.

Fyzikální charakteristiky půd vyhodnocené na podkladě rozborů neporušených půdních vzorků odebraných z pokusných pozemků v jednotlivých termínech měření jsou uvedeny v tabulkách č. 1 až 4. Zvýrazněny jsou hodnoty fyzikálních charakteristik, u kterých byla překročena mezní hodnota dle Lhotského (2000). U objemové hmotnosti redukované je kritická hodnota pro půdy písčitohlinité nad  $1,55 \text{ g.cm}^{-3}$ , pro pórovitost pod 42 % obj. Provdzušnost by se u orníčních horizontů v dobrém kulturním stavu měla pohybovat v rozmezí 18–24 % obj. a minimální obsah vzduchu by neměl klesnout pod 9 % (Jandák, Pokorný a Prax 2009).

V průměru nejvyšší hodnoty okamžité vlhkosti půdy byly v porostu RRD zaznamenány v prvním termínu měření s postupným snižováním v průběhu vegetačního období. Maximální hodnota byla dosažena 11. 5. ve 30 cm (28,09 % obj.) a minimální v posledním termínu měření ve 30 cm (8,22 % obj.). TTP se vyznačuje vyrovnanější okamžitou vlhkostí půdy během sledovaného období v průměru s nejvyššími hodnotami v říjnovém termínu měření a nejnižšími při srpnovém měření (plný vzrůst porostu TTP týden před třetím pokosem). Na obsah vody v půdě má kromě samotných srážkových úhrnů vliv také vývojová fáze daného porostu se svojí vláhou potřebou a následným odčerpáním vody z půdního profilu během vegetační sezony.

Důležitým faktorem, který se odráží na infiltrační schopnosti půdy, je její zhutnění. O stavu půdy z uvedeného hlediska ze sledovaných charakteristik vypovídá objemová hmotnost redukovaná a pórovitost. Hodnoty objemové hmotnosti redukované na obou pozemcích dle očekávání s hloubkou postupně narůstaly. Na pozemku RRD byla v hloubce 20 a 30 cm (s výjimkou 23. 8. ve 30 cm) překročena Lhotského kritická hodnota ve všech čtyřech termínech měření. Ve svrchní vrstvě mezní hodnoty pro půdy písčitohlinité překročeny nebyly. V TTP nejvyšší hodnoty objemové hmotnosti redukované překračující kritické hodnoty dle Lhotského (2000) pro půdy písčitohlinité byly zjištěny pouze 28. 6. ve 30 cm a 24. 8. ve 20 a 30 cm.

Tabulka 1: Fyzikální charakteristiky půdy (květen)

Termín odběru půdy	11. 5. 2011			12. 5. 2011		
	RRD			TTP		
Pozemek						
Hloubka odběru [cm]	10	20	30	10	20	30
Objemová hmotnost redukovaná [ $\text{g.cm}^{-3}$ ]	1,49	<b>1,63</b>	<b>1,64</b>	1,41	1,48	1,38
Okamžitá vlhkost [% obj.]	22,74	25,96	28,09	23,43	23,56	20,23
Pórovitost [% obj.]	44,60	<b>40,22</b>	<b>39,77</b>	47,33	44,45	48,93
Kapilární póry [% obj.]	26,72	28,27	28,33	34,09	32,79	26,14
Semikapilární póry [% obj.]	10,48	7,41	6,82	8,55	7,20	11,67
Nekapilární póry [% obj.]	7,39	4,54	4,63	4,69	4,46	11,12
Provdzušnost [% obj.]	21,86	<b>14,26</b>	<b>11,69</b>	23,89	20,88	<b>28,70</b>

Tabulka 2: Fyzikální charakteristiky půdy (červen)

Termín odběru půdy	29. 6. 2011			28. 6. 2011		
Pozemek	RRD			TTP		
Hloubka odběru [cm]	10	20	30	10	20	30
Objemová hmotnost redukována [g.cm <sup>-3</sup> ]	1,39	<b>1,63</b>	<b>1,71</b>	1,29	1,53	<b>1,56</b>
Okamžitá vlhkost [% obj.]	22,86	23,07	16,07	21,40	19,90	18,22
Pórovitost [% obj.]	48,73	<b>39,47</b>	<b>38,09</b>	50,95	42,10	<b>41,83</b>
Kapilární póry [% obj.]	29,62	30,03	20,51	28,18	28,11	27,14
Semikapilární póry [% obj.]	9,66	5,87	9,07	13,01	8,70	8,49
Nekapilární póry [% obj.]	9,45	3,57	8,51	9,76	5,28	6,20
Provdzušněnost [% obj.]	25,86	<b>16,40</b>	22,03	<b>29,55</b>	22,20	23,61

Tabulka 3: Fyzikální charakteristiky půdy (srpen)

Termín odběru půdy	23. 8. 2011			24. 8. 2011		
Pozemek	RRD			TTP		
Hloubka odběru [cm]	10	20	30	10	20	30
Objemová hmotnost redukována [g.cm <sup>-3</sup> ]	1,37	<b>1,60</b>	1,49	1,37	<b>1,57</b>	<b>1,69</b>
Okamžitá vlhkost [% obj.]	19,44	20,23	18,62	23,90	17,32	15,28
Pórovitost [% obj.]	49,59	<b>41,29</b>	45,30	47,98	<b>41,60</b>	<b>37,16</b>
Kapilární póry [% obj.]	29,34	30,06	29,08	29,56	20,28	16,52
Semikapilární póry [% obj.]	12,26	7,67	9,55	13,73	13,36	12,53
Nekapilární póry [% obj.]	8,00	3,56	6,68	4,69	7,96	8,12
Provdzušněnost [% obj.]	<b>30,15</b>	21,06	<b>26,68</b>	24,08	24,28	21,88

Tabulka 4: Fyzikální charakteristiky půdy (říjen)

Termín odběru půdy	20. 10. 2011			19. 10. 2011		
Pozemek	RRD			TTP		
Hloubka odběru [cm]	10	20	30	10	20	30
Objemová hmotnost redukována [g.cm <sup>-3</sup> ]	1,46	<b>1,56</b>	<b>1,92</b>	1,42	1,47	1,49
Okamžitá vlhkost [% obj.]	17,61	14,35	8,22	25,11	23,96	26,48
Pórovitost [% obj.]	46,48	43,22	<b>30,74</b>	45,20	43,72	43,06
Kapilární póry [% obj.]	23,76	24,12	14,01	30,06	29,17	29,06
Semikapilární póry [% obj.]	14,90	13,93	11,55	9,54	8,81	7,14
Nekapilární póry [% obj.]	7,82	5,17	5,19	5,60	5,74	6,86
Provdzušněnost [% obj.]	<b>28,87</b>	<b>28,88</b>	22,52	20,09	19,75	<b>16,58</b>

Pórovitost půdy klesala se zvyšující se objemovou hmotností redukovanou. Překročení kritických hodnot pórovitosti dle Lhotského (2000) na sledovaných lokalitách koresponduje s překročením kritických hodnot objemové hmotnosti redukované.

Póry se dle velikosti dělí na kapilární, semikapilární a nekapilární. Nejpriznivější poměry pro půdu jsou, je-li celková pórovitost rozdělena z 1/3 na póry meziagregátové (nekapilární a semikapilární) a ze 2/3 na vnitroagregátové –

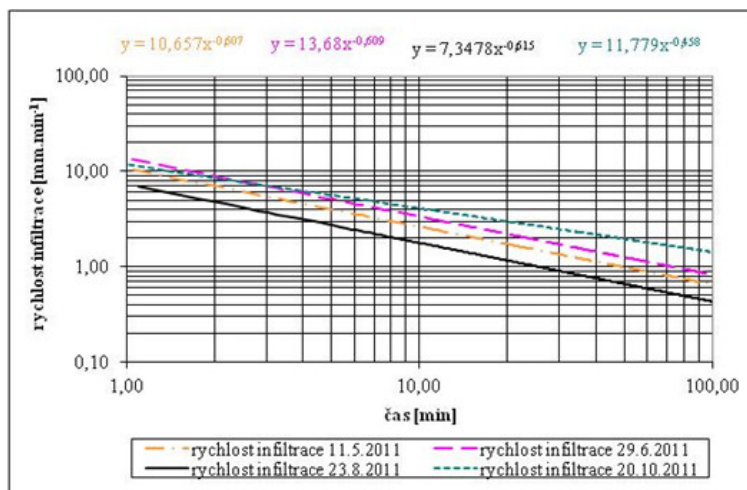
kapilární (Jandák, Pokorný a Prax 2009). Na pozemku s RRD bylo optimálního zastoupení kapilárních pórů dosaženo pouze 11. 5. a 23. 8. v hloubkách 20 a 30 cm a 29. 6. v hloubce 10 cm. Příznivé poměry z hlediska zastoupení jednotlivých druhů pórů byly v TTP zjištěny ve všech hloubkách půdního profilu 19. 10., 28. 6. v hloubkách 20 a 30 cm a 24. 8. v 10 cm. Poměr semikapilárních a nekapilárních pórů je u všech měření charakterizován větší či menší převahou semikapilárních pórů nad nekapilárními.

Provdzušenost půdy na pozemku RRD se v průběhu vegetačního období vyznačuje větším rozptylem hodnot oproti TTP. V TTP došlo k mírnému poklesu provzdušněnosti pod optimální rozmezí 18–24 % obj. pouze v hloubce 30 cm v posledním termínu měření. Nižší hodnoty provzdušněnosti blíží se až hranici minimální úrovně obsahu vzduchu v půdě byly zaznamenány v porostu RRD (11. 5. ve 20 a 30 cm). V několika případech došlo naopak k výraznému zvýšení provzdušněnosti půdy nad horní hranici optimálního rozmezí blíží se a v jednom případě, v porostu RRD, také přesahující hodnotu 30 % obj. Hodnoty provzdušněnosti korespondují především s objemovou hmotností, pórovitostí a okamžitou vlhkostí.

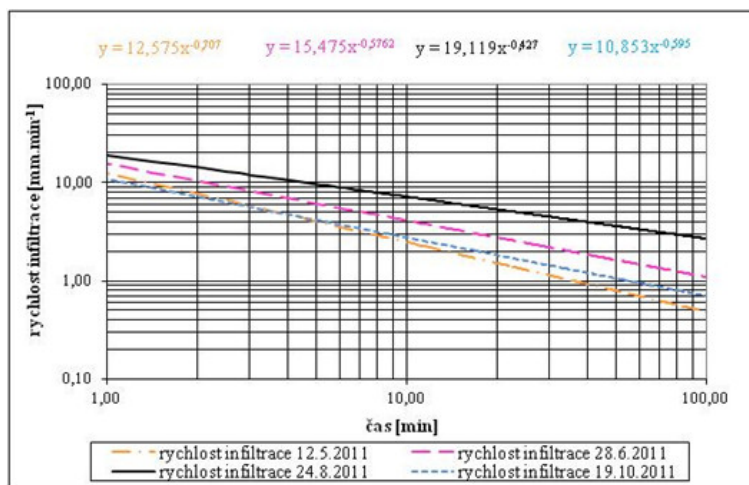
Při hodnocení strukturního stavu humusového půdního horizontu (týká se vzhledem k půdnímu typu a obsahu humusu půdního profilu do hloubky 20 cm) na základě hodnot objemové hmotnosti redukované a pórovitosti pro středně těžké a těžké půdy (Kutílek 1966) lze konstatovat, že půdy na obou pozemcích byly z uvedeného hlediska ve všech termínech měření v hloubce 20 cm nevyhovující (objemová hmotnost 1,4–1,6 g.cm<sup>-3</sup>, pórovitost 39–46 % obj.) a v RRD až nestrukturní (objemová hmotnost 1,6–1,8 g.cm<sup>-3</sup>, pórovitost 31–39 % obj.). Dobrý strukturní stav humusového horizontu byl na obou pozemcích zaznamenán pouze ve svrchní vrstvě půdního profilu při červnovém a srpnovém měření.

## Výsledky infiltračních měření

Graf 1: Závislost rychlosti infiltrace na čase v průběhu vegetační sezony 2011 (pozemek RRD „Pod letištěm“)



Graf 2: Závislost rychlosti infiltrace na čase v průběhu vegetační sezony 2011 (pozemek TTP „U Jasana“)



Průběh infiltračních pokusů na sledovaných lokalitách během vegetační sezony roku 2011 je zobrazen v grafech č. 1 a 2. V grafech je znázorněna průměrná rychlost infiltrace ( $\text{mm}\cdot\text{min}^{-1}$ ) v každém termínu měření v závislosti na čase. Průběh infiltrace je zobrazen od 1. do 100. minuty od počátku měření. Infiltrační pokusy prováděné v rámci jednoho dne se v některých termínech vyznačovaly heterogenitou. Měření, vykazující velkou odchylku od zbývajících, nebyla považována za reprezentativní, a tudíž nebyla zahrnuta do výpočtu průměrné rychlosti infiltrace.

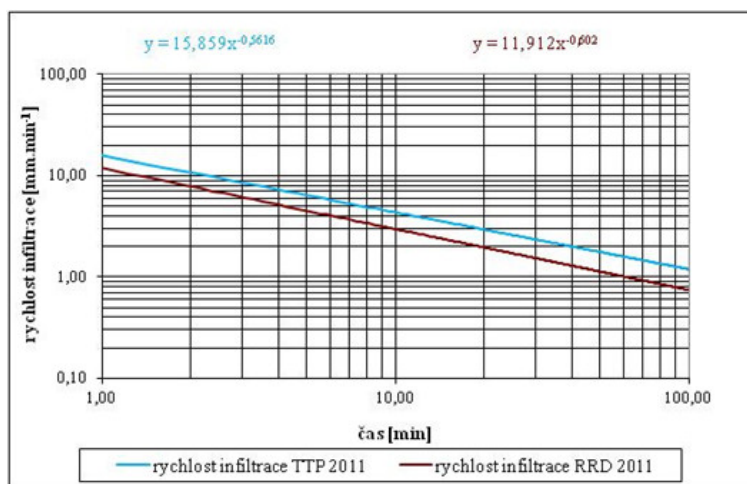
Z grafu č. 1 porovnávacího reprezentativní hodnoty rychlosti infiltrace v jednotlivých termínech měření vegetačního období roku 2011 v RRD vyplývá, že nejnižší rychlost vsaku vody do půdy byla zaznamenána v třetím termínu měření (23. 8.) a nejvyšší v posledním termínu (20.10.). V tomto termínu byla zjištěna sice nejnižší okamžitá vlhkost půdy za celé sledované období, ale objemová hmotnost redukovaná dosahovala hodnot nejvyšších. Nejnižší infiltrační rychlost (23. 8.) byla zaznamenána naopak při nejnižší objemové hmotnosti půdy a také relativně nízké okamžité vlhkosti. V pořadí druhá nejnižší rychlost vsaku vody do půdy byla změřena v prvním termínu měření, které se vyznačovalo nejvyšší okamžitou vlhkostí půdy a v průměru druhou nejvyšší utužeností.

V případě TTP je z grafu č. 2 patrný postupný nárůst sledovaného ukazatele od prvního po třetí měření s maximální hodnotou dosaženou v srpnu (24. 8.). S uvedeným trendem koresponduje postupně klesající okamžitá vlhkost půdního profilu v uvedeném období. Nejnižší hodnoty rychlosti infiltrace spolu s nejvyšší okamžitou vlhkostí půdy byly zaznamenány na začátku (12. 5.) a na konci (19. 10.) vegetačního období. Vliv objemové hmotnosti redukované, jako ukazatele utuženosti půdy, se v případě TTP také neprokázal jako rozhodující. Nejvyšší objemová hmotnost byla zaznamenána právě v termínu s nejvyšší infiltrační rychlostí.

Ze vzájemného porovnání průměrných rychlostí infiltrace mezi jednotlivými termíny měření na pozemku RRD a v TTP vnesených do grafů č. 1 a 2 je zřejmé, že rychlost vsaku vody do půdy v průběhu vegetační sezony nevykazuje v rámci sledovaných porostních typů významný rozdíl v rozptylu svých hodnot.

Srovnání průměrné rychlosti infiltrace za vegetační období 2011 mezi RRD a TTP je zobrazeno v grafu č. 3. V průměru vyšší rychlost vsaku vody do půdy vykazoval při vzájemném porovnání TTP. Rozdíl rychlostí infiltrace mezi 1. a 60. minutou měření mezi porostními typy není ovšem významný, pohybuje se v rozmezí 3,95–0,58 mm.min<sup>-1</sup>.

Graf 3: Srovnání průběhu infiltrační rychlosti u RRD a TTP za celou vegetační sezonu 2011



## Diskuse

Půda je velmi komplexní a složitý systém, kde jednotlivé faktory nepůsobí na pohyb vody izolovaně, ale vždy ve vzájemné interakci. Hodnocení infiltračních pokusů bylo zatíženo skutečností nevyrovnaných průběhů rychlostí vsaku vody do půdy mezi jednotlivými opakováními prováděnými v rámci jednoho dne měření. Na uvedeném rozptylu sledovaného ukazatele se významnou měrou podílela heterogenita půdního prostředí, která je dána především preferenčními cestami (trhliny, chodby mezo- a makroedafonu) nebo překážkami v cestě vsakující vody (skelet, vzduch uzavřený v pórech, aj.), tak jak uvádí také Dumbrovský, Kameníčková a Podhrázská (2011). I přes popsané skutečnosti lze v některých případech vysledovat zákonitosti pohybu vody v půdě v závislosti na fyzikálních charakteristikách půd.

V TTP se jako rozhodující činitel ovlivňující rychlost vsaku vody do půdy ukázala okamžitá vlhkost půdy. Vliv objemové hmotnosti redukované jako ukazatele zhutnění půdy ovšem prokázán nebyl. Soustředíme-li se právě na okamžitou vlhkost půdy jako rozhodujícího činitele vsaku vody do půdy v TTP,

mohli bychom konstatovat, že tato charakteristika je v daném případě odrazem ročního období (vyšší vlhkost půdy na jaře a na podzim, nižší v letním období). Vyšší hodnoty okamžité vlhkosti půdy v jarním a podzimním období způsobené nižšími teplotami, tj. menším výparem vody z půdy a nižší vláhovou potřebou rostlin (TTP) danou také jejich vývojovou fází, by mohly vysvětlovat nejnižší infiltrační schopnost půdy pod TTP v těchto obdobích a naopak.

V případě RRD nelze vysledovat jednoznačnou zákonitost mezi fyzikálními charakteristikami půdy a rychlostmi vsaku vody do půdy v průběhu vegetační sezony. Na infiltrační rychlosti se tak mohla významným způsobem podílet povrchová vrstva půdního profilu s absencí travního porostu v meziřadí RRD, čehož následkem mohla být po srážkových událostech tvorba půdního škraloupu způsobující omezení rychlosti vsaku vody do půdy. Tomu, že by určitou roli v rychlosti vsaku vody do půdy v RRD mohl sehrávat právě půdní škraloup, nasvědčuje rozdílnost v rychlostech infiltrace v průběhu vegetační sezony při vzájemném porovnání porostních typů. Nejpomalejší vsak vody do půdy v porostu RRD byl zaznamenán 23. 8. (v období větší pravděpodobnosti výskytu přívalových srážek), tedy v termínu kdy v TTP byla infiltrační rychlost naopak největší (graf č. 1, 2). Působení fyzikálních vlastností půdy na rychlost infiltrace je tak v případě RRD pravděpodobně převáženo vlivem povrchové půdní krusty a v obou porostních typech již zmíněnou heterogenitou půdního prostředí.

Menší rozptyl hodnot rychlosti vsaku vody do půdy v průběhu vegetační sezony mezi jednotlivými termíny měření v porostu RRD a TTP popsany u grafů č. 1 a 2 koresponduje se zjištěními Dumbrovského a kol. (2011) sledujícími rychlost infiltrace na půdách s konvenční a minimalizační technologií zpracování půdy. Při minimalizačním zpracování půdy (podobnost s TTP a RRD ve srovnání s konvenčně obdělávanou půdou) byla výše uvedeným autorem vysledována větší shoda naměřených hodnot sledovaného ukazatele.

V průměru vyšší rychlost vsaku vody do půdy v průběhu vegetační sezony byla zaznamenána v TTP, a to i přes vyšší zastoupení jílnatých částic v hloubkách 20 a 30 cm. K lepšímu vsaku vody do půdy v TTP naopak přispívá vyšší obsah humusu ve svrchní vrstvě půdního profilu. Na nižší průměrné infiltrační rychlosti v porostu RRD se mohla podílet již zmíněná skutečnost absence travního porostu v meziřadí s následkem vzniku povrchové půdní krusty vytvářející se především při přívalových srážkách.

## **Závěr**

Cílem předkládaného příspěvku bylo porovnat rychlost infiltrace v porostu RRD a v TTP ve vegetačním období roku 2011. Měření vsaku vody do půdy probíhalo výtopovou metodou dle Valíše a Šálka (1970) za použití dvou soustředných vsakovacích válců. Pro vyhodnocení výtopové infiltrace byly použity empirické rovnice dle Kostjakova (Kutílek, Kuráž a Císlerová 1993; Valíš a Šálek 1970; Velebný a Novák 1989). Z polních měření byla stanovena závislost rychlosti infiltrace v na čase  $t$ . Současně s infiltračními pokusy byly při každém měření na experimentálních plochách prováděny odběry neporušených půdních

vzorků a následně vyhodnoceny vybrané fyzikální charakteristiky půdy a proveden zrnitostní rozbor. Z odběru porušených půdních vzorků byl stanoven obsah humusu.

Při porovnání rychlosti infiltrace v TTP a RRD byl v průměru rychlejší vsaku vody do půdy ve vegetačním období 2011 prokázán v TTP, a to i přes vyšší podíl jílnatých částic v půdním profilu. K rychlejšímu vsaku vody do půdy v TTP mohl mimo jiné přispět vyšší obsah humusu ve svrchní vrstvě půdního profilu. Jako rozhodující činitel ovlivňující rychlost vsaku vody do půdy v TTP v průběhu vegetační sezony se ukázala okamžitá vlhkost půdy. Nejrychlejší vsaku vody do půdy byl zaznamenán při srpnovém měření (nejnižší okamžitá vlhkost), naopak nejpomalejší v měsíci květnu a říjnu (nejvyšší okamžitá vlhkost). V případě ostatních fyzikálních charakteristik půdy žádná další závislost pozorována nebyla. V porostu RRD nebyl prokázán rozhodující vliv žádné konkrétní fyzikální charakteristiky půdy na vsaku vody do půdy. Působení fyzikálních vlastností půdy na rychlost infiltrace v RRD je tak pravděpodobně převáženo existencí povrchové půdní krusty. Je třeba si ovšem uvědomit, že výsledky šetření v obou porostních typech mohou být zatíženy náhodným výběrem místa prováděných experimentů, tj. především heterogenitou půdního prostředí a také skutečností, že půda je velmi komplexní a složitý systém, kde jednotlivé faktory nepůsobí na pohyb vody izolovaně, ale vždy ve vzájemné interakci. Ze vzájemného porovnání průměrných rychlostí infiltrace mezi jednotlivými termíny měření na pozemku RRD a v TTP je zřejmé, že rychlost vsaku vody do půdy v průběhu vegetační sezony nevykazuje v rámci sledovaných porostních typů významný rozdíl v rozptylu naměřených hodnot.

S ohledem na složitost a provázanost působení mnoha faktorů na průběh infiltrace nelze vysledovat jednoznačné zákonitosti vlivu těchto faktorů na infiltrační schopnost půdy. I přes popsané skutečnosti má problematika sledování infiltrační schopnosti půd své opodstatnění z hlediska možnosti vytváření podmínek podporujících vsaku vody do půdy s následným efektem snížení ztráty půdy vodní erozí a protipovodňové ochrany. Pro učinění ucelenějších a přesnějších závěrů je nutné víceleté sledování.

## Poděkování

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## Monitoring of the Soil Infiltration Capacity in the Permanent Grassland and in the Fast-Growing Trees Plantations During the Growing Season in 2011

This paper aims to evaluate the progress of infiltration capacity of soils at selected locations in the Czech Highlands, particularly in Bystrice nad Pernštejnem – Domanínec region, cadastral area Sazomín, which is located 7 km southeast of Žďár nad Sázavou. Measurements were carried out in the permanent grassland and in the plantations of fast-growing trees (*Populus* sp.) in the growing season 2011. To determine and evaluate soil infiltration capacity the flooding infiltration measurement based on two concentric cylinders method was used. Graphic-empirical equations according to Kostiakov were used to evaluate flooding infiltration. Simultaneously with each infiltration measurement, undisturbed soil samples from the depths 10, 20 and 30 cm were collected with use of the soil sample rings for further laboratory determination of physical soil properties. At the same time, disturbed soil samples from surface layers were collected to determine the content of humus. All measured values were processed in tabular and graphical form. During the vegetation period in 2011 average water infiltration into the soil was faster in the permanent grassland. Immediate soil moisture showed as decisive factor influencing the infiltration rate in the permanent grassland. There is no evidence of specific physical characteristics of the soil in the fast growing species on infiltration rate.

**Keywords:** soil, soil infiltration, physical properties of soil, permanent grassland, fast-growing trees

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MAŠÍČEK, T., F. TOMAN a M. VIČANOVÁ. Sledování průběhu infiltrační schopnosti půdy v trvalém travním porostu a v porostu rychle rostoucích dřevin během vegetačního období roku 2011. *Littera Scripta*. 2013, **6**(2), 172–183. ISSN 1805-9112.

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# Microstructural Characterization, Chemical Composition and Hardness of As-Cast Biocompatible CoCrMo Alloy

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## Abstract

The aim of this work is to compare two different as-cast CoCrMo alloys. The microstructure of a cobalt-base alloy obtained by the investment casting process was studied. These alloys comply with the ISO 5832-4 standard and are widely used in the manufacturing of orthopedic implants because of their high strength, good corrosion resistance and excellent biocompatibility properties. This work focuses on the resulting microstructure arising from samples poured in a vacuum furnace. The characterization of the samples was achieved by using optical microscopy, scanning electron microscopy (SEM) and energy dispersion spectroscopy techniques (EDS) for semi-quantitative chemical analysis. The hardness was measured by instrumented indentation tests, a microhardness test was applied to investigate microhardness of matrix and precipitates. General the as-cast microstructure is a Co-fcc dendritic matrix with the presence of a secondary phase, such as the  $M_{23}C_6$  carbides precipitated at grain boundaries and interdendritic zones. These precipitates are the main strengthening mechanism in this type of alloys.

**Klíčová slova:** CoCrMo biocompatible alloy, investment casting, microstructure, hardness and microhardness, chemical composition

## Introduction

Nowadays in the surgical implant manufacture Co based alloys, Ti based alloys and stainless steels are used due to their good mechanical stability and biocompatibility (Ramírez-Vidaurri et al. 2008). The Co based alloys – specifically CoCrMo alloys are typical non-magnetic metallic biomaterials because they have excellent abrasive and corrosion resistances in chloride environments, so they have a proven track record as materials for artificial hip and knee joints (Bauer et al. 2012; Mori et al. 2010). The corrosion resistance is related to surface oxide formation which is strongly enriched with  $Cr_2O_3$  (Bauer et al.

2012). The alloy was developed by E. Haynes as Stellite, in 1913 the alloy CoCrW was patented. In 1930, the alloy based on Co was patented as Vitallium and used for aircraft engines, and in the same period it was also used in dental medicine, a decade later in orthopedics. The original specification of the alloy contains 30% Cr, 7% W and 0.5% C, later tungsten has been replaced by 5% Mo for changing the grain size and for increasing corrosion resistance (Milošev 2009). Alloying of other elements such as nickel, molybdenum, or tungsten improve their mechanical properties and abrasion resistance (Bauer et al. 2012). Since this time, the alloy composition has not changed significantly. The largest change was related in the area of carbon content due to better homogenization of hard carbide grains and increase abrasion resistance (Milošev 2009). Generally these alloys exhibit higher mechanical properties and higher corrosion resistance compared to steels (Losertová 2012). Large differences exist in the mechanical properties between cast and wrought (forged, ISO 5832-12) alloys, as well as between low and high-carbon containing alloys. Co alloys are divided by carbon content:

- Low carbon (up to 0.08%) – wrought
- High carbon (up to 0.2%) – wrought and cast (Bauer et al. 2012).

The most used as-cast alloys are CoCrMo (ISO 5832-4, ASTM F75 – see table 1). The cast CoCrMo alloy is used from about 1950, it is necessary to pay attention to rapid solidification, because it may result in large dendritic grains causing the yield strength reduction. Moreover, casting defects such as inclusions and micropores cannot be avoided and may act as stress risers and thereby result in the overall decrease of fatigue strength of the material (Bauer et al. 2012). Generally the cast alloy is characterized by an inhomogeneous structure, larger grains, cored microstructure (Milošev 2009). Larger grains can be reduced by subsequent hot isostatic pressing up to 8  $\mu\text{m}$  (Bauer et al. 2012; Milošev 2009). This operation is usually classified by precision casting and reduces the porosity of the alloy (Losertová 2012). Another possibility of how to improve the mechanical properties (table 2) is the homogenization heat treatment (Bauer et al. 2012). The as-cast alloys have a microstructure consisting of a dendritic matrix  $\alpha$  (Co fcc) Cr-rich or Mo-rich. The dendritic regions contain Co, while the interdendritic regions and the grain boundaries may consist of different phases (due to the higher carbon content majority of carbides  $\text{M}_{23}\text{C}_6$ ) Cr-rich, Co-rich or Cr- and Mo-rich (Bauer et al. 2012; Milošev 2009; Ramírez-Vidaurri et al. 2008). These extremely hard carbides precipitates increase the wear resistance of alloy (Bauer et al. 2012; Milošev 2009). A combination of high hardness and compression strength is the basis for their applications in joint replacements, but they are less important for fixation devices (Milošev 2009). The implants are manufactured by mechanical processing, powders metallurgy and investment casting process (Ramírez-Vidaurri et al. 2008). The CoCrMo as-cast alloy conforming to the ISO 5832-4 standard is widely used in the manufacturing of orthopedic implants with investment casting techniques (Giacchi et al. 2010).

Table 1: Chemical composition of CoCrMo alloys

Element	CoCrMo				CoCrMo			
	ISO 5832-4		ASTM F75		Low carbon		High carbon	
	Min [%]	Max [%]	Min [%]	Max [%]	Min [%]	Max [%]	Min [%]	Max [%]
Cr	26.5	30.0	27.00	30.00	26.0	30.0	26.0	30.0
Mo	4.5	7.0	5.00	7.00	5.0	7.0	5.0	7.0
Ni	-	1.0	-	0.50	-	1.0	-	1.0
Fe	-	1.0	-	0.75	-	0.75	-	0.75
C	-	0.35	-	0.35	-	0.14	0.15	0.35
Mn	-	1.0	-	1.00	-	1.0	-	1.0
Si	-	1.0	-	1.00	-	1.0	-	1.0
W	-	-	-	0.20	-	-	-	-
P	-	-	-	0.020	-	-	-	-
S	-	-	-	0.010	-	-	-	-
N	-	-	-	0.25	-	0.25	-	0.25
Al	-	-	-	0.10	-	-	-	-
Ti	-	-	-	0.10	-	-	-	-
B	-	-	-	0.010	-	-	-	-
Co	-	balance	-	balance	-	balance	-	balance

Source: ASTM F75, ISO 5832-4, ISO 5832-12

For the fabrication of implants casting of CoCr based alloys is not a preferred technique, but for difficult shapes such as the femoral knee joint casting technique is unavoidable.

The objective of this study is to provide information about the material structure, chemical composition of matrix and carbides areas, their microhardness and Vickers hardness of alloy.

Table 2: Mechanical properties of CoCrMo alloys

Standard		Proof stress	Tensile strength	Percentage elongation
ASTM	ISO	$R_{p\ 0,2min}$ [MPa]	$R_{m\ min}$ [MPa]	$A_{min}$ [%]
F75	-	450	655	8
-	5832-4	450	665	8
-	5832-12	Annealed	Annealed	20
		517	897	
		Hot worked	Hot worked	12
		700	1000	
		Warm worked	Warm worked	12
		827	1172	

Source: ASTM F75, ISO 5832-4, ISO 5832-12

## Material and methods

### Casting technique

Two different samples of CoCrMo alloys were poured in a vacuum furnace, all of them complying with the ISO 5832-4 chemical composition standard. The precision casting technique was performed to obtain two samples, this technology utilizes injection wax (REMET RF 1/478) into the cavity of the metal mold under pressure. Models are bonded to a common inlet, then they are immersed in a zirconia ceramic slurry to form a ceramic shell. The sample M was immersed firstly in ceramic slurry with the addition of inoculant ( $\text{Co}(\text{AlO}_2)_2$ ), the sample B is without inoculant. This process form approximately 8 mm thin film that dries for 24 hours. The wax is melted out from the shell and before pouring the shell is annealed at temperature  $1030 \pm 10$  °C, at least 4 hours. The mold is preheated at  $1380 \pm 10$  °C and the pouring temperature was  $1360 \pm 10$  °C, pouring time is 2 s. After cooling, the castings samples (cylinders) are cut off and cleaned.

### Metallographic preparation

The top layers of these two samples were cut off due to improper thickness for analyzing chemical composition. The thickness is about 2 mm (metallographic saw MICRON 110 MTH and metallographic saw LECO). Each surface was wet ground with Hermes sandpapers of different grain size 120, 240, 500, 1000, 2500 and 4000. Subsequently, the samples were polished using diamond paste 1  $\mu\text{m}$  (type POM L). Finally the samples were etched in solution of 100 ml HCl, 100 ml ethanol, 5 g  $\text{CuCl}_2$ . The sample B was etched by im-

mersion for 15 s, the sample M for 30 s. At the end, both samples were cleaned ultrasonically in the device PULSONIC-2.

### Hardness and microhardness

The hardness was measured by instrumented indentation test with load 294.2 N of both samples on universal hardness tester Zwick Roell ZHU 2.5 with software testXpert V12.3 Master. Each sample was measured in five points.

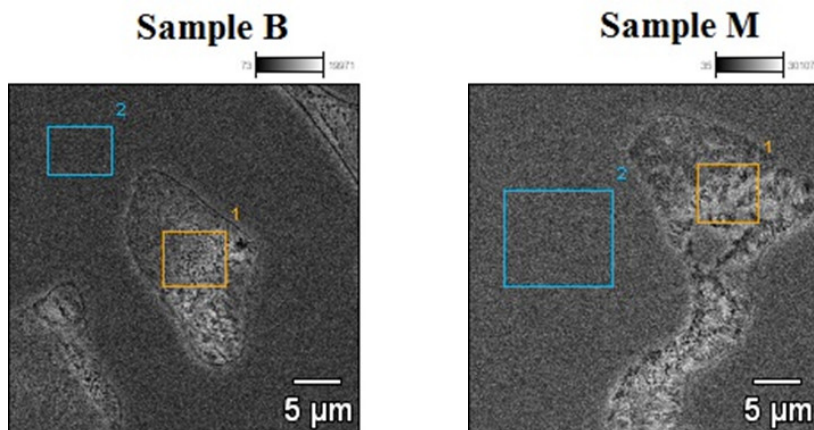
Automatic tester LM247/AT LECO with software Amh43 1.58 was used for microhardness values. As values of hardness, microhardness was measured in five points on each sample for each phase with load 0.049 N.

### Microstructural characterization and chemical composition

Optical micrographs from  $50\times$  to  $1000\times$  were used in order to obtain a wide field of view. The high magnifications were used to identify different phases. The samples were observed by optical microscopy using Olympus GX 51 microscope with the software QuickPHOTO Industrial v2.3. For magnification  $2000\times$  and  $3000\times$ , the samples were examined by scanning electron microscopy using TESCAN Vega TS 5135 with the software SEM Vega TC. Energy dispersive spectroscopy technique (EDS NORAN System SIX/300) was also employed to provide more accurate chemical characterization of the different phases (figure 1), even the EDS technique provides a semi-quantitative analysis. The chemical composition was measured with acceleration voltage 30 kV for both samples, the sample B was examined with working distance 24.1797 mm, absorption current 51 pA and take off angle  $44.4^\circ$ . The sample M was examined with working distance 23.2908 mm, absorption current 70 pA and take off angle  $43.8^\circ$ .

### Results and discussion

Figure 1: SEM micrograph of samples B (left) and M (right) with zones, where chemical composition was measured



Metallographic analysis of different samples was carried out by analyzing the samples in different sections. A comparison between the microstructure of the sample B and the sample M was also carried out, as well as hardness, microhardness of phases and their chemical composition.

The microstructure observed by optical microscopy consisted of a dendritic matrix and a continuous carbides network (figure 2). The matrix is  $\alpha$ -fcc Co-rich, Cr-rich in sample B and M – zones 2 (figure 5, figure 7, table 3). Furthermore, both samples show the presence of precipitates at grain boundaries and interdendritic zones (figure 8), which are Cr-rich, Co-rich and Mo-rich – zones 1 (figure 4, figure 6, table 3). Generally, both structures are very similar, they have a continuous carbide network. Precipitates in the sample M seem to be larger and connected together (figure 2).

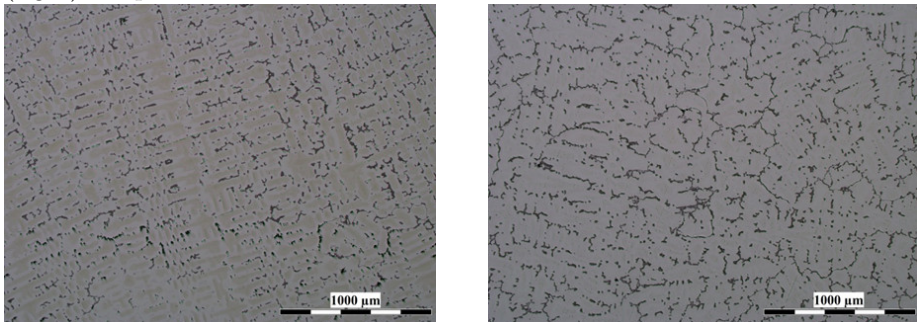
Table 3 presents the chemical composition of two samples at their two points. The Cr content is a little bit higher in the precipitates than in the matrix. The content of Mo is also higher in the areas of the precipitates than in the matrix. The presence of Fe and Ti is only in zone 1 of sample M. P occurs only in zone 1 of B sample. In all zones there is presence of Si, which is occurred in form of compound  $\text{SiO}_2$ . Both samples have the content of Co significantly higher in the matrix.

Table 3: Chemical composition of zone 1 and zone 2 in sample B and M

Sample	Cr	Mo	Fe	Si	P	Ti	Co
	wt. [%]	wt. [%]	wt. [%]	wt. [%]	wt. [%]	wt. [%]	wt. [%]
B zone 1	35.40	20.60	-	3.77	0.44	-	40.33
B zone 2	31.46	5.81	-	2.50	-	-	60.23
M zone 1	40.61	16.83	0.39	3.74	-	0.47	37.97
M zone 2	30.22	4.81	-	1.47	-	-	63.50

Elements such as Cr, Mo and Si stabilize hcp phase, whereas Fe stabilizes fcc phase. Cr also plays an important role in the formation of carbides, improves oxidation and corrosion resistance. Mo contributes to solid solution strengthening and increase abrasion resistance (Mishra et al. 1999; Lie et al. 2010).

Figure 2: Optical micrograph of the as-cast microstructure of B (left) and M (right) samples



The images from the electron microscope present the microstructure of individual precipitates (figure 3). It is evident, that they are inhomogeneous. These precipitates are mostly composed of phase  $\sigma$ ,  $M_{23}C_6$  carbides and phase  $\alpha$  (Giacchi et al. 2010; Ramirez-Vidaurre et al. 2008).

Figure 3: SEM micrograph of main phases present in sample B (left) and sample M (right)

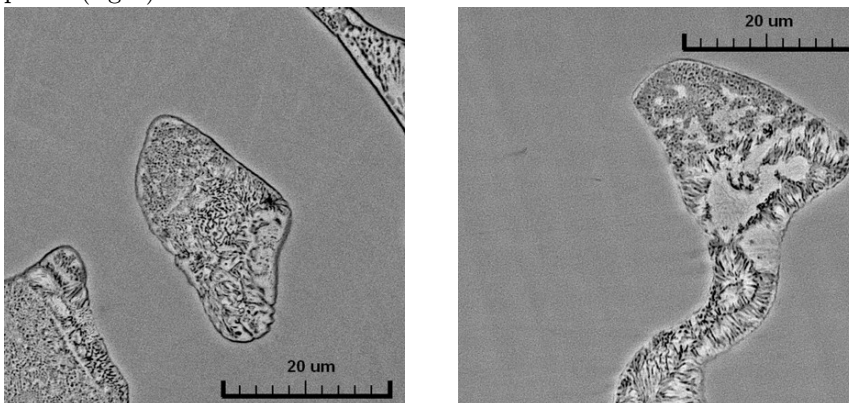


Figure 4: EDS analysis of the sample B in zone 1

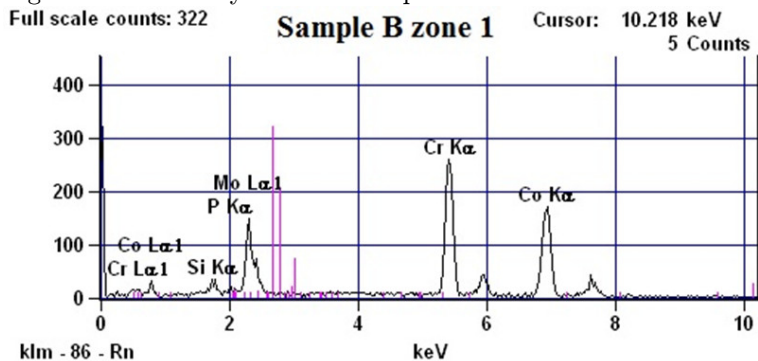


Figure 5: EDS analysis of the sample B in zone 2

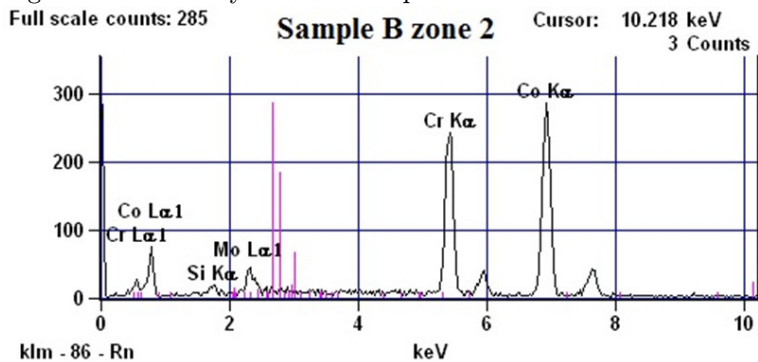


Figure 6: EDS analysis of the sample M in zone 1

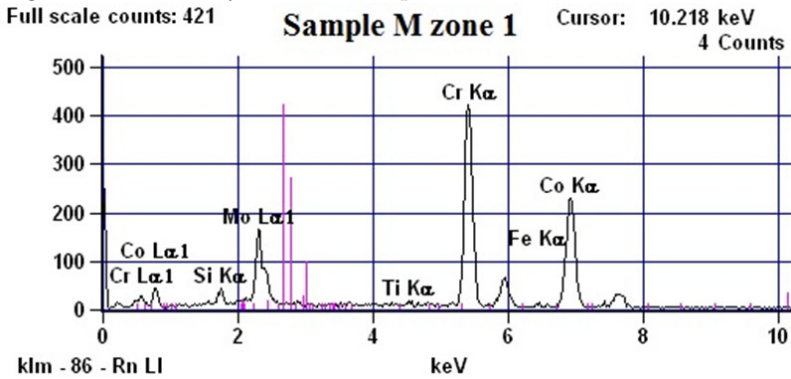
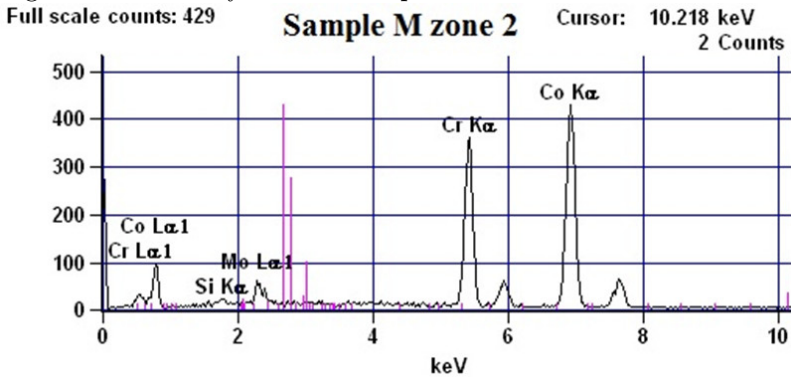


Figure 7: EDS analysis of the sample M in zone 2



The microhardness was measured in two zones in each sample. The average value of the microhardness HV is graphically assigned to each phase and shown in figure 8. Table 4 shows the minimum, the average and the maximum value of each phase.

Figure 8: optical micrograph of the as-cast microstructure of B (left) and M (right) samples. The white arrows show microhardness of appropriate phases.

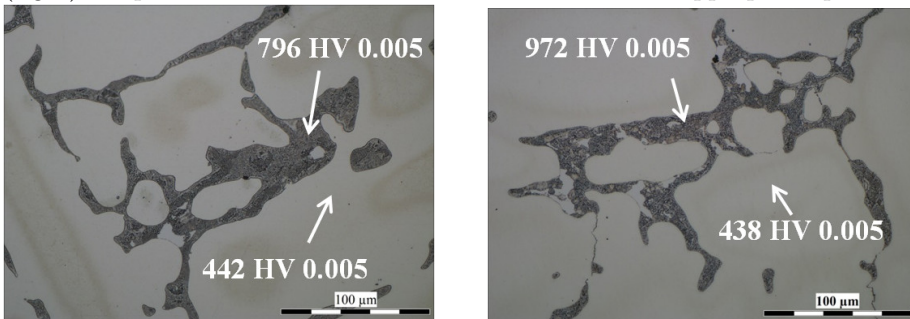


Table 4: The microhardness values of samples B and M in two different areas

Value	Load [N]	Microhardness of the sample B		Microhardness of the sample M	
		Matrix	Precipitate	Matrix	Precipitate
Lowest value	0.049	411 HV 0.005	741 HV 0.005	403 HV 0.005	607 HV 0.005
Highest value		478 HV 0.005	839 HV 0.005	468 HV 0.005	1140 HV 0.005
Average value		442 HV 0.005	796 HV 0.005	438 HV 0.005	972 HV 0.005
Coef. of variation		5.6 %	5.8 %	5.9 %	22.6 %

The difference between the microhardness of phases is large in one case and in the second case is small. The microhardness between matrixes exhibits difference 4 HV 0.005, the difference between carbides is 176 HV 0.005.

Table 5 shows all Vickers hardness measurement for both samples in five points plus their average value. The comparison of mean Vickers hardness values of the sample B and M presents difference only 3 HV 30.

Table 5: Hardness HV of CoCrMo alloys (ISO 5832-4)

Number of measurement	Load [N]	Hardness of the sample B	Hardness of the sample M
1	294.2	309 HV 30	289 HV 30
2		313 HV 30	297 HV 30
3		278 HV 30	302 HV 30
4		307 HV 30	304 HV 30
5		296 HV 30	296 HV 30
Average value		301 ± 14 HV 30	298 ± 6 HV 30

Source: ISO 6507-1

## Conclusions

Two Co-based alloys with a composition conforming to the ISO 5832-4 standard poured in a vacuum furnace. The different phases present were identified by using optical and electron microscopy and EDS technique. In both cases, the microstructure agreed with those reported in the literature and especially carbides were well identified by color metallography. The EDS analysis was employed for an accurate identification.

The carbides were identified and detected at grain boundaries and interdendritic zones. EDS show that these precipitates are Cr-rich, Co-rich and Mo-rich in both samples. The matrix is  $\alpha$ -fcc Co-rich and Cr-rich as EDS shows. The carbides have a continuous network in the sample B and M, in the sample M are larger and more connected together. The addition of inoculant ( $\text{Co}(\text{AlO}_2)_2$ ) has influence on the distribution of carbides and also effect of their microhardness. The carbides in sample M are 176 HV 0.005 harder although the microhardness of matrix is not influence by inoculant in both samples. Moreover, the inoculant does not affect overall hardness of the alloy.

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## Mikrostruktura, chemické složení a tvrdost lité, biokompatibilní slitiny CoCrMo

Cílem práce je porovnání dvou odlišných litých CoCrMo slitin. Byla zkoumaná mikrostruktura slitin na bázi kobaltu získaná metodou přesného lití. Tyto slitiny splňují normu ISO 5832-4 a jsou široce rozšířeny při výrobě ortopedických implantátů díky své vysoké pevnosti, dobré korozní odolnosti a vynikajícím biokompatibilním vlastnostem. Práce se zaměřuje na výslednou mikrostrukturu vzorků odlitých ve vakuové peci. K charakterizaci vzorků byla použita optická mikroskopie, elektronový rastrovací mikroskop (SEM) spolu s energeticky disperzním spektrometrem (EDS) pro semi-kvantitativní chemickou analýzu. Tvrdost materiálu byla měřena instrumentovanou vnikací zkouškou, pro hodnocení jednotlivých fází (matrice a precipitáty) byla použita mikrotvrdost. Obecně se struktura lité slitiny skládá z Co-fcc dendritické matrice a sekundárních fází, jako jsou karbidy  $M_{23}C_6$  vyskytující se na hranicích zrn a v mezidendritických oblastech. Precipitáty mají hlavní zesilující účinek u tohoto typu slitin.

**Keywords:** biokompatibilní slitina CoCrMo, přesné lití, mikrostruktura, tvrdost a mikrotvrdost, chemické složení

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