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AGRIS on-line Papers in Economics and Informatics
Information and Consulting Center of FEM CULS Prague
Kamýcká 129, 165 21 Praha 6 – Suchdol
Czech Republic
Phone: +420 224 382 050
E-mail: agrisonline(at)pef.czu.cz

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The Technical Efficiency Analysis – Case of Agricultural Basic Industry in Slovakia

P. Bielik, D. Hupková

Department of Economics, Faculty of Economics and Management, Slovak University of Agriculture in Nitra

Abstract

The agricultural companies are operating in the environment with high level of competition and therefore it is for them important to retain respectively to improve their market position to reach higher measure of production process efficiency. As the principal measurement of the production performance was applied technical efficiency which is the assumption to reach the total economical efficiency of company.

According to the results we can state that the technical efficiency measure has during analysed period declining trend. Since the year 2001 when the technical efficiency measure reached the highest level was registered decline of the technical efficiency, except the year 2005. The average level of the technical efficiency measure during the years 2006 and 2007 is possible to explain with increasing differences between the analysed companies. Just few companies achieved very good results in the production process. Based on the results of the technical efficiency measure is possible to expect deepening of differences between the companies in future.

Key words

the Data Envelopment Analysis - DEA, Technical Efficiency, Agricultural Enterprises, Basic Industry

Introduction

Generally is possible to state that objective of the rational owner respectively management is the profit maximization with minimal inputs applying, that means costs. This objective is possible to define as optimizing task which solution could be achieved with applying linear programming methods that means non parametric approach or by econometric methodology – parametric approach. Common sign for both mentioned approaches is production frontier quantification. While parametric approach assume that we know explicit estimation of production function but we do not know its parameters, results of non-parametric approach are estimated measures of technical efficiency which reflect on company's position either on production frontier in case of effective company either under the frontier in case of inefficient company.

We focused research on non-parametric approach application to estimate companies' efficiency which is known as the Data Envelopment Analysis (DEA). The DEA reach good results on small extents of analysed companies and in case of combination with proper statistical tools can answer questions dealing with companies' efficiency.

Theoretical background of technical efficiency analysis set Koopmans, T. C. (1951) who defined technical efficiency as permissible variation input/output vector in which is technically not possible to increase any output (or to reduce any input) without simultaneous reduction of other output or increasing other input. Later Farrell, M. J. (1957) derived input oriented indexes of technical efficiency expressed by radial reduction of all inputs at given level of outputs. These indexes were later inspiration for Charnes, A., Cooper, W. W. and Rhodes, E. (1978), Banker, R. D., Charnes, A. and Cooper, W. W. (1984) a Fähre, R., Grosskopf, S. and Lovell, C. A. K. (1985, 1994) who established the DEA. The DEA is technique which according to the estimation of convex data envelope of analysed producers that means production possibility frontier allowed relative efficiency calculation of all analysed producers. This technique became very popular by technical

efficiency estimation because it allowed with simple method to consider transformation more inputs into more outputs. It is non parametric approach and it does not require input prices and is not needed to define type of producer's behaviour.

Period of lat years is in field of efficiency analysis characterised by new models and methods development as well as with many applications in different branches of economy. With regard on solved issues was major attention paid on empiric applications based on radial and additive models which examine technical efficiency at the companies' level in conditions of the Slovak agriculture. Mentioned approach applied Mathijs, E., Blaas, G. a Doucha, T. (1999) and others.

In issue of the technological level of agricultural production and the level of productivity Smutka, L. et al (2009) emphasized that the character of agricultural sector changed during the last more than 40 years. The number of machines and vehicles increased during the analyzed period by more than 122% and the world agricultural production increased by 148%

There exist many opinions on relation between productivity development (efficiency) and legal forms in transition economies. Petrick, M. a Weingarten, P. (2004) maintain a position that countries in which remain sustentative companies with large area of cultivated land from central planed economy period but which simultaneously adapted organizational structure to new system and optimized number of employees reach higher efficiency measure.

The process of stabilisation and production and productivity growth started in the year 2004 after accession of the new member states into the EU by reduction number employees in agriculture, creation of new institutions and market relations stabilisation (Swinnen, J. M. F. and Vranken, L., 2005).

With aim to prove that private farms are more efficient than cooperatives estimated Mathijs, E. a Vranken, L. (2001) the technical efficiency measure of analysed companies in Bulgaria and Hungary based on the DEA. They stated that there is gradual increase of the technical efficiency of cooperatives which are adapting to the market economy conditions. Private farms reached lower levels of technical efficiency in fields which had higher measure of production uncertainty.

Bielik, P. et al. (2010) stated that no significant differences were occurred between analysed legal forms of Slovak agricultural companies. Any legal form did not reach such tendencies in the TFP index development which will determine it as a dominant group of companies according to the productivity and efficiency long term development. According Čechura, L. (2010) technical inefficiency is a significant phenomenon in Czech agriculture. The average level of technical efficiency is around 90% for Czech agricultural companies.

Thiele, H. a Brodersen, C. (1999) on the basis of the DEA analyzed differences between farm productivity in the east and West Germany. Farms in the West Germany reached higher average technical efficiency measure comparing with the East German farms. The East German farms were characterized by higher variability of the TE what is possible to explain with differences in the managerial skills achieved during the transformation process.

Fast new technologies introduction into the production process is important mainly from the reason of cost reduction per unit of production what with is short-term increasing profit of company which is realizing this process (Hanzell, P. and Haddad, L., 2001). But empirical evidences indicate that the regions or countries which did not utilize production growth possibilities with adopting new technologies are loosing the competitiveness on the global level. On the country level that means that increase of agriculture productivity impact positively decline of foodstuffs prices and that is establishing place for industrial goods and services consumption which will be exhibited by economic growth increase.

Material and methods

The objective of research is the Technical Efficiency estimation of agricultural basic industry subjects in the Slovak Republic during period 1999-2007 and identification of developmental trends. The data were obtained from the Central Database of the Ministry of Agriculture of the Slovak Republic (Information Letters of the MoA SR for the period 1999 – 2007). The base file comprise subjects which object of activity was agricultural

basic industry and file was divided into two sub-files due to different accountancy. In the year 2007 were into sub-file Legal Entities (LE) integrated 1 365 companies, in proportion: 539 agricultural cooperatives (AC), 820 trading companies (TC) and 6 state enterprises. Legal Entities farmed 1 422 360 hectares of agricultural land (average per one company is 1 042 ha of agricultural land, for AC it is 1 363 ha, for TC it is 835 ha, for state enterprises is it 490 ha).

Into sub-file Independently operating farmers (IOF) were included 1 144 farmers which farmed 146 493 ha agricultural land. Average area of cultivated land is 128 ha per one Independently operating farmer.

Into analysed file were included all legal entities and Independently operating farmers which farmed more than 40 ha of agricultural land, declared more than 20 head of cattle or combination of cattle breeding and farming on agricultural land as well as companies farming without land or with small area of land, but in sector of intensive animal breeding.

Independently operating farmers incorporated in analysed data file represented 7.45 % from subjects which received payments in year 2007 (15 532 subjects). Share of legal entities on total quantity of subjects receiving payments in the year 2007 was 8.89 % but they are farming more than three quarters of authorized area for all agricultural subjects in Slovakia.

From the fundamental data file were draw up in the next step by random choice panel data for the period 1999 – 2007 which comprised of 338 legal entities and 83 independently operated farmers so that incorporate proportional representation of subjects farming in all regions in Slovakia, the numerousness of subjects in individual regions was considered also. Analysed data file was redeemed from subjects counting extreme values of variables applied in analysis which will affect total results.

Radial models of the DEA

The technical efficiency is convenient measure to compare production efficiency of group of companies. The advantage of this measure compared partial efficiency indicators is possibility of more input and output application by companies measurement.

Koopmans, T. C. (1951) defined input-output vector technical efficient only in case if increase of any output or decline of any input is possible only by conditions of decline of other output or increase of other input.

Farell, M. J. (1957) developed radial technical efficiency which is comparing vector of concrete firms inputs with production function on which are placed efficient companies. Final value of technical efficiency is in the interval (0,1) and interprets as efficiency of input utilization of concrete company. Firm will be efficient if it reduces inputs by 1 with fixed outputs.

The technical efficiency estimation could be done on the basis of parametric methods of Stochastic Production Functions (SFA) which were presented by Aiger, D., Lovell, C. A. K. and Schmidt, P. (1977) and non-parametric methods of Data Envelope Analysis (DEA) which were worked out by Charnes, A., Cooper, W. W. and Rhodes, E. (1978). The advantage of the DEA comparing with the SFA is independence of functional form of production function. The basis of DEA models is production function estimation with linear programming. Basic DEA model assuming constant returns to scale (DEA CRS) is solving subsequent tasks of mathematical programming

$$\begin{aligned} &min_{\theta,\lambda}\ \theta \\ &-y_i + Y\lambda \geq 0 \\ &\theta x_i + X\lambda \geq 0 \\ &\lambda \geq 0\ , \end{aligned} \qquad (1)$$

where y_i and x_i are values of outputs and inputs, Y and X are matrixes of outputs and inputs, θ scalar a λ vector of constants $N\times 1$.

Subsequently Banker, R. D., Charnes, R. F. and Cooper, W. W. (1984) developed the DEA model which was adjusted to technical efficiency estimation (DEA VRS). With this model was reached possibility to compare companies operating in different areas of return to scale and from this reason was model modified to this equation

$$\begin{aligned} &min_{\theta,\lambda}\ \theta \\ &-y_i + Y\lambda \geq 0 \\ &\theta x_i + X\lambda \geq 0 \\ &N1'\lambda = 1 \\ &\lambda \geq 0\ , \end{aligned} \qquad (2)$$

where y_i and x_i are values of outputs and inputs, Y and X are matrixes of outputs and inputs, θ scalar and λ vector of constants $N \times 1$.

The condition $N1'\lambda = 1$ assigns comparison of companies' efficiency only with those groups of companies which have similar input vector structure.

The result of radial model is simply interpreting because it is summarized in one coefficient which interprets relative company efficiency. Another advantage of radial DEA model is its independence of used measure units. On the other hand the biggest disadvantage is principle of individual input reduction to reach the efficiency.

Relative efficiency of radial DEA model is in the interval <0,1> where the coefficient value 1 means that company is identified as efficient. The difference (1 – coefficient of efficiency) means the value of how much has the company to reduce inputs to be efficient.

Results and discussion

Due to limited monitoring of individual variables in accounting statements of primary producers for technical efficiency estimation according to the fact, that in data file are legal entities and also independently operating farmers, were selected one output – total revenues (incomes) and three inputs - total assets, cultivated land according LPIS and total costs (expenditures). By selecting inputs and outputs were besides of data availability also considered approaches of other authors who examined technical efficiency in group of agricultural companies (Mathijs, E. - Vranken, L., 2001; Swinnen, J. - Vranken, L., 2005).

The development of individual variables which were used in technical efficiency measures as well as its individual components as inputs and outputs is reported in table 1.

Significant changes, which had finally influenced total production efficiency, were recorded in event of total revenues/incomes which as the output were significantly influenced by external factors, mainly weather conditions during individual years of analysed period. Increase of total assets was during the period after accession the Slovak Republic into the EU connected with investment increase which rose during analysed period due to realizing projects co-financed by the EU funds.

During analysed period continued increase of input prices in agriculture mostly due to increase of propellants, feeds, seeds, fertilizers and agents to protect crops. New technologies introduction (in crop production) on the other hand was connected with declining usage of propellants as well as in savings of operating costs. Generally was not obtained significant decrease of operating costs and according to these fact total costs/expenditures increased during whole analysed period.

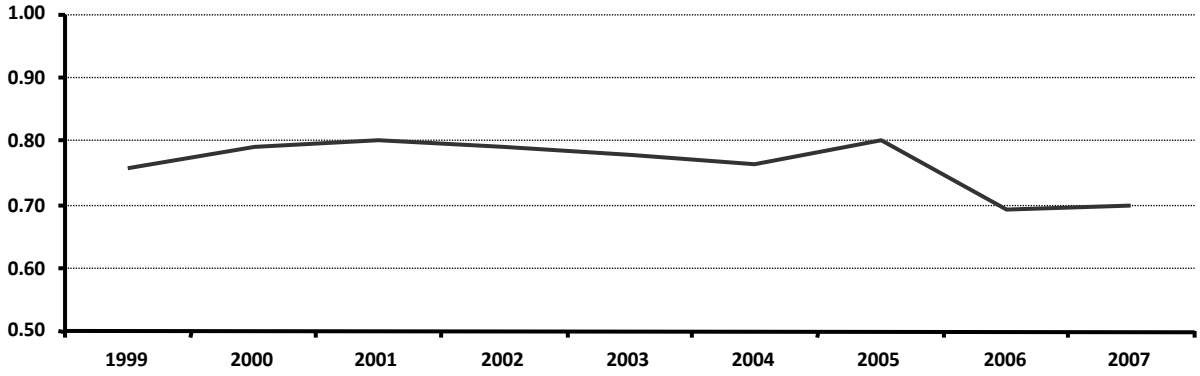
	1999	2000	2001	2002	2003	2004	2005	2006	2007
Revenues (incomes) total in thousands SKK									
Mean value	21 160	22 815	25 206	25 263	23 155	24 718	25 017	26 108	27 211
Maximum	145 050	121 528	131 027	128 108	110 304	111 273	118 902	127 061	132 670
Minimum	179	493	496	562	165	658	14	914	309
Variance coefficient	0.862	0.825	0.829	0.828	0.836	0.830	0.843	0.828	0.816
Total assets in thousands SKK									
Mean value	35 714	34 873	36 279	36 653	34 561	35 522	36 308	35 939	37 223
Maximum	239 863	157 352	178 677	151 445	138 058	134 951	140 422	134 742	159 041
Minimum	140	157	143	343	498	529	6	494	494
Variance coefficient	0.957	0.918	0.903	0.878	0.886	0.863	0.857	0.847	0.830
Farmed land according to the LPIS (farmed land in utilization) in ha									
Mean value	866	875	892	892	891	840	842	829	826
Maximum	3 675	3 675	3 675	3 675	3 425	3 425	3 425	3 425	3 425
Minimum	13	13	25	35	38	39	38	40	27
Variance coefficient	0.631	0.609	0.603	0.600	0.592	0.585	0.574	0.566	0.566
Costs (expenditures) total in thousands SKK									
Mean value	21 546	23 238	24 851	25 147	24 627	24 216	25 048	25 818	26 378
Maximum	143 125	125 444	134 367	123 321	108 695	106 063	110 210	125 053	128 977
Minimum	295	492	535	432	150	655	13	708	393
Variance coefficient	0.855	0.824	0.829	0.825	0.825	0.833	0.834	0.833	0.817

Source: own calculations

Table 1: Descriptive statistics of output and inputs for whole analysed data file during period 1999 – 2007.

The Technical Efficiency Analysis of the Data set

Figure 1 illustrates the technical efficiency measures of analysed data set of companies during the analysed period. According to the results we can state that technical efficiency measure had during analysed period declining trend. Since the year 2001 when the technical efficiency measure reached the highest level (0.802) was registered decline of the technical efficiency, except the year 2005. The average level of the technical efficiency measure during the years 2006 and 2007 is possible to explain with increasing differences between the analysed companies. Just few companies achieved very good results in the production process. Based on the results of the technical efficiency measure is possible to expect deepening of differences between the companies in future.



Source: own calculations

Figure 1: The Technical Efficiency Measure of analysed data set during the period 1999 – 2007.

	1999	2000	2001	2002	2003	2004	2005	2006	2007
Mean value	0.758	0.792	0.802	0.792	0.781	0.764	0.802	0.692	0.700
Maximum	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000
Minimum	0.080	0.467	0.553	0.307	0.353	0.312	0.206	0.284	0.282
Variance coefficient	0.192	0.114	0.105	0.122	0.135	0.120	0.113	0.196	0.164

Source: own calculations

Table 2: Descriptive statistics of the Technical Efficiency Measure during period 1999 – 2007.

	1999	2000	2001	2002	2003	2004	2005	2006	2007
0.00 - 0.10	0.00 %	0.00 %	0.00 %	0.00 %	0.00 %	0.00 %	0.00 %	0.00 %	0.00 %
0.11 - 0.20	0.24 %	0.00 %	0.00 %	0.00 %	0.00 %	0.00 %	0.00 %	0.00 %	0.00 %
0.21 - 0.30	0.24 %	0.00 %	0.00 %	0.00 %	0.00 %	0.00 %	0.24 %	0.00 %	0.00 %
0.31 - 0.40	1.19 %	0.00 %	0.00 %	0.24 %	0.00 %	0.24 %	0.00 %	0.48 %	0.48 %
0.41 - 0.50	2.38 %	0.00 %	0.00 %	0.00 %	0.48 %	0.00 %	0.24 %	1.19 %	0.48 %
0.51 - 0.60	4.04 %	0.95 %	0.00 %	0.71 %	1.19 %	0.48 %	0.71 %	14.96 %	6.41 %
0.61 - 0.70	9.74 %	5.70 %	3.80 %	5.23 %	9.50 %	4.28 %	4.04 %	21.38 %	26.13 %
0.71 - 0.80	24.94 %	23.52 %	27.32 %	26.60 %	24.94 %	45.84 %	17.34 %	26.60 %	34.92 %
0.81 - 0.90	28.74 %	43.94 %	39.43 %	38.00 %	37.29 %	32.78 %	51.54 %	23.99 %	21.38 %
0.91 - 0.99	25.89 %	23.52 %	27.08 %	27.32 %	24.94 %	13.78 %	23.28 %	9.03 %	8.55 %
1	2.61 %	2.38 %	2.38 %	1.90 %	1.66 %	2.61 %	2.61 %	2.38 %	1.66 %

Source: own calculations

Table 3: Percentage categorization of the companies into the groups according to the achieved measures of the technical efficiency during period 1999 – 2007.

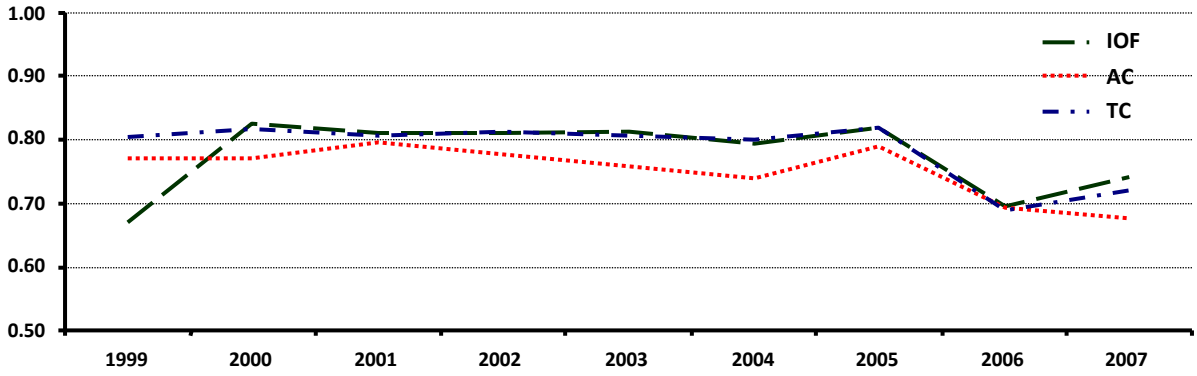
In spite of that the average measure of technical efficiency purvey informational estimation of the total efficiency is appropriate to achieved results verify with companies percentage categorization into the groups according to the achieved measures of the technical efficiency (Table 3).

According to the achieved results is evident that decline of the technical efficiency measure which was confirmed by movements of companies from the groups with higher level of the technical efficiency into the groups with lower level of the measure during the last two years of analysed period.

The Technical Efficiency Analysis of selected groups of companies

With the aim to identify the company type which reached highest measures of the technical efficiency was the analysed data set divided according to the different criterions.

The first criterion was the legal form of the companies. Second criterion was the production orientation. Analysed data set was divided into three groups: group of companies oriented on the crop production, group of companies oriented on the animal breeding and group of companies oriented on the combined production. The distributing criterion was the share of the revenues from the crop production and animal breeding on the total revenues. Into the group of companies oriented on crop production were included companies which reached minimal 75% of total revenues from the crop production. Into the group of companies oriented on animal breeding were included companies which reached minimal 75% of revenues from the animal production. The remained companies were included into the group of combined production.



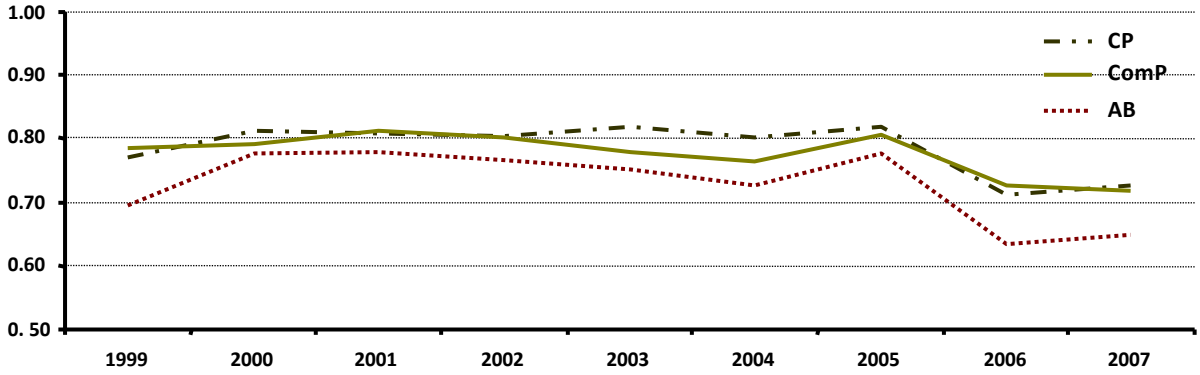
Source: own calculations

Figure 2: The Technical Efficiency Measure in the groups of companies according to the legal form during the period 1999 – 2007.

	1999	2000	2001	2002	2003	2004	2005	2006	2007
P-value	< 0.0001	< 0.0001	0.3256	0.0004	< 0.0001	< 0.0001	0.0012	0.9688	< 0.0001
Significant differences between the groups									
IOF / AC	+	+	-	+	+	+	+	-	+
IOF / TC	+	-	-	-	-	-	-	-	-
AC / TC	-	+	-	+	+	+	+	-	+

Note: (+) significant difference, (-) non-significant difference
Source: own calculations

Table 4: Test of Mean Values of the Technical Efficiency in the groups of companies according to the legal form.



Source: own calculations

Figure 3: The Technical Efficiency Measure in the groups of companies according to the production orientation during the period. 1999 - 2007

Except the years 1999 and 2006 (Figure 2) the trading companies (TC) and Independently operated farmers (IOF) reached higher measures of the technical efficiency.

To verify the statistical differences we applied the test of mean values.

The significant differences of the Technical Efficiency (Table 4) were registered between the Independently Operating Farmers and Agricultural Cooperatives (AC) as well as between the Trading Companies and Agricultural Cooperatives with exception the years 2001 and 2006 when the significant differences were not obtained. Possible reason of this trend is that Agricultural Cooperatives owned Assets not efficiently used and also were characterized with higher debt charge. In comparison the Trading Companies has more balanced structure of assets and the indebtedness was relatively low.

The second criterion was the differentiation according to the production orientation.

According to the presumptions the lowest level of the Technical Efficiency reached companies oriented on the animal breeding (AB). In other hand the most effective were the companies oriented on combined production (ComP).

The significant differences of the technical efficiency were registered during the whole analysed period between the groups of companies oriented on the crop production and on the animal breeding. Except years 2000 and 2003, years characterized with the extremely drought, were recorded also significant differences between the companies oriented on crop production and combined production. This was caused with fact that companies oriented on animal production own high value of assets connected with the animal breeding which consequently caused lower measures of the technical efficiency in comparison with companies oriented on the undemanding crop production with narrow specialization on the cereals and technical crops what is not so significantly assets demanding.

After the accession into the EU was recorded gradual increase of companies oriented exclusively on crop production of main commodities. The companies with combined production finished the breeding of livestock. This trend is connected with companies fitting to the new market conditions and more strict rules of the CAP EU.

Another criterion for technical efficiency estimation of individual groups of companies was the companies' size determined with the cultivated land area and number of employees. Achieved measures of the technical efficiency are illustrated on the figure 4 - 5.

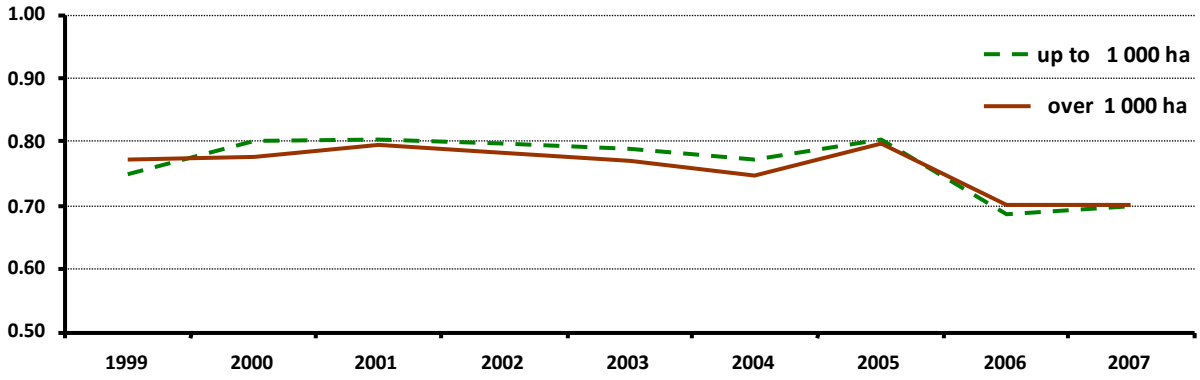
In group of companies with the land area up to 1 000 hectares were predominant the individual operated farmers and companies oriented on the crop production.

The statistical differences in the technical efficiency measures between the groups of companies are specified in table 6.

	1999	2000	2001	2002	2003	2004	2005	2006	2007
P-value	0.0001	0.0071	0.0006	0.0030	0.0001	0.0001	0.0002	0.0001	0.0001
Significant differences between the groups									
CP / ComP	-	-	-	-	+	+	-	-	-
CP / AB	+	+	+	+	+	+	+	+	+
ComP / AB	+	-	+	+	-	+	+	+	+

Note: (+) significant difference, (-) non-significant difference
Source: own calculations

Table 5: Test of Mean Values of the Technical Efficiency in the groups of companies according to the production orientation.



Source: own calculations

Figure 4: The Technical Efficiency Measure in the groups of companies according to the cultivated land area during the period 1999 – 2007.

	1999	2000	2001	2002	2003	2004	2005	2006	2007
P-value	0.0959	0.0056	0.2867	0.0938	0.1308	0.0060	0.5297	0.2107	0.8456
Significant differences between the groups									
up to 1 000 ha / over 1 000 ha	-	+	-	-	-	+	-	-	-

Note: (+) significant difference, (-) non-significant difference
Source: own calculations

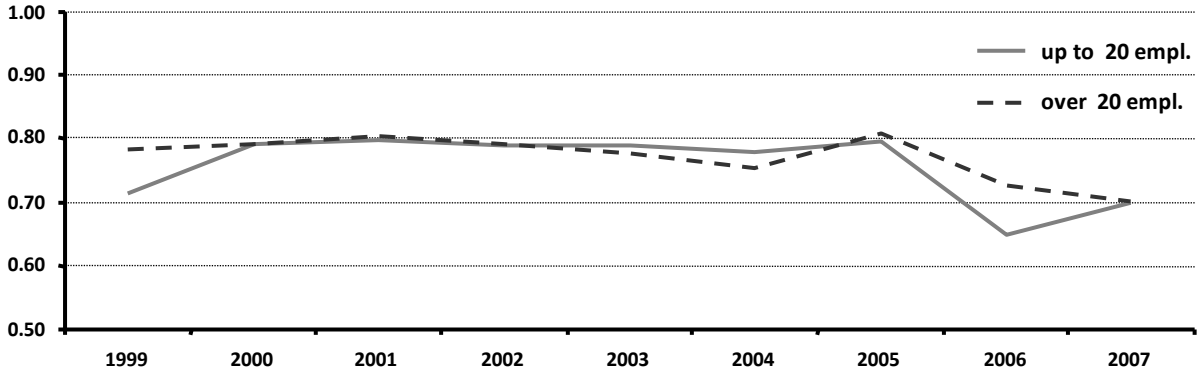
Table 6: Test of Mean Values of the Technical Efficiency in the groups of companies according to the cultivated land area.

During analysed period were reached significant differences in technical efficiency measures just during the years 2000 and 2004 what is possible to explain with minimal crop production due to impact of drought in the year 2000 and 2003. Based on obtained results is not possible to confirm higher measure of technical efficiency of companies with smaller land area.

Except year 2004 (Figure 5) companies with more than 20 employees reached higher measures of technical efficiency what could be connected with higher level of production process efficiency in these companies with higher quality management.

The statistical differences in the technical efficiency measures between the groups of companies are specified in table 7.

During analysed period (Figure 7) were achieved significant differences in technical efficiency in the years 1999, 2004 and 2006 but only in the year 2004 the companies with less than 20 employees reached higher measure of technical efficiency. This fact is possible to explain with considerable impact of poor crop due to drought in the year 2003 what subsequently negatively influenced also the animal breeding in the year 2004.



Source: own calculations

Figure 5: The Technical Efficiency Measure in the groups of companies according to the number of employees during the period 1999 – 2007.

	1999	2000	2001	2002	2003	2004	2005	2006	2007
P-value	< 0.0001	0.8817	0.5019	0.6510	0.2091	0.0056	0.2194	< 0.0001	0.8334
Significant differences between the groups									
up to 20 empl. / over 20 empl.	+	-	-	-	-	+	-	+	-

Note: (+) significant difference, (-) non-significant difference
Source: own calculations

Table 7: Test of Mean Values of the Technical Efficiency in the groups of companies according to the number of employees.

Conclusion

Change of technical efficiency can be interpreted also as relative measure of managerial abilities to exploit inputs in given technological conditions.

The most stabile development was reached in case of total productivity change which except years 2003 and 2005 reached in comparing with previous periods positive increase. Years 2003 and 2005 were characteristic by not favourable weather and climate conditions which in resort of agriculture negatively affected the significant decline of production. Finally we can state that in spite of not favourable conditions in separate period total productivity during analysed period increased. The development of the average measures of the Technical Efficiency of the companies reached moderate decline after the accession into the EU, what is probably the consequence of the increasing investing activity. The average measure of the Technical Efficiency is possible to explain with increasing differences between the companies in analysed data set.

From the reason of more detailed analysis were companies divided into groups according to the specific criterions. Based on the results is clear that between some of analysed groups are significant differences.

The production orientation was confirmed as the significant factor influencing the total efficiency. Companies oriented on animal breeding reached the lowest level of technical efficiency in comparison with companies oriented on crop production and combined production. This fact confirm current situation in the animal production which is characterized with decline of total production and gradual decline of prices.

As the main reason of inefficiency in analysed data set was identified input of assets. The highest measure of inefficiency was obtained in group of companies oriented on animal breeding. This fact confirmed also the hypothesis of not efficient assets exploitation of animal breeding companies.

According to the Technical Efficiency development we expect that the differences will deepen in future period.

Corresponding author:
Ing. Daniela Hupková, PhD.
Department of Economics, Faculty of Economics and Managemenet,
Slovak University of Agriculture in Nitra,
Tr. A. Hlinku 2, 949 76 Nitra, Slovakia
Phone: +421376414580
e-mail: daniela.hupkova@fem.uniag.sk

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Consequences of BSE disease outbreaks in the Canadian beef industry

J. Stephen Clark[1], L. Čechura[2]

[1]Nova Scotia Agricultural College Abstract
[2]Czech University of Life Sciences Prague

Abstract

This study examines farm to wholesale prices spreads to measure the impact of the BSE disease outbreak on the Canadian beef industry. The study uses structure break tests developed by Gregory and Hansen (1996) and Hansen (1992) examine possible breaks within co integrating relationships. The study finds evidence that the industry began realignment as a result of the UK BSE disease outbreak, and the Canadian BSE disease outbreak was simply the largest realignment of the process beginning with the UK disease outbreak. However, the only statistically significant break was the BSE disease outbreak itself in May 2003. Stability was not restored until the border was reopened in 2005. Specific results indicated that the processing sector exploited the border closure in May 2003 to enhance its market power and that the system returned to a competitive one after the border re-opened in July 2005.

Key words

Beef industry, price transmission, BSE, market power, parameter instability, cointegration with structural break

Introduction

The BSE disease outbreak was one of the most devastating events in the Canadian beef industry. For the two years when the US market was unavailable to live cattle imports, Canadian beef producers had little choice but to supply cattle to that the Canadian beef local Canadian meat producers. There is much controversy surrounding these events, in particular if the processing industry used the crisis to enhance their profits.

This paper will explore the extent to which the beef processing sector was able to use its market power exploit the ban resulting from the BSE disease outbreak. In general, the extent to which the processing sector was able to do this would depend on its market power. There are two types of ways the processing sector could use market power within the BSE crisis that will be explored in this study:

1) The processing sector could have had pre-existing market power and was able to use this to extract profit from the primary beef industry due to the special circumstances surrounding the BSE crisis; and
2) The processing industry could have used the BSE crisis it enhance its market power.

This study will explore market power in the beef processing industry with special reference to BSE disease outbreaks in the beef industry. Specifically, interest centers not only if the Canadian beef industry was able to exploit BSE disease outbreaks because it did have market power, but also if the beef industry was able to enhance its market power position as a result of the BSE outbreak.

Measuring the extent of market power and testing for the existence of Market power has a long history in the literature. For example, Quagrainie et al. (2003) tested for market power using a structural model and Muth et al. (1999) used a conjectural variation approach.

As an econometric problem, this analysis investigates the extent and timing of structural breaks in the spread of farm to wholesale beef prices in Canada. Interest centres both the existence and timing of a structural break and a possible change in market power resulting from the break. The literature on structural breaks is a large and growing one, beginning with Chow (1960), and Quandt (1960) for the case of stationary data with

more modern examples including Hansen (19991a) and Gregory and Hansen (1996), for the case of non-stationary data.

The results of this study indicate that there was a large and striking structural change between farm and wholesale prices in the Canadian beef industry that resulted from the discovery of BSE in Canada in May 2003: There is significant evidence that the Canadian processing industry used the BSE to enhance its market power within the marketing chain. This study also finds that there was also evidence of an, albeit smaller, realignment of market relationships between processing and farm pricing relationships resulted from the earlier BSE disease outbreak in the UK. This latter result is somewhat unique to the literature of the BSE in Canada and gives credence to the argument made by, for example Le Roy and Klein (2005) and Loppacher and Kerr (2004) that the Canadian beef industry could have been better prepared for a disease outbreak. The results of this study indicate that the UK disease outbreak began a process of realignment in the Canadian beef market, with the largest adjustment with the border closure resulting from the Canadian BSE disease outbreak in May 2003 and culminating with the reopening of the border in July 2005.

This study is organized as follows. The next section describes the price spreads within the Canadian beef market. A model of market power is introduced after that. This is followed by a discussion of the econometric specification and testing procedures. Data and data sources are then presented along with empirical results. The final section concludes.

Price spreads within the Canadian beef market

Figure 1a presents a plot of the farm price, wholesale price and the retail price indexes of beef in Canada from 1986:01-2009:12. The sample covers a time period of trade liberalization due to the implementation of CUSTA in 1989 and NAFTA in 1994. The plot indicates that the farm price of beef is somewhat more volatile than the wholesale price. The retail price and the wholesale price indexes tend to track one another fairly consistently. Interest in the BSE concentrates on May 2003 and the plot clearly shows a dramatic shift in the relationship among different levels of the market, with a much greater drop in farm prices than those in the retail and wholesale levels of the market. The wholesale to retail price spread does not display the same dramatic shift during the BSE as the farm to wholesale price spread, indicating that the dramatic effects of the BSE did not seem to extend beyond the wholesale to farm price spread. This study will examine the extent of market power by econometric evaluation of the price spread between farm and wholesale prices. This spread is plotted in figure 1b. The plot is very suggestive of a peculiar relationship during the time period when raw beef imports were banned into the US (between May 2003 and July 2005). The spread is particularly dramatic between farm and wholesale price spreads during the early time period of BSE ban. After the ban ended, there seems to indicate a return to "normal".

While the informal eyeballing of the data is highly suggestive of a structural break in the Canadian beef industry because of the BSE disease outbreak and the ban on beef exports to the US, such informal techniques are subject to data snooping and measurement without theory. Furthermore, other structural breaks in the series do not seem evident from visual inspection techniques. The following two sections explore a theoretical and empirical apparatus that can formally test the existence of a structural break in the series together with its relationship to the market power of the processing sector.

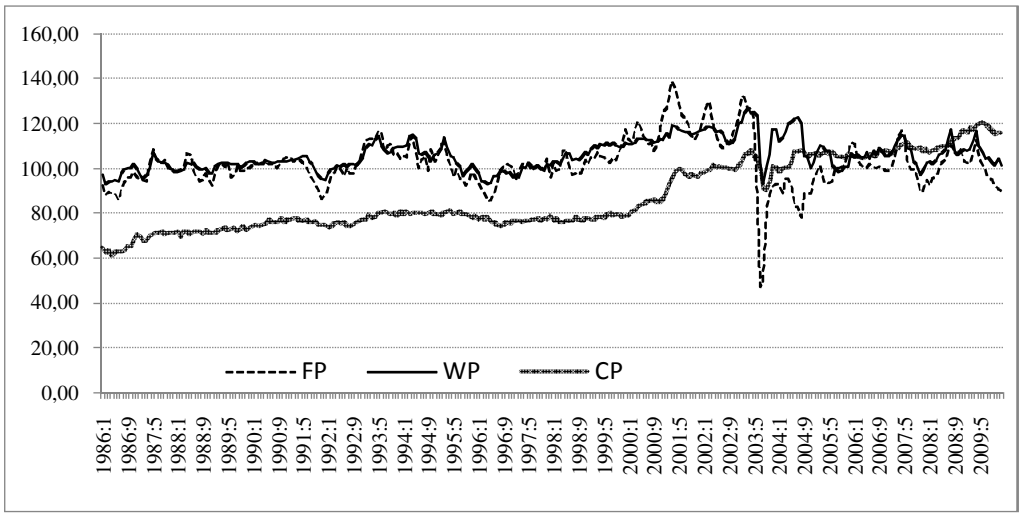
A model of market power in the Canadian beef industry

The model developed in this section is a basic farm to wholesale marketing margin model. Other studies that have used the same theoretical structure include Bakucs and Ferto (2006), Bojnec (2002) and Jumah (2000).

Consider a homogeneous product produced using a constant returns to scale technology (e.g. McCorriston et al. (2001)). Given these assumptions, then it is sufficient to examine the characteristics of the marketing margin to explain market power. The price margin between farm and wholesale prices:

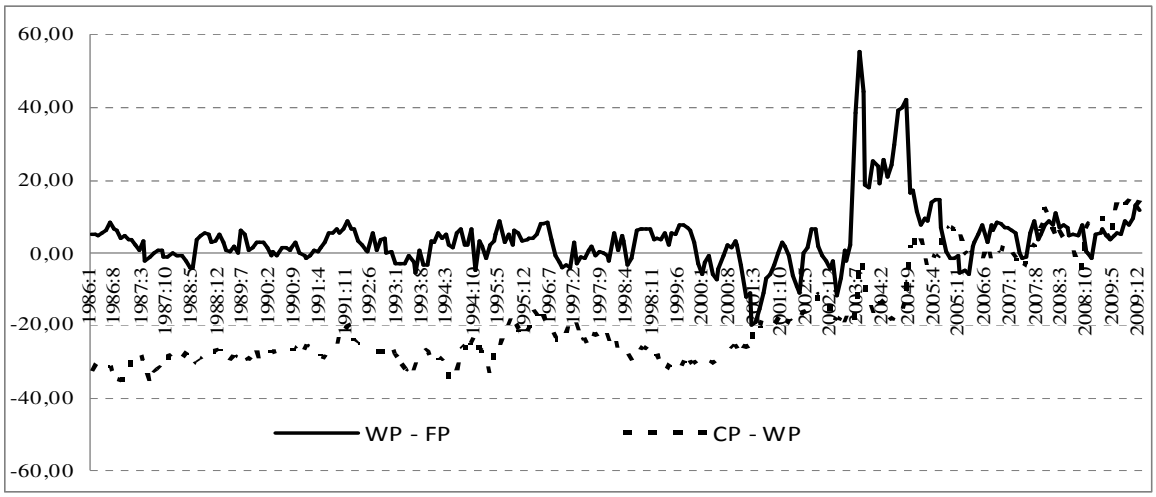
$$M_t = WP_t - FP_t, \qquad (1)$$

where M is the marketing margin (price spread), WP for wholesale price and FP is the farm price.



Source: Statistics Canada 2010a, 2010b and 2010c. Notes to table: FP- farm price, WP-Wholesale price, RP-retail price

Figure 1a: Farm Price, Wholesale Price and Consumer price index (1997=100).



Source: Statistics Canada 2010a, 2010b and 2010c. Notes to table: FP- farm price, WP-Wholesale price, RP-retail price

Figure 1b: Changes in price spreads within the Canadian beef market.

Assuming the price is determined by the processor a mark-down rule is defined as:

$$M_d = c + dFP, \qquad (2)$$

where M_d is the mark-down. The constant term c represents the marginal cost of marketing and slope parameter d ($0 \le d < 1$) indicates the market power of processing sector. The slope d expresses how much the marketing margin can be increased due to their market power.

Substituting (2) for M into (1) and rearranging results in:

$$FP_t = -\frac{c}{1+d} + \frac{1}{1+d} WP_t \ , \qquad (3)$$

If the parameter d is equal to 0, the constant term reduces to c and the slope term is equal to 1. This would indicate a perfect price transmission model and no market power. However, if parameter d is not equal to 0, the slope parameter in (3) is less than 1, indicating that the processing sector has market power over the farm sector. If the prices in equation (3) are in logarithms, the slope parameter in equation (3) is a price transmission elasticity.

Addition assumptions made with respect to equation (3) include that it is a long-run relationship between prices and represents a sub-game perfect equilibrium of a dynamic repeated game. Structural change is measured as a change in the parameters of equation (3) resulting from an event at time t. The change can be in the intercept of the model (3), due

to the change in the marketing costs, or in the slope due to a change in market power or both.

Estimation and testing for structural breaks in non-stationary time series

The marketing margin model given by equation (3) is estimated and then tested for a structural break. It has long been known that the estimation strategies and test statistics for structural breaks depend on the time series properties of the data.

The data are tested for a unit roots using an augmented Dickey Fuller (ADF) test (Dickey and Fuller (1979)) to determine the order of integration, I (d). If the time series is non-stationary with a single unit root the next question is if the time series are cointegrated, i.e. if there is a long-run relationship among time series. The empirical section uses two approaches to test for cointegration: The Engle-Granger (1987) two-step approach and the Johansen (1988 and 1991) maximum likelihood approach.

This study will analyze two possible impacts on the retail to farm price spread in the beef industry. First, the processing sector could have used its pre-existing market power to enhance its profits due to border restrictions related to the BSE disease outbreak. Second, the processing sector could have used the border closing as a pretext to change its market power relationship with the beef farm sector. While the former is related to a stable pre-existing relationship in the marketing margin given by equation (3), the latter is related to a change in the marketing margin relationship itself.

From an econometric perspective, interest lies in detecting parameter instability of the marketing margin equation (3). Since analysis deals with the impact of BSE disease outbreak on price transmission and market structure in Canadian beef industry, interest centres on parameter instability. There are several methods by which parameter instability can be examined with an econometric relationship. Early examples include Chow (1960) and Quandt (1960). In the spirit these tests, Hansen (1992) extends the tests to include cases where the break point is unknown (to avoid data snooping) and regressors are I (1). Other methods that detect parameter instability include threshold estimation methods (e.g. Hansen (2000) and Caner and Hansen (2001)). This study uses methods developed by Hansen (1992) and Gregory and Hansen (1996). This approach is superior to classical threshold models because it allows for regime shifts in long-run relationship that allows the study of a change in market power after the structural shock. A maintained hypothesis used in this study is that the relationship can be well approximated by a linear model. Linearity vs. non-linearity of the relationship, is another methodological issue (see e.g. Hansen, 1999) that is not dealt with.

Hansen (1992) proposed three tests – SupF, MeanF, and Lc – for testing parameter instability in cointegrating relationships. All tests have the same null hypothesis; parameter stability, but differ in their choice of alternative hypotheses. Whereas the SupF test has power to detect a one-time regime shift, the MeanF and Lc tests are appropriate to test the stability of the relationship described by the model. The Lc test is a test of the null of cointegration against the alternative of no cointegration. Since the tests are based on Phillips-Hansen fully modified estimator the estimates of cointegrating vectors are asymptotically efficient.

Gregory and Hansen (1996) proposed extension of ADF, Zt and Zα test (we denote the extended versions of the tests – ADF*, Zt* and Zα*) for cointegration with regime shift in either the intercept or the entire coefficient vector. All test the null of no cointegration against the alternative of cointegration in the presence of a possible regime shift and a break of unknown timing. Three forms of structural change are considered:

Level shift model - C

$$y_{1t} = \mu_1 + \mu_2 \varphi_{t\tau} + \alpha^T y_{2t} + e_t, \qquad t = 1,\ldots, \ n. \quad (4)$$

Level shift model with trend – C/T

$$y_{1t} = \mu_1 + \mu_2 \varphi_{t\tau} + \beta t + \alpha^T y_{2t} + e_t, \quad t = 1,\ldots, \ n. \quad (5)$$

Regime shift model – C/S

$$y_{1t} = \mu_1 + \mu_2 \varphi_{t\tau} + \alpha_1^T y_{2t} + \alpha_2^T y_{2t} \varphi_{t\tau} + e_t, \quad t = 1,\ldots, \ n. \quad (6)$$

where y_{1t} is real-valued and y_{2t} is an m-vector of I(1) variables, e_t is I(0). The parameters μ and α describe the m-dimensional hyperplane that the vector process $y_t = (y_{1t}, y_{2t})$ converges over time.

Let the dummy variable, $\varphi_{t\tau}$, be defined as:

$$\varphi_{t\tau} = \begin{cases} 0 & if \quad t \le [n\tau], \\ 1 & if \quad t > [n\tau], \end{cases} \qquad (7)$$

where $\tau \in (0,1)$ is the unknown parameter which denotes the timing of the break point and $[\ ]$ denotes the integer part.

The shift given by equation (4) (C) represents a level shift in the cointegrating relationship, the shift represented by equation (5) allows for a shift in both level and trend (C/T) and the shift represented by equation (6) allows the both a shift in the slope and intercept term (C/S). The last case allows for a shift in both intercept and slope. That is, the structural change is captured either by change in the intercept μ or changes to the slope α or both. The tests statistics (ADF*, Zt* and Zα*) are computed recursively for each data point in the interval $([0.15n],[0.85n])$ from OLS estimates of cointegrating vectors. The smallest value of the test calculated test within the interval is used to evaluate the null hypothesis.

The C/S shift is particularly relevant for examining the impacts of the BSE on the relationship between wholesale and farm prices. Assuming that the smallest value is obtained for the BSE disease outbreak in May 2003 and is statistically significant, then if the shift in the in the slope parameter went from some value close to unity to some value less than unity, this would indicate that the processing sector went from a position of close to competitiveness to one of increasing market power, i.e. it took advantage of the its special control over the market to enhance its profits. If the value before the BSE was less than unity, then this would indicate a level of pre-existing market power that could be used in the event of the crisis like the border closure resulting from the BSE disease outbreak.

The calculations of ADF test, Hansen (1992) instability test and Gregory-Hansen (1996) tests were carried out in GAUSS. The GLS estimates of long-run relationships were run in RATS software.

Data and results

The data used included data on the farm price (FP) index for beef and veal from Statistics Canada CANSIM database (Statistics Canada, 2010a), a wholesale price (WP) index for beef and veal from Statistics Canada CANSIM database (Statistics Canada, 2010b) and a retail price of beef and veal (RP) from Statistics Canada CANSIM database (Statistics Canada, 2010c). The data are monthly prices and run from 1986:1 to 2009:12.

The first step in the process of examining parameter stability is to test the order of integration of farmer (FP) and wholesale price (WP) time series. Table 1 presents the ADF test statistics for different lags and deterministic assumptions. The table indicates that different results for different lags and deterministic assumptions are obtained. The time series seems to be stationary in levels when low lags lengths are used in the ADF test. However, with 12 and 18 lags lengths, the data do not reject unit roots except in the case of FP including an intercept and no trend. Given the monthly nature of the data, we conclude longer lags are more appropriate for these data. Therefore, we conclude that the data are consistent with unit root non-stationarity. Table 1 also indicates that in all cases two unit roots are strongly rejected for all prices.

Subsequent testing for cointegration indicated that using the Dickey-Fuller test for cointegration (the Engle-Granger two steps procedure) the time series are not cointegrated. The Johansen trace test for cointegration using maximum likelihood indicated the existence of a cointegraing relationship. Lack of consistent conclusions between the Johansen approach and the Engel Granger approach could be due to then existence of structural breaks in the series rather than a lack of a contegrating relationship; i.e. the time series may be cointegrated with structural breaks.

All three Hansen (1992) parameter stability tests, SupF (242.56), MeanF (81.05), and Lc (7.674), strongly reject the null hypothesis of a stable relationship between wholesale and farm prices, indicating parameter instability. The results of these tests could support the notion that parameter instability could be due to structural breaks.

The Lc test could be viewed as a test of the null of cointegration against the alternative no cointegration which suggests there is a lack of cointegration between farmer and wholesale price. The SupF test suggests that the regime shifts may have occurred. That is, the Lc test rejects the null hypothesis of cointegration with the maintained

hypothesis of long-run stability in the cointegrating vector. However, the SupF test suggests there may be two or more cointegrating regimes which shifted at a particular time in the period under investigation. Hence the rejection of a single cointegrating relationship resulting from the Lc test could be the result of the inappropriate maintained hypothesis of a single cointegrating relationship without any structural break.

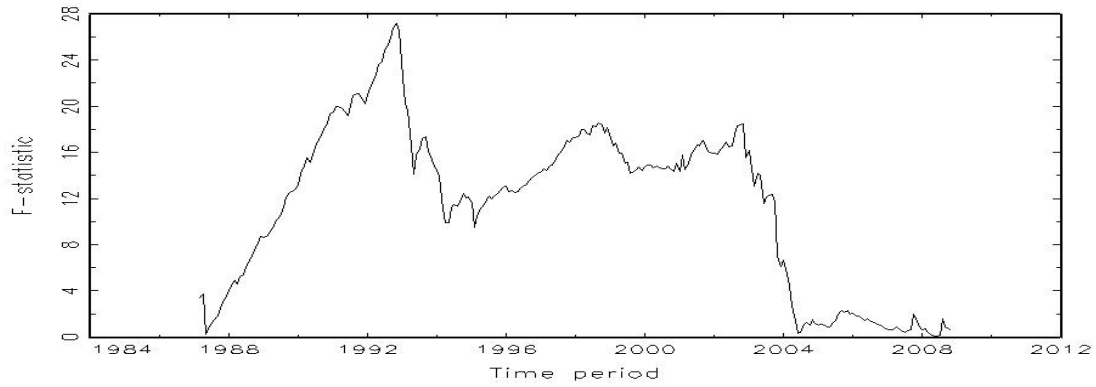
Figure 2 plots the F-statistic for the wholesale to farm marketing margin for each observation in the data. Maximums of this test would indicate the existence of a structural break. The SupF statistic is the largest value attained of the F-statistics, somewhere between 1992 and 1993. This could be related to the implementation of the North American free trade agreement. Other local maximums in the F-statistic may indicate other possible breaks in the processor to farm marketing margin. Time periods of these local maximums revealed in Figure 2 are sometime in the late 1990's and the BSE outbreak in Canada in May 2003.

Table 2 presents test statistics for a cointegrating relationship between wholesale and farm prices with a regime shift using the Gregory-Hansen (1996) approach. All three of the ADF*, Zt* and Zα* indicate cointegration with a regime shift. All three tests strongly reject the null hypothesis of no cointegration. These results are in contrast to the results of Engel Granger ADF test presented above, which indicated no cointegration. These results tend to support the notion that there is a structural break in an otherwise stable wholesale to farm marketing margin equation. The actual breakpoint estimated by all three tests and model specifications was close to or exactly May 2003, the time of the initial ban of beef products entering the US due to the BSE disease outbreak. For example, May 2003 was the estimated time period of the structural break for the C/S model using all three regime shift tests using the Gregory-Hansen approach.

ADF test		FP	dFP	WP	dWP
2 lags	no intercept	-0.45	-10.99***	-0.15	-10.99***
	Intercept	-4.72***	-10.98***	-4.42***	-10.97***
	intercept and trend	-4.70***	-10.97***	-4.83***	-10.97***
6 lags	no intercept	-0.28	-9.27***	0.029	-9.54***
	Intercept	-3.59***	-9.25***	-2.73*	-9.53***
	intercept and trend	-3.55***	-9.26***	-2.77	-9.55***
12 lags	no intercept	-0.20	-5.45***	0.18	-6.37***
	Intercept	-2.90**	-5.47***	-2.14	-6.36***
	intercept and trend	-2.83	-5.49***	-2.01	-6.42***
18 lags	no intercept	-0.26	-4.93***	0.02	-4.36***
	Intercept	-2.57	-4.91***	-2.02	-4.34***
	intercept and trend	-2.53	-4.92***	-2.03	-4.38***

Note: *, ** and *** indicates significance at the 10%, 5% and 1% levels, respectively. FP is farm price, WP is wholesale price, dFP is first differenced farm price, dWP is first differenced wholesale price. Source: own calculations

Table 1: Augmented Dickey-Fuller (ADF) unit root test.



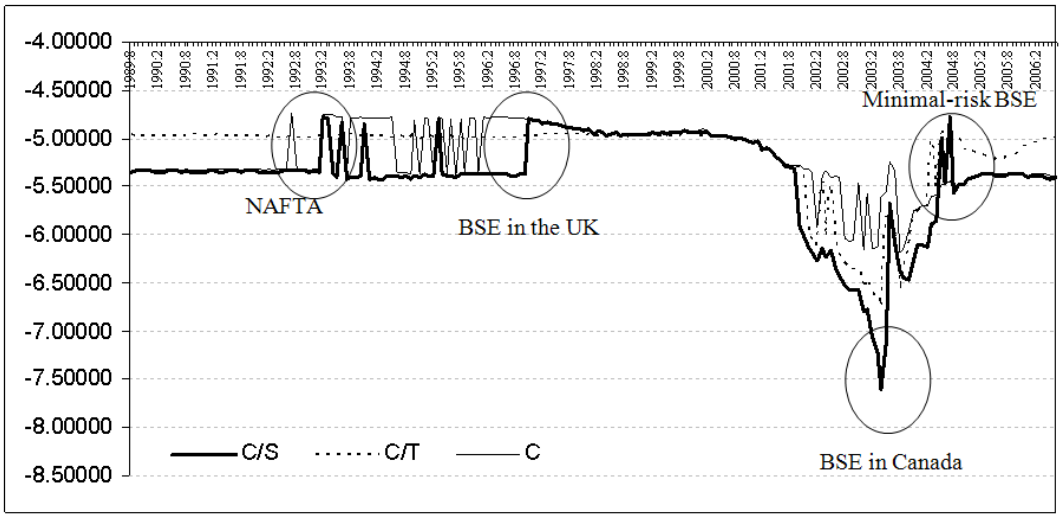
Source: own calculations

Figure 2: Hansen parameter instability test – SupF test – FP and WP regression.

	Test statistic	Breakpoint
ADF*		
C (with 1 lag)	-6.18***	0.74
C/T (with 1 lag)	-6.74***	0.72
C/S (with 1 lag)	-7.61***	0.72
Zt		
C	-5.91***	0.71
C/T	-6.16***	0.71
C/S	-6.68***	0.72
Za		
C	-63.91***	0.71
C/T	-69.49***	0.71
C/S	-78.89***	0.72

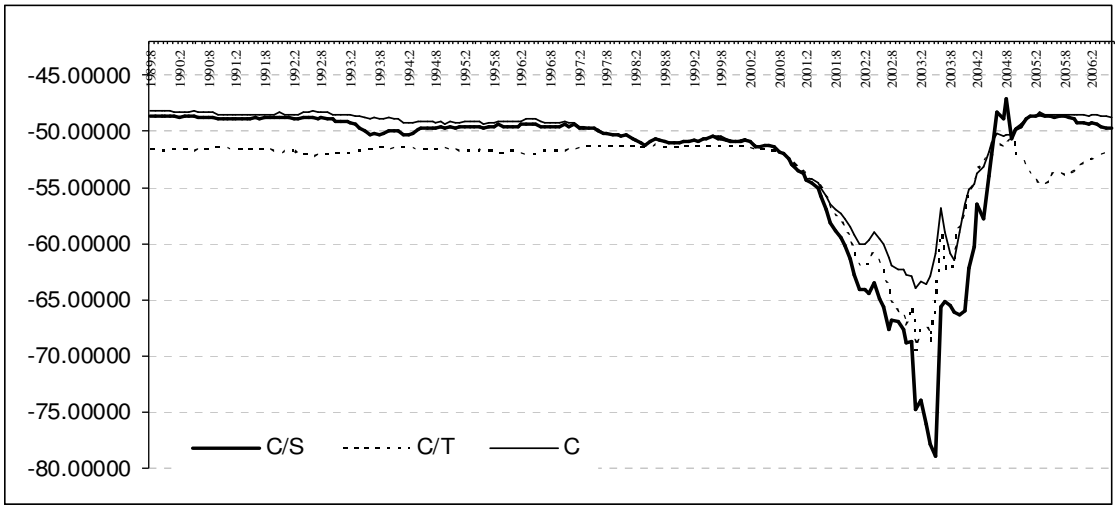
Source: own calculations

Table 2: Gregory-Hansen cointegration test – testing for regime shifts in Canadian beef.



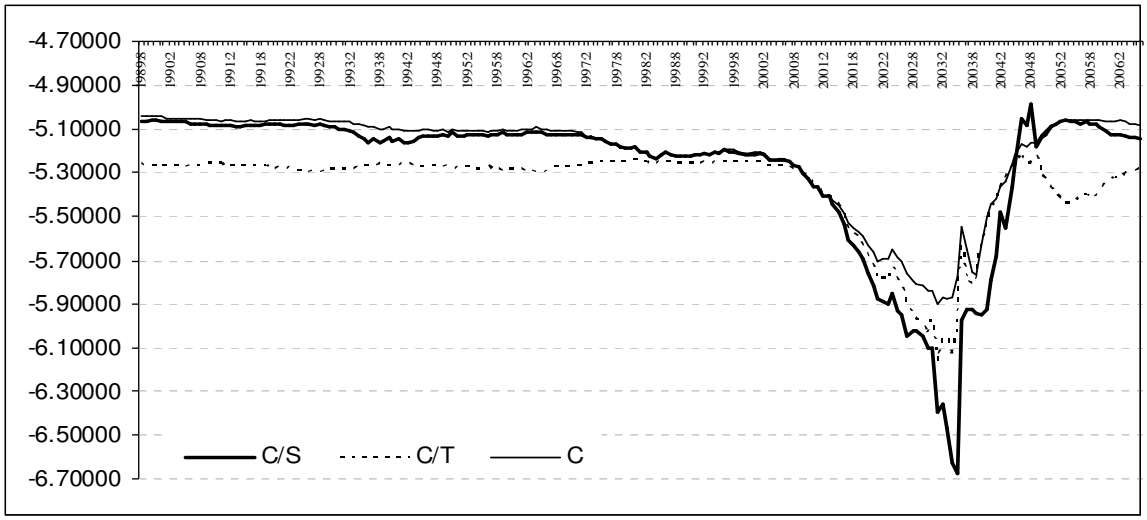
Source: own calculations

Figure 3: Gregory-Hansen cointegration test with break – ADF* test.



Source: own calculations

Figure 4: Gregory-Hansen cointegration test with break – Zα* test.



Source: own calculations

Figure 5: Gregory-Hansen cointegration test with break – Zt* test.

Figures 3 (ADF*), 4 (Zα*) and 5 (Zt*) plot the test statistics for regime shifts of the wholesale to farm marketing margin under the C, C/T and C/S models. All three plots clearly show that the minimum value of these test statistics correspond to the closure of the US border to Canadian imports of live animals into the US that resulted from the discovery of BSE in Canada. All tests also reveal a "return to normal" toward the end of 2004, six months prior to the time the ban was completely lifted in July 2005.

The plot of the Gregory-Hansen ADF* test presented in figure 3 shows a clear drop in the ADF* statistic that began in 1997, which was a time period of the BSE disease outbreak in the UK that lasted from the mid to late 1990's. Beginning in 1997, the ADF* statistic begins a long downward trend, culminating in the BSE outbreak in Canada in May 2003. Thereafter, the ADF* statistic makes a recovery until July 2005, when it returned to pre-UK BSE crisis level. This pattern is repeated, albeit in less dramatic style, with the Zα* and Zt* test statistics. These results indicate that the beginning of realignment in the Canadian beef marketing margin equation may have begun with the initial disease outbreak in the UK rather than the BSE outbreak in Canada. Realignment seems to have been taking place during the whole time period since UK BSE, although the sharpest realignment happened with the closure of the US border in May 2003 resulting from the discovery of BSE in Canada. While these results are suggestive, they are not statistically significant, art from the closure of the border into the US resulting from the discovery of BSE in Canada.

While the analysis until now has focused on test statistics, it does not reveal the nature and extent of market power changes within the Canadian beef marketing system. To undertake this analysis estimates of the marketing margin price markup are examined. Recall from equation (3) that market power implies a coefficient estimate of the slope parameter in the marketing margin to be less than one. Table 3 presents results of estimating the marketing margin model using two sets of Engel Granger cointegrating regression results. The first is the four regime model, with the four regimes being pre UK BSE (1986:01-1997:04), UK BSE (1997:05-2003:05), CDN BSE (2003:05-2004:12) and post CDN BSE (2005:01-2009:12). The table indicates that under both models, the parameter on the slope term fell to 0.88, indicating processors took advantage of the border closure resulting from the BSE disease outbreak to enhance its market power. After the border for Canadian beef was restored, (post CDN BSE), the system was restored to a relatively competitive regime, with the slope coefficient returning to 1.26 under that two regime model or a competitive 0.99 under the four regime model. This indicates that the system was restored to a relatively competitive one as a result of the reopening of the border in 2005, when Canada was declared a minimum risk BSE region by the US.

Four Regime model			Two Regime Model	
Regime	Constant	Slope	Constant	Slope
Pre UK BSE (1986:01-1997:04)	-22.11 (9.98)	1.20 (0.10)	-29.56 (15.77)	1.26 (0.05)
UK BSE (1997:05-2003:05)	-45.41 (11.07)	1.42 (0.10)	-29.56 (15.77)	1.26 (0.05)
CDN BSE (2003:05-2004:12)	-12.40 (14.93)	0.88 (0.13)	-12.40 (15.77)	0.88 (0.14)
Post CDN BSE (2005:01-2009:12)	-3.40 (17.07)	0.99 (0.16)	-29.56 (15.77)	1.26 (0.05)

Note: Values in parentheses are standard errors

Table 3: Estimates of the parameters of the farm to wholesale marketing margin from Engle- Granger Cointegrating regression.

Conclusions

This study examines farm to wholesale prices spreads to measure the impact of the BSE disease outbreak on the Canadian beef industry. The study finds evidence that the industry began a realignment as a result of the UK BSE disease outbreak, and the Canadian BSE disease outbreak was simply the largest realignment of the process beginning with the UK disease outbreak and ending with the reopening of the border in May 2005. There is also some evidence that realignment began earlier, with the implementation of NAFTA in 1997. However, the only statistically significant break was the BSE disease outbreak itself in May 2003, and not breaks in the series resulting from the implementation of NAFTA or the UK disease outbreak. Stability was not restored until the border was reopened in 2005.

Specific results indicated that the processing sector exploited the border closure in May 2003 to enhance its market power and that a competitive system was resulted after the border re-opened in July 2005

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Corresponding authors:
Prof. J. Stephen Clark
Nova Scotia Agricultural College;
e-mail: sclark@nsac.ca

doc. Ing. Lukáš Čechura, Ph.D.
Czech University of Life Sciences Prague, Department of Economics
Kamýcká 129, 165 21 Prague-Suchdol, Czech Republic
Phone: +420 224 382 279, e-mail: cechura@pef.czu.cz

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Is there any future for cash crops in developing countries? The case of vanilla.

I. Pokorná, L. Smutka

Czech University of Life Sciences, Faculty of Economics and Management, Department of Economics

Abstract

A generally used term for easy marketable commodities usually with high prices is cash crops As a result of it these commodities are produced by many developing and especially least developed countries (LDC). These crops have witnessed fluctuation in prices during the last decade. We can suppose that these products would be the domain of developing countries nevertheless the opposite is true.

Vanilla is a very good example of those products especially because just very few producers exist. We can suppose that vanilla trade would be the sphere of very few producers and beside that the agents would deal mostly with the demand site on the international market. However, the international vanilla market shows slight differences. Nevertheless, it can be grown just in very few areas. Madagascar belongs between the most well known producers.

The aim of this paper is to analyse the international vanilla trade with regards to the production and consumption side and specifics of cash crops in general. International vanilla trade is even higher than the production itself. These results indicate that vanilla is being re-exported and the trade is not just a normal commodity trade but being use as a investment instrument as well.

Key words

Cash crops, vanilla, international trade, RCA.

Anotace

Termín cash crops se používá v případě zemědělských komodit, které jsou lehce zpeněžitelné na mezinárodním trhu obvykle za vysoké ceny. Tyto komodity jsou obvykle pěstovány v rozvojových a hlavně nejméně rozvinutých zemích (LCD). V průběhu minulého desetiletí došlo k výraznému kolísání jejich cen na mezinárodních trzích. Bylo by možné očekávat, že tyto plodiny jsou doménou nejméně rozvinutých zemí. Opak je však pravdou.

Vzhledem k omezenému množství producentů patří vanilka mezi dobré příklady těchto komodit. Mohli bychom očekávat, že obchod s vanilkou budou doménou pouze několika málo producentů a na mezinárodním trhu bude dominovat strana poptávky. Trh s vanilkou však vykazuje výrazné rozdíly. I přes tuto důležitost může být vanilka pěstována pouze v několika oblastech světa (např. Madagaskar).

Cílem tohoto článku je analyzovat produkční a spotřební stranu obchodu s vanilkou se zaměřením na specifika obchodu s lehce zpeněžitelnými produkty. Výsledky ukazují, že obchod s vanilkou je podstatně vyšší než produkce a existuje zde tedy velké množství re-exportů.

Klíčová slova

Lehce zpeněžitelné produkty, vanilka, mezinárodní obchod, RCA

Introduction

The term cash crops are being very often interchanged with the term export crops. Cash crops represent food and non-food commodity either sold domestically or exported abroad with comparison to the export crops which are just being sold abroad (Barbier, 1989). In this paper we shall use the common sense definition of crops being sold for cash. The group of non-food cash crops consist, for example, of tea, coffee, sugar, tobacco and spices. The shift between food crops and cash crops is known as commercialization. Effect of this shift has been described by many studies (see Maxwell and Fernando, 1989). Some of them document the possible positive effects and alternatively many of them highlight the disastrous consequence of such a shift.

Many developing countries try to assign priorities whether to specialize in cash crops or focus more on substance production of food crops. This debate is very often based on competitive advantage and terms of trade. Many economics stress the fact that specialization in cash crops can be helpful for farmers who can sell their cash crop production and buy food crops (Timmer, 1997; Govereh and Jayne, 2003; Goetz, 1992; Balat et al. 2009; Jeníček, 2008; Kennedy et al, 1992; Ali and Farooq, 2003); however, the premise can be valid just in a case that the vulnerability of cash crops do not exist. The stability of the prices has also been stressed by Mintem et al. (2009), Svatoš, (2008), Čechura (2009) and Schweitzer (2009). Contrarily, Dorosh and Haggblade (1993) found out that investment in food crops (rice) generate higher GDP and employment. On the other hand Easterly and Levine (2003) point out that cash crop can be a burden for economic development. Cash crop production can also negatively influence the biodiversity (Mertz et al, 2005) which can have negative impact on economic growth. On the other hand, vanilla very often intercropped areca – palm. Planting both together make the plantation structurally complex. For example, vanilla is often planted together with some other cash crops – such as bananas and coffee in Uganda.

This paper focuses on vanilla that is an aromatic spices originated in Mexico. About 110 species of Vanilla belong to the orchid family (Orchidaceae). Commercial vanilla flavour is being derived from Vanilla planifolia (Verma et al, 2008). Vanilla spices are being connected mostly with culinary delights, however, is has its history as a medical plant too. The production of Vanilla beans demands special climatic and soil conditions and it is also labour intensive (Blarel and Dolinsky, 1995). The previous statements confirm that the vanilla is one of the most expensive spices. Some authors even mention that it is the second most expensive one after saffron.

Data and Methodology

The aim of this paper is to analyse the structure of foreign trade with vanilla. As a vanilla belong to the group of cash crops and there is a tendency of agriculture commodities price decline (Rakotorisoa and Shapouri, 2001) we aim to examine the trends in vanilla foreign trade. The commodity selection was done on the base of primary producer structure. We assume that as vanilla is being produce just in very few developing countries it can significantly contribute to the economic growth of those countries.

Firstly, we begin to investigate the structure of producers. The descriptive analysis is employed and data come from FAOSTAT. Based on the first stage we continue to analyse the export and import site of the vanilla trade. Partially, we also touch the question of prices as the prices play a key role in the foreign trade. We also use the revealed comparative advantage indices for our analyses. The original RCA index, formulated by Balassa (1965) can be written as:

$$B = (xij / xit) / (xnj / xnt) \quad (1)$$

where x represents exports, i is a country, j is a commodity, t is a set of commodities and n is a set of countries. RCA I measures a country's exports of a commodity (or industry) relative to its total exports, and to the corresponding exports of a set of countries, e.g. the world.

A comparative advantage is "revealed", if RCA I > 1. If RCA is less than unity, the country is said to have a comparative disadvantage in the commodity/industry. It is argued that the RCA I index is based due to the omission of imports especially when country-size is significant. We accept the fact that the RCA indices are not predicative enough about the real structure of trade. For trade analysis we use data from COMTRADE

but there exists one problem. COMTRADE trade matrices include both types of vanilla – one use for culinary purposes and the second one used for perfumes.

Results and discussion

Vanilla production

Many developing countries try to assign priorities whether to specialize in cash or food crops. This question is crucial especially for net food importing countries (such as Madagascar, Kenya and Malawi) specializing in cash crop production. According to FAOSTAT vanilla is being produces in 13 countries on 82 098 hectares of land (2008). The four main producers according to harvested area are Madagascar (69 th. ha), Indonesia (9 th. ha), China (1.5 th. ha) and Mexico (1.1 th. ha). The harvested area of other producers is under 1 000 ha. The value of mean is rather high – 6 315, 23 ha compare to the value of median (250 ha) and mode (40 ha). Madagascar represents 84.5% of the whole harvested area and Indonesia, China and Mexico all together account approximately for 15%. The previously mentioned data show that the distribution is far above the ground. 97 % of the harvested area is located in low income or food deficit countries.

Similar situation can be seen when we describe the production in tones. The overall production was 9 080 tons in 2008. Indonesia is the biggest producer of 3 700 tons accounting for 40.75%, follow by Madagascar (3 700 tons and 30.84%), China (1 400 tons and 15.42%) and Mexico (637 tons and 7.02%). All together these countries account for 94% of the total production. The production of vanilla is very unstable because vanilla tends to have problems with fungus and diseases and this very often causes the full removal of the plant. However, the production of vanilla tended to growths by 5 % per year. The standard deviation of production oscillates around 1 837 tons between the years1985–2008.

Based on previous data we can say that the inequality of vanilla hectare yields must exist. As Madagascar has the highest harvested area, however, it is just the second highest producer regarding tons. As is evident from the chart 1 enormous discrepancies exist between yields in producing countries. The trend of median does not show any distinct differences even though the difference between maximum and minimum value is increasing. China has been witnessing the highest increase in hectare yields compare to Madagascar that use an extensive production with decreasing hectare yields.

Due to the previous facts we cannot explain the increase in production either by increasing harvested area or increasing hectare yields. The producers' prices are rather stable except for Madagascar. Even through the decline in yields the producer prices in Madagascar were more then three times higher than is the value of median in 2003. The rapid increase in prices was given by the problems of Madagascar vanilla industry caused by three seasons of crop failures. The Madagascar's producer's price was growing by 1.25 % between the years 1991 and 2007. Mexico, Portugal, Indonesia and Zimbabwe witness decline in production prices in the monitored years.

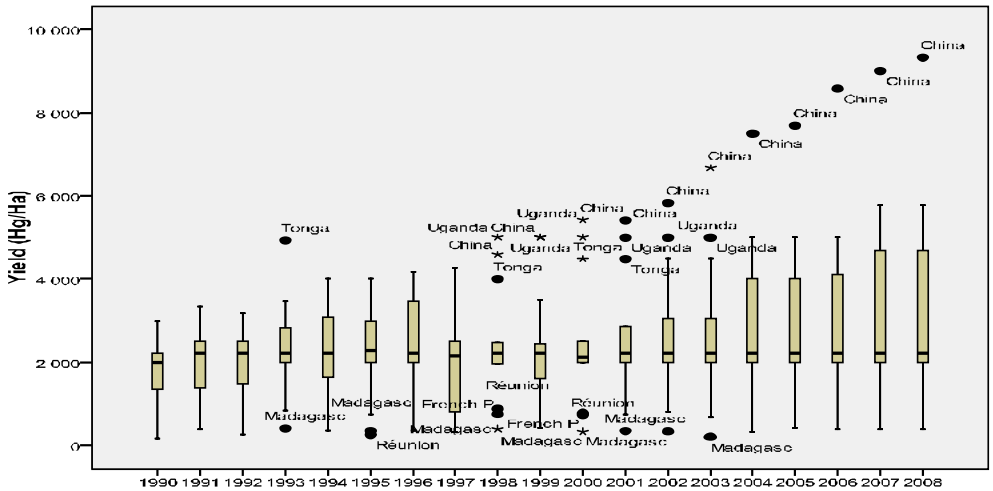
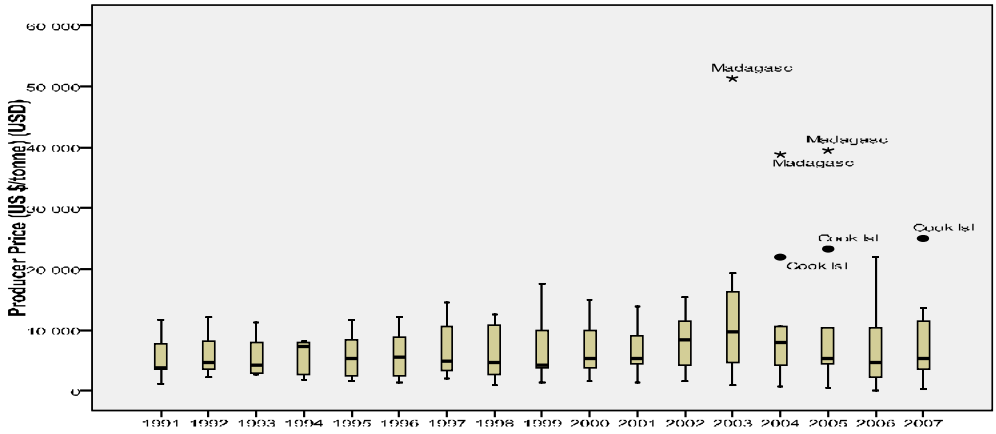


Chart 1: The variation of vanilla yields between years 1990 – 2008.



Source: own calculation based on FAO data

Chart 2: The variation of producer price between years 1991 – 2007.

Vanilla trade

Vanilla is traded all around the globe. In the last century the trade was controlled by Madagascar. During the previous years the situation has changed. However, there are differences in the export and import site. As is evident from the previous fact vanilla trade have to copy the pattern of the production. As mentioned above the production is approximately 9 000 tons. The traded quantity is around 7 000 tons. Chart 3 displays the vanilla production and trade development. The difference between production and export quantity is influenced by two main factors. First of them is intermediate consumption, second factor is the quantity of stock. The latter one plays a key role in the trade. For example in 1985 Madagascar had the stock of 1 500 tons and the expected production was nearly the same. This caused a drop in prices. The price of vanilla is very vulnerable at the international market and many producer wait for better conditions. The trend of export and import showed the same pattern till 1995. Since 1996 the structure changed. The difference between export and import is given by re-exports which are not included in the calculation. High re-export is one of the main characteristics of the cash crops. France, USA and Germany belong between the biggest re-exporters. They focus on both – processed vanilla and fresh one as well. The prices of re-export fluctuate significantly between years and countries.

The difference between productions, export quantity and export value is displayed in table 1. Export analysis can be divided into two parts – export quantity and export value. Both are dominated by Madagascar followed by India. Compare to the production, where Indonesia is on the first position, this time export quantity and export value are dominated by Madagascar and India. However, Indonesian's export price per unit is higher than Indian's. If we compare the export price we realize that the best trader is French Polynesia followed by Comoros and Madagascar. Prices of French Polynesia are really high although this is given by the special type of vanilla (vanilla tahitensis) which is only being produced there. This type of vanilla is not used for culinary purposes but for perfumes and is known for very high prices and diminishing production.

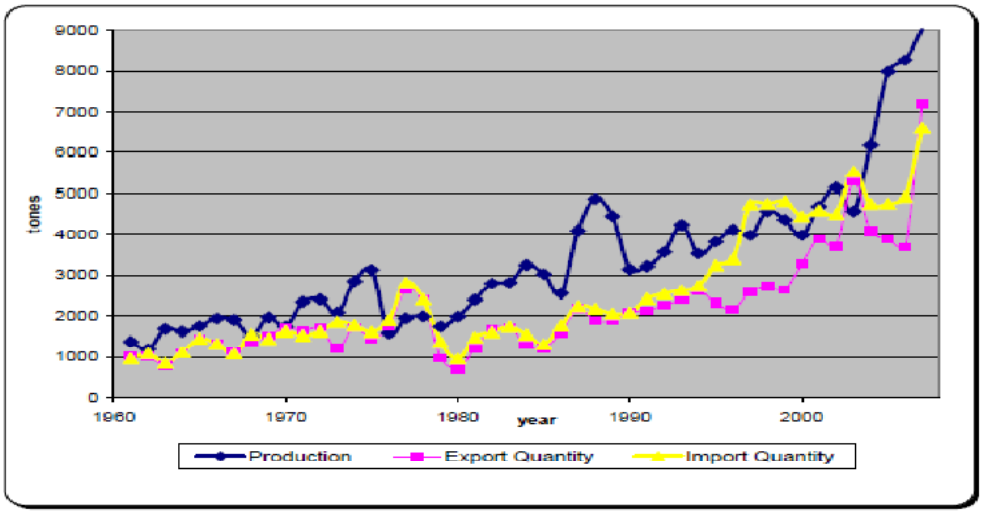
Very low price for the traded amount receive Kenya, Turkey and India. This analysis is just based on the production quantity. During the last century the export prices were really high. This was caused by Madagascar which was able to control most of the international market by its own trading companies. Few years ago the situation just as other countries (Indonesia, Uganda and China) started to produces vanilla. We have also witnessed the increased export from these countries. Another reason for breaking the cartel of Madagascar vanilla trader was the increasing position of smuggling gangs that smuggle vanilla from Madagascar.

Comparing the list of the biggest producers (table 1) and exporters (table 2) we found out some differences. Surprisingly, China's export of vanilla is not very significant at the international level. Some other states (such as Mexico, Portugal, Tonga or Turkey) are also absent from the previous list of producers. We have here, in contrast, some other states (such as Germany, Belgium, Luxemburg or France) that do not produce vanilla beans. If we put

side by side the ten biggest importers the average price for country fluctuates between 18 USD/kg (Italy) and 82 USD/kg (Switzerland) in 2007. This fluctuation is also significant for each country. Italy import vanilla from Austria for 280 USD/kg and for 5 USD/kg from Uganda. In total Europe imports 49.5 % of the import value which account for 41 % of import quantity. Europe is followed by Northern America (41.7 % of the import value and 41.6 % of import quantity). As is evident the average price for Northern America is lower than for Europe. USA and Europe are also the biggest consumers of vanilla.

For example, in 2007 Germany imported vanilla from 12 states (Indonesia, India, Madagascar or Turkey) in the trade value over 10 mil USD and net weight over 548 th. kg and in the same year re-exported vanilla into 38 states. The trade value for was nearly the same 10,47 mil USD but the net weight was halved to 268 th. kg. There also exists difference between the realised prices. The average import price is 42 USD/kg and export price 54 USD/kg. Comparing the import prices there also exist huge disproportions. Similar situation happens in the case of Belgium's import and export. Import is realised just from 4 countries for average price 36,2 USD/kg and export for average price of 100 USD/kg. There is also difference in realised export prices. As is evident from these numbers the export prices differ from developed and developing countries. The only exception for developing countries is French Polynesia which has one of the highest realised average export prices (the reasons were explained above).

In general, export value is important for most of the countries. The share of low income and food deficit countries on the export value is just 62 % which is equal to 76 % of the export quantity. Europe is on the other side. The export value is 24.8 % and the share in export quantity is 12.3 %.



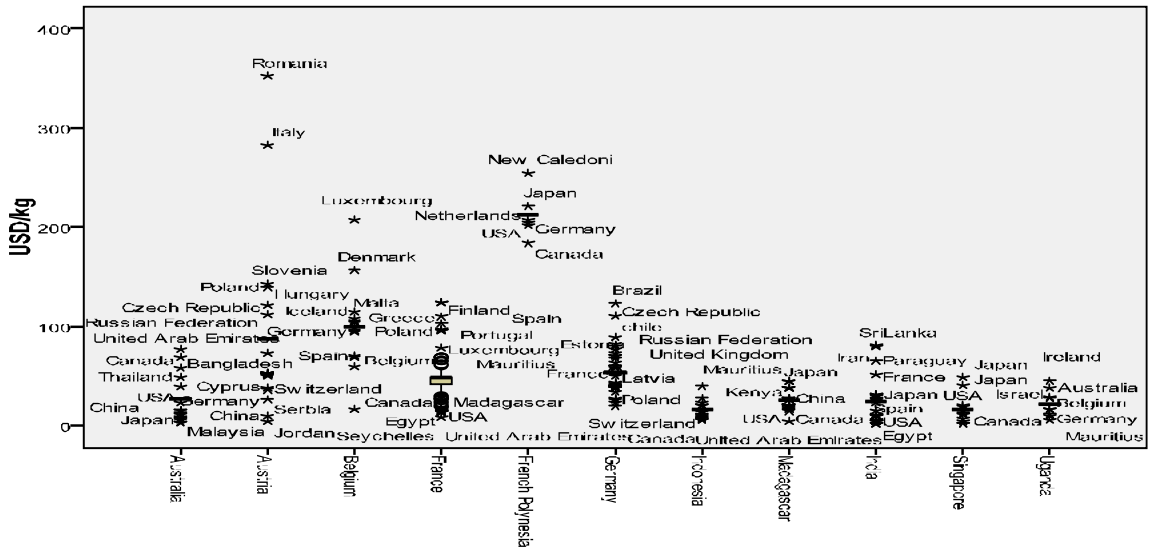
Source: FAO data

Chart 3 Production, export and import quantity of vanilla.

Production	**tones**		**Export Quantity**	**tones**		**Export Value**	**thousands $**
Comoros	50		Comoros	60		Comoros	1 871
French Polynesia	30		French Polynesia	11		French Polynesia	2 686
China	1 350		China	8		China	78
India	233		India	1 074		India	6 411
Indonesia	3 700		Indonesia	540		Indonesia	6 066
Kenya	8		Kenya	2		Kenya	1
Madagascar	2 800		Madagascar	3 085		Madagascar	48 962
Malawi	20		Malawi	0		Malawi	0
Mexico	637		Mexico	41		Mexico	429
Portugal	15		Portugal	0,2		Portugal	2
Tonga	150		Tonga	10		Tonga	133
Turkey	170		Turkey	139		Turkey	393
Uganda	70		Uganda	422		Uganda	6 262
Zimbabwe	10		Zimbabwe	0		Zimbabwe	0
Total	9 243		Total	5 392		Total	73 294
World	**9 255**		**World**	**7 210**		**World**	**116 298**

Source: own calculation based on COMTRADE data

Table 1 Structure of vanilla production and trade (in 2007).



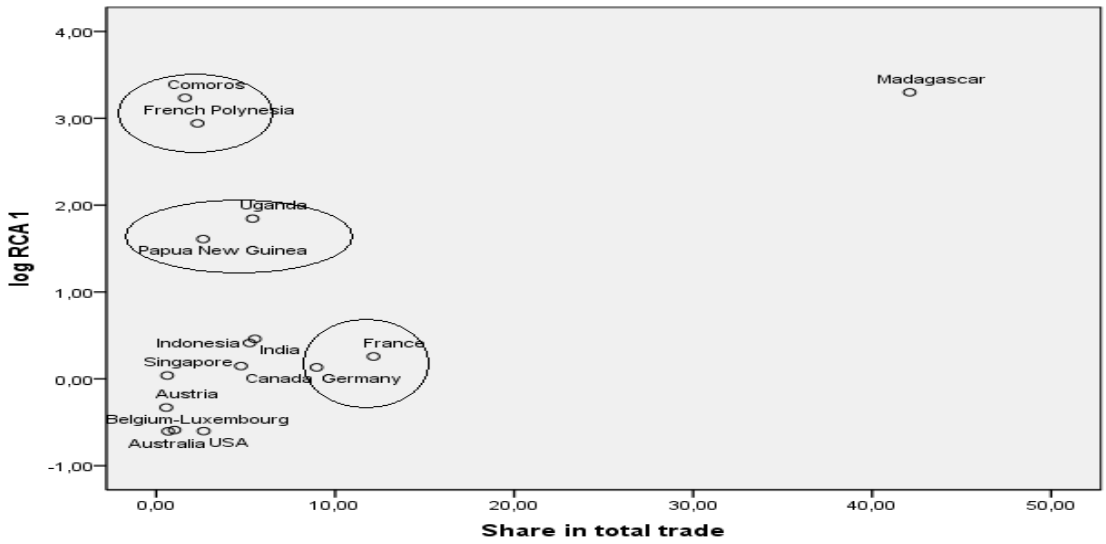
Source: own calculation based on COMTRADE data

Chart 4: Variance in export prices for selected exporters in 2007.

RCA1	1961	1971	1981	1985	1991	2001	2007
Australia	0	0	0	0	0.033	0.013	0.249
Austria	0	0	0	0.017	0.025	0.154	0.467
Belgium-Luxembourg	0	0	0	0	0	0.042	0.258
Canada	0	0	0	0	0.508	0.149	1.405
Comoros	1571.769	1758.145	2457.091	2071.111	2390.334	1830.591	1717.168
France	0.214	0.120	0.727948	0.653283	0.381153	1.037832	1.809652
French Polynesia	927.988	453.798	41.75969	109.4176	385.837	195.6368	875.4563
Germany	0.040	1.680	2.591414	1.904296	1.892804	1.36996	1.365478
India	0	0	0	0.00242	0	0.535632	2.884697
Indonesia	0.620	1.983	5.028213	9.376117	20.56248	10.41504	2.585743
Madagascar	293.742	356	489.6072	573.8968	883.6251	940.2852	1990.831
Papua New Guinea	0	0	0	0	0	5.030518	40.66152
Singapore	0	0.011417	11.36267	0.01346	0.003954	1.515997	1.092744
Uganda	0.831	0.473526	0	0	3.144988	37.28654	69.96586
USA	0	0	0	0	0.084114	0.436012	0.250521

Source: own calculation based on COMTRADE data

Table 2: RCA 1 for exporters.



Source: own calculation based on COMTRADE data

Chart 4: Relation between shares in total trade and log RCA 1 (2007).

This has to raise the question if it is still profitable for developing countries to specialize in cash crops. This is closely related to the question of competitiveness of these countries and product on international market.

Very important indicator for measurement of the competitiveness on the international market is RCA 1 index if it is higher than 1 it is a sign of competitiveness on the international market.

The previous table two includes 15 biggest exporters which all together have more than 96 % share on the vanilla market in 2007. Nearly half of these countries belong to the developed nations and do not produce vanilla.

It is evident that the biggest producer Madagascar is competitive during the whole monitored period, though; its level of competiveness is rather fluctuating. This fluctuation is given by the unstable international prices. There were only three countries (Comoros, French Polynesia and Madagascar) exporting vanilla with comparative advantage in 1961. Thirty years later six countries were competitive. In 2007 eleven countries had RCA1 higher than one. The level of RCA is different.

Based on the relationship between share in total world vanilla trade and log RCA 1 we can divide the biggest traders into four main group plus Madagascar. The latter one has its own special group. This is given by a very high share in total trade (42 %) and also extremely high RCA index. Madagascar is keeping this position also due to the highest share on the production. This country is also known for its extensive way of vanilla production.

The second group is represented by Comoros and French Polynesia. These two countries have really high comparative advantage and what is also important they have reached high level of RCA during the whole monitored period. Next group includes Uganda and Papua New Guinea which are relatively new to the vanilla market; however, their level of comparative advantage is increasing.

The four groups contain France and Germany. Both countries are not primary producers. Their share on the market fluctuates around 10 % and they are both competitive. Even if Germany's RCA index has declining trend and France has become competitive just during the last decade. However, this means that even countries which are not primary producers can reach comparative advantage. This also means that developing countries are loosing one of their very important budgetary resources. This also shows that vanilla is a trade article for re-export.

The last group consists of countries with relatively low share on the international market. It includes both developed and developing countries. Maybe it would be better to divide this group into two; one which has RCA higher than one and the second with comparative disadvantage. The latter one includes USA, Austria, Australia and Belgium and Luxembourg.

Conclusions

Vanilla belongs between cash crops which can gain resources for small producers as well as national budget. The production of vanilla is being control by few countries because it required special conditions for production. The biggest producers are Indonesia, Madagascar and China and the production quantity is very unstable. Two types of vanilla is being produced – one for culinary purposes and the second one for perfumes. The latter is much more expensive than the former one. Even "only" culinary vanilla is one of the most expensive spices (after saffron) and it is a ground for speculations. Due to this the price of vanilla is very vulnerable at the international market. This volatility is determined beyond the control of the producing countries which cannot influence it. There exist negative affect on the supply when the farmers cannot rely on the market with planning the crop rotation.

Comparing the production with trade (export and import) we found out that vanilla is quite often re-exported. Re-export does not include just processed vanilla but bean as well. As it was mentioned above vanilla is mostly produced in developing countries, however, the gain of producers and states is not sufficient. The comparison of export quantity and export value showed that the share of developing countries is rather low. The export quantity is not equal to the export value. If we put it in contrast, France, Germany or Belgium have high share in export value even if they do not have any plantation of vanilla. The price of producing countries is low compare to the prices of re-export. This is closely connected with competitiveness. The most competitive ones are developing countries;

however, even countries with obvious comparative disadvantage can re-export vanilla.

All the above mentioned facts raise the question if it is still beneficial and profitable for developing countries to focus on cash crop. They face the problem of low prices, however, the question is if it helps them to add some added value and be able to sell processed products instead of raw material. Would not be better to specialised in the food crop and be able to feet their own people?

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Corresponding author
Ing. Irena Pokorná, Ph.D.
Czech University of Life Sciences
Prague Faculty of Economics and Management, Department of Economics, Kamýcká 129, 165 00 Praha 6 – Suchdol
e-mail: pokornai@pef.czu.c

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Analysis of Development of Investments in the Agricultural Sector of the Czech Republic

D. Žídková, H. Řezbová, E. Rosochatecká

Department of Economics, Faculty of Economics and Management, Czech University of Life Sciences Prague

Abstract

The aim of this article is to analyse the investment activities realized in the agricultural sector of the Czech Republic during the period of 1998-2009. The study focuses on the development of the volume of investments in agriculture, their composition and economic efficiency. The analysis is based on data from the Aggregate Agricultural Account drawn up by the Czech Statistical Office (Český statistický úřad, ČSÚ). Investment activity is studied on the basis of such indicators as the gross fixed capital formation, net fixed capital formation, gross investment rate, requirements for investments. The impact of selected factors influencing the gross fixed capital formation and its composition is evaluated.

Key words

investment activities, agricultural sector, gross fixed capital formation, requirements for investments

Anotace

Cílem příspěvku je provést analýzu investiční aktivity v zemědělství ČR v období let 1998-2009. Hodnocen je vývoj objemu investic v zemědělství, jejich struktura a jejich ekonomická efektivnost. Pro analýzu jsou využity údaje Souhrnného zemědělského účtu, zpracovávaného ČSÚ. Investiční aktivita je sledována na základě ukazatelů tvorba hrubého fixního kapitálu, čistá tvorba fixního kapitálu, hrubá míra investic, investiční náročnost. Je posouzen vliv vybraných faktorů, ovlivňujících tvorbu hrubého fixního kapitálu a jeho strukturu.

Klíčová slova

investiční aktivita, zemědělství, tvorba hrubého fixního kapitálu, investiční náročnost

Introduction and Literature Review

An important factor of the development of every national economy sector is the level of its investment activity. Investment activities – investments – realized in a specific period create conditions for achieving required future outcomes. According to the theory of economics, the basic factors influencing investment activity in a specific period include the interest rate, the volume of available financial resources, employment rate, technological progress, business expectations and other.

When following the issues concerning investments on the macroeconomic level, authors of scientific articles assess relationships between the gross domestic product growth and gross fixed capital formation (Sedláček 2006, Kadeřábková et al. 2008). The authors verify the basic hypothesis that when GDP grows, gross fixed capital formation grows too.

Furthermore, the above mentioned studies monitor the influence of the interest rate value and the influence of available financial resources on the development of gross fixed capital formation.

The study by Dubská (2006) also deals with the development of fixed capital and its proportion to the level of gross domestic product. The author observes that the share that investments to fixed assets have in gross domestic product is an important indicator of future development of economy, although not all their types contribute to future economic growth in the same manner.

From among foreign studies, the study by Zwolak (2008) deals with investment issues on the macroeconomic level. Contrary to the previous studies, the author shows the dependency of gross, final and market production on gross value of fixed capital. He uses a number of ratio indicators and mathematical functions. The study shows that the influence of fixed capital productivity decreased and the efficiency of the Polish agriculture production fell down in 2002-2005. Zwolak identifies the relatively stable age structure of fixed capital and low average annual rate of investment growth (8.74 %) to be the reasons for this.

The aim of this article is to analyse the investment activities realized in the agricultural sector of the Czech Republic during the period of 1998-2009.

Material and methods

The subject of the analysis is the development of the investments in agriculture, their structure and economic efficiency during 1998-2009. The analysis is based on data from the Aggregate Agricultural Account drawn up by the Czech Statistical Office. For the present, the data collected in 2009 are preliminary. In this study, investments are expressed by means of the gross fixed capital formation (hereinafter only GFCF) indicator. GFCF shows the value of both tangible and intangible fixed assets acquisition, either purchased (including the acquisition by means of financial leasing) or received gratuitously or produced at one's own expense, decreased by the value of any sold or gratuitously passed over assets. The tangible fixed assets include new investments in buildings, constructions, machinery and equipment, to acquire cultivated assets (as regards the agricultural sector this means acquisition of permanent crops, i.e. hop gardens, vineyards, orchards), and also costs of large-scale repairs, improvements of fixed assets, changes in inventory - animals, large-scale improvements of lands (as regards the agricultural sector this means the costs of soil amelioration, i.e. the land improvements by means of drainage and irrigation, land adjustments).

Investment activities in the agricultural sector are studied from several points of view. The subjects of the analysis are as follows:

i) The development of the value of investments (the horizontal, trend analysis); the volume of GFCF is established in monetary units in individual years and the development of this volume is studied in a determined period.

ii) The gross investment rate = GFCF / gross value added

Gross value added is defined as production in the current price without intermediate consumption in the current price. The term production means final production of the sector and the term intermediate consumption means the aggregate of all consumed inputs.

When gross investment rate grows in time, it means that the investment activity is higher. Contrarily, when gross investment rate decreases, it means that the level of activity is lower.

iii) Net fixed capital formation = GFCF – fixed capital consumption.

Fixed capital consumption is defined as fixed actives wear and tear in a specific period (depreciations).

When the net formation is positive, then it theoretically means that other resources, own or another's (credits, subsidies), were used apart from the value of depreciations to finance investments. When it is negative, the financing resources were not sufficient; they even did not cover the renewal of a worn-out value of fixed capital either.

iv) The material structure of investments and its changes; the percentage of individual types of investments in individual years in a monitored period is expressed.

The data source is the Aggregate Agricultural Account for 1998-2009, drawn up by the Czech Statistical Office, the Report on the Agriculture in the Czech Republic for 1998 to 2007, and the ARAD database of the Czech National Bank (ČNB) for 2000 - 2009.

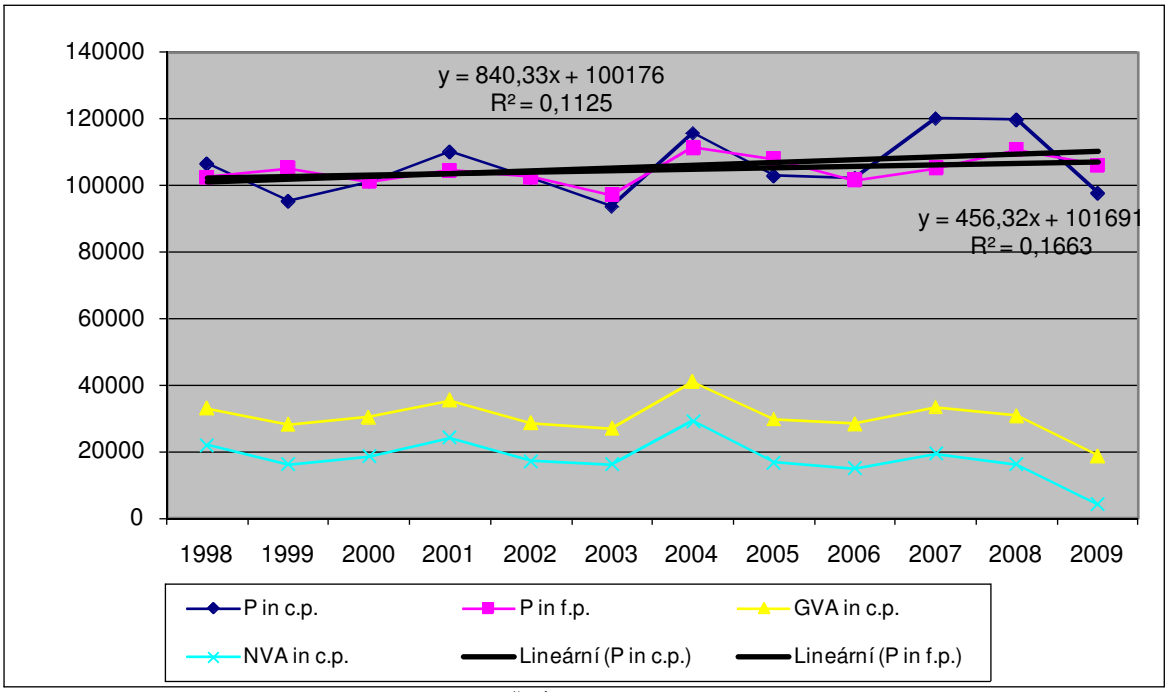
The tendencies in development of indicators are described in words, by means of basis indexes, and in some cases the development is characterized by means of linear regression - only the regression coefficient and the correlation index are applied.

Results of the Analysis of the 1998-2009 Period

The production in the agricultural sector expressed in current as well as fixed prices shows a slightly growing trend throughout the whole period. The

growth (see Chart 1) is faster in current prices (annual increase amounting to CZK 837.7 million) than in fixed prices (CZK 452.9 million), the reason behind this is that the growth of production prices is faster than the growth of produced quantity of production. Generally, the development may be evaluated as positive. However, the comparison of the production level and development in fixed and current prices draws attention to the negative influence of the current prices of the production in the several years that are the subject-matter of the study. In case the value in fixed prices is higher than the value in current prices, then the current prices did not reach the level of the fixed prices of 2000. This is the situation that occurred in the 6 years of the studied period, while the state of 2009 was the 2nd worst - the current price-fixed price ratio reached only 0.92. After 2004, the price ration achieved the level higher than 1 within four years, however, it must be stated that farming enterprises still are not successful in improving their agricultural production in any considerable manner. This is a negative phenomenon, limiting the possibilities of a faster growth of investments in the area of financial sources formation.

The gross value added in AAA is formed as a difference between production and intermediate consumption. It is the source covering other costs and the source of the profit made in the agricultural production (crop and animal farming), agricultural services and related non-agricultural sectors. It is divided to two parts important for investing – depreciations (fixed capital consumption) and net value added. However, the GVA in the studied period shows a decreasing trend caused by the growth of the intermediate consumption faster than the production growth. While the intermediary consumption in fixed prices was nearly stagnating, current prices were growing. The impact of the intermediary consumption prices is shown in Table 1.



Source: drawn up by the author according to the ČSÚ, Time series, Agriculture, Aggregate Agricultural Account, Note: fixed prices of 2000

Chart 1: Development of the production and gross value added in agriculture during 1998-2009, CZK in millions.

The ration of c.p.of intermediary consumption to f.p. of intermediary consumption	1998	1999	2000	2001	2002	2003
	1.008	0.944	1.000	1.049	1.060	1.030
	2004	2005	2006	2007	2008	2009
	1.043	1.036	1.051	1.163	1.220	1.128

Source: ČSÚ, AAA and the author's own calculation

Table 1: Development of current prices of the intermediary consumption in agriculture during 1998-2009, fixed prices =1.

year /indicator	GFC formation in c.p.	GVA in c.p.	GVA contribution to P in c.p., %	Gross investment rate GFCF/GVA %	FC consumption c.p.	Net FC formation	FC consumption/GFCF ratio, %	GFCF/P ratio in f.p.
1998	13 664	33 150	31,1	41,2	11 167	2 497	81,7	14
1999	7 432	28 261	29,7	26,3	12 022	-4 589	161,7	7,4
2000	8 691	30 425	30,1	28,6	11 829	-3 138	136,1	8,6
2001	10 441	35 544	32,3	29,4	11 231	-790	107,6	9,6
2002	10 438	28 736	28,1	36,3	11 448	-1 010	109,7	9,7
2003	9 846	27 070	28,9	36,4	10 804	-959	109,7	10
2004	11 807	40 987	35,4	28,8	11 813	-6	100	10,3
2005	14 172	29 789	29	47,6	12 992	1 180	91,7	12,4
2006	14 714	28 470	27,8	51,7	13 501	1 213	91,8	13,6
2007	15 685	33 550	27,9	46,8	14 181	1 504	90,4	13,3
2008	17 112	30 869	25,8	55,4	14 610	2 502	85,4	13
2009	11 701	18 904	19,4	61,9	14 704	-3 003	125,7	7,3

Source: drawn up by the author according to the ČSÚ, Time series, Agriculture, Aggregate Agricultural Account
Note: fixed prices of 2000, * … a preliminary figure for 2009

Table 2: Indicators of the level and development of investments in the agricultural sector in 1998-2009*, CZK in millions.

The impact of the value of purchased inputs was unfavourable for the formation of own resources for investment financing. The average annual decrease in the GVA amounted to CZK 553 thousand. The value of the GVA of 2009 is the lowest in the whole studied period.

The net value added is as much fluctuating as is the value of the GVA, also showing a generally decreasing tendency; in 2009, its value dropped deep under the level of the previous years. In all the studied years, the NVA was so low that it even did not cover staff expenditure and production (costs) taxes and other operational costs. According to these data, the possibilities for gross fixed capital formation in agriculture were deteriorating, especially as regards using profit as farmers' own internal source of financing the costs of investments. Under these conditions, depreciations have remained to be the decisive disposable component of internal resources for GFCF.

The values of the absolute as well as ratio indicators characterizing the investment activity in agriculture in the studied period are shown in Table 2.The growing trend of GFCF (Chart 2) prevails in the studied period. Although the FC consumption was also growing during most of the studied years, its increase was slower, which was demonstrated as a gradual improvement of the net fixed capital formation value. The net formation in 2004 turned from negative figures to positive ones, but in 2009 it was negative once again. Because the aggregate of all positive values of net FCF is smaller (8,896) than the aggregate of negative values (-13,495), it must be stated that the investments made in

1998-2009 did not secure the simple reproduction of the original value of tangible and intangible fixed (investment) assets.[1]

In the years with net FCF, investments were also financed by means of a part of the positive entrepreneurial income[2], as shown in Table 3. It may be considered to be positive that entrepreneurial income got to positive figures after 2004, but in 2009 it decreased approximately to a quarter of the value of the previous year, which again limited the possibility of financing provided from this source.

The low proportion of other financing sources in GFCF is caused by unfavourable income of the agricultural sector – here they are expressed in the form of entrepreneurial income - that reached negative or low positive values in most of the years.

This negatively influenced not only the possibility to use the profit for investments, but also access to loans and credits. The interest expense stated in Table 4 inform about how bank loans were used. The decrease down to 31.3 % of the original value results especially from decreasing interest rates. Unfortunately, neither the volume of credits nor the interest rates from the Aggregate Agricultural Account may be documented with numbers.

The gross investment rate in agriculture according to data from the Aggregate Agricultural Account shows considerable interannual differences. The simple average of the period was 37.7 %. It is positive that it started to increase after the drop in 1999-2001, increasing significantly after 2004 – it grew by more than 50 % - and also that, once again, other equity and debt resources started to contribute to financing resources from 2005 in a more intensive manner (see the FC consumption/GFCF ratio in 2005-2008 and also the net FCF indicator in the same period). (Table 4)

The table 5 shows that the total value of investment donations was the highest in 1998 and since then the level has not been reached again. The interannual fluctuation is high. The evidence suggests that not even state subsidies provided under grant headings created the conditions required for more intensive stabilization of development of the agricultural sector as a whole either. The importance of investment subsidies for investment financing is documented in Table 5 by means of their proportion to GFCF, and furthermore in Table 6 by means of the proportion of their value to the value of the basic internal source of financing, i.e. depreciations.

The last indicator in Table 2 - i.e. GFCF/production - draws attention to the growing investment demands of agricultural production since 1999. The value has increased up to 1.85 multiple in 2008, while GFCF has a decisive share in this increase because the production in fixed prices did not grow nearly at all. The value achieved in 2009 is out of the common run, which is caused first by a drop in production and subsequently by a drop in both the GVA and entrepreneurial income. The reciprocal of the indicator may be described as the production efficiency of investments - the tendency is decreasing, i.e. negative.

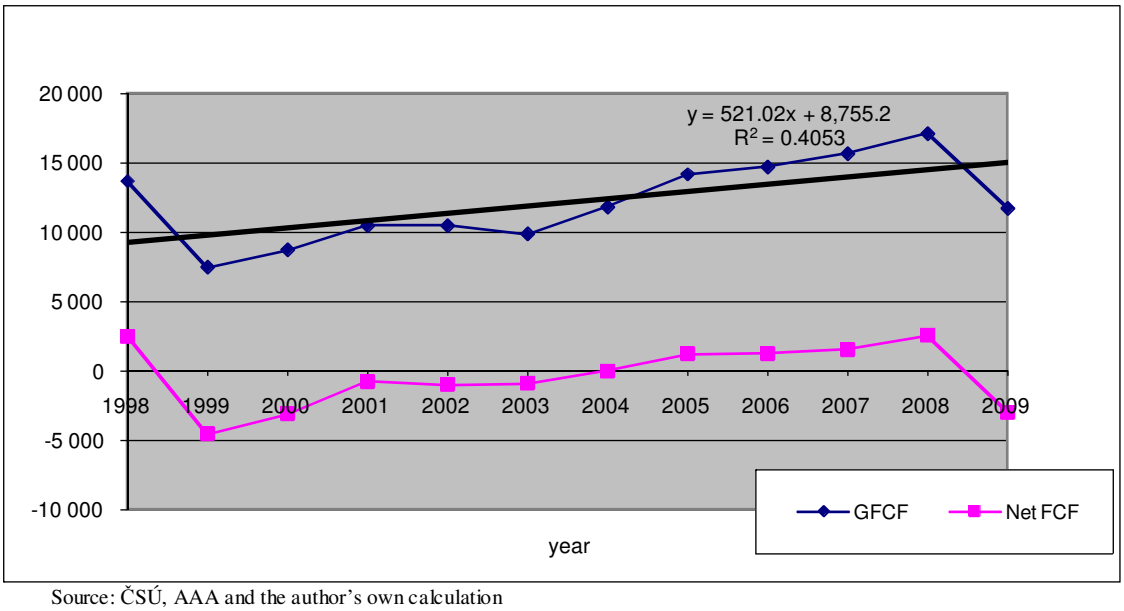
The focus of the investment activities in agriculture during the studied period is documented by the material structure of investments – GFCF – as shown in Chart 3.

The decisive component of the material structure of GFCF (Table 7) is the expenses on non-agricultural products expended during the whole period, i.e. on deliveries from other sectors of the national economy. Their absolute value had been slightly growing until 2008. The contribution of GFCF was very volatile, with a slight tendency towards decreasing.

At the same time, the structure of deliveries of non-agricultural products had been changing – the proportion of expenses on machinery had mostly been increasing and the proportion of expenses on buildings and constructions had been decreasing until 2006. The development after 2006 was reversed – the proportion of expenses on machinery and equipment had decreased but the proportion of investments to buildings and constructions has increased. This is partially related to a change in the

[1] This is based on the assumption that: the assets of1998 + acquisition – retirement – depreciations = the assets of 2009. According to the available data, the assets of 2009 are lower than the assets of 1998.

[2] As regards its contents, the entrepreneurial income nearly corresponds to profit from ordinary activities before tax, i.e. the sum of earnings from operational and financial activities. Because profit from extraordinary activities usually oscillates in low values, it is possible to abstract away from it and, consequently, consider the entrepreneurial income to be the gross profit of farming enterprises, i.e. the profit before income tax.



Source: ČSÚ, AAA and the author's own calculation

Chart 2: GFCF and net FCF in 1998-2009, c.p. in CZK million.

Entrepreneurial income	year	1998	1999	2000	2001	2002	2003
	c.p. in CZK million	-4,332.64	-8,080.65	-1,183.7	3,056.443	-2,643.08	-2,502
	year	2004	2005	2006	2007	2008	2009
	c.p. in CZK million	8,547.789	7,050.756	6,834.788	10,009.01	10,142.68	2,584.612

Source: ČSÚ, AAA and the author's own calculation

Table 3: Development of the entrepreneurial income in agriculture in 1998-2009, c.p. in CZK million.

Interest expense	year	1998	1999	2000	2001	2002	2003
	interest	3,648.6	3,475.0	1,762.0	1,550.6	1,505.9	1,714.9
	development in %	100	95.2	48.3	42.5	41.3	47.0
	year	2004	2005	2006	2007	2008	2009
	interest	1,388.1	1,521.6	1,567.6	1,434.0	1,443.5	1,140.8
	development in %	38.0	41.7	43.0	39.3	39.6	31.3

Source: ČSÚ, AAA and the author's own calculation

Table 4: Development of interest expense in 1998-2009, c.p. in CZK million.

Interest expense	year	1998	1999	2000	2001	2002	2003
	interest	3,648.6	3,475.0	1,762.0	1,550.6	1,505.9	1,714.9
	development in %	100	95.2	48.3	42.5	41.3	47.0
	year	2004	2005	2006	2007	2008	2009
	interest	1,388.1	1,521.6	1,567.6	1,434.0	1,443.5	1,140.8
	development in %	38.0	41.7	43.0	39.3	39.6	31.3

Source: ČSÚ, AAA and the author's own calculation

Table 5: Development of investment subsidies to agriculture in 1998-2009, c.p. in CZK million.

The proportion of investment subsidies	year	1 998	1 999	2 000	2 001	2 002	2 003
	%	18.32	6.21	12.24	13.7	13.7	13.66
	year	2 004	2 005	2 006	2 007	2 008	2 009
	%	16.01	7.08	5.85	5.73	8.22	12.85

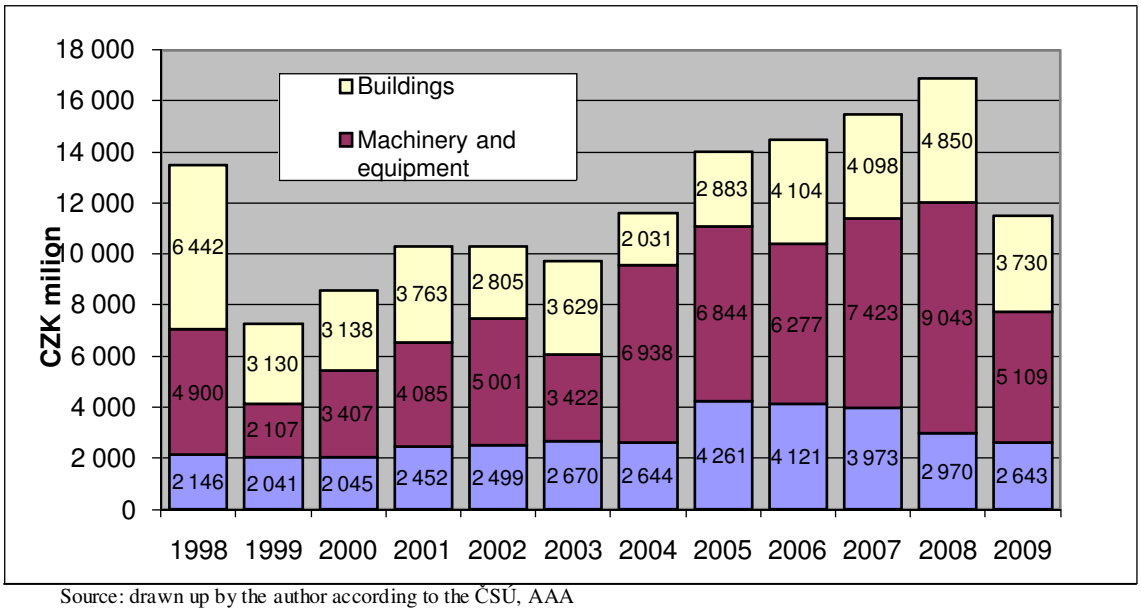
Source: drawn up by the author according to the ČSÚ, AAA

Table 6: The proportion of investment subsidies to the value of the FC consumption in agriculture in 1998-2009.

year/indicator	GFCF of agricultural products	Out of which plantings	Out of which animals	GFCF of non-agricultural products	Out of which machinery and equipment	Out of which buildings	Out of which other GFCF	Net FC formation
1998	16.96	1,26	15,71	84.5	35,5	48,9	0	18,28
1999	29.48	2,01	27,46	69.6	27,6	41,9	0,1	-61,75
2000	24.62	1,09	23,53	75.4	39,2	36,1	0,1	-36,1
2001	24.57	1,09	23,49	76.4	40	36,1	0,2	-7,57
2002	24.95	1,01	23,94	76.0	48,9	26,9	0,2	-9,68
2003	28.27	1,15	27,12	68.9	34,5	34,3	0,1	-9,74
2004	23.89	1,5	22,39	75.0	59,3	15,5	0,1	-0,05
2005	31.28	1,21	30,07	66.7	48,2	18,4	0,1	8,32
2006	29.34	1,33	28,01	66.8	49	17,7	0,1	8,25
2007	26.43	1,1	25,33	84.5	35,5	48,9	0	9,59
2008	18.61	1,26	17,36	69.6	27,6	41,9	0,1	14,62
2009	24.28	1,69	22,59	75.4	39,2	36,1	0,1	-25,66

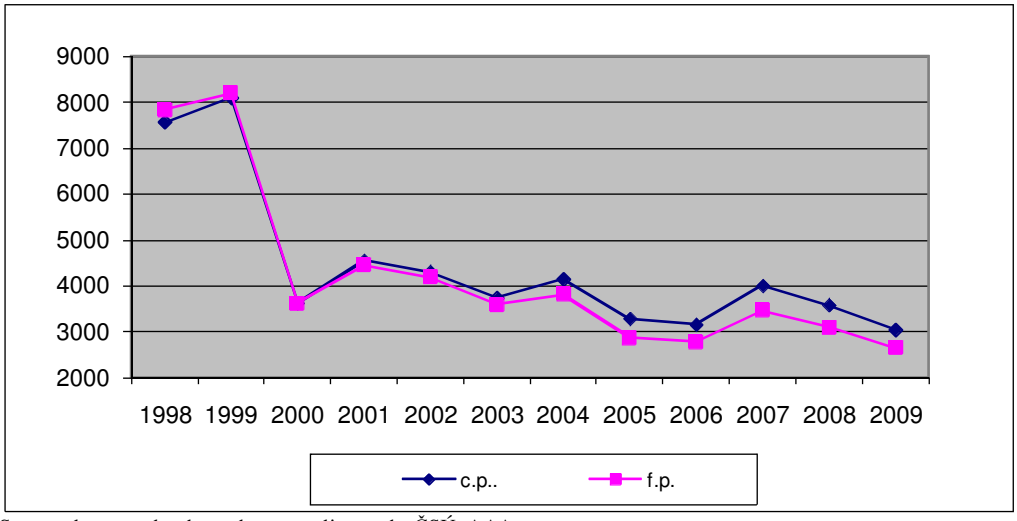
Source: drawn up by the author according to the ČSÚ, AAA, Note: Total GFCF = 100 %

Table 7: Material structure of GFCF in agriculture in 1998-2009, in % out of the current prices.



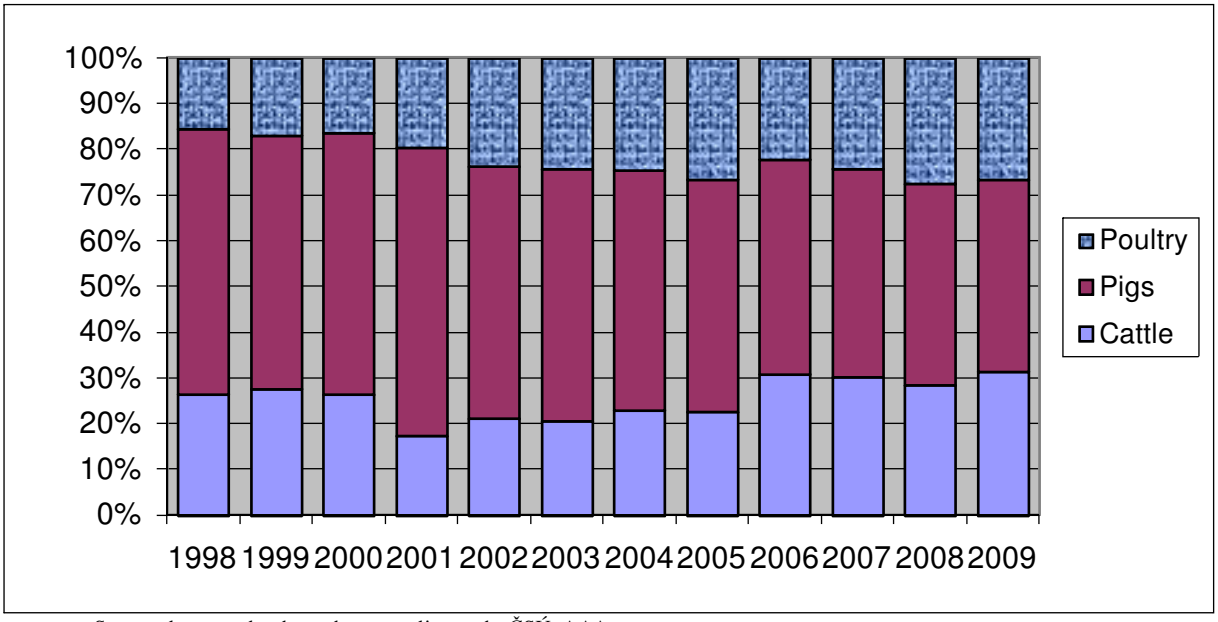
Source: drawn up by the author according to the ČSÚ, AAA

Chart 3: Focus of investments in agriculture in 1998-2009, in CZK million.



Source: drawn up by the author according to the ČSÚ, AAA

Chart 4: Development of the costs of maintenance and repairs of machinery in agriculture in 1998-2009, in CZK million.



Source: drawn up by the author according to the ČSÚ, AAA

Chart 5: Development of the structure of animal production in 1998 – 2009, in %.

	1998	1999	2000	2001	2002	2003
GFCF -animals /production of animals ratio	0.070	0.078	0.072	0.077	0.096	0.110
	2004	2005	2006	2007	2008	2009
	0.102	0.175	0.160	0.154	0.110	0.111

Source: drawn up by the author according to the ČSÚ, AAA

Table 8: Requirements of animal production for investments on animals in 1998-2009, in CZK.

orientation of the policy of subsidies since 2007, when the Rural Development Programme funded from the EAFRD3 started to contribute to the financing.

The absolute values of all three important components of GFCF are very volatile. The volatility rate may be expressed by r^2 coefficient. The value of buildings and constructions was the most volatile of all, hence the development tendency is not pronounced – r^2 nearly equals to 0.

[3]Axis I, Priority 1.1. Modernization, innovation and quality

This may be explained by the nature of these investments - their preparation is more time-consuming, financially demanding, they are acquired for a longer period of time, and so they require the market development to be known in a perspective which is longer than the other types that are being compared here. The growing tendency is shown for machinery and equipment (the average annual growth is 394.58, $r^2 = 0.5114$), which is given by the pressing need to substitute human labour, save the costs of energy and the costs of repairs and maintenance. The volume of these investments was increasing especially in 2004-2008. Considerable changes were introduced in this area, i.e. availability of assets in enterprises, as regards efficiency and labour productivity. The influence on operational costs is shown in Chart 4.

In GFCF - agricultural products, investment expenditures on animals prevailed. The absolute value of investments on animals showed growth during the whole period - the average annual growth in the whole period was 143.1, $r^2 = 0.414$. A significant change in the gradual growth occurred in 2005 when - compared to the previous year - the value increased to 198 % to be decreased down to 123 % subsequently in 2009. The investing on animals is accompanied with a decrease in the animal production caused by declining inventory of animals and a change in the structure of the inventory, which is indirectly expressed in AAA by the production of animals in c.p. and its structure - the value of the production of animals in 2009 represents only 77.8 % of the value of 1998 (i.e. the decrease is approximately from CZK 30,609 million mil. to CZK 23,804 million), while the most significant change has been recorded as regards pig breeding the production of which dropped down to 55.8 % of the value of 1998.

As a result of the growth of investments on animals and the decreasing production, the requirements of the production for these investments were increasing (i.e. the production efficiency was decreasing) - see Table 7. At the beginning of the period, every CZK 1 of the production received CZK 0.07 of investments, however at the end of the period it was already CZK 0.11.

After 2007, investments creating conditions for meeting of applicable EU regulations and standards are supported in the animal farming sector to improve the quality of production, eliminate negative impacts on the environment, and improve animals' welfare and health. Further increase in the costs of animal farming may be expected because this support is not intended to increase the production

Conclusion

The evaluated period is quite long, affected with a number of changes in the economic policy of the state on the national economy level and especially on the level of agriculture. Farming enterprises were adapting to the changes in the business environment during the whole studied period also in the area of investments on tangible and intangible fixed assets.

The increasing investment activity in 1998-2009 may be explained by positive expectations of farmers (the necessity and will to invest with respect to) in connection with preparations for the accession to EU and the accession to EU itself, improved profit/loss formation (i.e. the entrepreneurial income in this study) - especially by means of enhanced incomes of farmers resulting from increased subsidies – in other words non-investment subsidies contributing to the funds covering operational costs of farming enterprises, enabling to create profit (single area direct payments – SAPS and complementary national direct payments – CNDP, TOP-UP), and partially also by assistance to credit applications and obtaining. The development of investments, the structure of investments and its changes are always influenced by a number of factors concurrently. On one side, the structure of investments reflects the structure of assets from the previous period (when production is to continue, worn assets need to be renewed). On the other side, it also reflects changes in the orientation of production or the scope of production or production processes (technologies), but also changes caused by technical progress in the production of machinery and equipments and the construction production. Last but not least the development of the investment structure is influenced by the development of prices of individual types of assets. On the supra-enterprise level of the study, the effects of these factors are difficult to be documented because the incompleteness and inconsistency of statistical surveys, data aggregation or changes in methodologies prevent this. The studying of outputs of the agricultural sector by means of the AAA

method application enables to consider investment activities only in a partial manner through a limited number of indicators and also to consider only a limited number of influencing factors.

The executed analysis of investment activities enabled to acquire the following knowledge:

i) GFCF, representing the result of investing and the aggregate of all sources used to acquire assets, was increasing;

ii) Development of the final production was acting in favour of GFCF, specifically by the slight increase of the production in f.p. (it shows the implemented quantity), and by a slight increase in the current prices of production;

iii) The growth of intermediate consumption, i.e. inputs purchased from other sectors of the economy, had a negative impact; the negative impact of the price factor (growing current prices) is prevailing because the intermediate consumption in fixed prices was stagnating;

iv) Net FCF was improving but its level did not manage to cover the simple reproduction of the value of tangible and intangible fixed assets;

v) GVA was decreasing and because of the growing value of depreciations NVA was decreasing; the amount of NVA and its development suggest that the agricultural production itself did not generate any profit; the positive entrepreneurial income reported in the 7 years was created thanks to production subsidies;

vi) Investment subsidies were not a stable source; their importance in GFCF dropped considerably in 2005-2008;

vii) Requirements for investments in agriculture were generally increasing;

viii) AAA does not monitor assets (property), so it is not possible to know the pace of reproduction of the fixed items of assets;

ix) The methodology applied by AAA uses the term ´entrepreneurial income´ to define profit/loss and it is shown as a gross value before the income tax and it is not known how it is divided among owners, an enterprise, the state and other entities; accumulation may not be expressed.

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Corresponding author:
Ing. Dana Žídková,CSc., Ing. Helena Řezbová Ph.D., Doc.Ing. Eva Rosochatecká,CSc.
Czech University of Live Sciences Prague, Faculty of Economics and Management
Kamýcká 129, 165 21 Prague 6 - Suchdol
Phone: +420 224 382 081
e-mail: zidkova@pef.czu.cz, ***rezbova@pef.czu.cz, rosochatecka****@pef.czu.cz*

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Implementation of subontology of Planning and control for business analysis domain

I. Atanasová

Department of computer science, Faculty of mathematics and natural sciences, South West University "N. Rilski"- Blagoevgrad, Bulgaria

Abstract

Ontologies are at the heart of the semantic web. They define the concepts and relationships that make global interoperability possible. However, as these ontologies grow in size they become more and more difficult to create, use, understand, maintain, transform and classify.

As ontologies become common in more applications and as those applications become larger and longer-lived, it is becoming increasingly common for ontologies to be developed in different area of public sector of economics. Ontologies present special challenges to the problem of conceptual modeling.

This paper describes the process of the implementation of a subontology of forecasting and evaluations for business analysis domain in order to develop an easy and correct way to find the needed statistical information in a knowledge base.

Key words

ontology, forecasting, assessment, Protégé, implementation

Introduction

Understanding and solving global business analysis problems requires a new kind of science: science that is collaborative, interdisciplinary, and responsive to the needs of decision-makers. Cross-disciplinary networks of scientists worldwide are marshalling their understanding in efforts to provide scientific results that target complex problems.

In recent years ontologies have become the subject of interest in communities beyond just those of knowledge representation and library science. Many times these ontologies were built by people highly trained in knowledge representation and reasoning. Many times the authors became highly literate in the domain as well. Conceptual modeling for these kinds of situations has been studied. The knowledge acquisition is a fairly centralized process in proposed strategies for conceptual modeling in literature.

Large ontologies have become more common in broad consumer applications ranging from search, to e-commerce and auctions, to configuration, to more general information sites. Developing of ontologies requires creative thinking. Development of solutions to such problems can be conceived as two-phased:

- an idea generation phase (specification, conceptualization) – it requires a combination of domain expertise and divergent thinking;

- implementation phase;

Our work is motivated by research in other domains as well as by our intention to exploit repositories of information in a specific domain - business analysis.

In our area of interest, domain and its applications appear to be an area of challenge in constructing subontologies for some subdomain.

Business analysis ontologies can be developed manually, semi-automatically or automatically, by

knowledge servers reasoning on formal knowledge representation languages. The resulting ontologies generally consist of concepts modeled by hierarchical relationships. Concepts are identified by names and described by properties and associative relationships with other concepts. The hierarchical or associative and direct or indirect relationships constitute the explicit knowledge represented in the ontologies.

The goal of this paper is to propose innovative design of the business analysis ontology.

Several methodologies and frameworks have been developed – CommonKADS, MIKE, MOKA, and Protégé [14], [4], [2], [9]. They all lay emphasis on modeling. Models capture the essential features of a real system by breaking them down into smaller components to be better understood. They are used in system development to facilitate communication between different people.

To understand the working mechanisms within a knowledge-based system we use models [3]. Models and modeling contribute to the understanding of the source of knowledge [1]. Thus knowledge modeling is the important key component for the construction of knowledge bases. One of the modeling paradigms for knowledge engineering methodologies is ontology. The ontology provides a way of representing domain knowledge. It consists of concepts, relations and constraints on the relations.

The domain knowledge consists of the domain schema and the knowledge base.

Ontologies could help people and computers to access the information they need by making the link between the information form and content explicit. Moreover, ontology is now recognized as powerful tool that enables sharing knowledge [15].

An ontology defines a common vocabulary for researchers who need to share information in a domain. A domain ontology corresponds to an organized set of domain generic terms that can be used to describe a particular domain by providing machine-interpretable definitions of basic concepts in the domain and the relationships between them [11].

The most important task in the methodology is the definition of a Domain Conceptual Model. Then, it is important to assign all the necessary time to carry out a good conceptual analysis. The conceptual model resumes the knowledge adquired during the specification phase and it is the basis of conceptualization. This conceptualization has to be agreed on by domain experts.

Methods

Our domain of interest for this study is business analysis. We build and engine a subontology representing subdomain of business analysis – Onto-BAn.

Onto-BAn is an ontology that has been under development at the South West University of Blagoevgrad since 2009. Its objective is to conceptualize the business analysis objects. The underlying data model for Onto-BAn is a frame-based structure implemented with Protégé 3.4.1. Onto-BAn is modeled by IS-A and PART-OF relationships and allows multiple inheritance.

Building ontologies with Protégé

Protégé is a popular open source ontology editor and knowledge base framework [13].

Protégé supports the export to standard ontology languages as OWL and RDF schema, but it is easily extensible through its plug-in interface. This makes it a flexible base for a rapid prototyping and application development. Protégé has several built-in advantageous features. These include GUI – a standardized graphical user interface, and flexible platform for knowledge-based domain modeling.

We are going to describe the Protégé features in detail, and demonstrate how we used them for subontology of Planning and control development.

Protégé is an ontology development environment with a large community of active users. The representation mechanism for ontologies and knowledge bases (Protégé's model) is based on a flexible metamodel which is comparable to object-orientated and frame-based systems. It basically can represent ontologies consisting of classes, properties (slots), property characteristics (facets and constraints), and instances. Recently Protégé has been extended with support for OWL, and has become one of the leading OWL tools. Protégé provides functionality for editing classes, properties, and instances.

The Protégé GUI consists of overlapping tabs that offer a "browser" and "form" for creation, viewing, editing, and saving different type of information. These tabs include "classes", "slots" and "instances" (figure 1). The forms consist of configurable components, called widgets. Typically, each widget displays one property of the selected object

The classes tab displays the tree of the ontology's classes on the left, while the selected class is shown in a form in the center.

Protégé classes represent originally the abstract domain concepts. Each of these abstract classes is described by a set of defined attributes. These are in Protégé called slots. The concrete class occurrences are represented in Protégé as instances. We use these three forms to enter the different type of information required in the planning and control entries: methods for forecasting and evaluations.

During ontology design, the most interesting reasoning capability from this type of tools is classification. Classification is used to infer specialization relationships between classes from their formal definitions. Basically, a classifier takes a class hierarchy including the logical expressions, and then returns a new class hierarchy, which is logically equivalent to the input hierarchy. Protégé can display the classification results graphically. After the user has clicked the classify button, the system display both the asserted and the inferred hierarchies, and highlights the differences between them. The visualization can utilize the interaction between knowledge engineers and domain specialists and thus should increase the effectiveness of the knowledge acquisition process

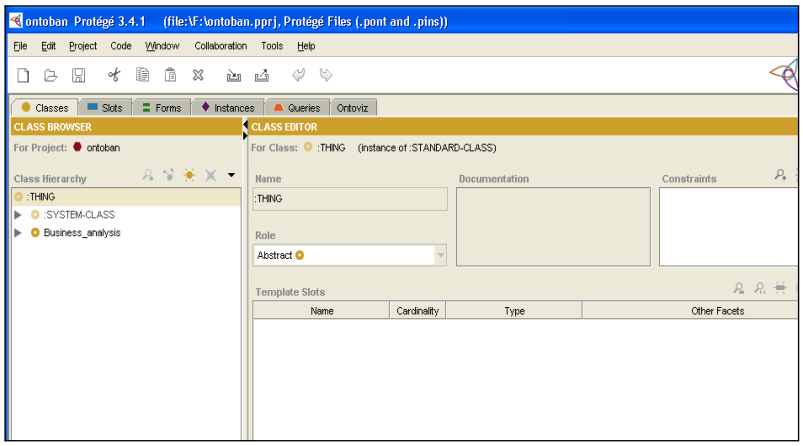

Figure 1: Protégé tabs.

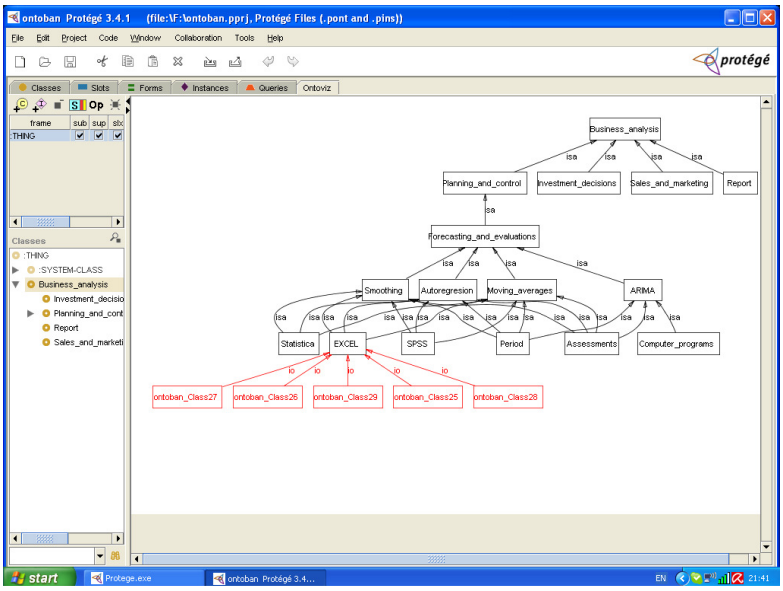

Figure 2: Visualization of the class hierarchy.

Results

A model of ontology of the business analysis domain (subdomain Forecasting and assessments)

In this paper we propose a domain ontology for business analysis. In order to elaborate an ontology for that domain we have used terms proposed in [7] and [10] for the business analysis of a company.

Onto-BAn ontology

The main terms are organized in:

- Report - Nature and analysis of financial report;

- Planning and control - Financial planning and control;

- Investment decisions;

- Sales and marketin

We are going to follow the two phases (specification and conceptualization, implementation) for the construction of the knowledge model of investment decisions subdomain of business analysis domain.

Specification: This section describes the process of developing an Onto-BAn ontology (subontology) for business analysis domain (forecasting and evaluations). This subontology only considers the needs for creating the forecasting related to expenses and data. It includes general concepts for the forecasting, evaluations, assessments and methods for forecasting and specific concepts for the formulation. According to the level of conceptualization and granularity, the ontology proposed here is domain ontology. Domain ontology describes the vocabulary related to a specific domain. In this case study, the ontology describes the business analysis domain (planning and control subdomain). The ontology objective is to facilitate communication among the members of the central administration staff or corporation leadership that must deal with the budget, bringing adequate terminology to non-expert users.

Conceptualization: In this step, a list of the most important terms was elaborated. The core of basic terms is identified first and then they are specified. Then with these concepts, the key term list was defined.

Each term is defined in properties and relations, generating a complex network of classes, subclasses, instance and slots. The ontology Onto-BAn is designed as a reflection of the views of specialists in the areas of business analysis, statistics, and knowledge engineering. The model of subontology of Forecasting and evaluations can be used as a starting point for the elaboration of a general model of the Business analysis and models of subdomains of business analysis.

In the following we describe the class “Forecasting and evaluations” of the class “Planning and control”.

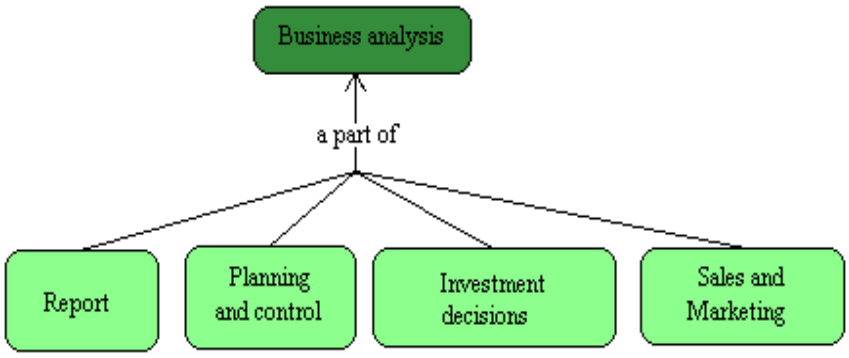

Figure 3: General diagram of the ontology Onto-BAn (superclass and classes).

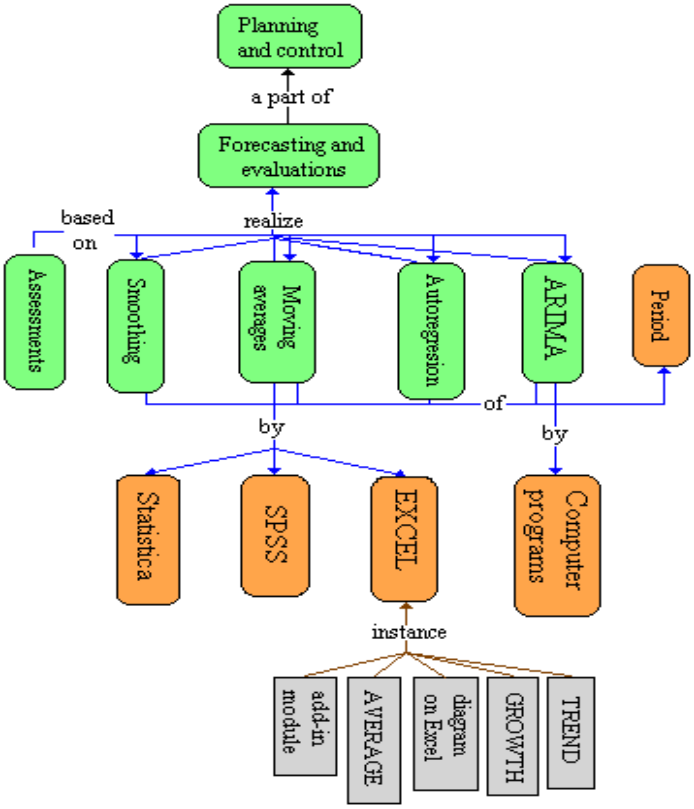

Figure 4: Class "Forecasting and evaluations" [6] Conceptual model.

Description of class "Forecasting and evaluations"

The class "Forecasting and evaluations" (see figure 4) is designed to describe the basic methods of forecasting and assessments. For the purpose of that investigation the concepts are grouped into four classes:

- Moving averages;

- Smoothing;

- Autoregression;

- ARIMA.

Since forecasting and assessments are very important for a company they are connected to other classes of the ontology Onto-BAn. The class "Forecasting and evaluations" and subclass "Assessments" correspond to the major issues directly, which makes them interesting for analysts – what is planned, what, how and where it is transacted, which are the results and the effects, what is the feedback to the corporate leadership.

The relations in class "Forecasting and evaluations" are of the type "a part of", "realize", "of", "base on", "by", and "instance".

For clarity, only some instances of subclass "Excel" are shown (the most popular) [6]. When we realize the ontology Onto-BAn in Protégé, we show some (the most important) instances of subclasses "SPSS" and "Statistica".

Implementation: In order to implement the ontology, we chose Protégé 3.4.1 because of the fact that it is extensible and provides a plug-and-play environment that makes it a flexible base for rapid prototyping and application development. Protégé ontologies can be exported into different formats including RDF Schema and Web Ontology Language.

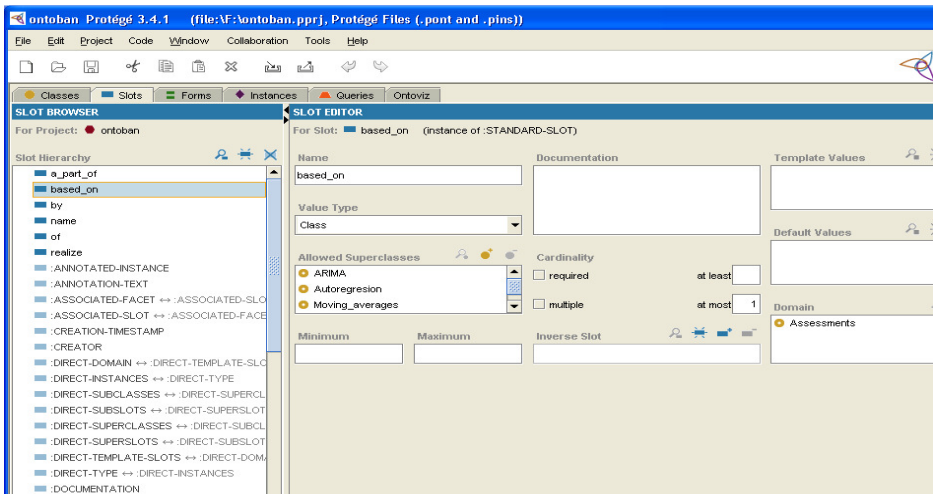

Figure 5: Realization in Protégé 1.

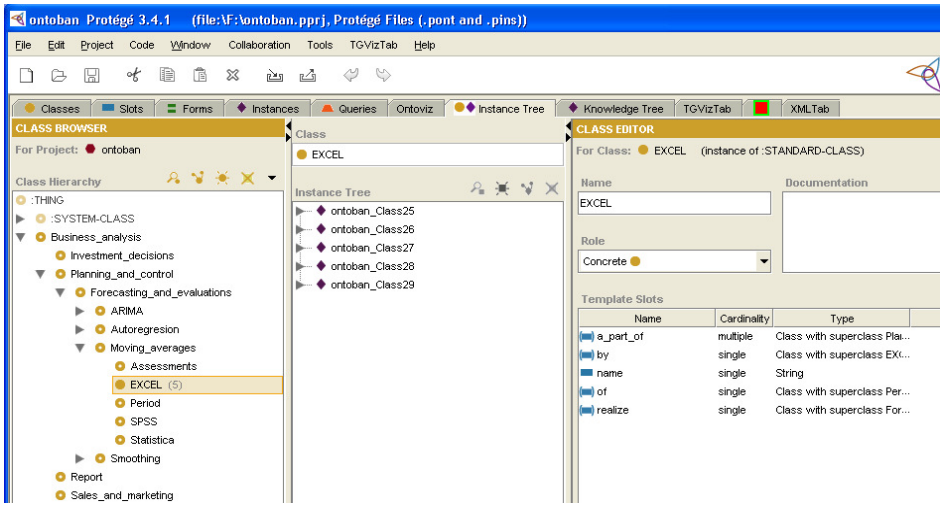

Figure 6: Realization in Protégé 2.

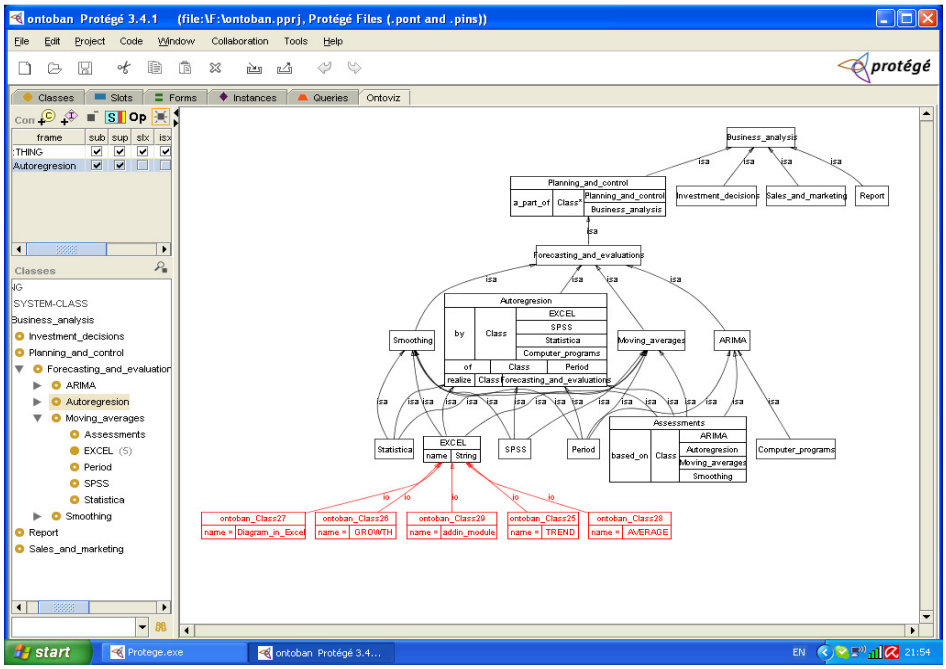

Figure 7: Visualization in Protégé.

Conclusions

In this paper, we focus on the implementation phase after linking short-term user needs supported by informal semantics with longer-term formal ontology development.

The considerations discussed in Section 2 can serve as arguments for the conclusion that Protégé is a perfect instrument for the development of software tools for intelligent search. Building domain ontologies is not a simple task when domain experts have no background knowledge on engineering techniques and/or they have not much time to invest in domain conceptualization.

Ontology building process is characterized by its very high cost and elaborate overlapping activities of development. Researchers have proposed many approaches namely bottom-up, top-down, and middle-out. In [16] Van der Vet sees that a bottom-up approach is very attractive for many scientific and engineering fields. The approach focuses on building complex concepts from their primitive (basic) concepts and a list of construction rules. We are going to use this approach to design, engineer, and create our ontology.

In knowledge engineering, a number of alignment tools are provided such as Protege [5], Chimeara [8], PROMPT [12], but we prefer to use Protege to build our ontology. In this paper we present an implementation of subontology for the forecasting subdomain. We provide the basic conceptualisation and we make implementation of our subontology "Planning and control" with Protégé.

Future research

In the future we intend to realize the subontologies for other classes of the ontology Onto-BAn for business analysis domain by using the bottom-up approach and integrated environment Protégé 3.4.1

IRENA ATANASOVA
Department of computer science
Faculty of natural science
South West University "N. Rilski"
Blagoevgrad 2700,
66 "Ivan Mihailov" Str.
Bulgaria
irenatm@swu.bg

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Social Networks as an Integration Tool in Rural Areas – Agricultural Enterprises of the Czech Republic

E. Červenková[1], P. Šimek[1], T. Vogeltanzová[2], M. Stočes[1]

[1]Department of Information Technology, Faculty of Economics and Management, Czech University of Life Sciences Prague, Czech Republic

[2]Department of Languages, Faculty of Economics and Management, Czech University of Life Sciences Prague, Czech Republic

Abstract

Social networks have been growing at a rapid pace. Social media represent one of the most significant phenomena of today's world and are more and more integrated from the private sphere into the commercial one (e.g. into marketing where social media already play a substantial role). The present paper is aimed at introducing an initial study on the use of social media in agricultural enterprises. The study was thus targeted at agricultural enterprises – both legal entities (public limited companies, limited liability companies and last but not least cooperatives) and natural persons (farmers) that farm the total area of more than 100 hectares (a basic selection criterion of the survey). This interesting study was conducted by means of a questionnaire survey that included information on social media awareness, development and use within the respective group of respondents (bigger agricultural enterprises). The paper deals with social media as such and naturally with the survey results. The data retrieved from the questionnaire were used not only for monitoring social networks integration in the agrarian sector (important factor in rural areas) but as well for exploring the potential of modern information tools in agriculture promotion. The survey has been carried out in mutual cooperation of the Department of Information Technologies with the Information and Consulting Centre, Faculty of Economics and Management, Czech University of Life Sciences Prague.

Key words

Social media, social network, Facebook, Twitter, Google Buzz, agrarian sector

Anotace

Sociální sítě rostou stále větším tempem. Sociální média jsou jedním z největších fenoménů dnešní doby, který postupně stále více proniká z původně osobní roviny do roviny komerční, např. do oblasti marketingu, kde již má svoji velmi důležitou roli. Cílem tohoto příspěvku je představit úvodní studii o využívání sociálních médií zemědělskými firmami. Cílovou skupinou proto tvořily zemědělské podniky buď vedené jako akciové společnosti, nebo společnosti s ručením omezeným a v neposlední řadě družstva. Další oslovenou skupinou byli soukromě hospodařící rolníci. Všechny tyto skupiny hospodaří na zemědělské půdě o celkové výměře vyšší než sto hektarů (základní výběrové kritérium komplexního šetření). Jedná se proto o zajímavou studii, v níž byly dotazníkovým šetřením získávány relevantní informace o znalosti, rozvoji a využívání sociálních médií v rámci dané skupiny respondentů (větších zemědělských podniků). Sociální média jako taková a především výsledky a závěry uvedeného šetření jsou předmětem tohoto příspěvku. Poznatky byly získávány za účelem monitoringu integrace sociálních sítí do odvětví zemědělství, jako významného subjektu působícího ve venkovském prostoru, a pro nalezení dalších nástrojů pro možnost propagace zemědělství při využití moderních informačních nástrojů. Tato studie byla realizována ve spolupráci Katedry informačních technologií a Informačního a poradenského centra Provozně ekonomické fakulty ČZU v Praze.

Klíčová slova

Sociální média, sociální síť, Facebook, Twitter, Google Buzz, zemědělský sector

Introduction

„New communication technologies are being introduced at an astonishing rate. Making sense of these technologies is increasingly difficult“[1] The Czech Republic has been recently using information technologies based on Web 2.0 which facilitates information sharing, brings maximum presentation freedom, enables interaction with other users by means of the given interface and last but not least allows - within the framework of a chosen Platform - to eliminate strict barriers between the content creator and user in the electronic environment. As a result, enterprises and their marketing can benefit from the social media upsurge while creating new communication channels. These channels firstly allow targeting people or groups of people who would otherwise be hard to keep in touch with and secondly maintaining a permanent active contact with these target groups. "Based on the surge in online communication, researchers have begun to explore self-disclosure online."[2]. Social networks started to permeate into corporate environment as a communication tool for both long-term and potential customers. We can assume that this trend is likely to replace the existing communication tools such as the e.g. Skype, ICQ etc. one day.

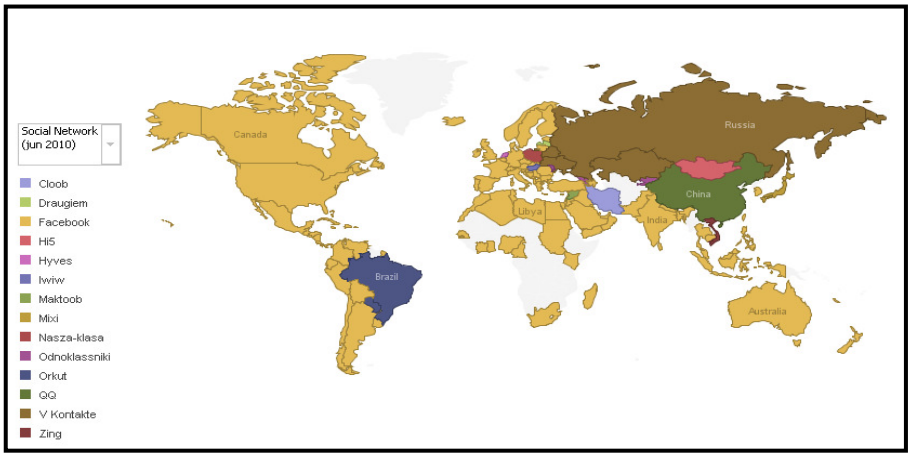

Figure 1: Social media – user support worldwide [14].

Figure 2: User interface of the QQ and Facebook social networks.

Social media

Social media have become an integral part of marketing strategies and cost structures of many companies all over the world (rem.: It is necessary to mention that social media user support differs and is not the same all over the world – see Fig. 1. The difference subsists not only in their popularity but as well in the cross-cultural differences – see Fig. 2). The costs of these marketing activities have been growing on the year and so has the number of companies that integrate their services with the social media. The Internet has become a transmitter for further rise and development of social networks targeted at different user groups. Internet social media overcome one of the biggest limitations – the place of residency, respectively the bond to a certain location. They incorporate a structure of "nodes" representing individuals, groups or organizations that are tied or connected by one or more specific types of interdependency; not only by friendship or kinship but nowadays more and more by professional interests or business relationships.

Recently, social media have been creating a new reality that allows people not only to discover new interesting pieces of information, to bridge over the distances and to facilitate business undertakings but at the same time to eliminate the so-called digital divide. Social networks in the Czech Republic are still used prevalently in private life and communication. However, we can shortly expect an intense development in professional and corporate sector as more and more companies started to explore the information and promotional potential of social media within the framework of their enterpreneurial prospectus. Scott Krinsky, for instance, perceives social media as *"a communication which is not targeted as traditional media. SM stand on the interaction among people. The crucial element is a feedback from the audience, no matter if in form of commentaries, editing of original text or content."[3].* It has to be stated here that a wide range of companies have been so far only monitoring the field (monitoring the competitors, opinions and attitudes towards their company etc.) but have been reluctant to utilize social media actively and directly.

Social media develop first of all spontaneously using similar platforms and technologies as e.g. typography does. For instance, Facebook (the most spread social network in the Czech Republic) is run as any other company and its investments. It thus started to be effective when it exceeded the so-called critical limit, i.e. 15% users of the total number of inhabitants. After exceeding the above limit, its popularity has not ceased in growing (see Fig. 3 – blue line). As we can see from the graph, other social networks are on the decrease. In the context of the Czech Republic, Facebook has been replacing other formerly very popular networks such as LíbímseTi, Spolužáci and Lidé whereas the number of Facebook registered users who started to use actively its functionalities has rocketed since 2009. Almost 3 million users were recorded within the last five years (as at 30 November 2010) [13]. The graph clearly shows that the most significant expansion occurred in the past two years (see Fig. 4).

The number of users in the Czech Republic is relatively high as there are approximately 550 million of registered Facebook users worldwide [9].

The promotion on Facebook is realized through many functions, especially by the advertisement tools themselves (e.g. banners), Applications and *Like Pages* or *Groups*. The latter will be mentioned later on, including information on their specificity and use.

As for marketing, Like Pages that act as spot brands are being and are likely to be the most trend-setting as they offer adaptability, SEO URL and many options. Accentuating their permanent development, Facebook is trying to actively predetermine *Like Pages* for marketing purposes. Nevertheless, from the point of view of virtual spread possibilities, Groups seem to be more suitable even if they have just a limited possibility of adding Applications and customizing. At the very beginning of the Facebook era, its use in terms of the community communication was obvious. However, using Facebook as one of the marketing tools has been recently gaining wider acceptance and popularity among progressive companies.

Social media users

Generally speaking, we can divide social network users into several age groups. The most numerous group is of course the group of users between 20 and 24 years of age that stands for 22.02%. The group between 16 and 19 years accounts for only a little less reaching 21.88% while users who range from 25 to 29 years of age represent 16.44% of all users. While talking about rural areas, we can of

course assume that the target group will not reach such a high percentage share in the pie chart (see Fig. 5) with regard to age structure. Age segmentation is relevant as well in relation to interest groups as these users share not only their interests and hobbies but as well the perception of the world around us. It is highly interesting that some groups overlap as for their interests but are never willing to leave the "group" entirely. These findings are really relevant for marketers in general.

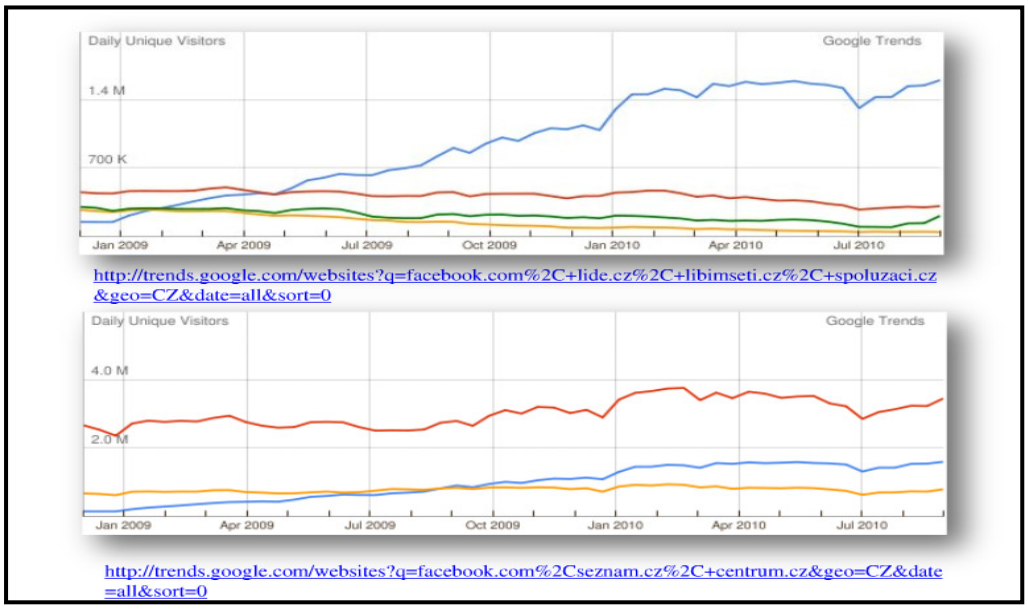

Figure 3: Facebook popularity in the Czech Republic [5, 6].

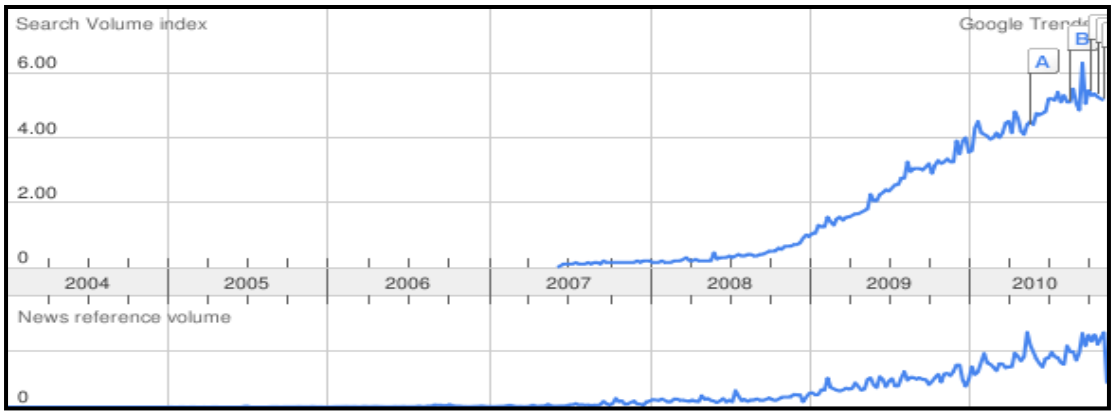

Figure 4: The growth of Facebook popularity in the world over 2004 – 2010 [7].

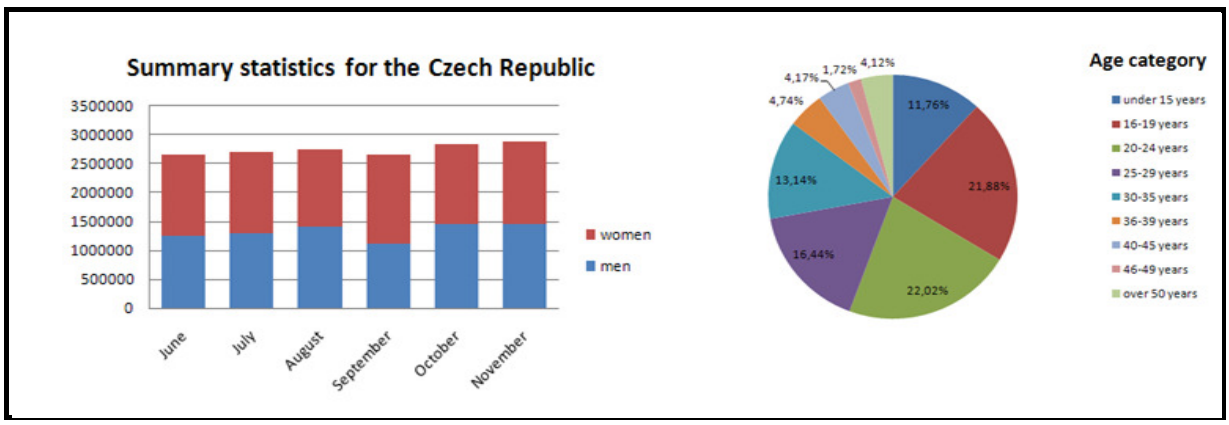

Figure 5: User structure (gender and age) [8].

Aims and Methods

The aim of the survey was to monitor the current state of social networks use and to assess their potential for agricultural enterprises of the Czech Republic. It goes without saying that the fore-mentioned general trends will be to some extent applicable here. However, there exist several departmental specificities and specificities of the rural areas. Firstly, we have to take into account the conservativeness of the users. Secondly, a limited availability of the Internet (connectivity) in the regions for both individuals and enterprises is still an important issue. Last but not least, the age structure of potential users is relevant together with other aspects.

Suitable communication infrastructure providing broadband connectivity is conditional for the use of all modern internet technologies and applications, including social media. Social media develop very fast towards multimedia content that is closely related with high quality connection requirements. Rural areas generally face substantial connectivity problems (even with connection availability), especially with the connection quality. These problems have been monitored and analysed by the Department of Information Technologies in the long term and are described e.g. in the following papers: [10] and [11].

So far, the first and isolated survey of social networks in the agrarian sector was carried out in 2010 within the framework of a study on the development and use of information and communication technologies in agricultural enterprises of the Czech Republic – Exploration 2010. The research was conducted by the Department of Information Technologies and the Information and Consulting Centre of the Faculty of Economics and Management, Czech University of Life Sciences Prague. The questionnaire was extended for this sake by items concerning the use of social networks, their structure and utilization. The methodology and further information on the above survey is available e. g. in [12].

The study was targeted at agricultural enterprises (public limited companies, limited liability companies, cooperatives and farmers). All the fore-mentioned entrepreneurs farm the total area of more than 100 hectares, which was a conditional selection criterion of the survey. The study was itself conducted by means of an electronic questionnaire survey (eventually by sending a paper form) that included information on social media awareness, development and use within the respective group of respondents (bigger agricultural enterprises). The data retrieved from the questionnaire were used not only for monitoring social networks integration in the agrarian sector (important factor in rural areas) but as well for exploring the potential of modern information tools in agriculture promotion.

As a result, the 2010 survey brought 902 relevant questionnaires, which account for 20.5% of the total number of the addressed respondents (enterprises). 853 of the enterprises, i.e. 94.57%, have an internet connection at their disposal. These enterprises were then concerned with further analysis, including the use of social networks.

Results and discussion

The survey showed that the target group is active on social networks. However, their practical use is relatively low, as expected. The volume of activity quite corresponds with the sector chosen (see Fig. 6). Of course, Facebook is by far the most used social network (see Fig. 7) that reflects the fore-mentioned graphical comparison and the overall boom of Facebook within the last two years.

In case of joining social networks, Facebook is the most commonly used with 100 respondents (out of the total number of 854 connected enterprises), followed by Google Buzz with 34 respondents. Other social media are used very little, representing only some 10 – 12 cases (Linkedln, MySpace, Twitter) – see Fig. 7.

The authors of the paper were really surprised at the number of positive responses to Google Buzz. In spite of the overall increase in different social networks, Google Buzz is a less used social medium. It mainly provides services that originate from Facebook and Twitter activities. Its users can create statuses and microblogs while Google Buzz automatically creates a user. These are people with whom an e-mail contact has been started and they are immediately offered recommended statuses.

Social media are especially used for personal communication, gathering information and for company communication. Surprisingly, company presentation is only used at a relatively small extent (see Fig. 8).

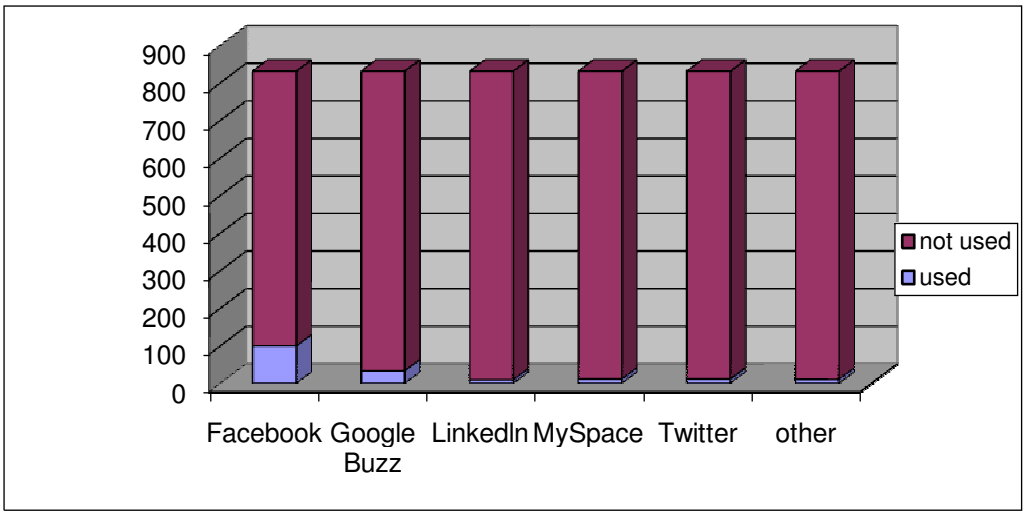

Figure 6: The use of social networks in the agrarian sector (Department of Information Technologies – Exploration 2010).

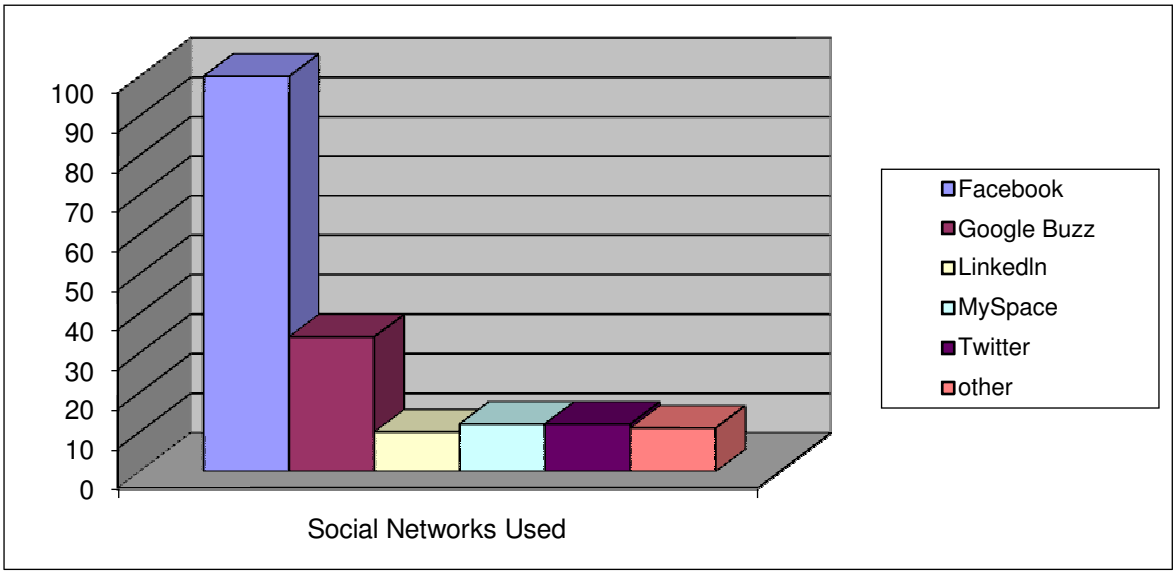

Figure 7: Social networks used in the agrarian sector (Department of Information Technologies – Exploration 2010).

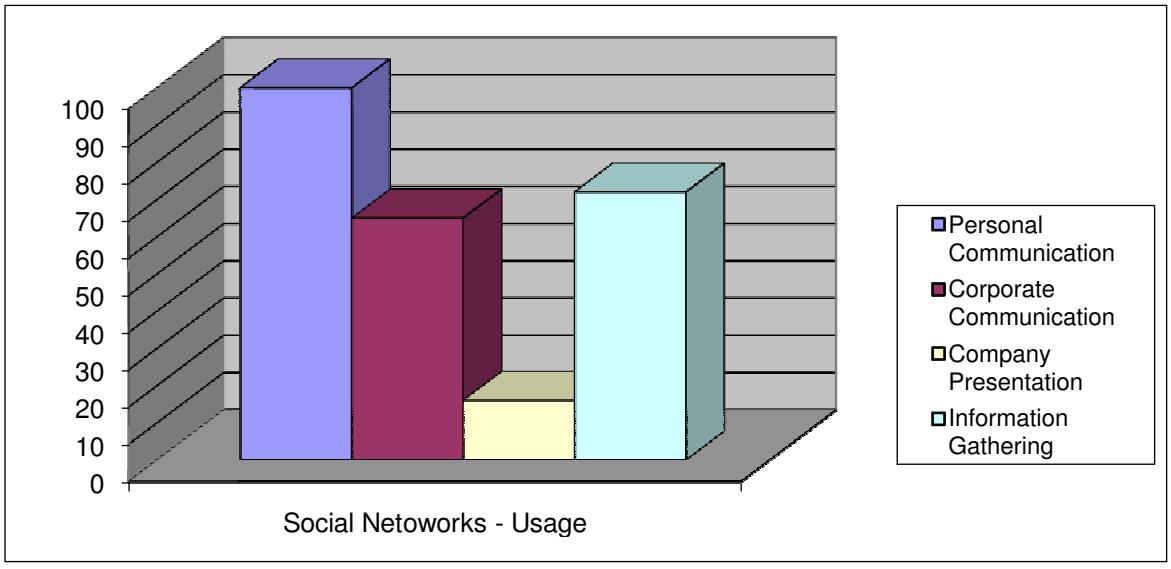

Figure 8: Social networks in the agrarian sector – usage (Department of Information Technologies – Exploration 2010).

It can be said that social media are an artificially created platform where a certain event or product is highly valued thanks to the social media popularity. That is one of the many reasons why we think that social media are increasingly popular and, compared to other media, enjoy a growing favour. Advertisement, newspapers and leaflets are not so trustworthy or in other words so popular with the new generation and modern users. Social media are not strictly intended for promotion and advertisement but primarily for the communication sake. Regardless to whether the two-way communication is with the existing or new users of the same product, service or event. This communication is always vital for feedback in any domain or sector, inclusive of agriculture.

Nobody doubts the fact that the popularity of social media will not cease to grow. It can be expected that the use of social media will be further extended as well within the framework of agricultural enterprises. However, a conservative and reserved approach is likely to prevail and prevent a much wider acceptance of social media. Positive personal experience of the individual users could potentially act as a development accelerator. Social networks can have a significant role in rural areas integration within the framework of global society and can also contribute to diminishing the digital divide in Czech countryside.

The paper authors will go on monitoring the development of social networks in this specific and interesting domain in a survey planned for 2011 which will be extended by other aspects of social networks development.

The knowledge and data presented in the paper were obtained at the Faculty of Economics and Management of the Czech University of Life Sciences Prague as a result of the Research Program titled "Economy of the Czech Agriculture Resources and Their Efficient Use within the Framework of the Multifunctional Agri-food Systems" of the Czech Ministry of Education, Youth and Sports number VZ MSM 6046070906.

Corresponding author:
Ing. Eva Červenková
Czech University of Life Sciences Prague, Department of Information Technologies
Kamýcká 129, 165 21 Prague-Suchdol, Czech Republic
Phone: +420 224 382 050
e-mail: cervenkova@pef.czu.cz

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Application of Electronic Data Collection in Research of Socio-Economic Importance of Forest Functions

V. Pospíšilová[1], J. Pospíšil[2], J. Hučko[3]

[1]Czech University of Life Sciences Prague, Faculty of Forestry and Wood Sciences, Department of Forestry Economics and Management
[2]LastStar.eu s.r.o
[3]Czech University of Life Sciences Prague, Faculty of Economics and Management, Department of Economics

Abstract

The main topic of the project is the application of electronic data collection using the web interface to the research of the socio-economic importance of forest functions. A unique system for data collection, the provision of evidence and processing was designed. The system leads to the simplification of the research, to the possibility of extending the investigation in the field and to the survey of forest visit trends in the long term. The approach will enable the formation of an extended database. The paper describes the steps of the project's implementation. The e-survey started at the end of September 2010 continues to this time.

Key words

E-survey, forest functions, assessment, web development, agile methods.

Anotace

Článek se zabývá aplikací elektronického sběru dat pomocí webového rozhraní na socio-ekonomický výzkum významnosti funkcí lesa jako moderní inovativní metodou v oboru. Podstatou projektu je tvorba unikátního systému pro sběr, evidenci a zpracování dat. Vytvořený systém povede k zjednodušení administrace výzkumu. Systém umožní vznik rozsáhlé databáze a sledování dlouhodobých trendů v oblasti návštěvnosti lesa a významnosti jeho funkcí. Článek popisuje jednotlivé kroky implementace projektu. Dotazníkové šetření zprostředkované vybudovanou aplikací bylo spuštěno v září 2010 a pokračuje dosud.

Klíčová slova

E-survey, funkce lesa, web development, agilní metody vývoje, oceňování

Introduction

Forest function assessment is an important topic, discussed by scientists in the Czech Republic (CR) as well as abroad. The evaluation can be carried out in different ways. The forest functions are assessed at monetary or non-monetary value. The methods, which can be used to accomplish the monetary value of forest functions, include e.g. the *Socio-economic Valuation of Public Forest Goods and Services* according to ŠIŠÁK (2006), *Contingent Valuation Method* (*CVM*), *Travel Cost Method* (*TCM*), *Hedonic Price Method* and *Shadow Price Method*. The non-monetary evaluation can be expressed e.g. as a verbal description of the function or by adding a scale degree. The chosen technique of the assessment depends on the type of evaluation - one of the favourite methods is a questionnaire survey. A 'classical paper questionnaire' has been used in the CR so far. This type of investigation is very demanding from the point of view of the organization and it is expensive. The electronic data collection using a web interface is an innovative approach in forest function research. It might be utilized as a supplement to the existing research, however it can also be used as the main proficient method of the investigation. The paper deals with the description of the application of electronic data collection using

a web interface and its application in the socio-economic assessment of the forest's functions.

Aim and Methods

The main topic of the project was the application of the electronic data collection using the web interface in the research of socio-economic importance of the forest functions. The aim of the project was to design a unique system for data collection, the provision of evidence and processing. Input data should be analyzed through the application of mathematical methods used specifically for socio-economic relationships. The application should lead to the simplification of research and to the extended monitoring of the development in the field. It should make possible surveys of long term trends of forest visits. The approach should enable the formation of an extended database. The system thus created can be modified according to future research needs. The application will also allow the respondent's feedback, which might be a very useful tool in public education.

The project team consisted of experts from different fields (forestry, economics, informatics), who closely cooperated in the individual sequences of the work. The project work included the choice of the appropriate methods of web application development, the preparation of the structure of the web application and the creation of the questionnaire itself. Proper project management was strongly required for sufficient project's organization. The methods used for the project were chosen and the project was prepared theoretically during the year 2009. The structure of the web application was created along with the questionnaire's form in the spring of 2010. The web application was produced and tested in summer 2010. The questionnaire survey was started at the beginning of the autumn semester of 2010/2011. The survey continues up to now and will be finished by the end of the year 2010. It is expected that the research will be repeated after 1 year.

The project management was based on the use of a Pivotal Tracker. Pivotal Tracker is a simple story-based project planning tool that allows teams to collaborate and instantly respond to relevant changes. It is based on agile software development methods, but it can be used on a variety of projects. A great advantage of a Pivotal Tracker is that it is completely free, there is no software to install, and it only takes a few minutes to sign up (PivotalTracker, 2010). The project management steps can be seen here:

https://www.pivotaltracker.com/projects/34251

Another advantage of the tool is that it is a user-friendly Internet service. The Pivotal Tracker allowed the team to get things done easily on time and to run the project smoothly.

Results and Discussion

Technological Part of Project

The choice of the used technologies was made according to the requirements of modern agile development. The emphasis was put on the methods, which are not very commonly used for programming in the Czech Republic. Most of the approaches have been used in the academic sphere for the first time.

The questionnaire system is based on a couple of building blocks. The programming language, used for the application development, is a modern scripting language called *Ruby*. All the data are stored in *MongoDB*, one of the leading *NOSQL* databases. The method which steered the project is *Behaviour Driven Development*, an agile type of the development method.

Ruby (Ruby, 2010) is an object oriented, dynamic scripting language created by Yukihiro Matsumoto. From its roots in Japan it has become one of the leading platforms of current web development. The most famous framework created in *Ruby* is called *Ruby on Rails*, however for this project a more lightweight approach was chosen, a framework called *Padrino*. The main advantage of this framework is that it is object relational mapping, javascript library and testing framework agnostic. *Mongoid*, *jQuery* and *RSpec* were chosen for relative parts.

MongoDB (Mongodb, 2010) is a document database, which is getting to be very popular nowadays. It differs greatly from the usual relational databases, used in most of the current web applications. The biggest advantage of this type of database is that it does not have any schema and therefore it is easier to change the software model without fear of breaking the link between them and underlying storage. This fact leads to the possibility of an advanced agile development. The database is written in *C++* for speed and convenience.

Behavior Driven Development (BDD) is a new agile method of analysis, development and release of software products. It is a bunch of good practices bound together based on *Test Driven Development* (*TDD*), *Extreme Programming*, *Scrum* and others. For testing purposes the *Cucumber* was used. *Cucumber* is a framework in which it is possible to write tests in a common language structured to the stories. The stories could be used as both, functional tests and documentation. (Chelimsky et al, 2010).

For story management, development velocity benchmarking, bug and feature tracking was used PivotalTracker (PivotalTracker, 2010).

The individual parts of the web development were implemented successfully according to the needs of the research. The structure of the application was the leading guideline for the programming work. The code is available as Open Source on Github service. The address is http://github.com/pepe/questionnaire, the code can be freely cloned and used.

Structure of Web Application

The structure of the web application correspondes closely to the e-survey requirements and aims of the project. The application consists of the *Front End* and *Back End*. The *Front End* includes the questionnaire and its individual parts (the introduction, the research questions = the body of the questionnaire and the conclusion). A detailed description of the single questionnaire units can be found in the Questionnaire Preparation part of the paper.

The *Back End* creates the functional body of the application and is accessible to the project administrators only. The *Back End* contains the list of questionnaires, the simple statistics and the administration part of the survey.

The list of the questionnaires serves as an the easy approach to the individual questionnaire. It supplies the information about the number of questionnaires and about the date, when the questionnaire was filled in. All the questionnaires with the detailed answers can be seen here. The questionnaires are marked numerically and with unique codes.

The simple statistics serve for the publication of the first research results. The statistics differ for the individual questions. The statistics include a computation of maximum, minimum and average values. In the case of the questions characterized by scale answers (from 1 to 5) the statistics express the representation of individual classes numerically and in percentages.

The administration part of the system is approachable only for the registered users who login with a password. It displays all successfully filled in questionnaires, which are editable here. This page can be used for the data processing of questionnaires in the situation where follow-up research of the *PAPI* type is necessary (*paper and pen interviews*). The users can export the data file of an '.xls' type for the purposes of further analysis here. The file is fully editable using *Excel* or a statistical programmes.

The web application includes the database, which serves as a store for the obtained data and record. The database contains all the information connected to the questionnaire survey (answers, dates of filling in, unique codes of the questionnaires, comments and email addresses of the respondents). The database includes information about the numbers of respondents and about the number of questionnaires which were not completed. The size of the database is neither time nor quantity restricted, it allows the storage and recording of any amount of the data infinitely. In the case that the questions will be changed, a new original database will be created automatically. The previous and current databases will coexist as all the data from the previous database will be preserved.

The application contains '*Google Analytics*', a modern tool for web analysis. It gives us the information about the website traffic and analyzes the approaches to the website (e.g. information about place, where the questionnaire was filled in and from where the respondent approached the website, when he started to fill in the questionnaire, how long did it took to fill in the questionnaire etc.) (GoogleAnalytics, 2010)

It is evident that the structure of the application closely relates to the needs of the survey and to the form of the questionnaire. It was built with the cooperation of all the team members. The structure provides a satisfactory basis for the realization of the research's aims.. The application of the modern up-to-date approaches allows the modern analyses of the project's implementation, which enhances the project's possibilities and makes the research more valuable.

Creation of Questionnaire

The preparation of the questionnaire is a crucial point of the project. The authors took into the consideration the experience obtained during previous research in the field.

The Department of Forestry Economics and Management, in the Faculty of Forestry and Wood Sciences (FFWS) at the Czech University of Life Sciences Prague (*CULS*) carried out research orientated towards the evaluation of forest functions in 2007-2009 (*Evaluation of Socio-Economic Importance of Recreation Function of Forest in Selected Localities*). This investigation was based on a questionnaire survey performed on-site (*paper and pen type of questionnaire survey*). For the purpose of this research a large proficient questionnaire was designed. The scientists applied the experience from this research in the preparation of the current questionnaire.

The aim of the current project was to design a short and accurate questionnaire. Respondents are much more willing to fill in a questionnaire if it is short rather then if it is too long. The survey was interested in the findings concerned with the evaluation of forest visits and forest functions. The final form of the questionnaire was tested by a pilot survey on a limited group of respondents during March and April 2010. The focus group of the questionnaire included the employees and students of CULS.

The theory of questionnaire design is described by e.g. Urban (2005), Buckingham (2004) and Creswell (2003). Urban (2004) deals with the types of questionnaire and provides basic instructions about how to create a questionnaire. Buckingham (2004) and Creswell (2003) discuss the correct approach to questionnaire solutions in detail. While preparing the current questionnaire, the advice of the above mentioned authors was taken into the account. The choice of the questions considered the basic rules of questionnaire preparation. The individual questions were individually analyzed thoroughly and the questionnaire was examined as a whole unit too. The e-survey is based on a '*self-administrated*' (*self-completed*) type of questionnaire using a web interface. An explanation of how to fill in the questionnaire is attached to individual questions.

The questionnaire consists of three parts (introduction, research questions and thank-you page). The first part introduces the research study to the respondent. It explains the topic and structure of the questionnaire. It assures the respondent of the anonymity of the research.

The research questions consist of two parts. The first part is focused on the attributes of forest visits (frequency and duration of forest visits, reasons for the visits and favourite area of visits). The second part focuses on an evaluation of the forest visits and functions. The expression of the monetary value of the forest visit was based on the simplified form of the *Contingent Valuation Method* (*CVM*). The questionnaire uses both versions of the method (*Willingness to Pay and Willingness to Accept*). Šišák (1994) says that *CVM* uses, as a basis, the amount which respondents would be willing to pay for the individual forest visit (*Willingness to Pay*). *Willingness to accept* is based on the sum, which the respondents were willing to accept in the case of permanent exclusion of forest visits. If both variants are used, the results are interestingly very different (higher in the case of *Willingness to Accept*) because of the *Income Effect*. The second part of the research questions concerns the evaluation of the importance of forest functions in the CR. This part of the research is based on Šišák's approach to the diversification of forest functions. Šišák (2003) says, that the complex forest functions were not uniform from the socio-economic point of view. The functions can be divided into market and non-market forest services according to the various socio-economic demands for them. The survey uses the individual categories of forest functions based on Šišák's approach (timber production, non-wood forest production, water protection, soil protection, climatic function, health-hygienic function and nature preservation) (Šišák, 2003). The value of the individual forest functions is expressed by a scale of importance (from 1 to 5). The last question of the questionnaire focuses on the basic characterization of the respondent, it distinguishes respondents from the university (students and academic staff) and respondents from public.

The final part of the questionnaire ('*thank-you page'*) contains an appreciation of the respondents' contribution. It displays the unique code of the questionnaire and allows the questionnaire to be printed. The page includes the possibility to write down the respondent's comments and an 'email window' used for future contact with the respondent in the case that the respondent would like to know the results of the research. The

respondent is informed that the email contact will be used only for this purpose.

Current State of Research

The survey focus group were the academic staff and the students of CULS Prague with the emphasis put on the students and staff of the FFWS. The survey was announced to the theoretical respondents using emails (in the case of FFWS only). The information about the research was displayed on the students' and staff intranet. The e-survey started at the end of September 2010 and continues up to now. The total of successfully filled in questionnaires was 250 by the middle of October and the number is increasing continuously. It is expected that a total of 300 - 350 questionnaires will be collected. The results of the research are not known yet, however the obtained data will be processed and further analyzed as soon as the survey is finished. It might be concluded that the project was successful so far and the project's aims had been fulfilled.

Conclusions

The application of the electronic data collection using the web interface is an important and innovative approach to the assessment of forest functions. The application leads to simplification of the research and to the extended monitoring of the development in the field. It allows the long term trends in forest visits to be surveyed. The advantage of the approach is that the investigation can be repeated periodically. The use of the e-survey is not so time and money demanding as classical questionnaire surveys. The approach enables the formation of an extended database. The data is easily editable and ready to be used in a short period of time. The system thus created can be modified according to the future research needs. Its application will also make possible to contact the respondent, which might be a very useful tool in public education.

The project included the choice of appropriate technologies, the preparation of the structure of the web application and the creation of the questionnaire itself. The project management was organized with help of an advanced management and planning tool PivotalTracker.

The choice of technologies to be used was done according to the requirements of modern agile development. The questionnaire system is based on a couple of building blocks. The programming language, used for the application development, is a modern scripting language called *Ruby*. All the data is stored in *MongoDB*, one of the leading *NOSQL* databases. The method which steered the project is *Behaviour Driven Development*, an agile type of development method.

The structure of the web application correspondes closely to the e-survey requirements and aims of the project. The application consists of *Front End* and *Back End*. The *Front End* includes the questionnaire and its individual parts, the *Back End* consists of the list of questionnaires, the simple statistics and the administrative part of the survey.

The creation of the questionnaire was based on the previous experience of the authors and followed the basic rules of questionnaire preparation. The questionnaire consists of three parts (introduction, research questions and 'thank-you page'). The research questions dealt with the assessment of forest visits by the respondents and their opinion on their evaluation of forest functions. The focus group included the employees and students of CULS.

The e-survey started at the end of September 2010 and continues up to now. The total of successfully filled in questionnaires was 250 by the middle of October and the number is increasing continuously and it is expected that a total of 300 - 350 questionnaires will be collected. The results of the research are not known yet, however the obtained data will be processed and further analyzed as soon as the survey is finished. It might be concluded that the project was successful so far and the project's aims were fulfilled.

The knowledge and data presented in the paper were obtained as a result of the Research Program "Application of Electronic Data Collection using web interface in Research of Socio-Economic Importance of Forest Functions" of the Czech University of Life Sciences - number 20091007 and of the project NAAR number QH71296 " System of the Socio-Economic Importance of the Forest Functions Including the Criteria and Indicators of Multi-Functional Forest Management". The paper has not been published anywhere else

Corresponding author:
Ing. Vendula Pospíšilová
Czech University of Life Sciences Prague, Kamýcká 1176, 165 00 Praha 6 – Suchdol
Tel.: 777835566,
pospisilova@fld.czu.cz

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Understanding and Adaptation of the Concept of Competences in the Water Sector

Ch. Thanopoulos[1], N. Manouselis[1], Ch. M. Stracke[2]

[1]Agro-Know Technologies, Greece
[2]University of Duisburg-Essen (UDE), Germany

Abstract

Competence models are proved as the most sufficient tool in order to support organizations and companies to achieve their main goals (e.g. selection of the most competent employees) and to enhance the offering training opportunities and help individuals with their personal performance. This article focuses on the identification of the main issues that will support the development of a successful and adaptable competence model in the water sector. An introductory overview of competence, competence model and competence modeling process is following by the investigation of the usefulness of the competence model in all the water sector domains. The scope of this study is the analysis of the water sector requirements for competence modeling, based on the initial results of a European survey that takes place in the context of EU project WACOM (www.wacom-project.eu).

Key words

Competence, water competence model, water sector

Introduction

A variety of organisations in all the professional sectors use competences to describe the skills that they expect their employees to have. The identification and application of the competences required for effective job performance has become a complex and sophisticated endeavor as experience with this approach has been gained in business and industry. More than 15 years ago, Van Der Veen (1993) mentioned the statement that business, industry, government institutions and nonprofit organizations in our rapidly changing world, are forced to create new, innovative responses to the "speed of light" changes in their environment.

Competences are observable performance dimensions, like individual knowledge, skills, attitudes and behaviours (Athey & Orth, 1999). The use of competences has the advantage to make the organizational expectations and the development and promotion process more clear and accessible for employees (Van Dongen, 2003).

Competence models support the main organizations goals in designing improvements to Human Resources Management systems, including job redesign, recruitment, internal organizational training, career management, performance improvements and compensation systems (United Nations Industrial Development Organization, 2002). Competent employees are the main resource of any organization in acquiring a competitive advantage. An organization's best source of competitive advantage lies with its employees. A competence model should be firstly intended to improve and develop employee competences, which it will become the vehicle for the enhancement of Job and organizational performance and it will support the competitive strategy of the organization (Vathanophas and Thai-ngam, 2007).

Responding to the need for developing sector specific competence models, WACOM (**www.wacom-project.eu**), Water Competence Model Transfer, is an European Project in the context of Lifelong Learning Program which intends to support employees and learners with the identification of required competences and qualifications for a specific working places. WACOM transfers the European Qualification Framework (EQF) and the German reference model for the competence modeling PAS 1093 (Publicly

Available Specification) into the European water sector vocational education and training. First, the developing competence model is adapted in the field of sewage treatment plants management and secondly it will be transferred to other fields of the water sector and other professional sectors.

This study reports on the initial findings from an European survey with experts from all the domains of the water sector. The outcomes of this survey inform and set the frame for the design and development of the water competence model for reporting the required and future needed employee competences for the accomplishment of specific tasks of a wide range of jobs professions in the water sector.

Competence Model

Overview

A required competence for a job has been defined as an underlying characteristic of a person that leads to or causes superior or effective performance (Yeung, 1996). McLagan (1996) goes on to further explain that those characteristics are composed of the knowledge and skills needed to perform a job effectively.

Competence is defined as an ability to perform a specific task adequately and all the competences that are needed for the successful accomplishment of the tasks or missions of a job are presented in a competence profile (Roe, 2002). A competence model is a model of key competences, which are generic clusters of competences (Viitala, 2005). Swiderski (1987) defined three main clusters of competences, namely hard, soft and conceptual competences. The hard skills are technical and administrative skills. The soft competences, also known as the interpersonal skills, consist of sensitivity, adaptability, creativity and flexibility (Rodriguez *et al.*, 2002). Conceptual competences can be defined as critical thinking, problem solving, judgement and decision-making (Swiderski, 1987).

According to the European Reference Framework "Key Competences for Lifelong Learning" (2007), the competences can be grouped in 8 categories of "key-competences" for a successful profession in a knowledge society: communication in the mother language, communication in foreign languages, mathematical competence and basic competences in science and technology, digital competence, learning to learn, social and civic competences, sense of initiative and entrepreneurship and cultural awareness and expression.

The danger of using key competences is that the underlying competences become less effective and successful due to too much attention for the core competences (Van Dongen, 2003).

Spencer and Spencer (1993) distinguish two categories of competences. The first one is threshold competences: competences, such as writing skills, which every employee should possess and do not give an indication of outstanding behaviour. The second category is differentiating competences, which are competences, like decision making, that make a difference between average and outstanding performance.

A common approach is to identify several "core" or "key" competences that are essential for all employees and then to identify several additional categories of competences that apply only to specific subgroups. (Marelli *et al.*, 2005) Some competence models are organized according to the type of competence, such as leadership, personal effectiveness, or technical capacity. Other models may employ a framework based on job level, with a basic set of competences for a given job family and additional competences added cumulatively for each higher job level within the job family.

Murray (2003) described the two different concepts of competences, namely organisation competences (the main goals and strategies of a company) and personal competences (indicators of personal strengths).

Before starting the description of the process for the development of a competence model it is intentional to set the definitions for sector, competence, the components of competences (knowledge, skills) and competence model, since the Water Competence Model is referring to a specific area of Job professions.

Sector

According to the European Qualification Framework, sector means a grouping of professional activities on the basis of their meain economic function, product, service or technology (EQF, 2008).

Competence

McClelland (1973) was the first to introduce the term "Competence" into the human resources

literature. His work "Testing for Competence Rather Than for Intelligence" was delivered to the United States Information Agency for improving their selection procedures of employees. Competences represent *the knowledge, skills, traits, attitudes, self-concepts, values or motives directly related to job performance or important life outcomes and shown to differentiate between superior and average performers* (McClelland, 1973).

Competence is a measurable human capability that is required for effective performance. It competency may be comprised of knowledge, a single skill or ability, a personal characteristic, or a cluster of two or more of these attributes. Competences are the building blocks of work performance. The performance of most tasks requires the simultaneous or sequenced demonstration of multiple competences (Hoge *et al.*, 2005).

A new approach based on the European Qualification Framework (EQF, 2008) and the Publicly Available Specification (PAS 1093, 2009) concludes the definition of a Competence as the ability to reasonably and intentionally perform a specific job and task in an unknown situation with success: Competences encompass a combination of knowledge, skills, and (intentional) behaviour and are constituted by defined activities for the observation and measurement. Competences are built and are normally demonstrated by individuals (but also by teams and whole organizations) (PAS 1093). In this paper we are following this approach as it is in line with the European policies, and required by the new knowledge and information societies as well as by the professional business, industries and enterprises.

Knowledge

Knowledge depicts the awareness, information, or understanding about facts, rules, principles, guidelines, concepts, theories, or processes needed to successfully perform a task (Marrelli, 2001, Mirabile, 1997). The knowledge may be concrete, specific, and easily measurable or more complex, abstract, and difficult to assess (Lucia & Lepsinger, 1999). Knowledge is acquired through learning and experience.

According to the EQF definition, knowledge means the outcome of the assimilation of information through learning. Knowledge is the body of facts, principles, theories and practices that is related to a field of work or study (EQF, 2008).

Skills

A skill is a capacity to perform mental or physical tasks with a specified outcome (Marrelli, 1998). Similar to knowledge, skills can range from highly concrete and easily identifiable tasks, such as filing documents alphabetically, to those that are less tangible and more abstract, such as managing a quality improvement project (Hoge *et al.*, 2005, Lucia and Lepsinger, 1999). According to the European Qualification Framework, skills are defined as the ability to apply knowledge and use know-how to compete tasks and solve problems (EQF, 2008).

Competence Models

Competence models depict a number of competences that are usually required for the successful accomplishment of a particular job, according to the tasks of work or professional specializations (Shippman *et al.*, 2000). These models can identify the needed skills, knowledge, behaviours and capabilities for the current and future staff selection in relation with the strategies and priorities of the industry/enterprise. They can enhance personal development by eliminating the gap between the required competences for a job profession and those that are available (Draganitis *et al.*, 2006).

A more concrete approach of the competence model definition emanates the Publicly Available Specification (PAS 1093, 2009) in combination with European Qualification Framework (EQF, 2008). A competence model describes the competences required to successfully perform in a particular job and organization. This set of competences is then used as basis and standard for the description of specific jobs, the selection of new staff, the evaluation of the on-going performance of the whole staff, the analysis of training needs, and the classification and provision of tailor-made vocational education and training for competence development.

Aims and objectives of the Competence Model

Reihl (1998) described the most important objectives concerning the general uses of Competence Models in various professional sectors. First of all Individuals (learners or employees) are inspired with greater responsibility to develop their

valued skills and are supported with the necessary information resources to define, measure and achieve that. On the other hand, people who are responsible for the managerial issues, feel greater accountability for the needed competences, as set of skills and knowledge.

Utilization of a competence model in a specific workplace aims to satisfy the following issues:

- Identify specific employer needs
- Provide a common framework for effective performance
- Develop competence-based curricula and training programmes
- Develop industry-defined performance indicators and skill standards
- Develop assessment and testing tools / instruments

Benefits for the users / stakeholders

Competence model can be proved beneficial for both individuals / employees and organizations / employers as a whole, as it:

- Helps employees to become familiar with what is expected on the job
- Supports employers to understand the performance management with the help of a specific set of competences that are observable and measurable
- Improves the available training programmes and sets the lines for the future competence-based curricula
- Defines a common language of competences in the organization
- Screens applicants during hiring, resulting in a higher quality applicant pool
- Enables leaders to create teams with the right mix of skills and abilities
- Compensates employees appropriately based on level of competences
- Assists with easing the transition during organizational change efforts
- Allows an organization to communicate and accomplish the overarching organizational mission, goals, and/or strategy.

Competence Modeling

Marelli *et al.* (2005) presented the seven main steps of the competence modeling process in a logical sequence.

- Defining the objectives
- Obtain the support of a sponsor
- Develop and implement a communication and education plan
- Plan the methodology
- Identify the competences and create competence model
- Apply the competence model
- Evaluate and update the competence model

The design and development of the competence model should be focused on the gained benefits for the related stakeholders (individuals, organization / employers, professional training providers) and the opportunities that will come up through the competence model implementation. The professional sector is analyzed and all the involved occupations and job specialization are defined. The sponsor support will ensure the competence model success, gaining the commitment and participation of the employees, managers, professionals, or other actors.

Through the communication and education plan indents to inform all the stakeholders about the model in the early planning phases and keep everyone updated of the progress being made and what they can expect next.

Next to that, the methodology involves the selection of the experts for the sector who will contribute information, and data and the methods that will be used for obtaining the data. In the third step, the case study and the specific job professions are broadly defined, as well the required and future needed competences. Then, the competence model is determined as a set of individual competences.

The next step is the most valuable and vital for the success of the competence model in all the Human Resources related processes like Selection, Performance management, Training etc. The competence model will be applicable if the competences are used to select, develop, manage, reward, and compensate employees for a specific Job / or tasks of a job. After the evaluation and application of the competence model, Evaluation of

the competence model it is important to evaluate the competence model development process, as well as the value of the resulting model to the organization and the training programmes.

In this work we focus and we analyze the second step by analyzing the needs of the water sector concerning the competence modeling.

Methodology

Online survey features

In this section, the identification of the specific demands and needs of the water management and existing practice concerning competence models in the water sector is analyzed and the fundamental elements that underpin the successful application of a competence model for the job-related in the water sector are described. The identification of the water sector needs is based on a survey, using an online questionnaire.

The Online survey advantages for collecting useful feedback for the competence modeling in the water sector can be summarized as following (Marelli *et al.*, 2005):

- Considerable data can be collected quickly and inexpensively
- Information can be easily collected from geographically dispersed respondents
- Respondents may complete the survey at a time and place that is convenient for them
- Surveys permit the input of many people in the organization and thus facilitate acceptance of the competency study
- The survey questionnaires can be easily customized for subgroups of respondents
- The anonymity of surveys encourages candid responses
- The multiple-choice or rating-type questions result in quantitative data that can be easily summarized and analyzed.

The Online Survey is available in 5 different languages:

- English
- German
- Greek
- Hungarian
- Romanian

The Open Source LimeSurvey Application (http://www.limesurvey.org/) was used for the launch of the questionnaire, as well as for the statistic analysis of the results. The Survey aims to collect the preferences and needs of experts from all the water sector eras for the better developments and adjustment of the competence model in this sector in general.

Target audience of the survey

The aim of the online survey is the collection of enough experts' opinions from as many work and research fields of the water sector. The intended target groups were from the EU member countries at first and secondly from interested experts from all over the world.

The stakeholders groups that were selected to be invited in the online survey are describing as follows:

- Teaching staff from universities, schools and other forms of formal education in the water sector
- Providers of vocational education and training programs in all the domains of the water sector
- Water associations
- Research institution in the water sector
- Governmental agencies, national authorities and ministries for the water resources management, environment and educational issues fir the water sector
- Local and regional administration authorities (municipalities etc)
- Employees from the industry in related working fields
- Enterprises and private companies with advisory services
- Non-profit/governmental organisations

Intended countries

The online survey was accessible via internet to all interested experts. The survey was focused mainly to the consortium partners of the WACOM project (Germany, Greece, Hungary and Romania) and secondly to the rest member countries of Europe and other third countries. Specifically, the intended countries were the following:

- Germany, Greece, Hungary and Romania (participating in project WACOM)
- Other EU countries members
- Other non-EU member countries

Structure of the Online Questionnaire

The online survey, for defining the needs of the water sector in general concerning the competence modeling, is launched and available to all interested Water Experts. The survey was based on a comprehensive questionnaire of 15 issues-questions and available in 5 different languages: English, German, Greek, Hungarian and Romanian. The survey was active for 2 months and accessible in the link http://survey.agroknow.gr/index.php?sid=38344&newtest=Y&lang=en (for English language). Main objectives of the whole initiative is to direct to as many water experts from the whole Europe (at least) and collect their aspects and visions on the development and adjustment of the competence model in the water sector.

The covering topics of the online questionnaire are the following:

a) Current Awareness of Competence Models,

b) Perceived Need of the Implementation of Competence Model in the Water Sector,

c) Vocational Education and Training in the Water Sector, and

d) Demographic Data of the participants.

The list of domains of the water sector that is appeared in the online questionnaire and gives its main divisions is the following:

- Irrigation Water
- Water Use in Animal Husbandry
- Hydrology (e.g. surface and ground water, water resources studies)
- Hydraulic Engineering (e.g. physical modeling, numerical modeling, seepage studies)
- Environmental Protection (e.g. Environmental research, protection of water resources from pollution)
- Legislation
- Hydroelectricity
- Geothermical power
- Wastewater management
- Sewage Treatment Plants
- Desalinization Plants
- Water Supply (potable Water)
- Domestic Water use (indoor and outdoor household purposes)
- Transportation on water (rivers and lakes navigation)
- Water Sports / Athletic Activities
- Recreational Uses of Water Resources (e.g. baths, spas,…)

For the first section (*Awareness of Competence Models*), a number of questions are raised in order to investigate the understanding of the terms "Competence" and "Competence Models", the aspect of the importance of competence models to explicit describe the frame of job profiles and further specializations, and the involvement or prospective application of competence models in the description of job professions/specializations in a specific field.

Next section *Perceived Need of the Implementation of Competence Model in the Water Sector* is divided in two parts with one corresponding question for each one part. The level of the importance of the competence model in the water sector in general to draw the related job profiles is inquired. In the second part, the significant reasons of the necessity of the competence model in describing the framework of job professions and specializations in the water sector and the level of their importance are listed.

The *Vocational Education and Training in the Water Sector* is comprised of two parts, one for the exploration on how the employees are well-skilled and competent enough in a list of domains of the water sector and the second one for defining the degree/level of the existence of specialised training opportunities for job professions of each one domain of the water sector.

At the end, a section with demographic questions is included for specifying the gender, age, level of higher education, country of origin, sector of work or research, and the relevance of their field of work/interest with the listed domains of water sector.

Results of the requirement analysis

Water sector experts' demographics

In the total, there were 87 completed questionnaires, with a national breakdown as it is presented in the figure 1. As about the sector of work and research of the participants on the survey, the results are presented in the following figure 2 without any significant difference among them. Since an expert may be involved in more than one occupational activity in his work / research field, there are marked more than one choice in this field. Only the portion of the representatives from the Research Institution is smaller than the rest.

When classifying the specialization in the work and their researching interest to the main 16 categories / domains of the water sector (figure 3), 59.77% replied that their working / researching expertise belongs to the field of *Wastewater management*, 58.62% to *Sewage management* and 55.17% to *Water supply field*. A percentage of 47.13% of the experts were involved in the *Environmental protection*. 34.48% of the total answered that their work is involved in *Legislation* issues of the water sector, 31.03% in the *Domestic water use* and 27.59% in the domain of *Hydrology*.

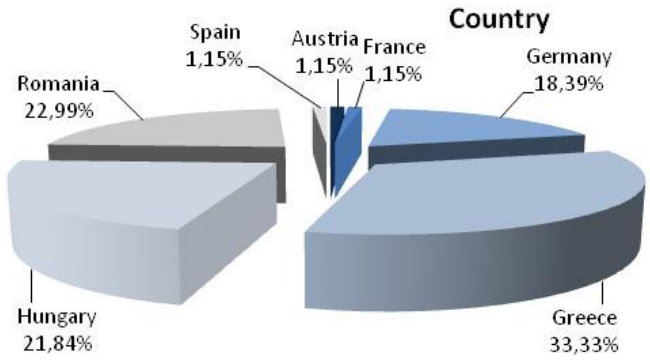

Figure 1: National breakdown of the participants.

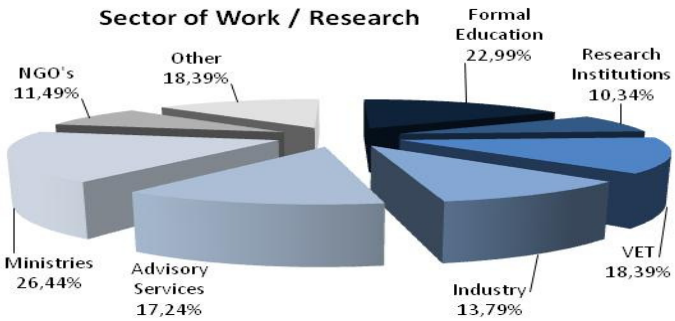

Figure 2: Sector of work / research of the participants.

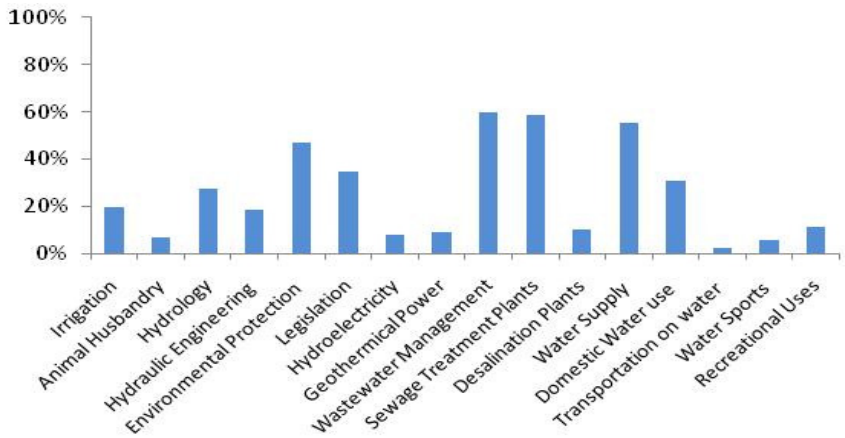

Figure 3: Classification of the work / research interest of the participants in accordance with the Water sector divisions.

Representatives from the *Irrigation* use of water were in a percentage of 19.54% as well as for the field of the *Hydraulic engineering*. The choices: water use in *Animal husbandry, Hydroelectricity, Geothermical power, Desalination, Transportation, Water sports* and *Recreational uses* of water resources were selected by a percentage of 10% or less than 10% respectively.

Current awareness of competence / competence models

In total, almost all the respondents have heard or known the term Competences (98.85%) and only a small percentage, 1.15%, gave a negative answer (figure 4). The term competence model is also well known, but in a smaller percentage, 70.11%. The remaining 29.89% has a different opinion and of course it is bigger than the reply for the term competence (figure 5).

Rating the current understanding on how the competence models can be used for the description of a job profile, the answers vary and most of the respondents, 42.53% gave a neutral answer (level III). 35.63% of the experts supported the opinion that the competence model will be proved important for the better description of the workplace (levels IV and V). The corresponding percentage that expressed a negative opinion was only 21.83% (figure 6)

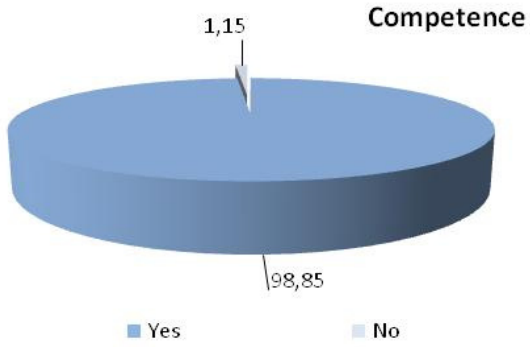

Figure 4: Awareness of the term "Competence".

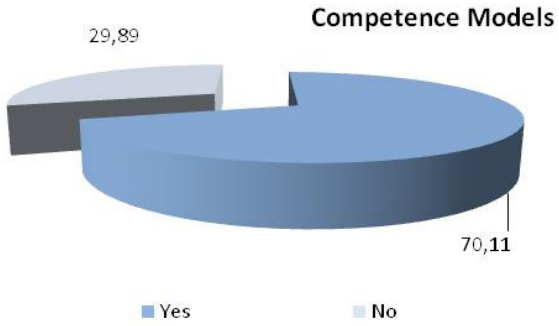

Figure 5: Awareness of the term "Competence Models".

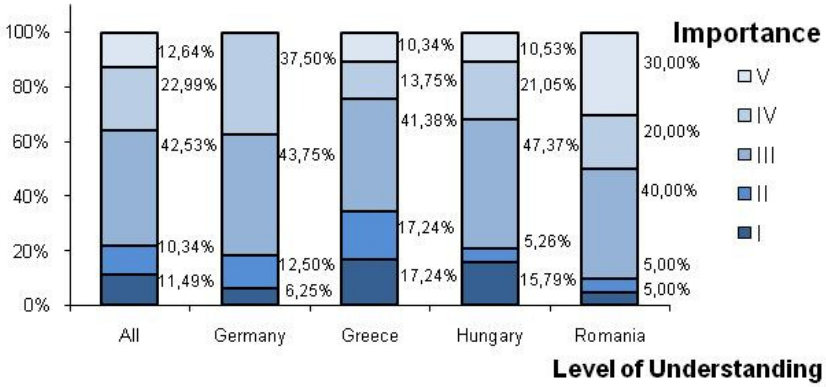

Figure 6: Understanding the usefulness of the competence model for the description of the job profile (Level I= minimum, Level V= maximum). Column "All" refers to the overall results of the survey and the rest columns to the results fo the German, Greek, Hungarian and Romanian surveys.

In Germany, Greece and Hungary, most of the answers prove the medium level III (basic understanding) as an accurate result. The German results indicate that the high level of understanding is selected by a percentage of 37.5% and the rest of them (19%) underline the first levels I and II as not so important. It is also interesting that no one of the German experts has selected the highest level V. In Hungary the results are almost equal with a percentage of 31.58% for the highest levels IV and V and 21.07% for the levels I and II.

Results from the Greek survey release the same pattern to the one that emerged from the analysis of the total results of the survey. The majority of the answers (41.38%) underline the medium level (level III). The levels of low understanding (levels I and II) have been selected in a greater percentage than the upper levels IV and V (I: 17.24%, II: 17.24%, IV: 13.79% and V: 10.34%). In addition to the previous results, Romanian experts expressed the opinion that they understand it sufficient, since half of them selected the levels IV and V, 40% the medium level III and only 10% the low levels I and II.

It is interesting that a significant percentage, 57.47%, of the experts has already used a competence or a set of competences for the description of a job profession or specification in their working / researching field. Similar to the overall results, German experts answered positive in a percentage of 56,25%. The corresponding percentages for the cases of Hungary and Romania are higher, 68,42% and 75% respectively. On the other hand, only one third of Greek experts agree with this aspect (figure 7).

Usefulness of competence model in the water sector

Concerning the implementation of the competence model in the water sector, most of the replies imply a high level of usefulness of the competence model for the job professions in the fields of the water sector (figure 8).

Overall, 76.76% of the experts marked the upper 2 levels, with 44.83% having mentioned the level IV and 31.93 noticing the highest level (level V) of the importance. A smaller percentage, 7.75%, can't find a significant need for competence modeling into the water sector. Also, 18.39% of the experts are not quite sure for the usefulness of the competence model into the transparency of the job description of the water sector.

Concerning the results from Germany and Hungary, the majority, 62-63% of them chose the high levels of usefulness, which is smaller than the overall percentage. A significant percentage of the experts recognized a basic importance (level III) of its usefulness (Germany: 25% and Hungary: 31.58%) Finally, the remainder 12.5% or less of the experts answered the first 2 levels I and II of the importance.

In Greece and Romania the experts believe strongly that the competence model can support the water sector, offering better description of the involved job occupations and recording the needed and required competences in a specific area of work. The upper levels IV and V were selected by the 79.31% of the Greek experts and 90% of the Romanian experts. Neutral answers (level III) were given by a smaller percentage 17% for the Greek survey and 6% for the Romanian respondents.

The presented reasons in the figure 9 proves the importance of the competence model in the water sector. All the respondents identify the importance of these reasons in this specific occupational field, selecting the highest levels IV and V.

For the better understanding and *Description of the job profiles*, that are involved, a noticeable percentage of 60.92% mentioned its importance, selecting the level IV (33.33) and the level V (27.59%). 13.80% of the answers mentioned this reason as not so important (levels I and II) and 25.29% gave a neutral answer (level III of importance). Responses from Greece, Hungary and Romania present similar results with the overall findings of the survey. 60-63% of the experts mentioned the highest levels IV and V of the importance, 21-27% expressed a neutral opinion and less than 15% believe that this reason is not very important. On the other hand, only half of the German experts support the great importance of this reason, 31.25% expressed a neutral opinion and the rest of them mentioned the low levels I and II.

Acquisition of the qualifications is proved as a stronger than the previous reason. A bigger portion, 67.82% answered the levels IV (39.08%) and V (28.74%) of the importance. On the other hand, almost the same percentage of 15.14, as before, replied the lowest levels (I and II) and 17.24% of the experts believed that the level III of the

importance is more appropriate for the qualifications. The differences among the countries answers release interesting results. In Greece case, this reason proved one of the most important, since 86.2% of the experts have voted it. The results from the Hungarian survey follow the same pattern with the overall results of the survey (Levels IV+V: 68,43%, Level III: 15.79% and Levels I+II: 15,79%). In Germany and Romania, the percentages of the levels IV and V present a reduction in comparison with the overall results. Only 55% of the Romanian experts and 43,75% of the German experts identify this reason as important element for the utilization of the competence model in a specific professional sector.

Additionally, *Organizational requirements* are proved as not so important as the previous 2 reasons. Only 57.47% of the answers, mentioned it with the higher level of importance. Small percentage (8.05%), as for the previous two reasons, marked the first 2 levels (I and II). It is also interesting, that bigger portion of the respondents (34.48%) than the previous two reasons find more accurate the medium level of the importance (level III). Greek experts consider that this reason is also beneficial for the implemented workplaces as the previous (Levels IV+V: 86,20%). Results from Germany, Romania and Hungarian surveys indicate the *Organizational requirements* as a reason with the minimum necessity, concerning the application of the competence model.

Regarding the *Comparability of the training opportunities*, a noticeable percentage of 65.52% believe that it is a significant reason (levels IV and V of importance). Only 8.05% of the respondents underlined the lower levels of the importance of this reason (levels I and II). Another 26.44% mentioned the normal level of the importance. The results from the Greek survey are quite similar with the overall findings. In Hungarian and Romanian surveys, the percentage of experts that indicate the importance of this reason are higher, 84.21% and 75% respectively. In contrast, 43.75% of the experts mentioned the importance of the Comparability of training opportunities.

At last, the reason of *Measuring the training needs* into a specific working field is proved as the most crucial reason. The biggest percentage of experts, 74.71%, revealed this reason as a very important fact (level IV and V) for the water sector. A small portion of the answers marked the low levels of the importance and 21.84% of the respondents underlined the medium level III of the importance. Alike to the overall findings, the results of the Greek, Hungarian and Romanian survey indicate this reason as critical for the implementation of the competence model. In addition, only 43.75% of the German experts believed that this reason is essential.

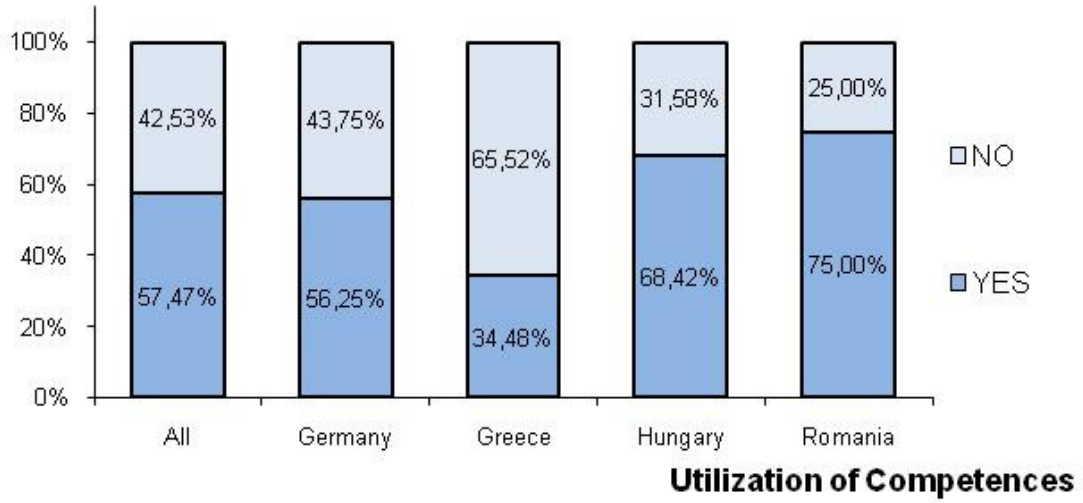

Figure 7: Utilization of competences in the description of a job profession in the participants work / research field. Column "All" refers to the overall results of the survey and the rest columns to the results fo the German, Greek, Hungarian and Romanian surveys.

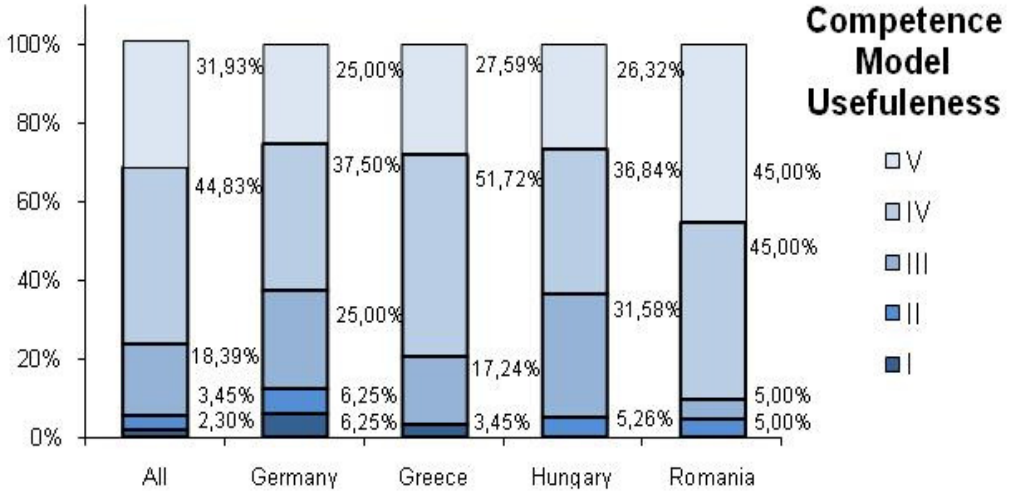

Figure 8: Usefulness of competence models for the water sector (Level I= lowest level of importance, Level 5= Highest level of Importance). Column "All" refers to the overall results of the survey and the rest columns to the results of the German, Greek, Hungarian and Romanian surveys.

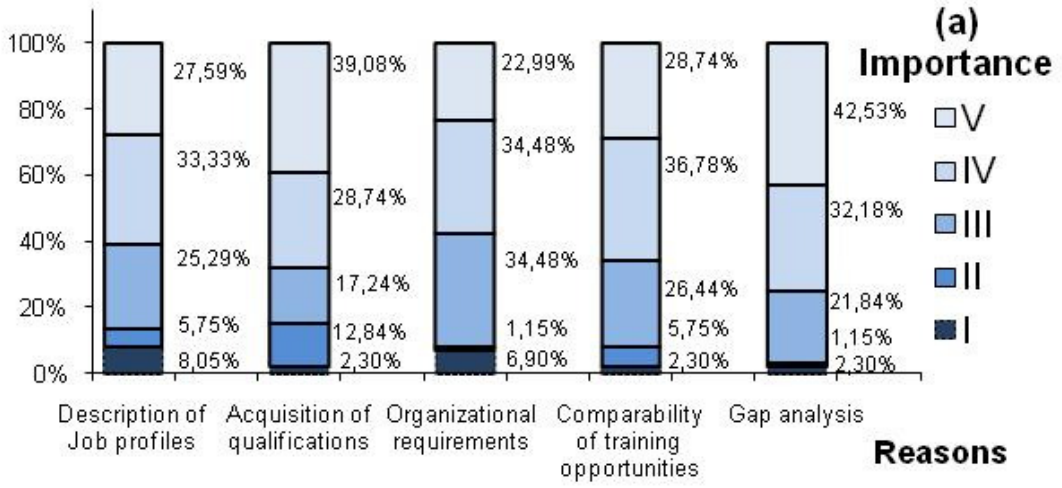

Figure 9: Reasons of importance of the competence model in the water sector (Level I= lowest level, Level V= Highest level) for the overall results.

Acquisition of the qualifications is proved as a stronger than the previous reason. A bigger portion, 67.82% answered the levels IV (39.08%) and V (28.74%) of the importance. On the other hand, almost the same percentage of 15.14, as before, replied the lowest levels (I and II) and 17.24% of the experts believed that the level III of the importance is more appropriate for the qualifications. The differences among the countries answers release interesting results. In Greece case, this reason proved one of the most important, since 86.2% of the experts have voted it. The results from the Hungarian survey follow the same pattern with the overall results of the survey (Levels IV+V: 68,43%, Level III: 15.79% and Levels I+II: 15,79%). In Germany and Romania, the percentages of the levels IV and V present a reduction in comparison with the overall results. Only 55% of the Romanian experts and 43,75% of the German experts identify this reason as important element for the utilization of the competence model in a specific professional sector.

Additionally, *Organizational requirements* are proved as not so important as the previous 2 reasons. Only 57.47% of the answers, mentioned it with the higher level of importance. Small percentage (8.05%), as for the previous two reasons, marked the first 2 levels (I and II). It is also interesting, that bigger portion of the respondents (34.48%) than the previous two reasons find more accurate the medium level of the importance (level III). Greek experts consider that this reason is also beneficial for the implemented workplaces as the previous (Levels IV+V: 86,20%).

Results from Germany, Romania and Hungarian surveys indicate the organizational requirements as a reason with the minimum necessity, concerning the application of the competence model.

Regarding the *Comparability of the training opportunities*, a noticeable percentage of 65.52% believe that it is a significant reason (levels IV and V of importance). Only 8.05% of the respondents underlined the lower levels of the importance of this reason (levels I and II). Another 26.44% mentioned the normal level of the importance. The results from the Greek survey are quite similar with the overall findings. In Hungarian and Romanian surveys, the percentage of experts that indicate the importance of this reason are higher, 84.21% and 75% respectively. In contrast, 43.75% of the experts mentioned the importance of the Comparability of training opportunities.

At last, the reason of *Measuring the training needs* into a specific working field is proved as the most crucial reason. The biggest percentage of experts, 74.71%, revealed this reason as a very important fact (level IV and V) for the water sector. A small portion of the answers marked the low levels of the importance and 21.84% of the respondents underlined the medium level III of the importance. Alike to the overall findings, the results of the Greek, Hungarian and Romanian survey indicate this reason as critical for the implementation of the competence model. In addition, only 43.75% of the German experts believed that this reason is essential.

Educational level of the job professions in the water sector

The aspect of the experts for the level of the people that are enough skilled and competent in the major domains of the water sector revealed interesting results. The full list of the water sector domain is presented in the figure 10.

Concerning the agricultural professionals that are related with the water sector, a noticeable percentage (29.74%) believed that people who are occupied with the *Irrigation* are enough competent and only 11.49% have the same opinion for the job professions related to the water use in the *Animal husbandry*. Almost equal results are presented for the Greek and Hungarian surveys. In the case of Germany, the corresponding percentages are smaller (almost half) of the overall results. On the other hand, Romanian experts expreesed the same opinion for the water use in *Animal husbandry* and believe that the job professions that are dealed with the *Irrigation* are not skilled enough at all (only 5%).

The respondents mentioned the domains of *Hydrology*, *Hydraulic engineering* and *Environmental protection* as more crucial and the job professions from the related working places are skilled enough in a greater percentage than the agricultural section. Specifically, the percentages of the well educated people are: 44.83% for *Hydrology*, 35.83% for Hydraulic engineering and 39.08% for *Environmental protection*. The results from Greek and German surveys agree with the overall findings. In contrast, experts from Hungary come in agreement with the overall results only for the job professions in the *Hydrology* domain. They believe that people from *Hydraulic engineering* and *Environment protection* are well educated in a smaller percentage than the presented results in Germany and Greece (less than 30%). Alike to the Hungarian results, the Romanian survey revealed that people from the corresponding fields are not well educated as the average results from the rest countries (20%, 20% and 30% respectively).

The domain of *Legislation* of the Water Use includes well educated people in a smaller percentage, 18.39%. In Germany and Greece, experts believe that the involved job professions are well educated in a greater than the average percentage (31,25% and 24,14% respectively). On the other hand, people from the related domain are less well performed as the average (15%) in case of Romania or not at all well educated in case of Hungary.

The same percentage for the occupations that are related with the water use for the production of Hydroelectricity is 24.14% and for the people who work in the *Geothermical power* units is 10.34%. Similar to *Geothermical* power, only 12.64% of the answers underline that people from the *Desalination plants* are enough competent. Results from the German and Hungarian surveys indicate that personnel from Hydroelectricity are not well performed as the overall percentage from all the countries (12% and 15,79% respectively). Also, Greek and Romanian surveys point out that the involved people in the Hydroelectrical units are well performed in a greater percentages than the corresponding in Germany and Hungary (27,59% and 35% respectively). *Geothermical* power seems

to not include well performed people, since the results are less than 6% (Hungary and Romania) or 0% (Germany), with the exception for Greece (20,69%). As about the *Desalination plants*, the personnel are well educated in a smaller percentage than the average, less than 6,25% (Germany and Romania) or 10,53% for the Hungary and in a greater portion than the average, 17.245 for the case of Greece.

It seems that *Wastewater management* and Sewage treatment are the two water sector domains with plenty of educational and training programmes. 54.02% of the respondents mentioned that the field of the *Wastewater management* includes well competent employees. The same percentage for the field of the Sewage treatment plants is 59.77%. The difference between the results of Wastewater and *Sewage management* fields maybe is influenced by the fact that citizens are well informed and more interested about the *Environmental protection* and the impacts of human activities into the environment. The results in Greece are similar to the overall findings of the survey (*Wastewater management*: 55.17% and Sewage treatment plants: 51.72%).

In Romania, the percentage for the Sewage treatment plants is similar to the average of the survey and completely greater from the corresponding for the Wastewater treatment plants (30%). Experts from Hungary expressed also the opinion that the corresponding percentage is equal for the Wastewater and *Sewage management* plants and greater than the overall findings (almost 70%). The majority of German experts believe that people from these two water sector domains are well performed in a greater percentage than the overall results or the results in the rest countries (Wastewater treatment plants: 93,75% and Sewage treatment plants: 81,25%).

Besides, 62.97% of the experts believe that people from the *Water supply* are well educated since this is an effect of the improvement of the living conditions and the fluently of the related training programmes. The corresponding percentage is smaller for Greece and Germany (50-55%) or bigger for Hungary and Romania (70-74%) than the overall findings. It is also interesting that the people in the *Water supply* domain are well educated as the rest from Wastewater and Sewage treatment plants in Greece and Hungary, less enough competent as their colleague from Wastewater anf Sewage treatment plants in Germany and better performed for the case of Romania.

Domestic water use seems to not have so many attention from the answers, since only the 22.99% of them believed that people and related jobs are well skilled. Alike to that, the results from the Romanian survey indicate a percentage of 25%. Smaller but not trivial percentage came up for the Greek (17,24%), and Hungarian (15.79%) survey and greater presented in the German survey (31.75%).

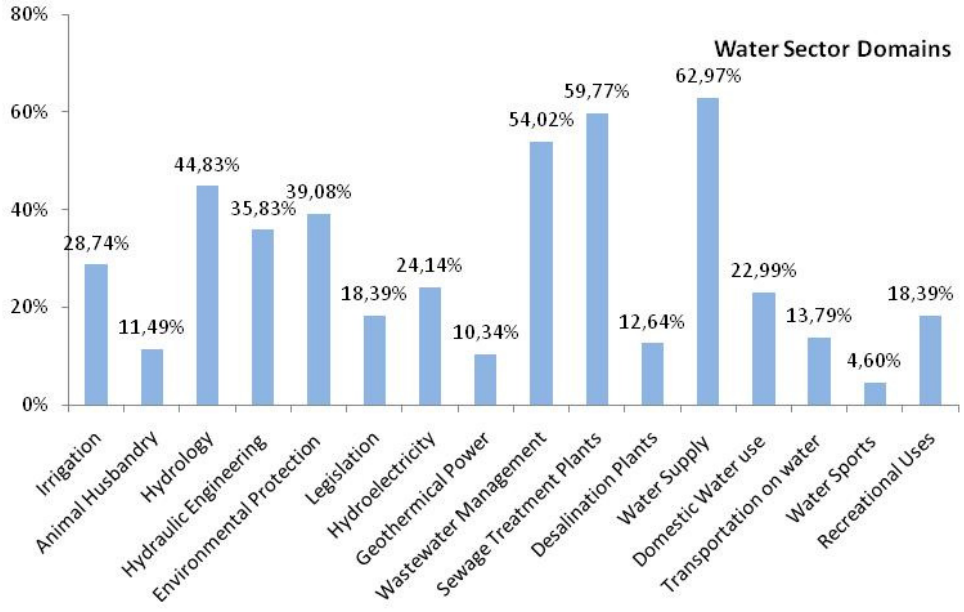

Figure: 10. Percentages of the enough skilled and competent people for the 16 main water sector domains.

In total, a smaller percentage of experts, 13.79%, has the same opinion for the *Transportation* on the water (rivers, lakes etc). The corresponding percentages for Romania, Germany and Hungary are greater, 15%, 18.75% and 21.05% respectively. In contrast, there is no interest in Greece, since the answers are less than 4%.

Experts from all the countries expressed the opinion that less than 5% of people who are involved in the *Water sports* are enough skilled. It is also interesting that there are no results from Germany and Romania surveys. Finally, 18.39% of total answers underline that people from the domain Recreation use of the water resources are enough competent. The same opinion was supported by 31% of the Greek and Hungarian experts. In case of Germany and Romania, no one of the experts mentioned this field.

Training opportunities in the water sector

The responses about the existence of education and training opportunities in the listed main domains of the water sector revealed significant results and in accordance with the previous issue of the educational level of the job professions and specialisations in the Water Sector disclose a very distinguish state of the vocational education and training in the main domains of the water sector (figure 11).

Concerning the use of water resources in the agriculture, the existence of the training opportunities varies and it is in close relation with the job profession and specialization. On one hand, for the *Irrigation*, 41.66% of the responses mentioned the lack of training opportunities (levels I and II) and a bit greater portion, 47.91% have the opinion that there are plenty of training opportunities (levels IV and V). Also, 10.42% of the answers underline a normal level (level III) of training opportunities. These results are similar with the answers from the Greek survey, in which the existence was mentioned by a percentage of 48% and the absence in percentage of 40%. The difference between the level of the existence is greater for the German results, 66.67% and 33,33% corresponding. Instead the German and Greek cases, in Hungary and Romania the results indicate mainly the low levels of existence related training programmes. Experts from Hungary gave a positive answer in a percentage of 44,44% and a negative in a percentage of 55.56%. The corresponding percentages for the Romanian survey are 36,36% and 45,45% respectively.

On the other hand for the water use in *Animal husbandry*, 27,66% of the experts believe that a great number of training programmes exists (levels IV and V), 51,70% mention the low levels I and II of the existence and 21.28% of them select the medium level III. The answers from Germany, Greece and Hungary indicate a great number of training programmes in the percentages of 40%, 36.67%% and 33.33% and the absence of them in the percentages of 60%, 50,09% and 66,67%. In the case of Romania the results show the small number of training programmes (Levels IV+V: 20%, Levels I+II: 30%) and the majority of the experts expressed a neutral opinion (Level III: 50%).

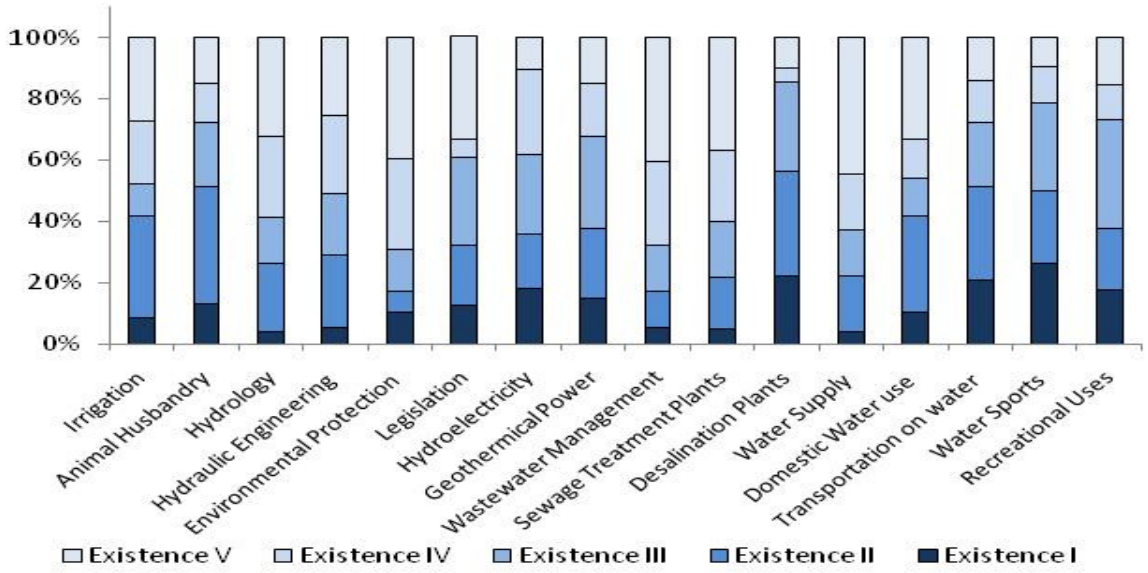

Figure 11: Level of the existence of training opportunities in the 16 water sector domains (Level I= lower, Level V= higher).

As about *Hydrology*, *Hydraulic engineering* and *Environmental protection* fields, the results are more distinguished. For the first field of *Hydrology*, most of the answers (58.55%) identify the existence of plenty of training programmes, choosing the levels IV and V. 24.34% chose the lowest levels I, and II and only a small percentage, 15.09% mentioned the medium level of existence. Similar results are presented for all the countries. In Germany the difference between existence and absence is greater (existence: 87.5%, absence: 12.5%) and in Greece (44%, 28%), Hungary (55%, 18%) and Romania (66,67%, 33,33%) it is similar to the average of the survey.

In the domain of Hydraulic engineering, 50.90% answered the levels IV and V for the existence, 29.19% the low levels I and II and only 20% mentioned a basic level of existence (level III). Results from Hungary and Romania indicate that the percentage of existence related training programmes is 53-55% and the 33% of the experts expressed a different opinion. In Greece the corresponding percentages are 41.67% and 25%. Experts from Germany, mentioned a greater percentage for the existence (71,43%).

The answers for the existence of training opportunities into the domain of *Environmental protection* were 68,97% for the high levels (IV and V), 13.79% for the medium level III and 17,24% for the low levels I and II. For the German survey, 62,5% of the answers indicate a well organized educational system with plenty of related courses and only 12,5% mentioned a lack of them. The corresponding percentages for Greece are 57,69%, and 26,92%. In Hungary almost all the participants mentioned the high levels of existence (90.91%). On the other hand, answers from Romania present equal percentage of 33.33% for the existence, absence and medium level of existence (level III).

Educational and training programmes into the domains of Legislation, Hydroelectricity and *Geothermical power* have almost the same results. 33-39% of the experts have the opinion of few training opportunities and the same percentage has the aspect of high level (IV and V) of existence of the training opportunities. Also, 26-30% of them believe that there is a medium level of training opportunities. The training opportunities for the employees of the *Desalination plants* are mainly few (56.09%), levels I and II. A smaller percentage, 29.27% answered that there is a medium level (level III) and no more than 15% of the experts selected the high levels IV and V.

In Germany and Greece, experts believe that mostly of the training opportunities are sufficient for the people in the *Legislation* domain. 57.15% of the Germans and 43% of the Greek experts supported the opinion of existence. The corresponding percentages with different opinion are 42.86% and 29.17%. The answers from Hungarian and Romanian surveys mainly imply that there is not a clear opinion, since 50% of the respondents answered the medium level III.

As about the results for Hydroelectrical plants in Germany, 40% of the experts have the opinion that the educational system includes a lot of related training programmes, as well as there is narrow for such programmes. The answers from Germany for the *Geothermical power* imply the existence of a lot of training programmes (level III: 50%, level V: 50%) and for the *Desalination plants* prove the disinterest of the experts, since such kind of units are not common in Germany (50% of them chose the level II and the remainder 50% the level III).

In case of Greece, the same portion of experts supports the existence and absence of training programmes for the Hydroelectrical plants (36.8%). They also recognize the absence of related training programmes for the *Geothermical* plants (levels I+II: 39.89%, Level III: 38.89%) and for the *Desalination plants* (Levels I+II: 41.91%, Level III: 19.05%).

The results from the Hungarian survey mostly revealed the absence of related training programmes or were not quite sure for the topic areas of Hydroelectricity, *Geothermical* and *Desalination plants*. The first opinion was supported by 62.5% of them for the field of Hydroelectricity, 44.44% for *Geothermical power* and 55.55% for *Desalination plants*. On the other hand, the second opinion was chosen by 25% for the Hydroelectricity, 33.33% for the Geothermics 22.22% for Desalination units.

Experts' opinions for the Hydroelectrical, Geothrmical and units of Desalination in Romania present various results. It seems that a huge number (75% for the levels IV and V) of training opportunities are already existed for the occupations in Hydroectrical field. In *Geothermical* and Desalination units, 60-66% of the participants are not able to classify the situation (level III) and

33-40% identifies the lack in the offering training opportunities.

The overall results for the *Wastewater management*, Sewage treatment plants and *Water supply* are almost equal as has already happened for the level of education of the people in the same domains of the water sector. 60-68%% of the responses mentioned the existence of plenty of training programmes (levels IV and V) and 17-22% noticed the low levels I and II of the existence. Only 15-18% of the answers identify the medium level III. In Germany, domains of Wastewater and *Sewage management* indicate the consensus of the respondents that a huge number of training opportunities are existed (levels IV and V). In case of *Wastewater management*, 63.63% of the experts marked the levels IV and V of the importance and only 27.27% of the experts advocated the gap of such training programmes. For the field of Sewage treatment, 80% of the experts mentioned the huge number of training programmes (levels IV and V). The results for the field of *Water supply* resemble with the results for the Sewage treatment plants. 88.88% of the experts alleged the existence of a lot of training opportunities and only 11.11% mentioned that new related courses, seminars etc could be developed.

In Greece, the results for the domains of Sewage treatment plants and *Water supply* were equal. The majority of experts expressed the opinion of the existence plenty of training opportunities in a percentage of 50% (levels IV and V), lack of sufficient related courses in a smaller percentage of 40% and only 10% of them replied the medium level (level III). In the field of *Wastewater management* the results are more distinguished. The respondents in a greater portion (60%) answered the high levels IV and V, 32% the low levels I and II and only 8% didn't had a clear opinion (level III).

Experts from Hungary believe that a huge number of training programmes are available for the personnel of related units or individuals, who want to be occupied on these fields. Indeed, 66.67%, 76.92% and 75% of experts selected the high levels of existence for *Wastewater management*, *Sewage management* and *Water supply* respectively. The corresponding percentages for the lowest levels I and II are 26.66%, 23.08% and 8.33%.

In Romania, concerning the Wastewater and *Sewage management*, the majority of participants (55-57%) chose the level III of existence, referring to the development new or improvement the already existing training courses. The rest portion of the experts expressed mainly the existence and the absence of such kind of training courses. The answers for the domain of Water supply, mentioned mainly the existence, levels of IV and V (44.44%) or not so distinguished situation, level III (44.44%).

In the field of Domestic water use (indoor and outdoor household purposes), 45.83% answered the high levels and 41.67% mentioned the low levels (levels I and II). This may due to the differentiation of the experts' opinions from country to country. A percentage of 12.5% of the experts answered the medium level of the existence. The corresponding percentages of existence and absence of training programmes are 50% and 33% in case of Germany, equal 47% for both of them in Greece, 40% and 50% in Hungarian results and finally 40% and 30% (and 30% for the medium level III) for Romania.

The training opportunities for the employees in the *Water sports* and *Transportation* domains are mainly few (51%), levels I and II. A smaller percentage, 21-28% answered that there are plenty of related training courses. In Germany, 40% of the experts answered that exist a lot of training programmes in the field of *Transportation* in water and a similar percentage mentioned the lack of such training opportunities. Concerning the *Water sports*, the majority of the experts mentioned the absence of related training programmes. In Greece, the majority believe that new training programmes are needed. Experts from the Hungarian survey pointed out the need of new training programmes (levels I and II) or revealed a aspect that they don't have a clear opinion on that level III). In Romania, the positive aspect that the available training programmes are efficient to educate the related job occupations was mentioned by 40% for the Domestic water use, 25% for the *Transportation* and *Water sports* for 60%.

Finally, the respondents gave equal portions for the levels I, II, IV and V of the existent training opportunities for the employees of the domain Recreation use of water resources (11-20%). Contradictory, 35.56% of the answers identify a basic level for the training programmes that already exist. In Germany and Greece, the experts mentioned the lack of related training programmes. In Hungary, equal percentages of 33.33% of the experts chose the option lack, existence or expressed a neutral opinion. Finally in Romania, the majority of the experts state a neutral opinion (level III).

Conclusions and Discussions

In the past, a lot of theories and opinions have been put across for the better depiction of the term competence (McClelland, 1973, Spencer and Spencer, 1993, Hoge *et al.*, 2003). Nowadays, the necessity of competences and competence models have been proved inextricable tools in designing, and developing the vocational training and creating experts and specialized employees in accordance with the industry demands.

In that way, the case of the implementation of the competence models and the identification of the required and future competences should be taken place in the job professions of the water sector. The determination of the requirements of the experts from the water sector in general divulges the variation of experts needs from different domain of the water sector as well as the different European country.

In total, the survey participants come from the Public Sector (Ministries and Local / Regional administrations), having critical position into the process of making decisions for the Water Sector. The next important representative group is the staff of formal education, playing a major role in the education of the people who are going to involved in related jobs with the Water Sector. Their research and work fields are more corresponding to the Wastewater and *Sewage management*, *Water supply* and *Environmental protection*. Domain of *Legislation* is also included in the selected domains of the German participants. The work and research fields of the Greek experts are also correlated with the *Hydrology*, *Hydraulic engineering* and *Irrigation*. Option of Domestic water use is presented in the answers of the Hungarian Romanian survey. In addition, participants in the Romanian survey select the Legislation.

Concerning the experts' level of understanding, almost all of them have already known the word competence, since the incorporation of new technologies into the Industry boosting the necessity for more specialized and competent personnel. Also, the term competence model, a number of competences, seems to be well-known in a smaller percentage of the experts. Exploring the common understanding on the usefulness of the competence model in the better description of the job profiles, the majority of experts keep an neutral side, which it means that further information and explanation is needed. The results on the experts' awareness of usefulness of competence model in job description and the usefulness of the competence model in the water sector are presented in the following table 1.

When experts were asked for the usefulness of the competence model in the water sector most of them replied positive, mentioning the benefits for individuals as well as the organization and vocational training providers.

Concerning the educational level of the job professions and specializations in the water sector, the domains of Wastewater and Sewage treatment plants, as well as the *Water supply* seems to include a great number of enough competent employees in all countries. People from the domain of *Hydrology* are also well performed for the most of the participated countries in the survey.

As about the existence of the training opportunities, the diversity among the different water sector domains is interesting. A sufficient number of training programmes are available in all countries for the Wastewater and Sewage treatment, Water Supply, *Hydrology*, Hydraulic engineering, *Environmental protection*. Design of new training programmes is also needed for *Transportation*, *Water sports* and Recreational Uses, water use in *Animal husbandry* and *Desalination plants*. Differentiation of the existence of training courses among European countries is presented for the *Irrigation*, Legislation, Hydroelectrical and *Geothermical* plants and Domestic water uses. This outcome in comparison with the lack of sufficient performance of employees in some of the water sector domains could be proved helpful for the design of new courses or the improvement of the already existed.

Water supply, Wastewater, and *Sewage management* could be the fields of the water sector for the first implementation of the competence model. These domains include a considerable portion of well performed and skilled people and a lot of available training opportunities. The concept of knowledge, skills and Competences have been described and analyzed in details for the related job tasks and specializations. In that case, the implementation of the competence tools is essential and feasible. Next to these, *Hydrology*, Hydraulic engineering, *Environmental protection* and *Irrigation* could be the water sector domains for further testing and evaluation of the Water Competence Model.

Awareness	Usefulness of Competence Model in the job description in general			Usefulness of Competence Model in the Water Sector		
	Low	Neutral	High	Low	Neutral	High
Overall		x				x
Germany		x				x
Greece		x				x
Hungary		x				x
Romania		x				x

Table 1: Experts' awareness of the usefulness of the competence model in the job description in general and into the water sector.

Adaptation of the Water Competence Model	
Pilot testing of the Model	Wastewater Treatment Plants Sewage Treatment Plants Water Supply
Further testing and evaluation of the Model	Hydrology Hydraulic Engineering *Environmental protection* Agricultural Use: Irrigation

Table 3: Water sector domains for pilot testing and further testing of the Water Competence Model.

The main outcomes and important clues for the design and development of the Water Competence Model can be concluded in the following lines:

1. Understanding the experts' awareness on the competence modeling
2. Analyzing the experts' opinion on the need and usefulness of Water Competence Model
3. Recording the level of the competence-based education of the personnel in the water sector
4. Describing the existence of the training opportunities in all the water sector domains
5. Defining the diversities on the need of competence model among the water sector divisions and European countries
6. Establishing of the domains for the pilot testing of the Water Competence Model
7. Determining the water sector domains for further testing and evaluation of the competence model
8. Enhancing the training opportunities by suggesting the design of new training programmes or improving the already existed training courses

Implications for Further Research and Practice

The design and development of competence models should be drawn according to the preferences, requirements, and innovations of each professional learning sector in which they will be implemented. The water sector is a wide range sector with a lot of fields of work and research and plenty of job professions and specializations. European policies have been developed and adopted for the protection and sustainable utilisation of water creating a huge demand in particular in the vocational training. This work provides the main lines and the tools for recording the specific requirements and needs of the domains of the water sector in order to develop a successful and applicable competence model for this Professional Learning Sector.

The Water Competence Model should be drawn heavily on the experience of competent personnel and to focus on the relationships emerge from these

people working in different workplaces or accomplishing different tasks. An investigation of the cases of many successful companies and organizations will assist in the better identification and description of the key and important competences for a number of occupations.

Courses need to be redesigned and created in order to meet the high-level competence needs of the job professions in an organization. In that way individuals and employees can take advantage of the new career opportunities in their work field and become more professionalized.

Implications for further research and practice is mainly referred to the detailed description of the job content and the job tasks, as well as the required competences as sets of knowledges and skills. The most valuable and vital issue for the successful development of the Water Competence Model is its implementation in a specific field of the water sector and its evaluation for the continuous improvement for the utilization from all the water sector domains.

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Corresponding authors:
Charalampos Thanopoulos
Agro-Know Technologies, Greece
e-mail: [cthanopoulos; nikosm]@agroknow.gr

Christian M. Stracke
University of Duisburg-Essen (UDE), Germany
e-mail: Christian.Stracke@icb.uni-due.de

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