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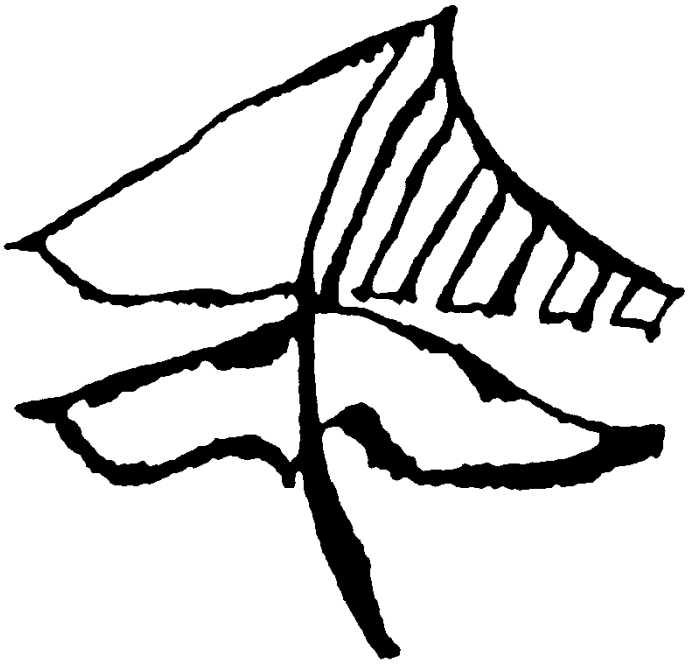

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intercathedra@intercathedra.pl

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CONTENTS

Dear Readers!

The *Intercathedra 2012* quarterly, which publishes a range of scientific papers from various universities, resulted from the co-operation of Central European academic research centers. The papers primarily relate to economic issues in the following areas: economy, management and marketing, especially but not exclusively, in the forest and wood products industry as well as other related fields.

We are pleased to provide you with the Second Edition of *Intercathedra 2012*. This edition marked as 28/2 includes, inter alia, papers which will be discussed at international scientific conferences: the Economic Forum 2012 in Laski and InterEconoMIX in Poznań. Especially invite You to participate in InterEconoMIX 2012 - the new conference on "A Young Researcher's Perspective on the Main Economics Issues", at the Poznań University of Life Sciences on 24 November 2012. The details of the conference informs Website: www.intereconomix.pl – please be sure to visit.

However, this year's Economic Forum, held in Laski near Kępno, at the Conference Center of Poznań University of Life Sciences on 18 - 20th September 2012, concerned "Problems of economics and business management of the wood industry enterprises in the perspective 12+ years of the third millennium".

Academic conferences known as the Economic Forum have been taking place annually since the early nineties of the 20th century. The Economic Forum 2012 was organized - as is tradition – by the Department of Economics and Wood Industry Management of Poznań University of Life Sciences.

The Economic Forum 2012 has been the 28th international scientific meeting of academic researchers conducting scientific work in common and related areas of research. This meeting brings together engineers, specialists in particular sectors as well as young scientists and entrepreneurs. These initiatives are supported by IATM – the International Association for Technology Management, an international scientific organization, which brings together the universities of Central Europe that conduct research in the field of economics and management in industry, in particular in the forest and wood industry.

Intercathedra 2012 has been issued under the auspices of IATM, whose members provided materials for the volume, were responsible for its review, and prepared both mentioned scientific conferences. They deserve our deepest gratitude.

We cordially invite you to read this volume.

Wojciech Lis

Judyta Cabańska[1]

IMMIGRATION AS A FACTOR OF POPULATION GROWTH IN THE EUROPEAN UNION MEMBER STATES

Abstract: For several years, the European Union faced the problem of aging population. It results from the low rate of natural change. However, the EU-27 population has been growing without a break for the last few years. This paper focuses on the importance of immigration in creation of population growth.

Key words: migration, European Union, population growth, foreigners in the European Union

INTRODUCTION

Population stock is influenced by combination of natural change (the difference between live births and deaths) and net migration (including statistical adjustment)[2]. In the light of the ongoing trend of population ageing experienced in the EU, international migration plays a significant role in the size and structure of population in most EU Member States. Relative economic prosperity and political stability of the EU are thought to have exerted a considerable pull effect on immigrants. The aim of the paper is the presentation of the impact of immigration on the population stock of EU Member States. An additional purpose of this article is the description of the share of foreigners in the EU-27 population.

This research concerns the size and structure of immigration in EU Member States, focusing especially on breakdown by origin and destination countries. Origin countries were also subdivided by level of development. Figures given in this paper represent not only migration flows to/from the EU as a whole, but also include flows between different EU Member States. The author presents the latest available figures on immigrants and foreign population in the EU-27 (most recent data is available for the years 2009, 2010 or 2011 - according to the issue presented). In order to indicate trends of the migration process and population growth, the latest figures were compared with figures covering the last twenty years .In this article the method of statistical analysis has been used, based on the Eurostat database.

POPULATION STOCK IN EUROPEAN UNION MEMBER STATES

The EU-27 population has been growing without a break for the last few years. On 1 January 2012, the EU-27 population topped over 503 million. This is almost 1 million more than a year before. In the last three years the population grew at a slower pace than prior to 2008, when an annual total population growth of more than 4.0 per 1000 inhabitants per year was registered for several consecutive years (Figure 1.) [3].

Figure 2 shows contributions made by natural change and net migration (including statistical adjustments) to population change in 1990-2011. The contribution of natural change to population growth has been less significant than that made by net migration since 1992. In 2003, natural change ratio fell to its historical low (0.21). Since then, it accounted for an increasing proportion of total population change. In 2011, natural change added 0.4 million (30%) to the total population growth in the EU-27 (over 0.1 million less than the year before) Net migration (including statistical adjustments) contributed 0.95 million (69%) [4].

[1] *Poznan University of Economics, Department of European Studies, ul. Powstańców Wielkopolskich 10, 60-854 Poznań, judyta.cabanska@ue.poznan.pl*

[2] *Net migration is calculated as the difference between the total change in the population and natural change.*

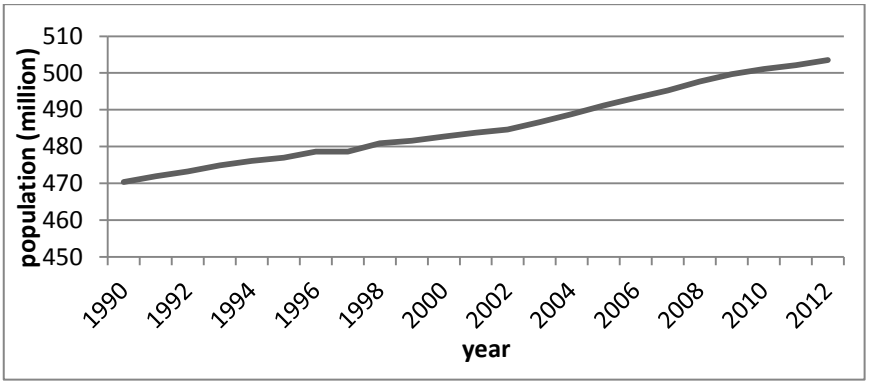

Figure 1. Population stock in the EU – 27 in 1990-2012 (as of 1 January).

Source: own study based on [1]

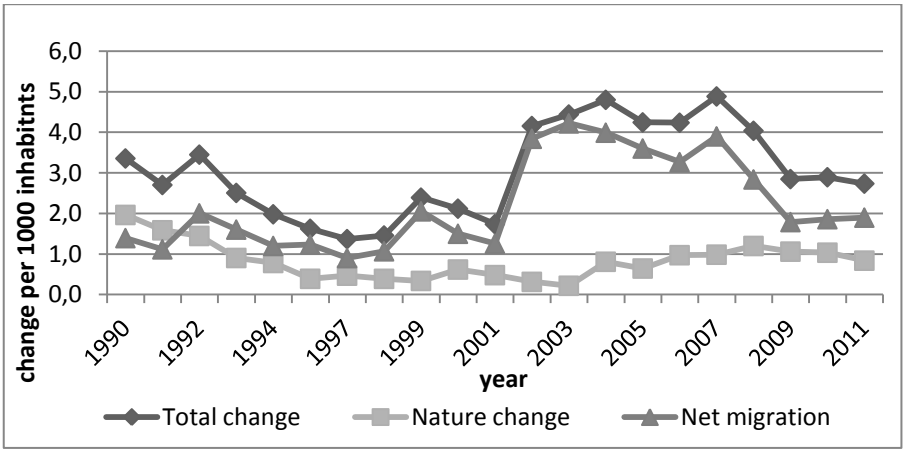

Figure 2. Crude rates of population change in EU-27

Source: own study based on Eurostat database [2]

The relatively low contribution made by natural change to total population growth is the result of low number of live births and high number of deaths as well as considerable increase in net migration in the EU-27 since 1990s. The increase in total population in most EU Member States in recent years was mainly due to high net migration [11].

IMMIGRATION TO THE EUROPEAN UNION MEMBER STATES

International migration has significant impact on the size and structure of population in many EU Member States. Net migration has became the main determinant of population growth. The population of EU Member States has increased, on average, by 1.7 million per year, solely because inflows outweighed outflows. Although, in 2009, emigration from EU Member States increased and immigration fell, this still resulted in net migration, which contributed to the majority of the total population growth. It is predicted that the downward trend in immigration to EU Member States, which started in 2008, will be continued in the next years. The provisional immigration and emigration figures for 2010 indicate that a similar trend has also been observed in most EU Member States [5].

During 2009, about 3.0 million people immigrated into one of the EU Member States. The latest figures available reveal a substantial decline in immigration in 2009 as compared with 2008. In

2009 the EU Member State recording the largest number of immigrants was the United Kingdom (566 500) followed by Spain (499 000) and Italy (442 900). These three countries recorded over half (50.3 %) of all of the immigrants into EU Member States. In relation to the size of the resident population (see Figure 3) Luxembourg (with 31.4 immigrants per 1 000 inhabitants) had the highest immigration in 2009, followed by Malta (17.4), Slovenia (14.8) and Cyprus (14.5).

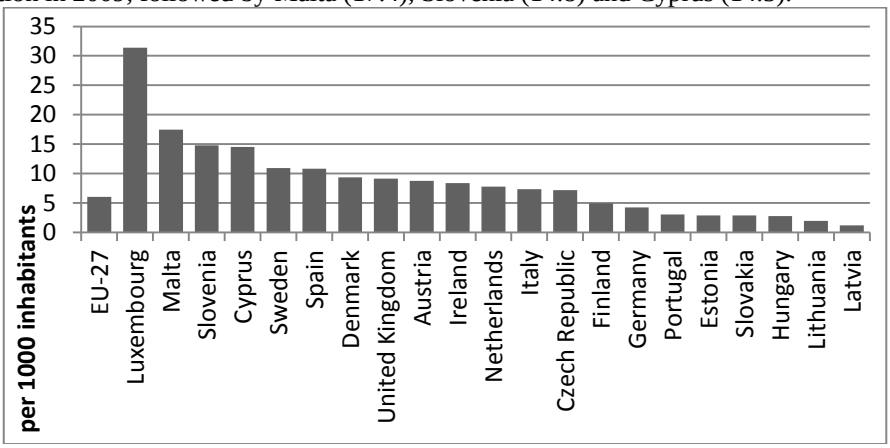

Figure 3. Immigrants in EU Member States in 2009 (per 1 000 inhabitants)[3]

Source: Eurostat database (online data codes: migr_imm1ctz and migr_pop1ctz)

It should be noted that these figures do not represent the migration flows to/from the EU as a whole. They also include flows between different EU Member States. Immigrants include not only foreigners (people who are not citizens of the destination country), but also nationals, i.e. citizens of that Member State (former emigrants returning 'home' and citizens born abroad who are immigrating for the first time).

In 2009, more than half of the immigrants (51 %) into the EU Member States (an estimated 1.6 million people) were citizens of non-member countries, 31 % were citizens of other EU Member States and 18 % were nationals. Immigrants from outside the EU (excluding EU candidates and EFTA countries) can be subdivided according to the level of development of their previous country of residence, based on the Human Development Index (HDI)[4] [9]. According to this indicator, more than half of the immigrants to the EU came from medium-developed countries, 30 % were previously residing in highly developed countries and only 10 % in less-HDI countries. This case is not consistent with the neoclassical theory of migration, according to which the economic disproportion between different regions is considered as a motivation for the decision about migration. There are a lot of doubts on the neoclassical theory. In fact, citizens of the poorest countries rarely move to high developed countries [2]. Contrary to the assumption of the neoclassical theory on treating migration as a mechanism for regulating the level of remuneration for work, migration does not contribute in reduction of differences in earnings, and sometimes even results in deepening of those differences [1].

FOREIGNERS LIVING IN THE EU MEMBER STATES

The total number of foreigners (people who are not citizens of their country of residence) living on the territory of an EU Member State on 1 January 2011 was 32.5 million persons, representing

[3] *Data on the number of immigrants in Belgium, Bulgaria, Greece, France, Poland and Romania is not available.*

[4] *HDI - Human Development Index is calculated by the United Nations under the United Nations Development Programme (UNDP). It is a composite measure used to rank countries worldwide by level of development based on statistics for life expectancy, literacy, education and standards of living (for details see http://hdr.undp.org/en/statistics/hdi/). The country classification used by Eurostat is based on the UN Human Development Index for 2006.*

6.6 % of the EU-27 population. The majority of non-nationals came from outside the EU (20.5 million) and more than one third (12.8 million) of them were citizens of another EU Member State (Table 1).

Table 1. Total population and resident non-national population by group of citizenship in 2011[5]

Total population (1 000)	Non-nationals					
	Total		Citizens of other EU Member States		Citizens of non-member countries	
	(1 000)	(%)	(1 000)	(%)	(1 000)	(%)
502 510	33 306	6,6	12 805	2,5	20 500	4,1

Source: own study based on the Eurostat database (online data code: migr_pop1ctz)[6]

In absolute terms, most non-nationals living in the EU were reported in Germany (7.1 million on 1 January 2011), followed by Spain (5.6 million), Italy (4.5 million), the United Kingdom (4.4 million), and France (3.8 million). Non-nationals in these five Member States collectively represented more than three quarters of the total number of non-nationals living in the EU-27. In relative terms, the EU Member State with the highest share of non-nationals was noted in Luxembourg, where the vast majority of non-nationals came from other EU Member States [10].

34.8 % of nationals from non-member countries living in the EU-27 in 2011 came from a high-HDI country, while a higher share (56.2%) possessed the citizenship of medium-HDI countries, and the remaining 8.9 % of nationals of non-member countries living in the EU were from low-HDI countries (Figure 4).

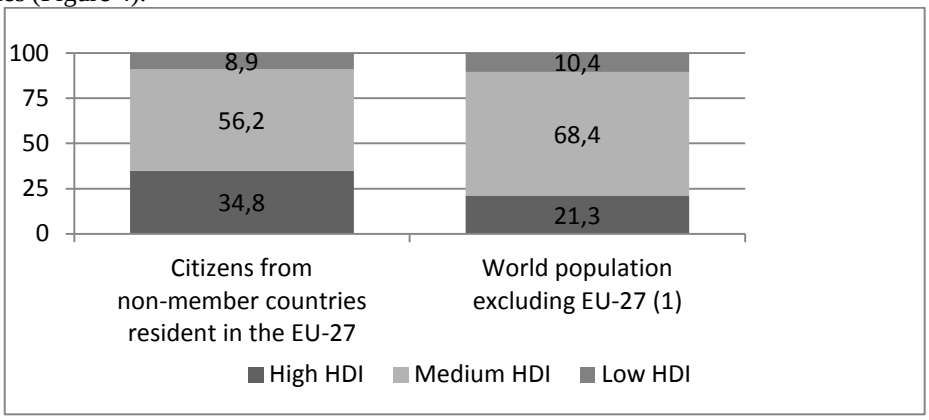

Figure 4. Non-EU citizens analysed by level of Human Development Index (HDI), 2011, (%).

Source: own study based on [8]

A breakdown of the world's population according to the Human Development Indicator shows that the largest share of global inhabitants is accounted by medium-HDI countries (68.4%). Only 21.3% people live in the high-HDI group and 10.4% in the less development countries. The citizenship structure of the population of non-nationals living in the EU is influenced by following factors:

- historical links between origin and destination country,
- labour migration (low earnings in origin country),
- established networks in destination countries [10].

[5] *EU-27 rounded totals are based on estimates; the individual values do not add up to the total due to rounding.*

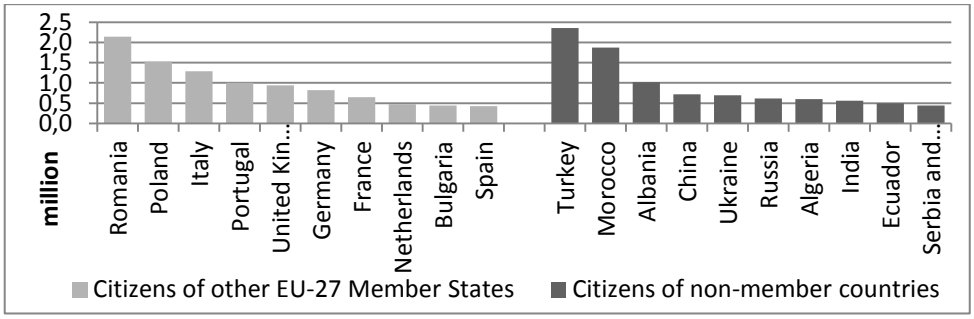

Figure 4. Main countries of origin of non-nationals, EU-27, 2010

Source: Eurostat database [7]

The largest group of non-nationals living in the EU in 2010 was Turkish (2.4 million people, 7.2% of all foreigners). Romanians made up the second biggest group (2.1 million people,6.6% of all non-nationals), followed by Moroccans (1.9 million people, 5.7%).

CONCLUSIONS

International migration plays a significant role in the size and structure of population in most EU Member States. Immigration has significant influence on population change. Number of foreigners living in the EU has been growing for the last few years. However, migration alone will almost certainly not reverse the ongoing trend of population ageing experienced in many parts of the EU.

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Miroslav Gombár[6], Ján Dobrovič[7], Ján Kmec[8], Alena Vagaska[9], Ľuba Bičejová[10]

ANALYSIS OF ELECTROPLATED NICKEL COATING THICKNESS

Abstract: The paper deals with analysis of the nickel coating thickness created by electrolytic nickel plating (also called galvanic nickel plating) using the Custom Design. As the basic type of electrolyte chloride electrolyte containing nickel chloride (NiCl2). was used. The effect of chemical factors was studied in an experimental procedure including: the amount of nickel chloride, boric acid, brightener additives Ni 1051, Ni 163, detergent Ni 165 and the effect of physical factors: the temperature of electrolyte, plating time and the total voltage at a constant current density of 1 A.dm2

Key words: design of experiments, nickel electroplating, nickel coating thickness

1. INTRODUCTION

The protective value of electroplated coatings is based on the ability to provide superior corrosion protection for deposited metal. Various factors should be considered for affecting this ability. First of all it is the thickness of the coating and its uniformity, then corrosion properties of the coating and base metal, and the electro-chemical bond between coating and deposited metal and the environment. Although the deposited film itself can provide complete protection for the basic metal, its other properties may cause that the coating will be unusable for the chosen purpose.

Generally speaking, the corrosion resistance of non porous electroplated coatings is essentially the same as the properties of cast metals and their alloys of the same composition. Knowledge of the corrosion properties of the base metals and their alloys is the basis for the correct choice of special purpose coatings. The basic factors affecting the corrosion resistance of electroplated (galvanic) coatings are:

1) environment,
2) coating types and the influence of base metal.

Ad.1) Effects of environmental factors

The durability of electrolytic coatings depends on a number of factors. The determining factor is environment/atmosphere. According to its effect on the electrolytic (galvanic) coatings, the atmosphere can be divided into two basic types.

The indoor atmosphere is the first type. It occurs in dry and covered places that are protected against to the rain and wet, i.e. indoor environment.

The second type is the outdoor atmosphere, which can be divided into:

a) industrial and urban atmosphere,
b) coastal and marine atmosphere,
c) tropical atmosphere,
d) rural atmosphere.

Generally speaking, the industrial atmosphere, marine atmosphere and tropical atmosphere affect coating least favourably. The rural atmosphere is the least harmful. Lead deposits present an exception to this rule.

Industrial and urban environments generally have high levels of atmospheric impurities such as automobile emissions, sulphurous gases and high rates of the by-products of the combustion of fuels, which elevate sulphur dioxide and nitrogen oxide concentrations. The high chloride

[6] *Ing.Miroslav Gombár, PhD., FVT-Prešov,TU-Košice, Bajerová 1,Prešov, miroslav.gombar@tuke.sk*
[7] *Ing.Ján Dobrovič, PhD., PÚ-Prešov,Fakulta manažmentu, Konštantínova 3,Prešov, jan.dobrovic@unipo.sk*
[8] *Doc.Ing.Ján Kmec, CSc., PÚ-Prešov,Fakulta manažmentu, Konštantínova 3,Prešov, doc.kmec@gmail.com*
[9] *PaedDr.Alena Vagaska, PhD., FVT-Prešov,TU-Košice, Bajerová 1,Prešov, alena.vagaska@tuke.sk*
[10] *Ing.Ľuba Bičejová, PhD., FVT-Prešov,TU-Košice, Bajerová 1,Prešov, luba.bicejova@tuke.sk*

containing contaminants are typical for the coastal and marine atmosphere, while tropical areas are characterized by high temperature and humidity. So we can see that electrolytic coatings can be influenced by various factors. Also using of salt in the winter to remove snow and ice from roads is very harmful to the durability of coatings used in automotive industry.

Ad.2) Coating types and the influence of base metal

According to mechanism protection of the metal base by coating we can distinguish:

a) anode coatings - electronegative coatings in relation to base metal, they are made of metal, which shows lower potential than the metal base one in a specified corrosion environment,
b) cathode coatings – electropositive coatings made of metal, which show electrochemical potential higher than metal base potential in a specified corrosion environment.

The first group includes zinc and cadmium coatings on steel surfaces; other commonly used coatings belong to the second group. It should be noted that the value of the potential difference that may exist between the base metal and coating depends not only on the metals but also on the environment. Electronegative coatings are less noble than base metal and can be characterized by their ability to protect metals against corrosion in any level of coating porosity. The amount of used electrolyte and its conductivity is an important factor in this reaction.

Electropositive coatings are much more noble than the base metal on which they are deposited. As with anodic coatings, an electrolyte is necessary for this reaction. Electropositive coatings tend to support corrosion of the base metal if they are porous. The protective value of cathode coating is depended on the ability to create uniform, non porous film to isolate the metal base surface from surrounding environment.

2. NICKEL PLATING AND NICKEL ELECTROPLATED COATINGS

Nickel plating is the electrolytic deposition of a layer of nickel on a substrate. The process involves the dissolution of one electrode (the anode) and the deposition of metallic nickel on the other electrode (the cathode). Direct current is applied between the anode and the cathode. Conductivity between the electrodes is provided by an aqueous solution of nickel salts. When nickel salts are dissolved in water, nickel is present in solution as divalent, positively charged ion (Ni^{2+}). When current flows, divalent nickel ions react with two electrons and are converted to metallic nickel (Ni^0) at the cathode.

Nickel coatings are the most widely used because they meet the requirements of decorative appearance as well as corrosion protection. The corrosion resistance of electropositive nickel coating is closely related to the thickness of the deposit.

Nickel is particularly useful for corrosion resistance in almost all types of environments. In decorative applications, electroplated nickel is most often applied in combination with electrodeposited chromium. The thin layer of chromium is electrodeposited over nickel coating in order to improve decorative appearance. A thin layer of silver, gold, copper, platinum or tin is used in special cases.

Nickel electroplating is a commercially important and has a versatile surface-finishing process. Nickel coatings are often used to recover the surface of worn or corroded machine parts. Nickel coatings are also used to protect operating equipments.

It is interesting that modern multilayered nickel coatings of different composition offer better corrosion protection than a single nickel layer of equal thickness in certain atmosphere conditions.

3. EXPERIMENTAL PROCEDURE

A frequent goal of experiments in technological and engineering practice is to establish relations and connections between certain variables of the investigated process. It especially refers to the cases when the process is too complex and there is no suitable mathematical - physical - chemical model. The most common goal of the experiment is to determine how certain factors affect the observed variable, often called the response. The data required to build the model can be obtained by observing the variables of the investigated process.

The statistically designed experiments ensures that experiments are designed economically, that they are efficient, that individual and joint factors effects can be evaluated and by limiting the number of test runs we can obtain maximum information. In the experimental design theory the terminology is not uniform across disciplines, so it should be noted that experiment represents a set of test runs. Generally experiment is considered to be a larger entity formed by the combination of a number of trials, i.e. efforts (measurement and observation).

To analyse the nickel coating thickness in our experiment, the following parameters of the nickel plating process were investigated: the amount of nickel chloride, boric acid, brightener additives Ni 1051, Ni 163, detergent Ni 165 and the effect of physical factors: the temperature of electrolyte, plating time and the total voltage at a constant current density of 1 A.dm-2. As the basic type of electrolyte was used chloride electrolyte containing nickel chloride (NiCl2). The Custom Design was chosen in order to implement the research. The matrix of this experimental design for eight independent variables is shown in Table 1.

Table 1. The matrix of experimental Custom Design

Combination Number	x_1	x_2	x_3	x_4	x_5	x_6	x_7	x_8
1	-1	1	-1	1	1	-1	1	-1
2	1	-1	1	1	1	-1	1	-1
3	-1	-1	1	1	-1	1	1	1
4	1	1	1	1	-1	-1	1	1
5	1	-1	-1	1	-1	-1	-1	-1
6	1	1	-1	-1	1	-1	-1	-1
7	1	-1	1	-1	1	1	-1	1
8	-1	-1	-1	-1	1	-1	-1	1
9	-1	1	-1	1	-1	1	-1	-1
10	-1	-1	1	-1	-1	-1	1	-1
11	-1	1	1	-1	-1	-1	-1	1
12	-1	1	-1	1	1	1	1	1
13	1	1	1	-1	1	1	1	-1
14	1	-1	-1	1	-1	1	-1	1
15	-1	-1	1	1	1	1	-1	-1
16	1	1	1	1	1	-1	-1	1
17	1	1	-1	-1	-1	1	1	1
18	-1	-1	-1	-1	1	-1	1	1
19	-1	1	1	-1	-1	1	-1	-1
20	1	-1	-1	-1	-1	1	1	-1
21	0	0	0	0	0	0	0	0
22	0	0	0	0	0	0	0	0

The actual experiment was carried out under the conditions listed in Table 2.

Table 2. Actual experimental conditions

Coded factor	factor	unit	Factor level		
			-1	0	1
x_1	$NiCl_2$	$g.l^{-1}$	0,1375	0,2625	0,3875
x_2	H_3BO_3	$g.l^{-1}$	0,0175	0,0350	0,0525
x_3	Ni163	$ml.l^{-1}$	0,0075	0,0175	0,0275
x_4	Ni1051	$ml.l^{-1}$	0,0025	0,0075	0,0125
x_5	Ni165	$ml.l^{-1}$	0,0025	0,005	0,0075
x_6	Temperature of electrolyte	^0C	40	55	70
x_7	Plating time	min	10	30	50
x_8	Voltage	V	2	5,5	9

The cathode current density JK of the value 1 A.dm-2 and material of electroplated sample E355 with dimension 100 × 70 × 0,5 mm were considered to be constant during experimental procedure.

Ni1051 – represents brightener addition agent, which offers extremely bright nickel coatings of excellent throwing power even at a very low thickness over a wide range of cathode current density.

Ni163 – basic component, its main function is to provide deposits with increased lustre and decrease internal tensile stress.

Ni165 – surfactant (also called wetting agent) for the baths agitated by cathode bar motion, its function is to control pitting and lower the surface tension of the plating solution so that air and hydrogen bubbles do not cling to the parts being plated.

4. RESULTS AND DISCUSSION

Screening analysis of experimentally obtained data (Figure 1) pointed to the influence of three fundamental factors, namely addition of agents Ni1051, Ni165 and the temperature of the electrolyte.

Term	Contrast		Lenth t-Ratio	Individual p-Value	Simultaneous p-Value
	0,651215		2,00	0,0625	0,5750
	0,597821		1,83	0,0802	0,6861
	0,573031		1,76	0,0906	0,7358
X3	0,531079		1,63	0,1120	0,8148
X1	-0,286039		-0,88	0,3524	1,0000
X2	-0,217389		-0,67	0,4924	1,0000
X8	0,076277		0,23	0,8181	1,0000
X7	-0,073417		-0,23	0,8246	1,0000
X5*X5	-0,254707		-0,78	0,4074	1,0000
X5*X4	0,184850	*	0,57	0,5869	1,0000
X5*X6	-0,410916	*	-1,26	0,1967	0,9720
	0,601407	*	1,84	0,0788	0,6783
X5*X3	-0,184629	*	-0,57	0,5877	1,0000
X4*X3	0,386655	*	1,19	0,2197	0,9862
X6*X3	-0,143959	*	-0,44	0,6705	1,0000
X5*X1	-0,202642	*	-0,62	0,5537	1,0000
X4*X1	0,129161	*	0,40	0,7011	1,0000
X6*X1	0,097180	*	0,30	0,7718	1,0000
X3*X1	-0,224007	*	-0,69	0,4684	1,0000
X5*X2	-0,051063	*	-0,16	0,8790	1,0000
Null22	-0,120605		-0,37	0,7203	1,0000

Figure 1. Screening analysis of the experiment

Fundamental results of statistical analysis are shown in Table 3 and in Table 4.

Table 3. Fundamental results of statistical analysis

Parameter	Value
RSquare	0,624861
RSquareAdj	0,536592
RootMeanSquareError	1,101804
MeanofResponse	9,674545
Observations (or SumWgts)	22

Table 4. Analysis of variance

Source	DF	SumofSquares	MeanSquare	F Ratio
Model	4	34,375421	8,59386	7,0791
Error	17	20,637525	1,21397	Prob> F
C. Total	21	55,012945		0,0015*

Based on these results it can be stated that adjusted coefficient of determination as well as the explanation degree of variability in the data by used model is 53,66%. Based on Fisher-Snedecor test criteria at the significance level of $\alpha = 5\%$, the model is adequate so it is possible to use it for next analysis.

The analysis of factor effects on the nickel plating process with chloride electrolyte (Table 5) with cathode current density JK = 1 A.dm-2 confirms the fact that the amount of thrown brightener addition agent Ni1051 is the most significant independent variable. Other significant factors are additive brighteners Ni163, the temperature of electrolyte and linear combination of factors x4.x6. The absolute term (Intercept) has the greatest impact on the coating thickness. It can be caused by the type of designated experiment, respectively by the choice of the scale of independent variables in experimental procedure. The absolute term also represents the influence of other neglected factors. It should be noted that the results of the mathematics-statistical analysis are only valid within the range of the used intervals of the factors.

Table 5. Parameter Estimates

Term	Estimate	StdError	t Ratio	Prob>|t|
Intercept	9,6745455	0,234905	41,18	<,0001*
x_5	0,5389583	0,251451	2,14	0,0468*
x_4	0,627	0,246371	2,54	0,0209*
x_6	0,601	0,246371	2,44	0,0260*
$x_4.x_6$	0,7202083	0,251451	2,86	0,0107*

The effects of significant factors are obvious from Figure 2. It can be said that all statistically significant factors (shown in Table 5) show a directly proportional effect on the coating thickness, i.e. increasing values of individual factors within the range of the used intervals increases the value of the observed parameter.

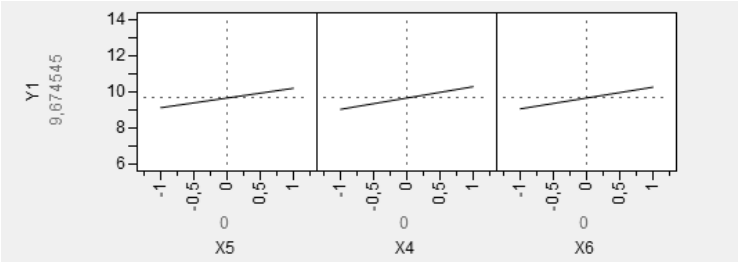

Figure 2. Effects of significant factors

Based on the analysis of the performed experiments, the mathematical-statistical predictive model of the nickel coating thickness was developed according to the statistically significant factors. The general statistical model can be entered in the form:

$$y(h) = b_0 + b_4.x_4 + b_5.x_5 + b_6.x_6 + b_{46}.x_4.x_6 \quad (1)$$

If we substitute the results from the Table 5 to the equation (1), the general equation can be specified in the form:

$$y(h) = 9{,}67 + 0{,}63.x_4 + 0{,}54.x_5 + 0{,}60.x_6 + 0{,}72.x_4.x_6 \quad (2)$$

Consider DoE coding of elementary factors according to the formula (3)

$$x_d(i) = \frac{x_i - \frac{x_{max} + x_{min}}{2}}{\frac{x_{max} - x_{min}}{2}} \quad (3)$$

x(i) – real fundamental variables, i = 1, 2, .., k; k – the number of fundamental factors,
xd(i) – coded variables according to the DoE method,
xmax – the maximum value of the real variable x(i),
xmin – the minimum value of the real variable x(i).

Using the inverse transformation of individual factors the equation (2) can be written as follows:

$$h = 9{,}405 + 216{,}000.m(Ni165) - 402{,}000.m(Ni1051) - 0{,}032.T + 9{,}600.m(1051).T \quad (4)$$

From the statistical analysis of performed experiments the final predicting mathematical formula (4) including only significant factors at the chosen level of α = 5% was obtained. In the following figures (3, 4) the graphical representation of the spatial dependence of studied parameters is shown.

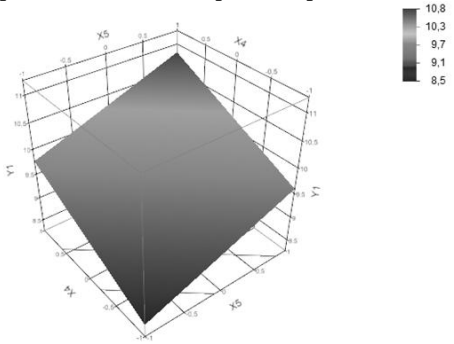

Figure 3. Spatial dependence of the coating thickness (Y1) on the factors x4 and x5

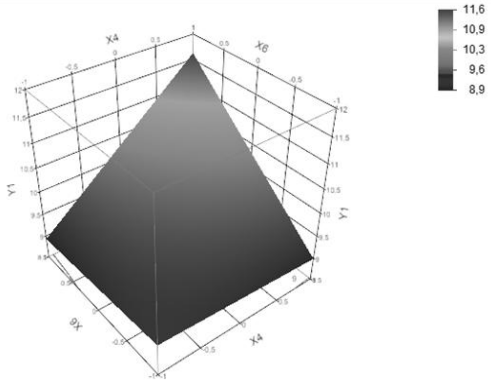

Figure 4. Spatial dependence of the coating thickness (Y1) on the factors x4 and x6

CONCLUSION

The statistical analysis was carried out on the experimental results obtained from a self-designed experiment with 22 test runs. The main effect and interaction effect of fundamental chemical and physical factors to the nickel electroplated nickel coating were estimated. The following can be concluded:

- the amount of brightener addition agents Ni163, Ni1051 and the temperature of electrolyte are significant factors at significance level alpha 0,05;
- the amount of thrown brightener agent Ni1051 appears to be the most influential factor;
- the predictive equation (4), expressing the effect of individual factors on the final nickel coating thickness, explains the variability of independent parameter in 53,66%. So there exists a 46% unexplained variability. The high value of the absolute term also confirms this, see Table 5;
- with the increasing value of significant factors, the resulting coating thickness also increases, Figure 2;
- it is possible to achieve the maximum values of the deposited coating thickness at the upper limit of the selected interval of statistically significant factors.

For future research in the field of electrolytic nickel plating it is necessary to use other types of designed experiments and to spread intervals of individual independent parameters in order to achieve more objective results.

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Julia Gościańska[11]

ENERGY EFFICIENCY IN AGRICULTURE IN WESTERN POLAND

Abstract: There is an urgent need to improve energy efficiency in the European Union. In order to enable end-users to make rational decisions, there is a need to provide them with better knowledge. Local actions should give information about available energy efficiency improvement techniques, technical characteristics of machines, transport and energy consuming equipment. The selected field of research was the agriculture sector. The changes in the agricultural sector in the late 90's, initially did not contribute to a decline in energy consumption. The current situation clearly shows that among selected European countries, Poland has a relatively high energy consumption in this sector. The paper shows how these issues are understood by representatives of the agricultural sector**.**

Key words: energy, efficiency, energy efficiency, European Union, agriculture, farmers.

INTRODUCTION

Nowadays one of the crucial concerns is global warming as a consequence of a lack of innovation and technological progress in the energy sector, our bad habits and GHG emission. It has a significant impact on climate change and the new standard of living of the population. Consumption of energy plays a fundamental role in modern society. In all scenarios that are being made, the electrification of society is set to continue [7]. The Lisbon Strategy set social, economic and environmental goals to underline the need to modernise Europe's economy. The main challenges today are to create and link new policies to international agreements and manage to keep development and environment in close relationship. It is the only way to achieve success [4].

In the European Union, there is an urgent need to improve the efficiency of energy use especially by end users. Improving energy efficiency leads to a reduction in the energy intensity of the economy which is positive from every point of view. It does not carry any dilemma associated with the economic deterioration in the competitiveness of industry, agriculture, transport, etc. (such as emission charges). In order to enable end-users to make rational decisions about energy use, we need to provide them with better knowledge, facilitate them to take appropriate action. They should be aware of energy consumption and obtain information on available energy efficiency improvement measures, technical characteristics of machinery, vehicles and equipment that consume energy [2]. Information on the comparison of end-user profiles and their technical equipment can be a motivating factor for savings and objectively indicate how to achieve energy savings. Also an important issue is the promotion of rational energy consumption. In a special way this applies to people working on farms. This is due to the fact that agriculture is a sector of the economy, which consumes large amounts of energy and which has a very strong impact on the environment, water quality, soil, air and biodiversity. The current situation clearly shows that among selected European countries, Poland has a relatively high energy consumption in this sector (see Figure 1).

[11] *University of Economics, Faculty of Commodity Science , Al. Niepodległości 10, 61-875 Poznań, julia.goscianska@ue.poznan.pl*

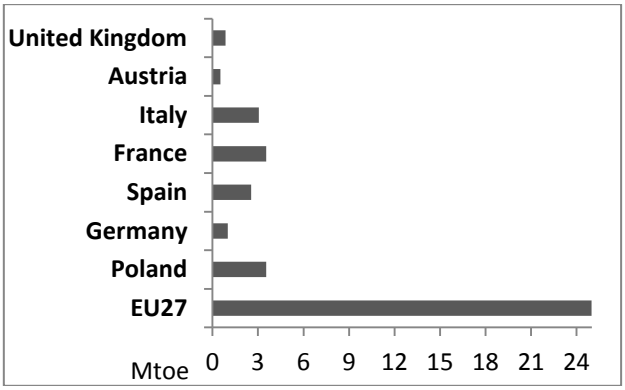

Figure 1. Total final energy consumption by agriculture sector in year 2009 [Mtoe - million tons of oil equivalent]

*Source: Eurostat database[**1**]*

The changes in the agricultural sector in the late 90's, caused by the liquidation and privatization of state farms and creation of modern, large-area holdings, initially did not contribute to a decline in energy consumption. The vital role of agriculture is providing food to the human population. This sector is a large consumer of energy and causes GHG emission. (see Figure 2).

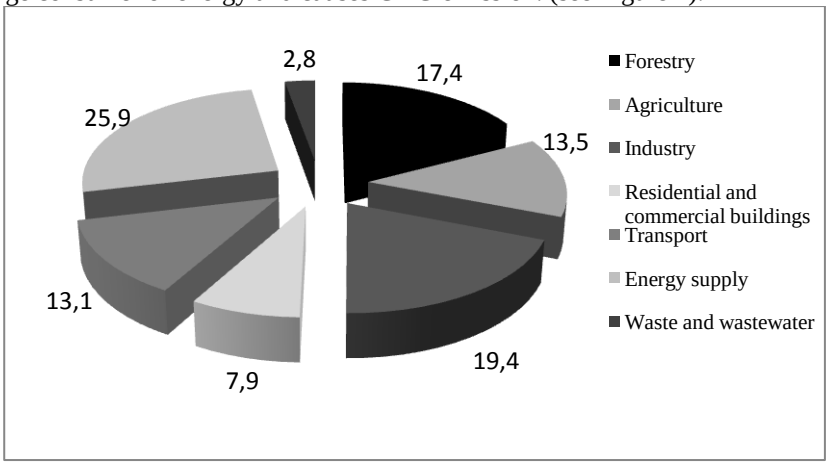

Figure 2. Contribution of different sectors to global GHG emissions

Source: author's own study based on [6]

Agricultural GHG's emissions are mainly anthropogenic: methane, nitrous oxide and carbon dioxide (see Table 1). Farmers use energy mainly for fuel for tractors, energy for milk machinery, crop drying, electricity of dairy farms, etc.

Table 1. Global agricultural GHG emission by main source

Emission	Source	Total [Mt CO_2eq)
N_2O	Soil	2128
CH_4	Enteric fermentation, rice, manure	2821
CO_2	Biomass incineration, fertilizer production, farm machinery and irrigation	1609
	Total	6558

Source: author's own study based on [6]

SCIENTIFIC HYPOTHESIS

1. Subject of Research.

Consequently, this paper undertakes the subject of the awareness of representatives of the agriculture sector on energy efficiency and some of the issues involved. The studies goal is to get to the causes of certain behavior, actions and thinking patterns. Researches on awareness of energy efficiency have been carried out using both qualitative and quantitative research. In this paper only the results of qualitative tests were presented.

2. Scope.

2.1. Essential. Qualitative studies are designed to clarify the motivation factors driving people to act in a certain way. Their goal is to get to the causes of this behaviour, by understanding and interpreting appropriate action and thinking pattern. The data collected was presented in a descriptive way - as thoughts, attitudes and feelings that directly or indirectly affect the behaviour of respondents. The basic and primary task of qualitative research is to learn and understand the causes of behaviour of the researched subjects.

2.2. Temporal. The research was conducted from September 2011 to February 2012.

2.3. Territorial. The study was carried out western Poland (*Wielkopolska*).

3. Description of Research Methodology.

In order to solve the problem of the research qualitative studies were carried out. It gave an attitude and approach to the problem studied. The general scheme of a qualitative study is presented below.

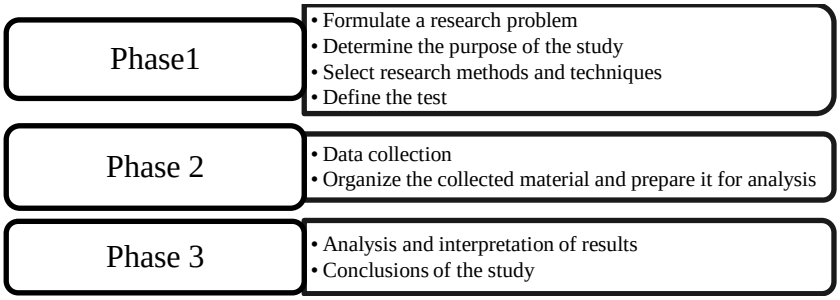

Figure 3. Phases of qualitative studies

Source: author's own study based on [5]

DETAILED DESCRIPTION OF THE RESEARCH ISSUE AND RESEARCH RESULTS

During the qualitative study, respondents had direct contact with the researcher. Individual interview was more casual in nature, but proceeded in accordance with the predetermined scenario interview. The test provided a sense of privacy, security, and a feeling that respondents will remain completely anonymous. This kind of research also reduced the pressure on other participants and adoption of conformist attitudes. Due to the interview being individual, respondents could calmly answer a series of questions based on their own experience and pass the accompanying emotions [l].

The chosen method of recording data from the qualitative study was immediate recording after each course of research. According to literature on the subject, the applied method is rarely used. It was chosen because of the specifics of the respondent group [5]. It should emphasize the initial distrust of representatives of the agricultural sector for all kinds of research that interferes with their views and their lives. In the Polish countryside, people who deal with issues related to the crucial role of environment in the economy are perceived as suspects - probably working to harm countrymen's interests. There is also concern among farmers that a number of questions such as subsidies and the European Union aim to reduce or even suspend funds directed to the agricultural sector.

Table 2. Selected results of the qualitative research

Researched area	Positive opinions	Negative opinions
European Union	Good chance for agriculture, a lot of money on new machinery, equipment, fertilizers, investments, etc.	Red tape, officials are inflexible, they stick to the rules, a lot of control, a lot of rules without any sense, the EU is a 'macabre', too much bureaucracy
Areas of use of EU funds	Development of machines, investment, construction of roads, streets, subsidies to agriculture, crops, planting areas	It's hard to get funding and to maintain proper accountancy
Energy efficiency awareness	It teaches how to save energy, information on where does the energy come from, awareness of what energy is, you can find out how to pay less	Not applicable
Impact on the environment	Agricultural waste, chemicals, fertilizers, greenhouse gas, water, electricity, gas, fuel, sewage, waste water, slurry, fumes, odor, light warming, air conditioning	It does not matter - we don't produce a lot of waste
Information sources on reducing energy consumption	Television, magazines, *ODR*	Nobody talks about it, we have very little information on this topic
Legal conditions, requirements, laws, etc.	Not applicable	Nobody said anything to us, by changing the rules everything will be more expensive

Source: author's own study

Qualitative tests showed that the attitude and feelings of farmers on the idea of efficiency vary (Table 2). Common elements include feelings towards supporting tools made available by the European Union. Farmers could clearly present the areas that are funded from EU funds. They see a lot of possibility to make their work more efficient and innovative but they still have fear of the unknown. The main barrier is the process of gaining European funds. It is long and complicated. It requires a lot of commitment, especially in writing the application and obtaining all necessary documentation. It seems to be time-consuming for the farmers and distracts them from their work in the field. Even if farmers gain European funding, they often have a problem with the financing part. The procedures are punctilious and require a lot of details in reporting. All the respondents complain about the bureaucracy and the fear of its further development. They do not understand the system as a whole and the need for such a large number of procedures. It makes them annoyed, which was easy to observe during the individual interviews. Respondents were clearly upset to talk about their experiences with office staff in applying for EU funds. The approach of the system and the amount of required documentation was overwhelming to them.

Farmers complained about the legal requirements and different kinds of laws. These documents are mostly incomprehensible, written in a difficult language. Farmers are not aware of some requirements. It is hard for them to gain additional information about certain issues. They are afraid that any changes in law requirements will cause financial loss for them.

Energy efficiency is, in general, properly understood by farmers. They understand the need for more efficient use of natural resources and savings in the energy field. They are interested in changing their habits in order to pay less for energy and to be more competitive on the market. They do make some first efforts in saving energy. They purchase energy-efficient light bulbs, warm buildings and purchase modern machinery and devices that are equipped with environment-friendly modes.

Most of the farmers realize that agriculture has a significant impact on the environment. They recognize the problem of agricultural waste, chemicals, fertilizers, etc. They are aware of the problem of GHG emission. They argue that all these specialized treatments are necessary in order to meet current demands of the market. It is also helpful in dealing with different weather conditions.

However, there were also farmers that did not want to talk about waste and its impact on the environment. These farmers were the minority.

One of the most gripping areas of the qualitative study was the issue of information sources on energy consumption. It can be clearly seen that the farmers are 'hungry' for energy news. Although, it has to be said, most of them faced problems in gaining knowledge on the subject. They do not know of any special meetings with the farming community; nobody talks about it also at ODR (Agricultural Advisory Centre). They seemed to be very keen in taking part in such communication events. At present they can only search for information via television and in specialized press.

CONCLUSIONS

1. Farming is essential but also damaging to the environment.
2. Among selected European countries, Poland has a relatively high energy consumption in agriculture.
3. The changes in the agricultural sector did not contribute to a decline in energy consumption.
4. Gaining EU funding is time-consuming for the farmers.
5. Agriculture shows excess consumption of resources like fuel, fertilizers and pesticides.
6. Farmers should be properly educated on energy efficiency. Energy efficiency is, in general, properly understood by farmers.
7. Their environmental awareness should be shared with others to make it more popular among the agricultural community.
8. Farmers want to be better informed in the field of energy and energy efficiency.
9. All actions are undertaken in order to slow down climate change, increase efficiency of natural resources' use and improve environmental protection.

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Magdalena Herbeć[12]

CLUSTERING IN THE WOOD SECTOR IN POLAND

Abstract: The aim of this publication is to characterize clusters of the wood sector compared to clusters and cluster initiatives in all economic areas in Poland taking into consideration the growing interest in such organizational structures in Poland and abroad. Based on information available from publications and Internet sources, an attempt at synthetic assessment of conditions conducive to the establishment and development of clusters was made. Additionally, main lines of cluster policy in the European Union and Poland and the effects of operation of such organizational structures have been presented.

Keywords: clusters, Polish wood sector.

INTRODUCTION

Changes occurring on the present-day market such as founding of global companies, shortening of products' life cycle, and faster access to information, cause companies to continuously look for new methods of competitiveness boosting. In pursuit of enhancement of innovativeness and competitiveness of companies, more and more importance is attached to the company's relations with their environment, because a modern market player should perceive business entities in their environment not only to be the other party in sales contracts, but also to become their prospective contractor (partner). The effects of synergy resulting from multiplanar interactions may become a source of significant competitive advantage on the national as well as the international market. Thus, created relations between the company and its environment make up a relation network. Hence, business operations of companies are not performed separately, but, to a great extent, they are a reaction to actions of entities within the company's environment. One of the symptoms of changes occurring in mutual relations of companies, i.e. network relations, is the establishment of clusters. Clusters are characterised by, among others, spatial concentration, interactions, affiliation to the same or related industry, common development line, competition and co-operation. It is worth adding that analysis of the reasons for establishment and development of clusters as well as of the lines of cluster operation is important not only for cluster members, but may also provide valuable knowledge of the country's economy. The operation of such organizational structures often reaches beyond the administration limits set within the country, contributes to strengthening of relations between entities from various economic sectors, and facilitates the flow of information, skills, technology etc. Therefore clusters enable a different approach to assessment of competitiveness and innovativeness of an economy[13].

The commonly growing significance of business networks and clusters is so important, that the aim of this paper is to present the characteristics of the wood sector clusters in Poland. This paper also addresses the effects of operation of such organizational structures in the light of challenges that are faced by present-day companies in the wood market, especially that running business in the wood sector is connected with building relations between entities operating in many different commodity markets. In the case of the Polish wood sector it is especially important due to the fact that its structure is dominated by small and medium-sized enterprises (SMEs), especially micro-companies.

STIMULI OF CLUSTERING

The most popular definition of a cluster was formulated by Michael Porter. According to Porter a cluster, also known as a "bunch", is „a geographically proximate group of interconnected

[12] *Magdalena Herbeć, MSc, Wood Technology Institute, Winiarska 1, 60-674 Poznań, m_herbec@itd.poznan.pl*

[13] *M. E. Porter, Clusters and the New Economics of Competition, Harvard Business Review, November-December 1998, p. 89.*

companies, specialized suppliers, service providers, companies operating in related sectors, and associated institutions (e.g. universities, standardization bodies, and industry associations) in a specific field based on commonalities and complementarities (…)"[14]. It is assessed that the relations formed on the basis of such interconnections between particular entities have a bearing on, among others, competitiveness development, and indirectly they contribute to sustainable development of the economy and the creation of jobs. Due to these reasons clustering is supported by the European Union (EU), which assumes that clusters are set up by a group of interrelated business entities, companies and institutions, which are characterised by proximate location and which have reached a size enough to develop specialist experience, services, resources, suppliers, and skills[15].

Apart from the term "cluster", the term "cluster initiative" is also used. The initiatives connected with clusters may be perceived to be ways of organizing business activity in such a manner that it goes beyond the traditional drive for reduction of costs of business and increase in the general level of business environment. This, on the other hand, may cause much greater interest and involvement of companies than actions taken for the general economy. Moreover, this type of initiatives may concern much narrower issues than fiscal policy and promotion of export, which until recently were quite popular[16].

In the concept of cluster creation two approaches are pointed out:

– a grass-roots initiative – where the original stimuli of cluster creation are business initiatives,
– a top-down initiative – cluster creation is initiated by the external environment, mainly administrative authority bodies, scientific and research institutions and higher education institutions.

It is commonly believed that clusters should be created naturally (the grass-roots approach), and the external business environment (public administration, scientific and research institutions, higher education institutions etc.) should do no more than support cluster development through assurance of stable economic conditions and conditions for effective co-operation with the R&D base[17]. However, in practice one may also encounter creation of clusters according to the top-down approach, where the co-founder or even the coordinator may be a representative of the public or science sector. A cluster created in this way may initially adopt the form of a cluster initiative.

The subject literature indicates diverse factors influencing the formation of clusters. Generally these factors may be divided into endogenous and exogenous. The endogenous stimuli of cluster development include: 1) high quality of internal technical infrastructure, 2) financial support for entrepreneurs, 3) high and diverse level of scientific and research base, 4) high qualifications of employees, 5) rich tradition in specialised activity areas, and 6) good access to specialised staff. On the other hand, the exogenous stimuli, which are conducive to cluster creation, encompass: 1) the

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[14] *Ibidem, p. 78.*

[15] *European Commission, Towards world-class clusters in the European Union, Communication from the Commission to the Council, the European Parliament, the European Economic and Social Committee and the Committee of the Regions, COM(2008) 652, Brussels, 17.10.2008, p. 2.*

[16] *M. E. Porter, Clusters and the New Economics …, op. cit., p. 89. It is worth adding that cluster initiatives may also be perceived to be deliberate actions taken by many groups of entities in order to create or enhance the strength of the cluster, while these entities may depend on one another in various ways, in: T. Andersson, E. Hansson, S. S. Serger, J. Sörvik, The clusters policies whitebook, IKED, Sweden 2004, p. 7. In this paper cluster is defined after M. Porter, and cluster initiative means "(…) a deliberate, organized undertaking with the aim of influencing the development potential of a given cluster in a more systematized way. An initiative involves key players in a given cluster – the representatives of economic, science, and public sectors. Cluster initiatives are financed by the involved entities, and also from public funds within cluster development support programmes. Most of such initiatives are in the form of projects and then are transformed into more formal structures within 12 to 36 months." Source: www.pi.gov.pl [12.07.2012]*

[17] *A. Lagendyk, D. Charles, Clustering as a New Growth Strategy for Regional Economies, w: Boosting Innovation. The Cluster Approach, OECD Proceedings, Paris 1999, p. 127-155; J. Staszewska, Wykorzystanie nowoczesnej koncepcji zarządzania przez sieć – przyczyny i skutki klasteringu, Przegląd organizacji 2009, no. 1, p. 31.; M. E. Porter, Clusters and the New Economics, op. cit., p. 89.*

traditions of particular regions, 2) proximity of absorptive national and foreign markets, 3) attractive prices of real estates, 4) the existence of many large enterprises which may be leaders, 5) high activity of some self-governments, and 6) good level of technical infrastructure[18].

The above stimuli have a significant bearing on the economic condition of companies operating their business in a given region, their mutual relations, and eventually on the level of innovativeness and competitiveness of particular sectors. Due to the important role of these economic categories in shaping the economic condition of the country, recent years have witnessed a significant increase in the interest in clusters and effects of their operation.

These issues are also the subject matter of discussion at the EU level, which treats clustering as one of nine strategic priorities of effective promotion of innovations and supports pro-cluster policy. In 2006 the EU adopted *The Community Strategic Guidelines on Cohesion 2007-2013*, where it urged its member states and regions to, among others, promotion of strong clusters as part of their strategies for economic reforms. Moreover, the EU also grants support to transnational co-operation, for example in the form of a European initiative INNOVA. This initiative primarily consists in common development of new or better tools used by cluster organizations. Thereby, it supports SMEs and improves business support services rendered to clusters in Europe. Importantly, the European Union also stresses that integration of SMEs and clusters brings mutual benefits, i.e. SMEs can taken innovative actions and develop relation network with big companies and international partners in conditions of favourable environment, and clusters may reach a high level of perfection and innovativeness[19].

In Poland, the adaptation to cluster policy of the EU also takes into consideration the concept of active development of clusters. Due to the fact that actions supporting cluster development are by nature horizontal and concern various areas of economic policy, the above-mentioned concept affects many development strategies[20]. It should be notices that support of cluster development is related, among others, to the mechanism of special economic zones. Thus created conditions, which are conducive to business, are favourable to building relations between entrepreneurs operating within these zones and outside them, for often geographic coverage of clusters does not overlap the territorial coverage of a zone.

THE WOOD SECTOR IN POLAND VERSUS CLUSTERING

Formulation, scope and degree of cluster development, which may associate companies of various sizes and institutions present in their environment, depends on such things as the size and the type of business entity structure in a given sector. Hence, analysing the degree of clustering development in the wood sector in Poland, one should notice that industries within this sector are characterised by a dominant number of micro and small enterprises. In 2011 the share of microenterprises (i.e. business entities employing up to 9 people) within total number of business entities in the wood industry and the furniture industry was 91% in both cases, and in the pulp and paper industry 85%[21]. Due to large dispersion of the Polish wood sector and a dual influence of such structure of company sizes on keeping the sector's competitiveness, building mutual relations based on coopetition principles (a phenomenon accompanying cluster development) may be especially important for business entities. The term coopetition describes mutual relations of business entities based on co-operation, where at the same time competition conditions are maintained, which enables benefitting from the economic effects of co-operation[22]. Thanks to multiplanar relations

[18] *J. Staszewska, Wykorzystanie nowoczesnej koncepcji …, op. cit., p. 31.*
[19] *European Commission, Towards world-class clusters …, op. cit., p. 2-4, 9.*
[20] *Lines of increasing innovation of the economy in the period 2007-2013, Ministry of Economy, Warsaw 2006; A strategy for economy innovativeness and effectiveness. Draft, Ministry of Economy, Warsaw 2011, www.mg.gov.pl [12.07.2012]*
[21] *Structural changes of groups of the national economy entities in the REGON register, 2011, GUS, Warszawa 2012, p. 42, 44.*
[22] *Running business in a way that joins competition and co-operation with entities in the company's environment was popularized by Raymond Noorda (1924–2006), an American entrepreneur within the computer industry and founder of*

SMEs may avoid market exclusion (also, for example, informational exclusion), which makes efficient operation in market economy conditions impossible. Unlike big companies, SMEs are characterised by better flexibility in the process of adaptation to changes occurring on the market; however, due to relatively smaller financial resources, SMEs are often unable to overcome various economic barriers, for example, connected with investments in equipment, used techniques and technologies, and product innovativeness. All these are important as regards building and maintenance of strong position in both national and international markets.

In practice clusters may make it easier for the entrepreneurs within the wood sector to operate in the wood market and face up to the challenges connected with this. It is characteristic that the wood market in Poland, as in other European countries, is an industry market which dynamizes many other commodity markets, which in turn influence its development. Moreover, the wood market, similarly to other segments of economy, requires creation of appropriate rules and economic incentives by political and economic organs in order to assure stable conditions of competition, which will lead to effectiveness increase. In recent years shortages of wood raw material, caused by the competition of the power sector, have been one of basic issues observed on this market.

In the light of the EU ecological policy and an increased role of sustainable development, the issue of rational management of wood raw material, including the drive for non-waste raw material management and optimal management of wood by-products and post-consumer wood, is also a question which is extremely crucial to the wood market. This type of wood by-products may be used by industry or the power sector. The co-operation of the wood sector companies within clusters may help establish contacts with prospect consumers of this type of by-products. The importance of the issue was confirmed by the fact that in 2010 the wood sector produced 10.5 M m^3 of wood by-products, which amounted to almost 30% of the annual harvest of wood raw material[23].

Participation in a cluster also contributes to strengthening of the company's competitive position in international market. This is important, because due to globalization business entities operating in the European market are exposed to challenges posed by competition with companies from other regions, especially these characterised by low production costs. Therefore, despite the dynamic development of the wood sector in Poland (and especially the furniture industry, which in terms of furniture production value places Poland at the sixth position in Europe, and in terms of exports value on the third position), the strong competition of entities operating in Asian countries (where demand for wood raw material is still increasing and manufactured wood products are exported to international market), may still be a challenge for Polish companies. Another type of challenge to companies, including the wood sector companies, may be posed by technical barriers related to foreign trade (e.g. a decrease in product competitiveness because of the obligation to comply with appropriate standards, certificates etc.)

CLUSTERS IN THE WOOD SECTOR IN POLAND

Clusters operate in various areas of economy and, depending on the characteristics of particular economic areas, differences in the level of innovativeness and technological advancement of clusters are noticeable, which is manifested by different strategies and perspectives of development. In the wood sector the first clusters in Europe were established in Scandinavian countries. Organizations promoting wood were created in Sweden, Finland, and Norway. An example of such organization is WoodFocus, the members of which are mainly entrepreneurs and forest owners from

Novell Company. According to Noorda "You have to be able to compete and cooperate at the same time". One of the publications popularizing the term "co-opetition" was a publication by A. M. Brandenburger, B. J. Nalebuff, Co-opetition, A Revolution Mindset That Combines Competition and Cooperation: The Game Theory Strategy That's Changing the Game of Business, HarperCollins Business 1996. Source: Y. Luo, A coopetition perpective of global competition, Journal of World Business 2007, No. 42; W. Czakon, Interorganizational knowledge management – towards coopetition strategies?, Argumenta Oeconomica 2009, no. 2; www.summaries.com [12.07.2012]; www.en.wikipedia.org [12.07.2012].

[23] *Calculations based on own research of the Wood Technology Institute in Poznań; Forestry 2011, GUS, Warszawa 2011, p. 101.*

Finland, Sweden, and Norway. Such organizations aim to execute programmes concerning wood promotion, development of forest and wood sciences, enhancement of competitiveness of wood processing companies, and also broadening of product assortment and increasing wood consumption. In a longer term such programmes aim to, among others, enhance export of the wood sector products and increase domestic consumption of raw material[24].

Despite the growing interest in business networks and clusters, there is still a cognitive gap as regards operation of clusters in economic practice, including their operation in the Polish wood sector. It is estimated that in Poland there are 173 clusters and cluster initiatives in various sectors of economy. The largest number of such organizational structures operate in Wielkopolskie Voivodship (21) and Mazowieckie Voivodship (19). In the wood sector there are 6 clusters and 7 cluster initiatives (Figure 1)[25].

Voivodship	Name
Kujawsko-Pomorskie	Klaster meblarski (Furniture cluster)
Lubelskie	Stowarzyszenie Lubelskie Drewno – Regionalny Klaster w Lublinie – Katalog 2011 (Lubelskie Wood Association – Regional cluster in Lublin – Catalogue 2011) Klaster Przemysłu Meblarskiego Polski Wschodniej (Eastern Poland Furniture Industry Cluster)
Lubuskie	Zachodni Klaster Papierniczy (Western Paper Cluster)
Opolskie	Śląski Klaster Drzewny (Silesian Wood Cluster)
Podlaskie	Północno–Wschodni Innowacyjny Klaster Drzewny (North-Eastern Innovative Wood Cluster)
Śląskie	Polish Wood Cluster
Warmińsko-Mazurskie	Lubawski Klaster Meblowy (Lubawa Furniture Cluster) Stowarzyszenie Klaster Mebel – Elbląg (Cluster Furniture – Elbląg Association)
Wielkopolskie	Klaster meblarski (Furniture cluster) Wielkopolski Klaster Mebel Design (Wielkopolska Furniture Design Cluster)
Zachodniopomorskie	Klaster Drzewno-Meblarski (Wood-Furniture Cluster) Zachodniopomorskie Drewno i Meble (Zachodniopomorski Wood and Furniture)

Legend:
1 - *number of clusters and cluster initiatives in the wood sector in a given voivodship.*
(9) - *number of clusters and cluster initiatives in a given voivodship.*
* *based on data collected by PARP during execution of projects co-financed by EU in the period 2010-2012, www.pi.gov.pl [12.07.2012].*
Source: Author's own study based on data by PARP from the Internet site: www.pi.gov.pl.

Figure1. Clusters in the wood sector in Poland in mid 2012

It is obvious that regions, where one finds clusters within the wood sector, are characterised by relatively high harvest of wood raw material and high degree of concentration of companies belonging to the wood sector or its environment. The development of particular industries within the sector and its environment is also of great importance to formation of wood sector clusters. It deserves notice that voivodships which are leaders in terms of the number of operating wood sector clusters, are also characterised by concentration of scientific and research institutions dealing with

[24] *www.rsi.org.pl/dane/download/2007_klaster_drzewny-_opis.pdf*

[25] *In connection with the fact that clusters are a relatively new phenomenon, their number in Poland is not quite defined and fragmentary analyses indicate that in 2008 there were 120 clusters in Poland, of which 21 in the wood sector. Based on: J. Pikul-Biniek, Renewable energy clusters – drivers of the Polish forestry-wood sector, Intercathedra 2009, No. 25, p. 117, W. Strykowski, Furniture clusters in Europe – some issues, Intercathedra 2010, No. 26, p. 126. Moreover, the issue of clusters in the wood sector was discussed in various scopes in such publications as: R. Dudík, Clusters – a challenge for woodworking companies, Intercathedra 2006, No. 22; J. Pikul-Biniek, An insight into forestry-wood clusters, Wood. Research papers. Reports. Announcements 2009, no. 181, p. 93; J. Pikul-Biniek, Renewable energy clusters…,op. cit., p. 116; W. Strykowski, Furniture clusters in Europe …, op. cit., p. 122; Istniejące klastry i inicjatywy klastrowe w województwie zachodniopomorskim, the Gdańsk Institute for Market Economics (GIME) and ICG, Szczecin 2011, p. 129, R. Kućmański, Rozwój branży drzewno-meblowej poprzez klastering oraz zewnętrzne źródła finansowania na przykładzie regionu elbląskiego, in: Conference materials of the 4th Polish Scientific Conference, Bełchatów 2011, www.konferencjakz.p.lodz.pl [12.07.2012].*

the issues of wood science[26]. Interestingly, 35% of all clusters and cluster initiatives in Poland are concentrated in voivodships which are leaders in terms of the share of industrial companies which invested in innovation within total number of these companies in 2010. Among these voivodships are the following: Śląskie (i.e. 17.3% of industrial companies), Podkarpackie (16.1%), Opolskie (15.5%), Lubelskie (15.1%), Warmińsko-Mazurskie (14.8%), and Kujawsko-Pomorskie (14.1%). In total 54% of the total number of clusters and cluster initiatives within the wood sector operate in the area of these voivodships. Moreover, the data presented by the Central Statistical Office of Poland (GUS) suggests that companies, which within their innovation activity co-operated within a cluster initiative in the period 2008-2010, accounted for approximately 0.2% of the total number of companies respectively in the wood industry and the furniture industry, and for 0.3% in the pulp and paper industry. In the wood industry these companies accounted for 1.5% of the total number of companies which were active in the field of innovation, in the furniture industry for 1.3%, and in the pulp and paper industry for 1.7%. It is also worth emphasising that Kujawsko-Pomorskie and Warmińsko-Mazurskie voivodships, in the area of which 23% of the wood sector clusters operate, hold the second and third place in terms of share of revenues from sale of new or substantially improved products in total revenues from sale among industrial companies (i.e. it is 14.7% in Kujawsko-Pomorskie Voivodship and 12.9% w Warmińsko-Mazurskie Voivodship)[27].

SUMMARY

Contemporary companies (both SMEs and big companies) assign more and more importance to relations with entities in their environment, because the feedback, which is characteristic of this type of relations, may affect their own economic situation. Carefully built, multiplanar relations between business entities bring about economic benefits and other effects, the usefulness of which is hardly quantifiable. An example of such effects may be access to information, which in the days of production economy and the growing social pressure of consumerism, is a precondition of holding a stable position on the market. This is the reason why the growing interest in business networks and clusters has been observed in recent years.

For the Polish wood sector and its entity structure dominated by SMEs, it is important that the integration of SMEs into clusters brings benefits to both the entrepreneurs (benefitting from synergy effects of relation network) and the clusters themselves (constant improvement in terms of technological advancement, development strategy etc.).

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Wojciech Lis[28]

DEMAND FOR WOOD VERSUS BIOMASS FOR ENERGY SECTOR

Abstract: Demand for round wood, whose important recipient – apart from the industry sectors that process wood mechanically and chemically – is the power industry, has been discussed. The use of biomass received from wood, which is also technologically useful for the favoured Renewable Energy Sources (RES), is the main reason of utilizing mixed coal and biomass (mainly forest biomass) results in a gradual withdrawal from these practices and constitutes a positive change aimed at regulating the problem of accessibility of technologically useful wood.

Key words: wood industry, biomass, renewable energy sources

INTRODUCTION

The situation of the Polish wood industry in relation to round wood supplies is deteriorating and will become even more difficult as long as wood remains the most important source of biomass and the background for the use of renewable energy sources.

This article addresses the issue of round wood biomass usage by the power industry and its projections until 2020. Utilizing wood by the power industry is one of the obstacles limiting round wood purchase opportunities by wood industry entrepreneurs and the main reason of demand for forest material.

USING BIOMASS IN POWER INDUSTRY

Currently, over 50% of energy generated from RES comes from forest biomass, which means wood in a variety of forms. A truly unlimited demand of the energy sector, especially the power industry, brings about an exceptional opportunity of selling round wood itself as well as all kinds of wood waste – regardless of quality, volume and fragmentation. The price of wood and its residues is practically irrelevant for the power industry as it is very easily and quickly transferred to the final recipients of energy, including those who deal with wood processing; hence, a systematic and never-before observed significant increase in wood prices – speeding from year to year – despite the rather unfavourable economic situation.

Table 1 shows results of an analysis of capacity change (MW) and the number of units considering individual forms of RES over the period of two and a half years from 30 June 2010 until 31 December 2012. A systematic growth of wind energy share is worth noticing (from 44% up to 57.6%), similarly to energy generated from biomass (from 11% up to 14%) as well as a decrease of hydropower plants' share from 42% to 25%.

The data included in Table 1 indicate that in the period from 30 June 2010 until 31 December 2011 the number of power plants using biomass (BM) grew in Poland from 15 to 19, and their capacity went up from 252.5 MW up to 409.7 MW. In mid-2010 biomass power plants generated 11.1% of energy and at the end of 2011 this share reached 13.3%. During the first half of 2012 the number of biomass power plants grew from 3 to 22 and the share of the installed capacity reached 14.04% of power generated from RES.

[28] *Poznan University of Life Sciences, Department of Economic and Wood Industry Management, Wojska Polskiego 38/42, 60-627 Poznań, Poland, wlis@up.poznan.pl*

Table 1. Capacity installed in Polish renewable energy sources

Situation on	30.06.2010				31.12.2010			
Renewable energy source	Number of units	The installed capacity			Number of units	The installed capacity		
		quantity	entity	%		quantity	entity	%
Windmills (WI)	347	1000	MW	44,04	378	1095,587	MW	45,98
Hydro-energy plants (WO)	733	947		41,71	737	948,363		39,80
Biomass power plants (BM)	15	252,5		11,12	16	259,490		10,89
Plants burning biogas (BG)	133	71		3,13	136	79,478		3,34
Solar energy plants (PV)	2	0,012		0,00	2	0,012		0,00
Plants co-burning biomass and coal (WS)	40				41			
Together	1270	2270,512		100,00	1310	2382,93		100,00
Change					40	112,418		4,95
Situation on	30.06.2011				31.12.2011			
Renewable energy source	Number of units	The installed capacity			Number of units	The installed capacity		
		quantity	entity	%		quantity	entity	%
Windmills (WI)	453	1351,866	MW	48,64	526	1616,361	MW	52,46
Hydro-energy plants (WO)	737	946,345		34,05	746	951,389		30,88
Biomass power plants (BM)	19	393,050		14,14	19	409,679		13,30
Plants burning biogas (BG)	149	87,773		3,16	171	103,487		3,36
Solar energy plants (PV)	4	0,104		0,00	6	0,1124		0,00
Plants co-burning biomass and coal (WS)	42				47			
Together	1404	2779,138		100,00	1515	3081,0284		100,00
Change	94	396,208		16,63	111	301,890		10,86
Situation on	30.06.2012							
Renewable energy source	Number of units	The installed capacity						
		quantity	entity	%				
Windmills (WI)	619	2188,941	MW	57,60				
Hydro-energy plants (WO)	762	957,379		25,19				
Biomass power plants (BM)	22	533,410		14,04				
Plants burning biogas (BG)	184	119,414		3,14				
Solar energy plants (PV)	8	1,251		0,03				
Plants co-burning biomass and coal (WS)	45							
Together	1640	3800,395		100,00				
Change	125	719,367		23,35				

Source: own study based on: www.ure.gov.pl

For co-burning installations capacity cannot be determined

During the period between 30 June 2010 and 31 December 2011, the number of power plants co-burning biomass and coal, in case of which it is difficult to determine the value of power, grew from 40 to 47. However, in the first quarter of 2012 – for the first time in history – it dropped to 45. This moment marked the beginning of a hopefully effective and permanent retreat from the inefficient processes of co-burning wood and coal.

High prices of "green" energy have an impact on decreasing competitiveness of the whole economy. Until recently the modernization of energy blocks in Polish power plants has been related to the intensive process of adjusting them to burning biomass, in particular forest biomass. Moreover, the modernizations that took place over the last two years at power plants and heat and power plants (CHP) included installation of boilers and technological adjusted to using agricultural biomass. This constituted a significant progress in the gradual decrease in the use of forest biomass by the power industry. However, in 2012 we have witnesses reversal of this very negative trend resulting in the decrease of share of the low-efficient coal and biomass co-burning plants in the Polish energy system.

WOOD USAGE FOR ELECTRICITY PRODUCTION UP TO 2020

Table 2 shows a prognosis for round wood usage in the production of electricity between 2007 and 2020. Based on the data on the production of electricity in Poland, the State Forests' planned harvest, the share of electricity generated from RES in electricity sold to final recipients, the share of energy from RES in domestic gross electricity usage, energy production at plants utilizing biomass – including co-burning as well as past trends in this sector – a forecast up to the year 2020 has been presented.

Table 2. Projection of round wood usage for electricity production between 2007 and 2020

Year	Production of electricity TWh	Wood consumption	State Forests total volume of round wood to be harvested	Calculation into the number of State Forests planned harvests	Share of electricity created from RES in the volume of electricity sold to final clients				Share of electricity from RES in gross domestic electricity usage		
		million m^3			%	TWh	million m^3 of wood	% planned harvests	TWh	million m^3 of wood	% planned harvests
1	2	3	4	5	6	7	8	9	10	11	12
2007	*159,453*	53,151	*30,622*	1,74	*5,1*	8,132	2,711	8,85	*3,40*	1,133	3,70
2008	*155,183*	51,728	*32,153*	1,61	*7,0*	10,863	3,621	11,26	*4,23*	1,410	4,39
2009	*151,697*	50,566	*32,634*	1,55	*8,7*	13,198	4,399	13,48	*5,76*	1,920	5,88
2010	*157,414*	52,471	*32,873*	1,60	*10,4*	16,371	5,457	16,60	*6,98*	2,327	7,08
2011	*160*	53,333	*34,171*	1,56	*10,4*	16,640	5,547	16,23	*8*	2,667	7,80
2012	*162*	54,000	*34,585*	1,56	*10,4*	16,848	5,616	16,24	*9*	3,000	8,67
2013	*164*	54,667	*36*	1,52	*12*	19,680	6,560	18,22	*10*	3,333	9,26
2014	*166*	55,333	*37*	1,50	*13*	21,580	7,193	19,44	*11*	3,667	9,91
2015	*168*	56,000	*38*	1,47	*14*	23,520	7,840	20,63	*12*	4,000	10,53
2016	*170*	56,667	*39*	1,45	*15*	25,500	8,500	21,79	*13*	4,333	11,11
2017	*172*	57,333	*40*	1,43	*16*	27,520	9,173	22,93	*14*	4,667	11,67
2018	*174*	58,000	*41*	1,41	*17*	29,580	9,860	24,05	*15*	5,000	12,20
2019	*176*	58,667	*42*	1,40	*18*	31,680	10,560	25,14	*16*	5,333	12,70
2020	*178*	59,333	*43*	1,38	*19*	33,820	11,273	26,22	*17*	5,667	13,18
Changes	*2*	Annual production growth = demand for electricity – energy saving									
	Increase harvest		*1*	Estimated growth in round wood harvest							
	Forecast average annual growth in green energy production								*1*		
		3	MWh/m^3	Wood energy value							

Year	Electricity production from sources utilizing biomass, including co-burning								
	TWh	Efficiency of 100%		Efficiency of 30%		Forest biomass			
		million m^3 of wood	% planned harvests	million m^3 of wood	% planned harvests	share %	million m^3 of wood	% planned harvests	
1	13	14	15	16	17	18	19	20	
2007	*2,343*	0,781	2,55	2,603	8,50	*100*	2,603	8,50	
2008	*3,267*	1,089	3,39	3,630	11,29	*95*	3,449	10,73	
2009	*4,888*	1,629	4,99	5,431	16,64	*90*	4,888	14,98	
2010	*5,756*	1,919	5,84	6,396	19,46	*85*	5,436	16,54	
2011	*7*	2,333	6,83	7,778	22,76	*80*	6,222	18,21	
2012	*8*	2,667	7,71	8,889	25,70	*75*	6,667	19,28	
2013	*9*	3,000	8,33	10,000	27,78	*70*	7,000	19,44	
2014	*10*	3,333	9,01	11,111	30,03	*65*	7,222	19,52	
2015	*11*	3,667	9,65	12,222	32,16	*60*	7,333	19,30	
2016	*12*	4,000	10,26	13,333	34,19	*55*	7,333	18,80	
2017	*13*	4,333	10,83	14,444	36,11	*50*	7,222	18,06	
2018	*14*	4,667	11,38	15,556	37,94	*45*	7,000	17,07	
2019	*15*	5,000	11,90	16,667	39,68	*40*	6,667	15,87	
2020	*16*	5,333	12,40	17,778	41,34	*35*	6,222	14,47	
Changes	*1*	Forecast increase in energy production in the process of....							
	Estimated annual share decrease					*5*	%		

Source: own study based on:
original data: Energy Market Agency (ARE), Ministry of Economy (MG), Directorate General of State Forests (LP), Polish Energy Regulatory Office (URE)

Table 2 shows that in 2012 electricity production will amount to 162 TWh. If all of it was to be generated from wood, 54 million m^3 of raw material would have to be used, which means 1.56 of harvest planned by the State Forests for the current year. However, in 2012, only 10.4% and not 100% of energy has to be generated using RES. In this situation 5.6 million m^3 of wood should be used for this production, i.e. 16.24% of the total volume of wood to be harvested by the State Forests. The share of electricity from RES in gross domestic electricity usage amounts to 9 TWh, which requires burning approximately 3 million m^3 of wood, i.e. 8.67% of the portion assigned for cutting in 2012.

Electricity production utilizing biomass – including co-burning – is estimated to reach 8 TWh in 2012, which would entail burning 2.67 million m^3 of forest material, which comes to 7.71% of the total volume planned for harvesting. It would be true for a performance level equal to 100%. In practice, average efficiency of wood burning systems in the process of electricity production is estimated to reach 30%. Hence, wood usage increases to 8.9 million m^3, i.e. over one quarter of the State Forests' harvesting plans (25.7%). Assuming that in 2012 the share of agricultural biomass

constitutes 25% and the share of forest biomass – 75%, wood usage totals 6.7 million m^3, i.e. 19.3% of all planned cuttings.

Taking into consideration the current trends, wood usage will decrease noticeably until 2020 when 35% of electricity from resources using biomass, including co-burning, will be generated from forest biomass; this will require approximately 6.2 million m^3 of wood, i.e. 14.5% of planned harvest.

CONCLUSION

The increasing usage of forest biomass in the power industry creates wood shortages and difficulties in supplying wood for the pulp and paper sectors. There are, however, positive signals, namely a radical change in the approach to this issue is beginning to take place. One of the important social demands that need to be respected in the new approach to renewable energy sources is the limited access of the power industry to large system installations processing forest biomass. It may result in more rational wood management, in accordance with wood-friendly nature of humans and in line with its valuable environmental features. Numerous possible solutions require decisions beyond the national and EU level.

A slowdown in the economy, which has already begun in Poland, the European Union, and around the world, creates substantial opportunities for calming various market segments including the round wood and electricity market, which might make the process of creating standards for forest wood sales within forestry and the wood sector somewhat easier.

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Wojciech Lis, Marek Tabert, Włodzimierz Popyk[29]

ECONOMIC SITUATION OF WOOD INDUSTRY IN POLAND IN 2012

Abstract: The article focuses on issues of economic situation and its impact on the annual volume of demand for round wood by the clients of State Forests. A significant correlation has been found between gross domestic and international product and the demand for round wood and wood prices in Poland.

Key words: wood industry, gross domestic product, wood prices

INTRODUCTION

Economic situation of timber industry in Poland depends on economic situation in the European Union, as well as the state itself, Europe and across the world. Also not to a small degree it is affected by industry factors. The most important factors being influences by forest-timber sector on its own are: timber price and its accessibility on the market. Both closely related to each other – for years cause great controversies. The significant problem of the State Forests (SF), the largest supplier or even natural monopolist on roundwood market - is a huge differences in clients demand for round wood.

This article is devoted to the relationship between national GDP and the demand for round wood and wood prices.

ECONOMIC CYCLE

Recession – is an economic phenomenon which presence is illustrated by economic indicators, that is values characterizing economy. The most transparent and the most commonly used one is GDP – gross domestic product (Table 1).

Gross Domestic Product is an economic term. It is one of the basic measurements of national income and embraces aggregated value of final goods and services produced within a country in a given period (most frequently one year). Geographical criterion (country borders) is the only definitive determinant here. It does not matter where the capital comes from and the company ownership is also irrelevant. The value of services and final goods produced within a country is calculated deducting from the total production of goods and services the value of those of them which have been used during the production process. Hence, added value is important. In other words, GDP is a sum of added value produced by every class of enterprise operating within a country.

Table 1 presents gross domestic product expressed in current prices (in millions currency used: zł - PLN) – since the beginning of 1995. GDP percentage changes have also been calculated – assuming that:

1) GDP value in the previous quarter of the year equalled 100% (previous quarter PQ). Noticeably in almost every year (except 1996) the value in the first quarter is lower than the value in the fourth quarter of the previous year, that is PQ index is lower than100%. GDP value is the biggest in Q4 of each year and the same relates to PQ indices. In Q1, Q 3 and Q4 PQ index is never lower than 100%, that is GDP always grows,
2) respective period of the previous year equalled 100% (current quarter CQ). The values of CQ index never get lower than 100%, that is GDP value in analogical periods of subsequent years. In the period under analysis CQ values range between 103,22% (minimum - in Q3 of 2002) and 130,02% (maximum - in Q4 of 1996).

[29] *Poznań University of Life Sciences, Department of Economic and Wood Industry Management, Wojska Polskiego 38/42, 60-627 Poznań, Poland, wlis@up.poznan.pl, mtabert@up.poznan.pl, wpopyk@up.poznan.pl*

Table 1. Gross domesticproduct in current prices (million zł) and in fixed prices (annual average prices of the previous year) in %

	Gross domestic product in Poland - quarterly values							
	Current prices in million zł				Previous quarter =100			
1995	76 012,1	81 778,2	86 713,7	92 717,9		107,59	106,04	106,92
1996	93 207,8	101 404,5	107 274,0	120 549,5	100,53	108,79	105,79	112,38
1997	113 958,3	124 055,8	129 974,6	147 364,5	94,53	108,86	104,77	113,38
1998	134 931,9	144 618,7	151 670,5	169 680,8	91,56	107,18	104,88	111,87
1999	146 070,0	158 884,8	167 797,9	192 935,7	86,09	108,77	105,61	114,98
2000	166 983,0	180 336,1	187 089,3	209 969,6	86,55	108,00	103,74	112,23
2001	179 169,1	191 140,7	194 062,7	215 191,3	85,33	106,68	101,53	110,89
2002	187 640,4	198 114,3	200 319,3	222 504,4	87,20	105,58	101,11	111,07
2003	193 842,5	207 307,1	208 268,4	233 738,2	87,12	106,95	100,46	112,23
2004	213 035,6	224 806,1	228 044,8	258 651,1	91,14	105,53	101,44	113,42
2005	229 395,8	238 094,5	241 759,8	274 052,2	88,69	103,79	101,54	113,36
2006	242 784,9	255 497,1	261 510,9	300 238,5	88,59	105,24	102,35	114,81
2007	270 132,1	282 921,9	291 058,5	332 624,2	89,97	104,73	102,88	114,28
2008	299 128,7	310 865,5	314 721,8	350 716,3	89,93	103,92	101,24	111,44
2009	313 028,0	325 455,6	332 447,9	373 452,0	89,25	103,97	102,15	112,33
2010	323 175,6	344 625,0	350 575,2	398 071,5	86,54	106,64	101,73	113,55
2011	349 374,3	369 803,5	376 124,2	429 376,5	87,77	105,85	101,71	114,16
2012	370 450,1				86,28			
Year	quarter				quarter			
	I	II	III	IV	I	II	III	IV
	fixed prices = average annual prices of previous year				analogical period of previous year = 100			
1996	103,5	105,7	107,4	*108,1*	122,62	124,00	123,71	130,02
1997	107,1	107,7	107,0	106,6	122,26	122,34	121,16	122,24
1998	106,6	105,4	105,0	103,2	118,40	116,58	116,69	115,14
1999	102,2	103,5	105,4	106,6	108,25	109,86	110,63	113,71
2000	106,0	105,4	103,3	102,7	114,32	113,50	111,50	108,83
2001	102,4	101,2	101,0	100,5	107,30	105,99	103,73	102,49
2002	100,6	100,9	101,9	102,2	104,73	103,65	*103,22*	103,40
2003	102,4	104,0	104,2	104,7	103,31	104,64	103,97	105,05
2004	106,9	106,0	104,8	104,0	109,90	108,44	109,50	110,66
2005	102,4	103,2	104,3	104,4	107,68	105,91	106,01	105,95
2006	105,4	106,3	106,6	106,6	105,84	107,31	108,17	109,56
2007	107,5	106,6	106,6	106,6	111,26	110,73	111,30	110,79
2008	106,3	106,1	105,2	103,2	110,73	109,88	108,13	105,44
2009	100,4	101,0	101,7	103,2	104,65	104,69	105,63	106,48
2010	102,7	103,6	104,2	104,7	103,24	105,89	105,45	106,59
2011	104,6	104,2	104,2	104,2	108,11	107,31	107,29	107,86
2012	103,5				106,03			
on average	104,1	104,4	104,5	104,5				

source: own elaboration based on the data of Central Statistical Office (CSO)

CSO data in accordance with the type of operations - in line with **Polish Classification of OPerations 2007** , developed on the basis of Statystical Classification of Economic Activities in the European Community - NACE Rev.2

CSO - Main information portan (17.07.2012)

Table 1 also shows Polish GDP in fixed prices – assuming (data taken from Central Statistical Office) as fixed prices – average annual prices from the previous year. Within the period under analysis indices of changes in GDP in fixed prices never went below 100%. This index was the lowest in Q1 of 2009 – and reached 100,4%. It was back then one of the best results in the European

Union and Poland was nick-named „green island" (among stagnating economies marked on the maps in red colour, it stood out as the only one or periodically one of the two growing economies marked in green).

The highest GDP index in fixed prices was recorded in Q4 of 1996– it reached, according to Central Statistical Office, 108,1%. Only three times within the period under analysis between 1996 and 2012 – its value was lower than 101% - apart from the minimum in Q1 of 2009, also in Q1 of 2002 (100,6%) and Q2 of 2002 (100,9%).

Hence the weakest and the most recessive years within the analyzed period between 1995 and 2012 – were 2009 and 2002. It is even difficult to decide – which was worse and when the stagnation was more visible (Table 1).

One may talk about recession when GDP decrease lasts for at least two quarters**.** In Poland within the period under analysis no such situation has occurred. Nevertheless, 60% of entrepreneurs running companies in Poland are of an opinion that that currently there is recession in our country.

An important economic situation indicator is also unemployment rate, which despite of favourable summer period does not decrease. There are even signals that it might be growing more intensively.

FINANCIAL AND ECONOMIC SITUATION WITHIN EUROPEAN UNION

European Union undergoes significant economic and financial problems. The worst situation is in Greece and Italy. Economies of those countries are greatly in debt. Greece (population 11 million, the 9th country in the EU population-wise, only with slightly larger population than Hungary and Czech Republic) has the biggest solvency problem. Italian debt reaches almost 2 bn. euro and for the EU it constitutes a bigger problem than Greek debts.

The biggest Italian problem (population-wise the 4th EU country - 59 million citizens, the third economy in Europe and the 8th in the world) is liquidity. There has been a significant decline in the economic situation of Portugal (10,8 million people, population- wise 10th EU country, comparable with Greece, Belgium, Czech Republic and Hungary), Ireland (4,7 million people, population-wise the 20th EU country, comparable with UE candidate - Croatia) and Spain (46,8 million of citizens, the 5th EU country with regards to population).

In Spain following the recession on real estate market, which previously largely contributed to economic boom in this country – that took place at the beginning of this millennium – high unemployment rate persists. It amounts to 21,5% (it is the highest index within all EU states), and over 5 million people remain jobless.

Also economic situation of Malta, the smallest EU state – 408 thousand citizens (a bit smaller than Gdansk – 456 thousands, and a bit bigger than Szczecin – 405 thousand, Bydgoszcz – 356 thousand, or Lublin – 348 thousand citizens). Small countries: Slovenia, Slovakia– also go through a phase of economic problems.

ECONOMIC SITUATION IN POLAND IN 2012

Macroeconomic data in Poland indicates a relatively small slowdown of economic growth. As of the third quarter of 2011 industrial and construction production, and retail sales figures have been decreasing. GDP increased in 4Q of 2011 by 1,1% in comparison with the previous quarter and was 4,3% higher than a year before. As it has been already said here – 4Q happens to be the best within the whole year, although for GDP measured in fixed prices – often comparable with 3Q (table 1).

Following a small decrease of fixed process in 2Q of 2011 – the index till the end of 2011, that is throughout the three quarters – remained on the same level of 104,2% (table 1). This level reflects average value over 16 years which between 1996 and 2011 amounted to 104,4%. The decline took place in Q1 of 2012, yet in comparison with worldwide economy it was not too big, nevertheless significant for Polish economic atmosphere.

According to the World Bank the pace of Polish economic growth in 2012 will amount to 2,9%; European Commission forecasts 2,5% growth of GDP. Currently the most significant factors

determining economic growth are: domestic demand – based on private consumption, private and public investments and stock accumulation.

GDP IN THE WORLD

In the USA, the largest economy in the world (GDP = 15,6 bn. USD, picture 1) – economic situation has been slowly but steadily improving. Economies of BRIC are rapidly growing: China (GDP = 6,99 bn. USD) outpaced Japan (5,85 bn. USD) and came second in relation to the share in worldwide GDP; Brazil (2,52 bn. USD) outrun Great Britain (2,48 bn. USD) and came sixth in the world – behind Germany (fourth place, 3,63 bn. USD) and France (fifth place, 2,81 bn. USD); as well as Russia (1,88 bn. USD) and India (1,84) quickly catching up with Italy affected by crisis (eighth place, GDP = 2,24 bn. USD).

The term BRIC – referring to the most efficient economies of the world- appeared in 2001. It was used by the economist of Goldman Sachs Bank – Jim O'Neill in his report from November 2001, which characterized four, at the time, most efficient economies. Over 11 years little has changed in this respect. Still Brazilian, Russian , Indian and Chinese economies are the fittest and the most rapidly developing economies of the world. In 2012 even more so than at the beginning of the third millennium they determine the level of global growth outpacing more and more EU states. In 2011 BRIC countries together produced 20% of worldwide GDP and EU countries generated 17%.

WOOD PRICES IN POLAND

Analysis carried out on the basis of data provided by State Forests (SF), Polish Monitor and quarterly magazine Rynek Drzewny (Wood Market) indicated that from 2009 till the end of 2011 – prices of coniferous wood on average grew by approximately 47%, and the evaluations done on the basis of data gathered from about 150 forest districts of the whole country mainly western Poland show that from the beginning of 2009 – increase in average supply prices quoted in tenders in the first half of 2012 (limited internet auctions in forest and wood portal - I auction and II auction and internet auction using the application e-drewno, so called systemic timber) – accounts for about 70%. Relevant data is presented in Table 2.

Such a significant increase over such short period – is a worldwide sensation. It can only be compared with the change in rents for the best located office spaces in the capital of rapidly growing China. In Beijing rents in 2011 increased by 75%, and in 2010 - by 48%. It was the highest increase among all cities at the time.

Yet already in May 2012 China noted decrease in prices in construction sector. Prices of new flats declined in 54 out of 70 largest cities. The greatest decrease took place in Wenzhou - 14%. In Beijing and Shanghai price decrease reached 1,6%. Following average decline by 0,3% in May – flat prices in China reached its lowest level over the last 16 months. Maybe it is a sign that the prices of round wood in Poland will also decrease noticeably?

Anyhow there are first signs of it. State Forests have informed that an average price of 1 m^3 of wood in supply for the second half of the year fell in relation to prices quoted in the first half of the year.

Table 2. Analisis of change in the price of m^3 coniferous round wood used for wooden pallets between 2008 and 2012

Year	Coniferous round wood				on average coniferous round wood for pallets
	sawmill - WC02		pulpwood - S2a, S2b		
	So/Mo	Św/Jd	So/Mo	Św/Jd	
Current prices zł/ m^3					
2009	186	186	113	109	126,96
2010	203	207	143	134	153,72
2011	256	261	171	165	187,24
2012	270	280	200	210	216,00
Price change - previous year = 100%					
2009	100,00	100,00	100,00	100,00	100,00
2010	109,14	111,29	126,55	122,94	121,08
2011	126,11	126,09	119,58	123,13	121,81
2012	105,47	107,28	116,96	127,27	115,36
Price increase - 2009 = 100%					
2009	100,00	100,00	100,00	100,00	100,00
2010	109,14	111,29	126,55	122,94	121,08
2011	137,63	140,32	151,33	151,38	147,48
2012	145,16	150,54	176,99	192,66	170,13

Source: own elaboration

ROUND WOOD SUPPLY IN 2012

Round wood offer for 2012, published by State Forests Board of General Directors on the 27th of October 2011- in comparison with previous years and trends in possessing wood is scant (table 3). It estimates increase in raw material supply for entrepreneurs by not even 1% and 1,21% of increase in the volume of overall offer – for all sectors of round wood market. It is very small. The increase is the smallest since 2010 when following the worldwide significant recession which came to an end in Poland in 2009– State Forests drastically reduced its offer. Such significant reduction in round wood supply for industrial customers done by a natural monopolist caused a situation almost creating price increase, which was visible at all three stages of this year's negotiations for the first half of the year. Offer is far too small for the development stage and current market demand, and due to its significant reduction it simple generated round wood high prices, despite of systematically growing symptoms of economic slowdown.

Numerous problems are also generated due to a large wood consumption by energy sector which as the result obtains subsidies for a so-called green energy, which distorts the principles of wood sales.

High price of „green" results in declining competitiveness of the whole economy and increasing usage of wooden biomass in professional energy sector creates growing structural shortage of wood and supply difficulties for wood industry as well as pulp and paper industry.

Tabela 3. State Forests offer for 2012 and comparing it with offers from the period between 2007 and 2011

number	Regional Directorate of State Forests	Offers for limited internet tender in pl-d	Offers for systemic internet auction in e-drewno application	Offer in total	Auctions/ submissions	Retail	Own needs	Total volume of round wood	
		round wood on sale m^3							
1	2	3	4	5	6	7	8	9	
1	BIAŁYSTOK	1 162 141	950 843	2 112 984	10	396 979	70 069	2 580 042	
2	KATOWICE	1 490 404	1 219 422	2 709 826	1 941	425 670	27 994	3 165 431	Possessing round wood in total according to CSO thousand m^3
3	KRAKÓW	336 840	275 597	612 437	173	203 447	8 468	824 525	
4	KROSNO	813 696	665 751	1 479 447	4 394	363 977	25 944	1 873 762	
5	LUBLIN	741 549	606 722	1 348 270	203	436 442	10 015	1 794 930	
6	ŁÓDŹ	528 680	432 557	961 237	500	199 775	12 460	1 173 972	
7	OLSZTYN	1 255 376	1 027 125	2 282 501	254	453 321	22 268	2 758 344	
8	PIŁA	705 110	576 909	1 282 019		254 876	13 582	1 550 477	
9	POZNAŃ	827 789	677 282	1 505 070	845	434 263	22 310	1 962 488	
10	SZCZECIN	1 571 408	1 285 698	2 857 106	1 114	412 843	46 248	3 317 311	
11	SZCZECINEK	1 533 562	1 254 733	2 788 295		448 864	32 949	3 270 108	
12	TORUN	775 820	634 762	1 410 582		426 365	22 191	1 859 138	
13	WROCŁAW	1 281 794	1 048 741	2 330 535	1 430	435 348	26 021	2 793 334	
14	ZIELONA GÓRA	892 790	730 464	1 623 254		234 816	34 759	1 892 829	
15	GDAŃSK	595 745	487 427	1 083 172		285 525	34 823	1 403 520	
16	RADOM	702 556	574 819	1 277 375	450	269 283	10 469	1 557 577	
17	WARSZAWA	332 099	271 717	603 816	250	195 923	7 429	807 418	
Year	2012	15 547 359	12 720 567	28 267 926	11 564	5 877 717	427 999	34 585 206	
	2011	15 398 011	12 598 372	27 996 383	10 743	5 780 001	383 817	34 170 944	
	2010	*13 405 728*	13 405 728	26 811 456	16 485	5 720 237	324 845	32 873 023	35 467
	2009	18 912 603	*8 105 401*	27 018 004	17 809	5 089 216	508 783	32 633 811	34 629
	2008	TOTAL SF		26 368 190	17 747	5 081 438	269 365	32 153 007	34 273
	2007			*25 102 408*	*7 399*	*4 843 324*	*95 085*	*30 621 839*	35 935
	2012	44,95	36,78	81,73	0,03	16,99	1,24		
	2011	45,06	36,87	81,93	0,03	16,91	1,12		
	2010	40,78	40,78	81,56	0,05	17,40	0,99	100	
	2009	57,95	24,84	82,79	0,05	15,59	1,56		
	2008	Share in offer in %		82,01	0,06	15,80	0,84		
	2007			81,98	0,02	15,82	0,31		
	2012			*112,61*	156,29	*121,36*	450,12	112,94	
	2011			111,53	145,20	119,34	403,66	111,59	
	2010	Comparison of wood offers 2007 = 100%		106,81	222,80	118,11	341,64	107,35	
	2009			107,63	*240,69*	105,08	*535,08*	106,57	
	2008			105,04	239,86	104,92	283,29	105,00	
	2007			100,00	100,00	100,00	100,00	100,00	
	2012	100,97	100,97	100,97	107,64	101,69	111,51	101,21	
	2011	114,86	93,98	104,42	*65,17*	101,04	118,15	103,95	
	2010	70,88	165,39	*99,24*	92,57	112,40	63,85	*100,73*	
	2009	Comparison of wood offers previous year = 100%		102,46	100,35	*100,15*	188,88	101,50	
	2008			105,04	239,86	104,92	283,29	105,00	

source: own elaboration based on table 1 in appendix 1 to the Directive 51 of General Director of State Forests from the 27th of October 2011 concerning wood sales by SF in 2012 (OM-900-8/11); table 1 in appendix 1 to the Directive 49/10 of State Forests General Director from 7th October 2010 concerning wood sales by SF in 2011 (OM-906-1-313/10); table 1 in appendix 1 to the Directive 69/09 of State Forests General Director from 14 th October 2009 regarding wood allocations for sales by SF in 2010; table 1 in appendix 1 to the Directive 89/08 of State Forests General Director from 20th November 2008 regarding wood sales by SF in 2009; Appendix 1 to the resolution 26 of Forest and Wood Commission from 02.10.2007. Directive 52A of State Forests General Director from 31st of October 2007; Appendix 1 to the resolution number 7 of Forest and Wood Commission from 26.10.2006. Directive+B24 of State Forests General Director Number 52 from 23.10.2006 CSO - Forestry 2011

CONCLUSION

Setting priorities for round wood usage– natural and rather obvious approach is allocating it for the production of expensive products characterized by a high level of processing and long-term usage. It will guarantee both positive economic and ecological effects. In wood chain an adequate

direction of satisfying need for round wood is as follows: from veneered wood and rotary cut wood to large size raw material of special usable features, then especially selected sawmill wood, raw material for constructing timber-frame houses and elements of houses built in other technologies (roof trusses, construction elements, elevation), sawmill wood for general usage (subsequently, in secondary processing, used for example for furniture or woodworking), wood for packaging (including pellet) and for the production of elements of small garden architecture, finishing with wood for the production of panels, for pulp and paper industry, for households and further for the production of briquettes and pellet. Only at the end of this chain of supply the goals of professional energy sector should be addressed. To satisfy its needs only the rest of a very small value could be allocated – wood waste from mechanical and chemical processing, part of arbomass as well as wood from branches, field and road plantings and trimmings as well as orchards grooming.

Wood will then be used in a rational way and adequately to its human friendly character and in accordance with its valuable environmental features.

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Izabela Niziałek, Emilia Grzegorzewska, Izabella Jenczyk- Tołłoczko[30]

ECO-INNOVATION ON THE EXAMPLE OF WOODEN FRAME HOUSES

Abstract: In the era of rapid changes, both economic and social, not only issues related with price and quality are becoming important for consumers, but also aspects connected with widely understood ecology. It is worth to pay attention to eco-innovation in the construction industry that promotes the use of natural raw material such as wood.

Keywords: eco-innovation, wood industry, wooden frame houses

INTRODUCTION

In the era of increasing demands on businesses, there is a problem of changes that must be done not only in the way of competing, but also in all of its operations. Awareness of advancing changes in technology, innovative in the broad sense and, above all, depletion of natural resources requires the introduction of the concept of sustainable development. The information presented in this paper point to the need of paying attention to the problem of changes in the approach to business management, in particular, to the fact that the wood sector is closely connected with the use of natural resources and interference with the environment. The wood industry sector in Poland is of major strategic importance to the economy, that is why drawing attention to the introduction of modern business management techniques to improve business competitiveness becomes increasingly important. Therefore it is essential to find solutions allowing to achieve the best results on the market and to acquire access to new markets. In the days when the term "environment-friendly" has dominated the consciousness of most potential customers, the idea of eco-innovation has more and more supporters, ipso facto providing new opportunities for development of construction technologies, which will be described in the article.

THE IMPORTANCE OF ECO-INNOVATION FOR THE ECONOMY

According to Carley and Spapens (2000) an eco-innovation is the development of products and processes in such a way as to contribute to sustainable development. In other words, an eco-innovation is a commercial application of knowledge to direct or indirect environmental improvements. The process of implementation of eco-innovation involves several key steps such as product engineering and management of the product during its life cycle. Such method helps to include environmental issues in product development and related processes. As a result of implementing eco-innovations solutions are developed, which reduce efforts, resources and energy, while increasing product and service quality (Carley, Spapens, 2000).

The occurrence of numerous competitors becomes a factor, which determines the desire to stand out on the market. Thus, application of eco-innovation can play a significant role in achieving market position and gaining new customers. There are many factors driving the company to reach for ecologic systems. These include, inter alia, such factors as:

- business,
- social,
- environmental.

In case of the examination of business factors, eco-innovation can be used as a particular form of economic activity. Due to the high demands of environmental protection, many companies see their chance to appear on the market in eco-innovation activities. Possibility of acquiring subsidies for

[30] *Dr inż. Izabela Niziałek, dr Emilia Grzegorzewska, mgr inż. Izabella Jenczyk-Tołłoczko, Department of Technology, Organisation and Management in Wood Industry, Faculty of Wood Technology, Warsaw University of Life Sciences - SGGW, 159 Nowoursynowska, 02-787 Warszawa; izabela_nizialek@sggw.pl; emilia_grzegorzewska@sggw.pl; izabella_jenczyk_tolloczko@sggw.pl*

business expansion purposes from the European Union for newly established or transforming companies are also worth attention.

Social eco-innovation is, first of all, the need for drawing society's attention to problems associated with care of the region's environment. Ecological innovation in the social aspect is increasingly considered as a sense of belonging to a particular social group. Increasing number of residential houses using solar energy as an alternative power source, construction of sewage treatment plants and water recycling are also worth noting.

The environmental factor is the most common for the introduction of eco-innovation. It is of greatest importance. Increasing public awareness of threats to the environment makes people want to prevent negative climate change, declining of natural resources and loss of biodiversity. An increasing number of individuals and companies seek to reduce air pollution, inter alia, by reducing CO2 emission to the atmosphere. Currently, recycling and the use of new technologies for water and wastewater management are becoming more popular (Romańczyk, 2010).

For many years, the wood industry, as a branch of the economy strongly associated with exploitation of natural resources, has been trying to implement as many as possible pro-environmental actions, which improve the environment. Undoubtedly, one of such initiatives are wooden frame houses, which can be classified as an eco-innovation. Despite the existence of this type of construction on the market for many years, construction technology of wooden frame houses is still being modernised and adapted to market requirements, consumer's needs and pro-environmental trends.

ECO-INNOVATION ON THE EXAMPLE OF WOODEN FRAME CONSTRUCTION

While describing the wooden frame houses as an example of eco-innovation, first it should be noted that the very raw material used for making a house in this technology is environment-friendly itself. Wood is a natural and renewable material. Wood harvesting does not reduce its quantity in the woods, due to sustainable management of forest resources. Certification of wood also becomes increasingly common. One of the ways of certification is an international FSC (Forest Stewardship Council) certificate, which aims to spread proper forest management.

Not only the use of environment-friendly material such as wood makes wood frame construction environment-friendly. There are many other factors that provide a better environmental impact than traditional brick building. One of the most significant is the use of a smaller amount of chemicals or energy needed to produce building materials. During the construction of a house, water consumption is much lower than in houses made from brick. The same occurs with regard to energy consumption (Mydlarz, 2011). Wooden frame houses are built with a smaller number of elements that are also lighter, which makes its transportation significantly easier and lowers its costs and also effects in smaller damage around the building area. Considering all available construction materials, wood has the smallest rate of energy expenditure on production of elements, their processing, as well as the use of them.

During the construction of a wooden frame building, there are other ways to reduce negative environmental impact. One of them is the use of dimensional modules adapted to the standard size of wood and wood-based materials. Sawn wood and wood-based materials are manufactured on the basis of a 60 cm sized module. With the use of modules of this size while designing a wooden frame building, the consumption of sawn wood or wood-based materials and also other building materials may be reduced (Nitka W.: Ekonomiczny sposób budowy…). Similar actions should be applied in the construction of external walls, which are most expensive. The most favourable is the use of the dual-module, i.e. 120 cm. This allows to limit the use of sawn wood, and above all, to limit the amount of waste. The use of modules also results in lower costs and simplifies the process of building a wooden frame house (Nitka W.: Ekonomiczny sposób budowy…). A common problem in the case of wooden frame houses in Poland is that their constructions are "oversized, which means that their elements have too large cross-sections or are too densely placed" (Nitka W.: Dom

drewniany…). Such operation does not improve the durability of the construction, but significantly increases the consumption of sawn wood and raises costs of construction, therefore reinforcement should be used only in places where it is necessary.

When building a wooden frame house it is also possible to reduce consumption of sawn wood through the use of other construction materials such as wood-based materials. Strength parameters of these materials are sufficiently high and allow their use as construction materials. What is most important, the use of these materials (which are often made of lower quality wood), may reduce consumption of high quality sawn wood.

The use of wooden frame houses has also a much lower impact on the environment than the use of traditional brick houses. One of the most important aspects is energy saving. Wooden houses, thanks to good thermal insulation, can save around 10% of heat energy compared to traditional constructions (Burakowska, 2006). According to expert's estimations, the use of 1 m3 of wood in house construction instead of other materials, reduces the amount of CO2 emitted into the atmosphere by about 0.8 tons (Nitka, 2010: European Commission Enterprise DG, 2003).

CONCLUSIONS

The idea of eco-innovation is primarily caring for the environment, but also meeting customers' expectations. Wooden frame construction, already recognized in the Nordic countries, is also being chosen more and more frequently by Polish customers. Such a decision is not taken solely based on the desire of owning a home built with natural materials, but also on the desire to save money, even through energy saving, as is shown in the article. If we want to reduce environmental pollution, as well as take care of our health by living in friendly surroundings, the promotion of this form of construction should be a priority.

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Andrzej Pacana[31], Igor Liberko[32], Lucia Bednárová[33]

PROPOSED APPLICATION OF THE AHP METHOD FOR SELECTION OF FOREST MEAN OF TRANSPORT

Abstract: The article attempts to use AHP method to support decision-making process about the purchase of the timber forwarder. The essence of the article is to present the methodology of the procedure, and not the best or worst tractor. Based on pair comparison it is relatively easy to get help in making decisions. Therefore, this method should be used for selection of e.g. forest tractors with similar prices and specifications.

Key words: AHP method, transport, management, planning, maintenance.

INTRODUCTION

The growing machine timber acquisition in Poland but also in the world forces enterprises to find solutions for efficient and effective management of forest transport. Management of this transport requires actions in the field of planning the development of the transport base i.e. activities within repairs and maintenance but primarily a rational purchase of tractors [1, 4]. The above mentioned process of purchase planning is closely related to decision-making, which is usually fraught with consequences. Good decisions resulting in the purchase of good quality transport means ensure efficient execution of tasks. Wrong decisions impede the attainment of objectives, reduce efficiency, complicate management. It is very important that decisions about purchasing means of transport are considered, and the best situation is when they are based on decision support methods. One of such methods is the decision support method AHP (Analytic Hierarchy Process). This article attempts to apply the mentioned method to support the decision-making process in purchasing a timber forwarder. The essence of the article is to present the methodology of the procedure, and not to show the best or worst tractor.

THE AHP METHOD

The AHP method is carried out in four steps [2, 3]:

1. Construction of the hierarchical model. Decomposition of the decision problem and the hierarchy structure factors (criteria) that affect the solution of the problem.
2. Assessment by pairwise comparison. Gathering of the ratings of pairwise comparison criteria and decision alternatives, by using a scale of dominance in the method adopted by AHP.
3. Determination of global and local preferences. Definition of the priority (importance) in relation to the criteria and options for decision-making by calculation using a spreadsheet (Excel).
4. Classification of decision options. Determining the arrangement of decision options including their role in achieving the main goal.

AHP method is used primarily to compare variants of decision-making, although it is also possible to make evaluations of the chosen diagnostic tool. Therefore, it is advisable to use such a method, for example, to choose a forest mean of transport.

ANALYSIS

In choosing appropriate decisions, many different aspects should be taken into consideration. In the present [5] case the choice of a forest forwarder tractor to acquire timber, the following criteria have been accepted:

1) power [kW];

[31] *Dr. inż. Andrzej Pacana, Rzeszow University of Technology, W. Pola 2, 35-959 Rzeszów, Poland, app@prz.edu.pl*
[32] *Prof.Ing. Igor Liberko, CSc.,Prešovská univerzita v Prešove, Slovenská 67, 080 01 Prešov, igor.liberko@unipo.sk*
[33] *Doc. Ing. Lucia Bednárová, PhD.Department of Management, Faculty of Management, University Prešov, Konštantínova 16, 0801 Prešov, Slovak Republic, lucia.bednarova@unipo.sk*

2) towing capacity [kN];
3) load capacity [kg];
4) crane outreach [m];
5) gripper cross-sectional area;
6) price [PLN (zł)].

The article deals with the case of choosing the best timber forwarder out of 5 relatively popular ones. These are: Lokomo 909P, Timberjack 1110, Timberjack 1410, Valmet 840, Ponsse Wisenn, Ponsse Elk. These tractors for the purpose of the article were randomly coded with letters: A, B, C, D and E.

The selected forest tractors differ slightly from each other, hence to make the decision it is advisable to use the AHP method based on pairwise comparisons. The selection of options (tractors) for AHP analysis was reduced to the use of only those five tractors, although the number of commercially available brands and models is much greater. The criteria selected for the analysis (marked K1 K6) and options (marked W1 W5) are presented in Table 1 in the form of a decision table.

In Table 1 the possible options were presented that were analyzed in terms of each of the criteria and they aim at achieving the objective, which is the choice of the optimal supplier. Taking into account the different possible criteria, there are five options for a solution, that is, five possible suppliers.

By means of the preference scale the comparison is made in pairs. The following scale has been adopted: maximum preference - 9, from very strong to maximum - 8; very strong preference -7, from strong to very strong - 6; strong preference - 5, from moderate to strong - 4; moderate preference - 3, from comparable to moderate - 2; comparable – 1.

Table 1. Decision table in AHP with regard to criteria and options

K1 power	K2 towing capacity	K3 loading capacity	K4 crane outreach	K5 gripper cross-sectional area	K6 price
W1 Tractor A	W1 Tractor A	W1 Tractor A	W1 Tractor A	W1 Tractor A	W1 Tractor A
W2 Tractor B	W2 Tractor B	W2 Tractor B	W2 Tractor B	W2 Tractor B	W2 Tractor B
W3 Tractor C	W3 Tractor C	W3 Tractor C	W3 Tractor C	W3 Tractor C	W3 Tractor C
W4 Tractor D	W4 Tractor D	W4 Tractor D	W4 Tractor D	W4 Tractor D	W4 Tractor D
W4 Tractor E	W4 Tractor E	W4 Tractor E	W4 Tractor E	W4 Tractor E	Tractor W4 E

The next step in the analysis of AHP is the vector construction of relative weightning of criteria within the permitted dominations. Setting preferences is a subjective process. If the given criterion is for the person taking the decision more important, it is necessary to determine the value of preferences at the highest level and in this case it is option nine. This procedure was applied on each of the compared pairs of criteria. Pairwise comparison determines the relative dominance of one criterion over another. It depends on the subjective assessment of the validity of various criteria. After determining the vector of relative weightning, it must be converted to a decimal (high accuracy is important). For example, such an assessment might look as is shown in Table 2.

Table 2. Criteria rating (vector of relative weightning of criteria)

List of criteria:		power K1	towing capacity K2	loading capacity K3	outstreacg K4	area K5	price K6
power	K1	1,00	5/1	4/1	5/1	3/1	2/1
towing capacity	K2	1/5	1,00	8/1	3/1	8/1	4/1
loading capacity	K3	1/4	1/8	1,00	6/1	4/1	8/1
outreach	K4	1/5	1/3	1/6	1,00	2/1	5/1
area	K5	1/3	1/ 8	1/4	1/2	1,00	3/1
price	K6	1/2	1/4	1/8	1/5	1/3	1,00

⇒

List of criteria:		power K1	towing capacity K2	loading capacity K3	outstreach K4	area K5	price K6
power	K1	1,00	5,00	4,00	5,00	3,00	2,00
towing capacity	K2	0,20	1,00	8,00	3,00	8,00	4,00
loading capacity	K3	0,25	0,13	1,00	6,00	4,00	8,00
outreach	K4	0,20	0,33	0,17	1,00	2,00	5,00
area	K5	0,33	0,13	0,25	0,50	1,00	3,00
price	K6	0,50	0,25	0,13	0,20	0,33	1,00

- Designate a square matrix,
- Sum the values of the elements in each row of the new matrix,
- Divide each value in the matrix column of validity of the criteria by the value of the sum,
- Determine the matrix of weights,
- Repeat steps in successive iterations until a zero-sum weight has been reached.

These calculations due to the possibility of using computer calculations and due to the authors' desire to reduce the volume of this presentation, have not been presented here.

For each iteration the weights of individual components and the difference are calculated. Iteration is calculated until these differences are minimal. Sometimes, only four iterations are enough in order to obtain accurate results and sometimes five iterations have to be carried out. In Table 3 the weights obtained in the calculation, their differences and the sum of the differences for each iteration have been presented. On the basis of these calculations, the final weights of individual criteria have been determined, which has been included in the last columns of Table 3.

Table 3. Weights and differences in iteration 1-5 for selected criteria

Iteration 1		Iteration 2		Iteration 3		Iteration 4		Iteration 5		Criterion
Weights	Difference	Weights	Difference	Weights	Difference	Weights	Difference	Final weights of criteria	Difference	
0,3693	-	0,3829	0,014	0,3787	-0,004	0,3783	0,000	0,3783	0,000	power
0,3407	-	0,2855	-0,055	0,2965	0,011	0,2970	0,001	0,2970	0,000	towing capacity
0,1565	-	0,1557	-0,001	0,1564	0,001	0,1566	0,000	0,1566	0,000	loading capacity
0,0607	-	0,0749	0,014	0,0728	-0,002	0,0728	0,000	0,0728	0,000	crane outreach
0,0409	-	0,0538	0,013	0,0516	-0,002	0,0515	0,000	0,0515	0,000	gripper area
0,0318		0,0471	0,015	0,0440	-0,003	0,0438	0,000	0,0438	0,000	price
sum	-	sum	0,1119	sum:	0,0232	sum	0,0015	sum	0,0000	

Looking at the obtained results of calculations, it can be noticed that the most important criterion in a selection is power (nearly 38%), while the least important, in the case of these particular tractors, is price (4.38%). This somewhat surprising result may be a consequence of selecting tractors with a similar price. Gripper cross-sectional area and crane outreach also followed at the end of the rating, which indicates that they probably do not play a significant role in solving the problem of choosing the optimal supplier.

The next step in the analysis of AHP is to compare the suppliers according to various criteria. The procedure for determining the validity is the same as for determining the weights of criteria, but this time options (tractors) are considered.

In Table 4 (likewise Table 2) a comparison of selected pairs of alternatives (suppliers) was shown. The values of these comparisons (and their significance) were introduced on the basis of subjective ratings of dominance of one supplier over another.

Table 4. Rating of criteria and calculations

power		W1	W2	W3	W4	W5		towing capacity	W1	W2	W3	W4	W5
Tractor A	W1	1,00	3,00	2,00	5,00	4,00		W1	1,00	5,00	7,00	3,00	6,00
Tractor B	W2	0,33	1,00	4,00	3,00	2,00		W2	0,20	1,00	4,00	5,00	3,00
Tractor C	W3	0,50	0,25	1,00	6,00	3,00		W3	0,14	0,25	1,00	2,00	4,00
Tractor D	W4	0,20	0,33	0,17	1,00	3,00		W4	0,33	0,20	0,50	1,00	2,00
Tractor E	W5	0,25	0,50	0,33	0,33	1,00		W5	0,17	0,33	0,25	0,50	1,00
load capacity		W1	W2	W3	W4	W5		crane outreach	W1	W2	W3	W4	W5
Tractor A	W1	1,00	3,00	7,00	3,00	4,00		W1	1,00	6,00	5,00	5,00	3,00
Tractor B	W2	0,33	1,00	2,00	5,00	8,00		W2	0,17	1,00	4,00	4,00	2,00
Tractor C	W3	0,14	0,50	1,00	2,00	5,00		W3	0,20	0,25	1,00	3,00	6,00
Tractor D	W4	0,33	0,20	0,50	1,00	2,00		W4	0,20	0,25	0,33	1,00	4,00
Tractor E	W5	0,25	0,13	0,20	0,50	1,00		W5	0,33	0,50	0,17	0,25	1,00
gripper area		W1	W2	W3	W4	W5		price	W1	W2	W3	W4	W5
Tractor A	W1	1,00	3,00	5,00	4,00	4,00		W1	1,00	3,00	4,00	2,00	4,00
Tractor B	W2	0,33	1,00	5,00	4,00	2,00		W2	0,33	1,00	3,00	4,00	2,00
Tractor C	W3	0,20	0,20	1,00	2,00	3,00		W3	0,25	0,33	1,00	3,00	2,00
Tractor D	W4	0,25	0,25	0,50	1,00	2,00		W4	0,50	0,25	0,33	1,00	2,00
Tractor E	W5	0,25	0,50	0,33	0,50	1,00		W5	0,25	0,50	0,50	0,50	1,00

As the result of five iterations with respect to each criterion (according to Table 4) results were obtained, as is shown in Table 6. The final rating of options is calculated based on multiplying the resulted matrix (Table 7 K1÷K6 X W1÷W5) and the matrix of criteria validity (Table 3). The result of calculations is shown in the last column of Table 5.

Table 5. Rating of options in view of applied criteria

Options		Preferences according to criteria						Final rating of options
		K1 power	K2 towing capacity	K3 load capacity	K4 crane outreach	K5 gripper area	K6 price	
W1	tractorA	38,66%	52,85%	47,27%	49,63%	45,13%	41,43%	45,48%
W2	tractor B	26,74%	23,37%	26,57%	21,34%	27,19%	25,52%	25,29%
W3	tractor C	19,69%	10,67%	13,21%	14,58%	11,83%	14,63%	14,99%
W4	tractor D	8,24%	8,09%	8,16%	8,41%	8,54%	10,54%	8,31%
W5	tractor E	6,67%	5,01%	4,79%	6,03%	7,32%	7,88%	5,92%

The best option, taking into account all the criteria, was the timber forwarder marked with the letter A. The hierarchy of the remaining machines, formed at the early stages of the calculations, has been retained to the end and so the next, second position in the overall ranking of suppliers used in the conducted AHP method, is taken by tractor B, and the next was marked with the letter C. Table 6 shows the criteria and options along with their weights. It can be used to choose a forest tractor when only one criterion is taken into account, e.g. price.

Table 6. Rating of criteria and options

K 1 power 37, 83%	K2 towing capacity 29,70%	K 3 load capacity 15,66%	K 4 crane outreach 7,28%	K 5 gripper area 5,15%	K 6 price 4,38%
W1 tractor A 38,66%	W1 tractor A 52,85%	W1 tractor A 47,27%	W1 tractor A 49,63%	W1 tractor A 45,13%	W1 tractor A 41,43%
W2 tractor B 26,74%	W2 tractor B 23,37%	W2 tractor B 26,57%	W2 tractor B 21,34%	W2 tractor B 27,19%	W2 tractor B 25,52%
W3 tractor C 19,69%	W3 tractor C 10,67%	W3 tractor C 13,27%	W3 tractor C 14,58%	W3 tractor 11,83%	W3 tractor C 14,63%
W4 tractor D 8,24%	W4 tractor D 8,09%	W4 tractor D 8,16%	W4 tractor D 8,41%	W4 tractor D 8,54%	W4 tractor D 10,54%
W5 tractor E 6,67%	W5 tractor E 5,01%	W5 tractor E 4,79%	W5 tractor E 6,03%	W5 tractor E 7,32%	W5 tractor E 7,88%

CONCLUSIONS

After conducting the AHP analysis for the selection of a forest forwarder tractor, it is evident that the tractor marked with the letter A is the most desirable one (0.4548). The tractors designated by the letters B and C may also be considered. However, the least favorable purchase would be tractors marked as D and E. To conclude, one may say that the AHP method is a very good tool in decision-making processes. It presents a wide range of applications in various fields. The presented analysis aims to encourage readers to s use this method more frequently, also in forest transport logistic issues, such as the choice of a forest timber forwarder. Do not be discouraged here by the calculations which, for your own use, can be placed in one relatively simple Excel spreadsheet. In formulating proposals, please note that this is only a presentation of the method. Another expert might choose to evaluate other factors (i.e. different tractors, and different criteria for their assessment). Otherwise, different experts might also conduct further reviews.

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Miriam Pekarčíková, Peter Trebuňa[34]

APPROACHES TO MODELLING THE ECONOMIC ORDER QUANTITY (EOQ)

Abstract: Maintenance of stocks in companies at an optimal level of effort has been since time immemorial. In the distant past businesses had to deal with the problem without any computer support which – in the present time – is indispensable. Inventory models for calculating optimal order quantities and reorder points have been in existence for a long time. Henry Ford was already aware of the degradation of financial resources bound in inventories and tried to answer key questions, i.e. When? and How much? Long before such systems as JIT, TOC and MRP were introduced, companies had been using other tools to manage their production and inventory.

Key words: modelling, order, quantity, cost.

INTRODUCTION

Inventory Management Explained focuses on the key planning aspects of inventory management like forecasting, lot sizing, safety stock and ordering system. Determining the number of orders can be performed in the following ways:

1) intuitive - when it comes to expert estimate,
2) by estimate - the amount of order based on a comparison of previous periods,
3) by calculation - the optimal amount of an order, the so-called Harris-Wilson formula.

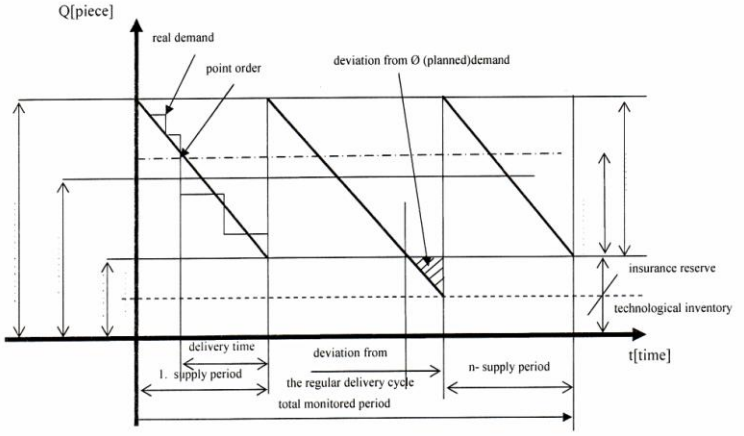


Figure 1. The saw diagram

The aim of the third approach is to determine a quantity that complies with the minimum total cost of ordering and stocking. Smaller quantities increase the number of orders and ordering costs, whereas higher order quantities result in higher storage costs.

It is therefore important to determine the point order or the time at which the company has entered an order to their supplier and when the inventory level does not fall below a minimum value and the size of orders does not cause an increase of costs. Figure 1 presents a graphic display of stock movement.

The key factors which influence the optimal replenishment mode include:

- continuity and intensity of consumption during a unit of time (day, decade, month),
- planning and organizational level and synchronization system as a whole,

[34] *Ing. Miriam Pekarčíková, PhD., doc. Ing. Peter Trebuňa, PhD., Technical University of Košice, Faculty of Mechanical Engineering, Institute of Technologies and Management, Department of industrial engineering and management, Němcovej 32, 042 00 Košice, Slovak republic, miriam.pekarcikova@tuke.sk, peter.trebuna@tuke.sk*

- dose size - the size of an order which ensures minimum total cost,
- order cycle - the time between two consecutive deliveries of the same heading,
- the number of orders per year - follows directly from the set of optimal order size and the need for a monitored period (year),
- total cost of supplies - related to the price of goods, acquisition costs and storage costs,
- the degree of uncertainty in production (supply), i.e. the provision of consumption (to determine the optimal amount of safety stock).

Methods for inventory supplementation and reduction in the actual process are as follows (Figure 2):

- cascading refill - smooth decline
- cascading refill - gradual decrease
- continuous replenishment - gradual decline,
- continuous refill - smooth decrease.

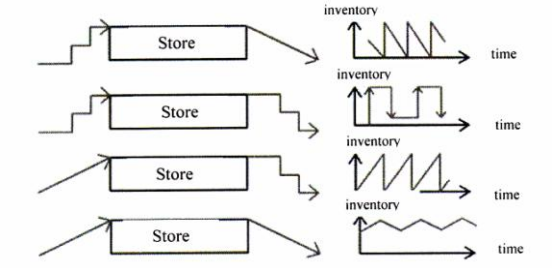


Figure 2. Methods for complementarily and inventory consumption

Economic ordering quantity is the level of inventory that minimizes the costs of storing and ordering. The comprehensive methodology for the calculation of metrics was defined by F.W. Harris in 1913.

The aim is to determine a quantity that guarantees minimum total cost connected with ordering and storage. Smaller ordering quantity increases the number of orders and ordering costs, whereas a bigger number of orders increases storage costs.

It is useful to formulate the conditions under which the model can be used:

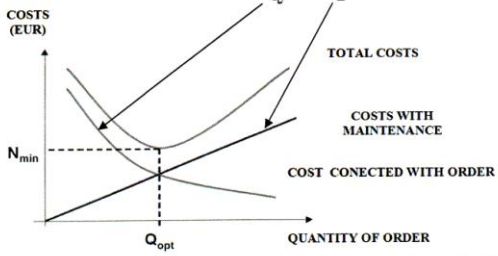
- ordering cycle is constant; the demand for goods storage is approximately linear in time,
- cost connected with ordering and price per unit are constant; the cost of implementing one order and storage costs, including commitment of capital in stock, are known,
- implementation period is constant; stock is replenished periodically to a quantity equivalent to optimal order size,
- delivery is complete; the overall demand for goods ordering during a given period is known; then, we are dealing with completely determined consumption, an ordered quantity is available when needed and the time required to ensure the quantity is not taken into account.

Tab.1 Costs associated with acquiring and maintaining inventory

MONITORED INDICATORS	
COSTS CONECTED WITH PRICE $N_c = P \times D$	total annual cost of purchasing needs of material inputs to meet the demand for that item
COST CONECTED WITH ORDER $N_o = C \times D/Q$	costs connected with order, with each ordering is associated fixed costs C (eg transport costs) and the volume of the order is expressed as follows D/Q, where D is annual demand, Q is the amount in one order.
COSTS WITH MAINTENANCE $N_{skl} = H \times Q/2$	represent the mean stocks are out of stock at the time between the arrival of supplies of entries, provided that ideally it is an average between the point of delivery when the stocks 'climb' to its maximum so Q and a point before the next delivery, when the stocks are to 0 (since it does not consider buffer stocks). Then these costs can be expressed as Q/2

TOTAL COSTS ASSOCIATED WITH ACQUIRING AND MAINTAINING INVENTORY

$$TC = PD + \frac{CD}{Q} + \frac{HQ}{2}$$



To find a local extreme (in this case the minimum) is required derivative function of the full cost (by DQ), which set equal to zero: Result after the transformation:

$$\frac{dTC(Q)}{dQ} = \frac{d}{dQ}\left(PD + \frac{CD}{Q} + \frac{HQ}{2}\right) = 0 \quad \Rightarrow \quad -\frac{CD}{Q^2} + \frac{H}{2} = 0$$

By indicating Q we obtain Q *, which represents the optimal ordering quantity:

$$Q^* = \sqrt{\frac{2CD}{H}}$$

Legend:
Q = Order quantity (pcs)
Q * = optimal ordering quantity (pcs)
D = annual demand for the product, expressed in units (pc)
P = price per piece (euro / pc)
C = fixed cost per order (Euro)
H = annual inventory costs expressed per unit (Euro / pc)

The formulation model assumes linear consumption of formed stocks in a given period without considering buffer stocks, i.e. minimum reserve totals zero and the maximum is equal to the size of an order.

Economic Order Quantity/EOQ is defined at the point where the function shall enter into local extremes, i.e. minimum ordering quantity. This is the point at which the function of total cost is minimum (at this point the costs of procurement and maintaining of inventory are equal).

The above formulas enable calculations with a fixed purchase price per item. In practice, orders are often placed in volumes which reflect a discount for the purchased quantity, so when purchasing higher quantities the supplier can provide discounts for all items (first type degressivity price) or only for the quantity of items which exceeds a specific limit (second type degressivity price). It is therefore necessary to decide whether it is better to purchase an optimal amount at a base price per item or consider a purchase that exceeds a specific limit of quantities at reduced prices. However, purchasing with a discount is favorable provided that the amount of the discount is higher than the costs that would be associated with storing large amounts of purchased inputs.

CONCLUSION

Many optimization models built on different criteria have been worked out to manage inventory levels and carry out storage management. Modifications of quantitative models include discounts when ordering discrete quantities (handling unit), ordering multiple items from one supplier, limited

storage capacity, limited financial resources etc. At the current stage of information technology development and its implementation in business practice, it is possible to utilize various computerized systems to manage the status and movement of inventory in real time, hence long-term normal stocks can be minimized.

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Włodzimierz Popyk, Wojciech Lis, Elżbieta Mikołajczak, Katarzyna Mydlarz[35]

EFFICIENCY OF THE FURNITURE INDUSTRY BETWEEN 2006 AND 2011

Abstract: The article characterizes economic results and operational efficiency of furniture companies in Poland between 2006 and 2011. Despite the European economic crisis, the Polish furniture industry recorded a significant increase in sold production, mainly due to substantial growth of export. Good sales results and favourable exchange rates positively boosted the profitability of furniture companies. Sales increase together with insignificant fluctuations in employment levels resulted in higher work efficiency while large capital intensity of the furniture industry has been decisive for the decline in industry capital return.

Key words: furniture industry, efficiency, financial result.

INTRODUCTION

The furniture industry due to sales volume and size of employment and, most of all, due to its impact on Polish export figures, plays a significant role in Polish economy. It is characterized by significant production capacity, which highly exceeds domestic market demand. Currently the production potential of furniture manufacturers in Poland is three times as large as the domestic demand for furniture. There are approximately 160 thousand people working in the Polish furniture sector. Poland is among the ten largest furniture producers in the world and comes fifth in terms of export volume.

For many years the furniture industry has been a leading net exporter of its products. It is one of the most significant product groups value-wise in Polish export. Its share reaches the level of approximately 8% of the overall value of export [2]. Operating efficiency of companies from the furniture industry, despite its fundamental dependence on export results, is also to a large extent a consequence of the situation on the domestic market, especially the house building sector as well as the wood industry being its raw material base.

THE FURNITURE INDUSTRY'S SOLD PRODUCTION

The global economic crisis, which in 2008 resulted in significant reduction of the pace of industrial production growth in Poland and in 2009 in its decline, did not have a direct material impact on the dynamics of the Polish furniture industry's sold production.

The size of sold production in companies from the furniture industry is presented in Picture 1 [3].

The value of the furniture industry's sold production measured in current prices has been systematically growing from 23, 4 billion PLN in 2006 up to 28,9 billion PLN in 2011. Within the period under analysis, production growth was recorded annually, except for the year 2010, when a slight decrease took place. Between 2006 and 2007, when there was a good economic situation on the market, production grew on average by 10% annually, while in subsequent years the dynamics of sold production slowed down. Between 2007 and 2010 the dynamics of sold production measured in fixed prices decreased from 109,5% in 2007 to 94,2 % in 2010.

A change of negative trends came in 2011. Despite the difficult situation on the domestic market and the recession in the house building sector, that year saw a record value of sold furniture production - around 29 billion PLN, which constituted a sales increase of 13% when compared with the previous year. Considerable sales increase was then achieved mainly due to a substantial stimulation of export into the markets of the European Union. Despite the production decrease in the building industry and the remaining difficult situation on the domestic market in 2011 and 2012,

[35] *Poznan University of Life Sciences, Department of Economic and Wood Industry Management, Wojska Polskiego 38/42, 60-627 Poznań, Poland, wpopyk@up.poznan.pl, wlis@up.poznan.pl, emikolaj@up.poznan.pl, kmydlarzk@up.poznan.pl*

the high speed of sold production growth was maintained [7]. It was mainly the result of the pro-export attitudes of producers from that sector resulting from the favourable currency rate between the zloty and the euro. The weakening of the Polish currency is a positive situation for exporters as it considerably increases the competitive position of Polish furniture on foreign markets. Good export results were achieved mainly due to export to Germany –the most important importer of Polish furniture, whose share in Polish furniture export is estimated to reach 40%. Good economic situation in this country promoted active operations of Polish furniture manufacturers in this economic area. There was also a slight increase in the sales of furniture on the domestic market. The domestic market's better results were mainly the consequence of private and public investment linked to projects financed with EU funds.

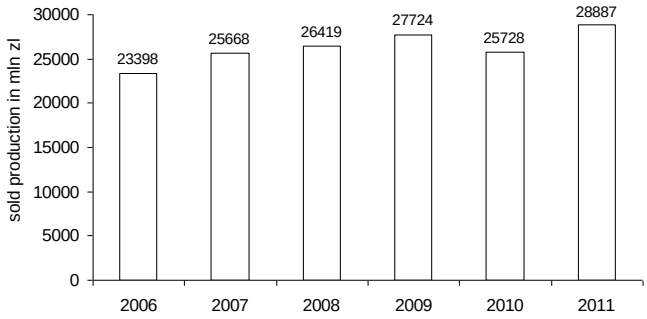

Figure1. Value of sold production of the furniture industry in the years 2006-2011

Source: own evaluation on the basis of Central Statistical Office

COMPANIES FINANCIAL RESULTS

In case of the furniture industry, whose financial condition is primarily related to the results of sales on foreign markets, export profitability reflects on the potential for generating capital. For many years a fundamental factor creating profitability ratios of the furniture sector has been the changing currency rate of the Polish zloty in relation to the euro. Increase of export profitability as the result of the growing furniture market in Germany allowed Polish producers to generate an adequate financial surplus. Fluctuations on both domestic and European markets had their direct impact on the level of profitability of furniture manufacturers between 2006 and 2011. Net profitability of furniture industry companies between 1996 and 2011 is presented in Figure 2 [6].

In the period between 2006 and 2011 furniture manufacturers achieved relatively good financial results. Between 2006 and 2008 a decline in profitability from net level of 4,3% in 2006 to 2,5% in 2008 was observed with a subsequent systematic increase up to 6,2% in 2010. Despite ever better sales results, the furniture industry's profitability in 2011 decreased to the level of 4,1%.

Range of additional factors causing faster dynamics of production costs in relation to sales growth had an impact on cutting financial results of furniture companies in 2011. Growing costs of purchasing material and semi-products for furniture production as well as the costs of labour negatively influence the profitability level of the furniture industry and decrease price competitiveness of Polish furniture on foreign markets.

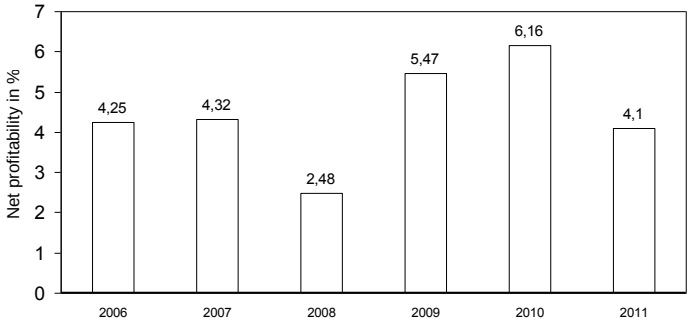

Figure2. Net profitability of furniture industry in the years 2006-2011

Source: own evaluation on the basis of Central Statistical Office

Along with the reduction of the results of the economic crisis in the upcoming years, one may expect better results of furniture manufactures on the domestic market. Growth of demand for furniture will correspond to the growth of society income, yet the demand may be limited by the increase in furniture prices linked to the growing trend in the prices of wood material and wood-based panels.

EFFICIENCY OF THE FURNITURE INDUSTRY

Not only the results of economic activities but also the relations between production and the value of assets and level of employment are a proof for the furniture industry's efficiency. The ratios describing the above mentioned links determine labour and productivity efficiency of those assets.

Labour efficiency measured using the volume of sold production per one employee between 2006 and 2011 was presented in Figure 3.

Within the period under analysis, regardless of the recessive phenomena, a small but systematic growth of work efficiency has been observed. Work efficiency measured by production sold per employee grew from 162 thousand PLN in 2006 to 192 thousand PLN in 2011. Slight decrease in work efficiency was recorded only in 2010, the year which was characterised by both a decline in production as well as a reduction in employment. Main factor determining the pace of efficiency alternations in the researched period were the changes in the growth of industrial production, while the changes in employment levels were of a lesser impact. Within the period of good economic situation a fast increase of work efficiency took place, while recessive periods resulted in significant reduction of the pace of efficiency growth [1].

Reverse trends took place in the productivity of furniture industry assets. Return on fixed assets worth a thousand PLN in current prices measured by sold production value is presented in Figure 4 [5].

Despite the a considerable production growth in subsequent years of the researched period, a systematic decline in return on assets was observed. Return on fixed assets worth one thousand PLN in the furniture industry decreased from 3008 PLN in 2006 to 2186 PLN in 2010. In percentage terms it meant a return on fixed assets of about 25%. In this period the speed growth of fixed assets value significantly outpaced the growth of value of sold production, which resulted in a decline of productivity.

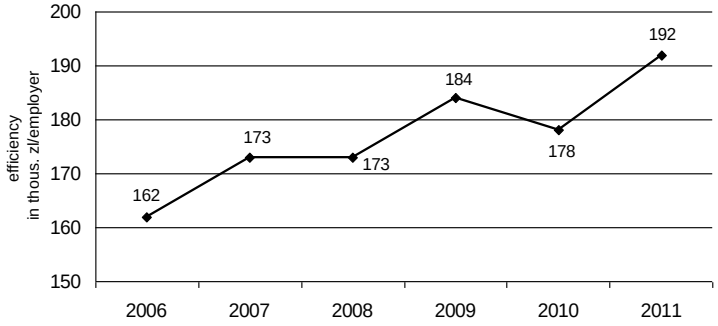

Figure 3. Efficiency of work in the furniture industry in the years 2006-2011

Source: own evaluation on the basis of Central Statistical Office

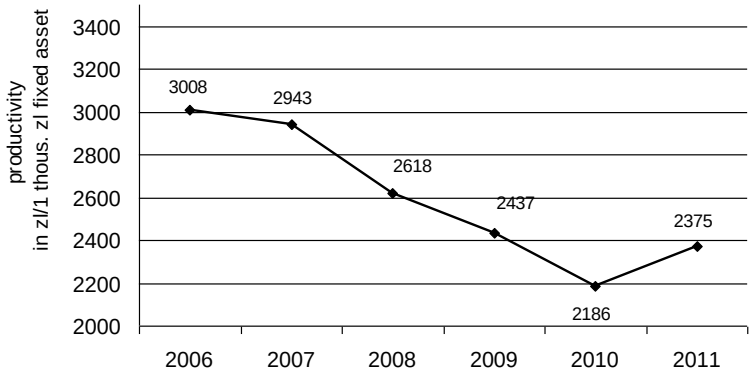

Figure 4. Productivity of the furniture industry in the years 2006-2011

Source: own evaluation on the basis of Central Statistical Office

A reverse of that disadvantageous situation in terms of productivity was observed in 2011. At the time recorded, return on fixed assets reached the level of 2375 PLN per each set of fixed assets worth a thousand PLN. A factor determining the growth of fixed assets return in that year was the substantial increase in sold production, with a rate of growth higher than that of fixed assets.

The decline of productivity levels is mainly a consequence of the fact that the furniture industry is rather highly capital intensive. Achieving the growth of furniture production, especially in highly technological production spheres, requires relatively higher capital per production unit. Moreover, the decreasing productivity is also the result of the rather limited level of utilizing production capacities [4].

SUMMARY

Operating under the conditions of a world-wide economic crisis, Polish furniture manufacturers managed to keep their highly competitive position on the European market, as well as flexibly adjust their production to the ever changing economic reality. In comparison with the recession in other industry sectors, the Polish furniture industry systematically increased its turnover reaching the highest level of sales in 2011. Increase in the sales of furniture products was possible due to substantial growth of export into the European market. Good sales results as well as a favourable currency rate positively influence the profitability of furniture companies. High dynamics of sales growth in consecutive years, along with similar levels of employment, positively affected work

efficiency, which improved systematically. At the same time, however, a decrease of return on fixed assets was observed, which was the result of the rather high capital intensity of the furniture industry.

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Marek Potkány[36]

COSTING ASPECTS OF THE PRODUCTION OF WOOD PELLETS

Abstract: Wood pellets are a highly comfortable homogeneous fuel, which is wonderfully easy-kept and it regulates heat. Heating with wood pellets is a real alternative to normal (fossil) fuels and comfort is similar to heating with natural gas. The main aim of this paper is to present the possibilities of applying the calculation method in the wood-processing industry in Slovakia with special regard to the production of wood pellets.

Key words: cost, calculation, absorption costing, wood pellets.

INTRODUCTION

Costing and budgeting are among the most important tools in the value management of each company. Importance of calculations is reflected in all management levels – operational, tactical and strategic. The relatively wide range of tasks which relate to the calculation (deciding the amount and range of performances, pricing, and valuation of assets created by own activities, compilation of plans and budgets, staff motivation), requires the creation of a complex system of individual types of calculations and relations between them, which form the so-called costing system of a company.

Calculation is the way to calculate the total costs of making and selling a product or providing a service. Calculation may be expressed as an activity. Its target is to find actual, alternatively planning (calculating) costs and the rest of pricing elements accrued to the calculating unit. The result of these activities is calculation. The calculating scheme has a certain integrated structure and it indicates the level of costs and other pricing elements of the calculation. The term "calculation of the costs to outputs" is understood in two ways [1]:

- as an activity determining the costs to outputs,
- as a result of this activity (concrete calculation of the costs to the calculating unit).

Costing represents the activity that is being calculated and in a certain way reflects the cost of the products and services respectively performance of each company [2]. Its objective is to identify the actual or planned costs and other price components per calculation unit. The calculation according to the cost structure expressed in a calculation formula is classified according to the cost and price calculation [2].

The cost calculation represents the level of invested costs by valuation of their economic efficiency in individual sections of the company. The price of the final product will be determined by adding them to the profit margin.

The price calculation endows the costs like they perform by selling prices of the products. It shows the costs from the aspect of the effectiveness of investing. This is the so-called retrospective style of designation of the calculation.

The allocation of costs is a process of assigning cost object calculation and is very closely connected with the amount and structure of overhead costs, i.e. the costs which cannot be directly expressed in a calculation unit. There are basic methods of costing for that. The calculation method is the method of determining or finding costs incurred for the chosen subject matter of calculation. The wood-processing industry enterprises most frequently use costing calculation based on the method of dividing calculation and absorption costing calculation.

1. WOOD PELLETS

Few decades ago, the question of how to replace traditional heating ways emerged in Western Europe. This is where the idea of "liquid wood" – pellets, came from. The key issue to solve was: how is wood going to provide as comfortable heating as gas or oil does. The solution is easy,

[36] *Technical University in Zvolen, Department of Business Economy, Masarykova 24, 960 53 Zvolen, Slovakia, potkany@tuzvo.sk .*

however a little weird at the first impression: the wood needs to be fluidised. "Liquid wood", called pellets, was developed 20 years ago in Austria and Sweden [7]. Wood pellets are a group of clean renewable energy sources for heating. Pellets are made of phyto-fuel, which is plant fuel. Wood pellets have a cylindrical shape with a diameter of 4-20 mm and a length of 10 to 50 mm. There are two groups of pellets (Figure 1):

- wood pellets are fuel made of 100% natural domestic material. Main raw materials for pellet production are fillings and shavings, i.e. a waste from the wood-processing industry. Pellet production is free of any chemical and synthetic additives. Lignin acts as a binder contained in the wood itself, which at high temperatures, due to the influence of friction, reaches a plastic state. Recently, wood pellets are being produced from targeted fast-grown trees;
- alternative pellets are made of straw (wheat, rye, soybeans, barley, peas, rapeseed) and agricultural waste (organic waste from industrial cleaning and drying of agricultural crops). The required strength and durability of alternative pellets produced by the adding waste rapeseed or sunflower seeds (2 to 3% of total composition) for straw and other agricultural waste for pelletising. This oil waste reduces the energy consumption in production, prolongs the durability and improves the quality of alternative pellets.

Fig. 1. Wood pellets and alternative pellets [4]

Wooden pellets make a perspective fuel for the present and future. They have a high heating capacity (more than 18 MJ/kg), the burning process is clean and the produced heat can be very effectively used to heat hot and industrial water. Perfectly burning, pellets provide minimum ash content without any harmful substances, which can be used as a fertiliser due to its nutrient content. The main reasons for heating with wood pellets are [5]:

- Higher energy efficiency;
- High heating capacity (up to 19 GJ/t);
- Low ash content (to 1%);
- Low water content (to 8%);
- Low storing capacity requirements (approx. 650 kg/m^3);
- Fully automatic operation and regulation;
- Low production of gas emissions from burning;
- Affordable price per produced heat unit;
- Fully-fledged compensation for other fuels;
- Not dangerous in case of accidental burner overflow;
- Renewable energy source for heating.

Prices for heating with pellets can be compared with those of other forms of heating. Figure 2 presents basic information about the average annual cost of heating a house with an annual consumption of 100 GJ of heat, which is 27.8 MWh, according to the Association of Legal Entities "Biomasa" [6].

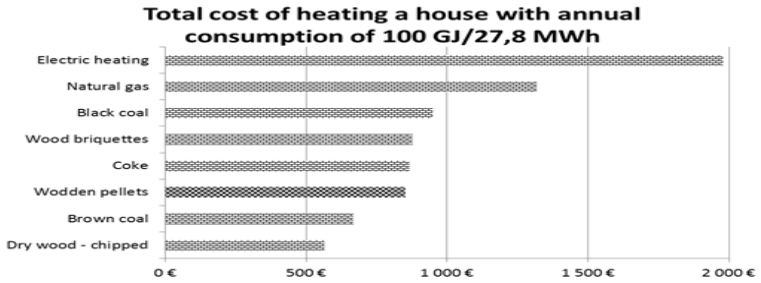

Fig. 2. Average annual cost of heating a house with annual consumption of 100 GJ/27.8 MWh [6].

2. SUITABLE CALCULATION METHODS FOR DETERMINING THE PRICE OF WOOD PELLETS

Absorption costing is also referred to as the full cost method (in many specific methodical variations – for example dividing costing, joint product costing, absorbing costing or standard cost method). It accumulates only product costs, direct and indirect, to measure product cost. The gross margin (in absorption costing) is the sales revenue minus all product costs, including applied fixed manufacturing overhead. Absorption costing averages all product costs from all units produced. When there are large amounts of committed or fixed costs, making more units reduces the average cost per unit, which may be a visible number. Also, placing some units in inventory defers all the costs of those units from being recognised as expenses, which could increase currently reported income.

The absorption costing methods (also known as full costing) is an inventory valuation that includes all manufacturing costs [3]:

- direct materials - those materials that become an integral part of end output and can be conveniently traced into it;
- direct labour - those factory labour costs that can be easily traced to individual units of products by norm of hours;
- both variable and fixed manufacturing overhead in the costs of a unit of product. These costs are transformed into product by the margin of manufacturing overhead through a suitable cost allocation base.

In practice, it is possible to find and use, basically, two types of cost allocation bases [1]:

- natural allocation base (quantitative): unit quantities of the processed material (given in kg, m3, m2) units of time (in hours of staff work, machine operating hours, standard hours). This type of allocation base excludes the impact of price inflation effects, but its drawback is the fact that it is more difficult to detect evidence of previous periods, or performing specific economic and technical analyses,
- monetary allocation base: the value of direct materials, direct wages and production costs is determined in monetary terms. Detection is relatively simple provided accurate accounting records of documents are maintained, but some problems are caused by frequent changes in exposure time inflationary effects.

Dividing calculation is used in cases where the costs for a certain period of time or for a certain amount of production are covered by one uniform type of performance. This includes, in particular, the production of pellets, briquettes, while the methodology can be applied also in specific cases in the timber industry, such as the processing of logs by cutting a uniform type of timber. This method of calculation allocates costs to performance on the basis of a ratio relation of the joint expense (with the possibility of their quantification in type-cost groups) to the quantity of calculation units.

Costing methods that result from a specific cost group and do not cover all cost items are among non-absorbent costing methods. This calculation can be specified as incomplete (variable) costs

calculation. The variable costing method (also: direct costing or marginal costing) is an inventory valuation that includes only variable manufacturing costs:
- direct materials - those materials that become an integral part of end output and can be conveniently traced into it;
- direct labour - those factory labour costs that can be easily traced to individual units of products by norm of hours;
- only variable manufacturing overhead in the costs of a unit of product. This cost is transformed to product by the variable margin of manufacturing overhead.

An important value is the level of the contribution margin, understood as the difference between the price of product and variable cost or gross margin, as a difference between the price of product and direct cost.

3. CASE STUDY

The entrepreneur, whose main business is processing logs into lumber, decided to start cutting wood waste (sawdust, bark and shavings), utilised in the production of wood pellets, which then is going to be marketed as a stand-alone product of a newly established subsidiary. Projected budget costs in each period of one year are presented in Table 1. The entrepreneur plans to produce in the period no. 2 160 tons of wood pellets, and the idea is that the sales price includes a profit of 10% (return on cost). Here, the calculation unit is a large capacity bag (big bag) weighing 1 ton of wood pellets with a length of 2-5 cm and a diameter of 6 mm.

Table 1. Budgeted cost for the production of wood pellets

Cost item	Monetary value
- cost of materials (sawdust, wood shavings) 14,650 s.m.(11.4 € / s.m.)	167 000 EUR
- labour costs (including charges) for 6 employees	56 400 EUR
- rental (production + storage space) + energy (technology + service)	72 800 EUR
- depreciation (line technology, cars, press, packing machine)	24 600 EUR
- other costs (fuel, insurance, interest, telecom. services, accounting)	22 800 EUR
Total	343 600 EUR

Dividing Costing.

Material costs	(167 000 EUR / 2 160 t)	77,31 EUR/t
Labour costs	(56 400 EUR / 2 160 t)	26,11EUR/t
Overhead costs	(120 200 EUR / 2 160 t)	55,65 EUR/t
Total own costs		159,07 EUR/t
Profit (10% return on cost)		15,91 EUR/t
Price without Value Added Tax		174,98 EUR/t
Value Added ttax (20%)		35,00 EUR/t
Selling price with Value Added Tax		209,98 EUR/t

Absorption Costing.

The dependence for the selection of monetary base is determined by the percentage of overhead surcharges as follows:

$$\text{Percentage margin of overhead cost} = \frac{\text{Total overhead costs} \times 100}{\text{Value allocation base (material /labour cost/)}} \quad (\%) \quad (1)$$

Alternative 1: allocation base material cost

Percentage margin of overhead cost = (120 200 x 100) / 167 000 = 71,98 %

Alternative 2: allocation base labour cost

Percentage margin of overhead cost = (120 200 x 100) / 56 400 = 213,12 %

	Alternative 1	Alternative 2
Material costs (167 000 EUR / 2 160 t)	77,31 EUR/t	77,31 EUR/t
Labour costs (56 400 EUR / 2 160 t)	26,11EUR/t	26,11EUR/t
Overhead costs (71,98 %)	55,65 EUR/ (213,12%)	55,65 EUR/t
Total own costs		159,07 EUR/t
Profit (10% return on cost)		15,91 EUR/t
Price without Value Added Tax		174,98 EUR/t
Value Added Tax (20%)		35,00 EUR/t
Selling price with Value Added Tax		209,98 EUR/t

Based on the results of the calculations it may be concluded that the determination of selling prices in the production of wood pellets as a homogeneous production, selection of calculation method is important, but the decisive factor is the structure and value of individual cost items. The selling price was calculated in all cases at 209,98 EUR/tone of wood pellets with Value Added Tax.

If no allocation of costs for fixed and variable, it is impossible to apply a system of calculation of variable costs in calculating the contribution margin. Therefore, based on the case study data, we apply the principle of incomplete cost calculation with the calculation of gross margin (as a difference between the price of product and direct cost).

Price without Value Added Tax	174,98 EUR/t
- direct cost (material costs, labour costs)	103,42 EUR/t
Gross margin	71,56 EUR/t

Gross margin is important information for decision making. This value informs on how much the product contributes to covering overhead costs and generating profit.

CONCLUSION

The increasing usage of forest biomass in the power industry creates wood shortages Pellet heating is considered to be CO_2-neutral and having a considerable contribution to air protection. People using wooden pellets for heating do not contribute to the global climate change and at the same time they help reduce the global warming and prevent other natural disasters. Before you decide on a certain energy source, you should compare investment costs to heating costs and mind their probable development. This is the way to easily calculate pellet heating costs [5]: 1 kg of pellets contains approx. 4.8 kWh of energy, 1 m^3 of oil corresponds to approx. 2.1 tons of pellets, 2.1 tons of pellets correspond to approx. 8-10 m^3 of lump wood. Transition from oil or gas heating to the use of pellets could save up to 35% per family house. However, the main "end users" are our environment and future generations.

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Łukasz Sarniak[37]

CORPORATE BOND ISSUE AS AN ALTERNATIVE METHOD TO RAISE CAPITAL

Abstract: This paper addresses issues connected with raising capital by enterprises by way of issuing corporate bonds and listing such bonds on exchanges. The author hereof describes essential matters pertaining to preparation and completion of the entire process. Particular focus is placed on proving that issuing corporate bonds and listing such bonds on exchanges is a better method for an enterprise to raise capital in a stock market downturn than issuing stock.

Key words: corporate bond issue, Catalyst market.

INTRODUCTION

Nowadays, one of numerous difficulties to be faced by enterprises is how to raise capital. Newly raised capital is usually intended to further develop the enterprise or satisfy the enterprise's liabilities, if any, and remove financial worries. One of the methods to raise capital is a bank loan. No bank loan is, however, easy to get. This is primarily due to the fact that the banks set extremely high level requirements for borrowers. These requirements have been subject to a further considerable increase recently. There is no doubt whatsoever that the reason for such increase can be attributed to one of the biggest financial crises of recent history, caused by problems in the mortgage loan market of the United States. The crisis is deemed to have affected almost all countries worldwide. Although several years have passed since the beginning of the crisis, the situation has not yet dramatically changed for many Member States of the European Union. What we continue to experience is economic slowdown or even recession in some countries. After concerns over Ireland and Hungary, it is being talked increasingly louder now about a possible Greek, Spanish, or Italian insolvency. Some people have formulated opinions that what we are about to face is the intensification of the crisis and the Eurozone's disintegration. All these undoubtedly fail to promote any economic growth in Poland. Concerned about possible worsening of the economic situation, the banks set very high level requirements for enterprises applying for a bank loan. Indebted enterprises find it very difficult to obtain a bank loan. Similar difficulties are experienced by young and dynamically developing enterprises. And this is the reason for enterprises to increasingly often use alternative capital raising methods. One of these is issue of stock or bonds.

To encourage investors to take hold of its securities, increasingly often an enterprise decides to list such securities on an exchange. As far as large corporations' stock is concerned, it is usually listed on the Primary Market of the Warsaw Stock Exchange. Smaller companies' stock, which fails to meet rigorous requirements to be listed thereon, is traded on the "NewConnect" Market. Yet, corporate bonds are listed on the Catalyst Market. Chart 1 illustrates a total number of new listings on the aforesaid markets, against the stock market index WIG20.

[37] *Poznan University of Economics, Department of Money Theory and Monetary Policy, Powstańców Wlkp. 16, 61 – 895 Poznań, lukasz.sarniak@ue.poznan.pl* .

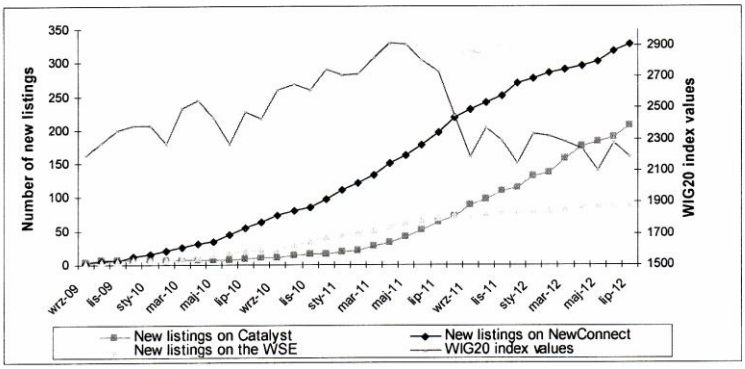

Chart 1. New stock and bond listings on the Warsaw Stock Exchange, September 2009 – July 2012

Source: Self-study based on information accessible from the following websites: www.gpw.pl, www.newconnect.pl, www.gpwcatalyst.pl, *and* www.gpwinfostrefa.pl *(accessed on 10 August 2012)*

Information included in Chart 1 allows for the conclusion that the number of new listings on the Primary Market of the Warsaw Stock Exchange decreases with the stock market downturn. This is not the case for the "NewConnect" Market, which shows a straight increase in the number of enterprises listed thereon. It should be, however, noted that new listings on the said market usually mark the start of trading in already existing stock and thus do not necessarily mean that capital has been raised by issuing new stock. The straight increase in the number of enterprises listed is not the case for the Catalyst Market. When a stock market is in upturn, the market shows little interest in any corporate bond issue. This tendency, however, is changed whenever the market experiences a downturn. When going through a downturn, the Catalyst Market shows a considerable increase in the number of new listings.

This paper describes a particular case of an enterprise raising capital by issuing corporate bonds. Increasingly often, enterprises choose to issue such bonds. Moreover, due to the precarious situation on stock markets worldwide, corporate bonds become progressively interesting for investors. This paper briefly presents the most important issues pertaining to the corporate bond issue process. In particular, it attempts to prove that issuing corporate bonds in a stock market downturn is one of best methods an enterprise can apply to raise capital. This thesis is verified based on an analysis of advantages of issuing bonds instead of stock.

CORPORATE BOND ISSUE

The law sees a bond as a security, in which the bond issuer acknowledges the indebtedness of the bond issuer to the bond holder, and undertakes to make a certain performance towards the holder. To issue bonds, one should first consider whether the bond issue project will be profitable. One should keep in mind that any funds raised by issuing bonds will have to be repaid at any later date. Therefore, the bond issue process is not recommended to enterprises which intend to use capital so raised for investments which cannot guarantee future profits.

After all, issuing corporate bonds is by no means an easy process. The market practice is to involve a Brokerage House or an Authorized Adviser to conduct the bond issue project. Employees of the said firms have considerable experience to help carry out the project and avoid any possible mistakes. Help from professionals is invaluable particularly when potential interest of investors in the product is to be assessed. The professionals are able to reach clients and check whether there is any chance to place a bond issue. If preliminary talks promise well, further efforts can be taken to prepare and carry out the entire bond issue process.

The next step would be making a formal decision to issue corporate bonds. A relevant resolution to this effect has to be adopted by the meeting of the enterprise's stockholders. Depending on what is set forth in the enterprise's articles of incorporation, a relevant decision may also be taken by a supervisory board. The resolution must specify fundamental parameters of bonds, primarily including: issue size, maturity date, face value, issue price, coupon rate, and payment frequency. The resolution should also specify other important aspects of the bond issue process, such as a placement method and a market on which the bonds are to be listed provided, of course, that such listing is intended by the enterprise. Table 1 shows average values of fundamental parameters of corporate bonds traded on the Catalyst market.

Table1. List of selected values of parameters for corporate bonds traded on the Catalyst market (as at 31 July 2012)

Percentage distribution of bonds listed, according to issue size	< 2 mio	2 – 5 mio	5 – 10 mio	10 – 20 mio	> 20 mio
	28%	33%	12%	13%	14%
Percentage distribution of bonds listed, according to face value	PLN 100	PLN 1000	other value		
	14%	71%	15%		
Percentage distribution of bonds listed, according to rate type	fixed	floating	zero coupon		
	19%	80%	1%		
Percentage distribution of bonds listed, according to maturity	up to 2 years	2 to 3 years	over 3 years		
	42%	36%	22%		

Source: Self-study based on information accessible from a website: www.gpwcatalyst.pl [accessed on 10 August 2012]

The data presented in Table 1 shows that most popular for enterprises are corporation bond issues with the value of PLN 2 - 5 million, face value of PLN 1000, floating rate, and relatively short maturity. In addition to the aforesaid parameters, crucial is also the way in which the entire process is carried out. In general, there are two possibilities: public offering or private placement.

A public offering is a relatively time-consuming process. It takes several to a dozen or so months to be completed. The length of the process reflects, among other, the necessity of preparing and approving an issue prospectus. A public offering can be carried out only by a brokerage house properly authorized by the Polish Financial Supervision Authority. The path of public offering is followed for large bond issue. The main advantage of any large issue is that it may be addressed to a very wide range of potential investors. But it should be also noted that the process is quite costly. Largest expenditures include advisor fees (brokerage house, law office, auditor, PR firm), costs of preparing and approving the issue prospectus, costs of marketing and promotion activities, or fees charged by a clearing house and a trade system organizer).

Because of relatively high costs and a long duration of the entire process, few enterprises decide to perform a public offering. They rather choose the second option, i.e. private placement. There is nothing to prevent the enterprise from conducting the private placement process unassisted. Nevertheless, the market practice is to use services of specialized entities which include brokerage houses and authorised advisors. Pursuant to Polish laws in force, a private placement can be addressed to a maximum of 99 people. Furthermore, no extensive advertising activities are permitted during a private placement. The largest advantage of a private placement is relatively low cost.

ASSESSMENT OF CORPORATE BOND ISSUE ATTRACTIVENESS IN STOCK MARKET DOWNTURN

In addition to the possibility of raising capital, issuing securities and listing them on exchanges entail also other benefits. These include a growth in the enterprise's prestige and additional promotion of the enterprise in the market, which is particularly noticeable even through media presence alone. Additionally, potential contractors are more positively inclined towards a brand which enjoys high recognition, and thus more willingly make new contracts with such brands. Of

course, the entire process has also many disadvantages. These include, for example, an obligation to inform and, in consequence, the necessity of facing the fact that competitors are precisely informed about the enterprise's strategy and position. The above-presented pros and cons are valid for stock issue as well as for corporate bond issue.

In a stock market downturn, some additional arguments can be indicated to support the claim that it is more beneficial for the enterprise to issue corporate bond instead of stock. These arguments primarily include: easiness of issue placement, investment certainty from the viewpoint of a potential client, no stockholding dispersion, and possibility of rolling or exchanging into stock.

In recent years, we have been enduring one of biggest financial crises caused by problems in the mortgage loan market of the United States. Moreover, many EU Member States have suffered an economic slowdown, while some have even faced recession. Undoubtedly, these experiences have largely contributed to global market sentiments. The largest stock market indices have lost much of their value. Stock has become a very risky investment. Undeniably, little interest in purchasing stock in the secondary market affected the primary market. This trend is illustrated by Chart 1 in the Introduction section of this paper. It makes corporate bonds much more popular during slowdown. Very often, bonds are with a coupon rate of a dozen or so per cent p.a., which is surely an attractive investment where an uncertain stock market shows a high risk of loss. This is why investors increasingly often in a stock market downturn prefer investing in corporate bonds which are much easier to place than stock. One might say that an increase in supply of corporate bonds by enterprises is to some extant a response to an increase in the investors' demand.

A stock market downturn occurs in consequence of economic problems. In a downturn, many enterprises encounter financial difficulties. Sometimes these lead them to declare bankruptcy. In the event of bankruptcy, an enterprise's assets are not distributed among stockholders until all creditors are satisfied. In practice, this is rarely the case for stockholders that there is anything left for them. In the case of corporate bonds, owners' claims against the enterprise are satisfied before creditors' claims. Therefore, in the event of bankruptcy, considerable probability exists that any capital invested will be recovered. Undoubtedly, this is why corporate bonds are more secure investments than stock from the viewpoint of potential investors.

The stock issue is usually addressed to new investors. By taking hold of stock, the investors become a given enterprise's stockholders. As stockholders, they are granted numerous rights connected with their stockholding. These rights include, but are not limited to the possibility of participating at General Meetings of Stockholders and of making decisions binding for the enterprise. Of course, to make their vote matter, a stockholder must hold a sizable fraction of all voting stock. Nevertheless, the enterprise must respect the rights of all stockholders to make their voices heard, which is likely to be troublesome. Therefore, to avoid excessive dilution of stockholding, it is more advisable for the enterprise to issue corporate bonds.

Yet the largest disadvantage of corporate bonds is the necessity of repaying cash once received plus a set coupon. This issue may be solved through rolling, i.e. existing bond holders are offered new bonds instead of corporate bond redemption. This, however, entails a risk that the investors will not be interested in taking hold of such new securities. Therefore, in the terms and conditions of the issue, the enterprise may reserve the possibility of exchanging corporate bonds into the enterprise's stock. This will allow the enterprise to avoid problems, if any, with redemption in the event of no capital available. One might thus say that a corporate bond issue may be deemed to be a postponed stock issue. Of course, the attention should be drawn to the fact that exchangeable corporate bonds may be much more difficult to place than regular ones.

CONCLUSIONS

Downturns in stock market undoubtedly increase the popularity of corporate bonds as compared to stock. This is primarily a consequence of investors' concerns over the economic situation, which makes them limit their tendency to invest in stock acquirable through public offerings or private

placements. The investors seek safer possibilities to invest capital. Moreover, unlike stock, corporate bonds are much easier to place, ensure investment certainty from the viewpoint of investors, guarantee no dispersion of stockholding, and provide an opportunity for future rolling or exchanging bonds into stock.

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Andrea Sujová[38]

IDENTIFICATION AND PERFORMANCE VALUATION OF BUSINESS PROCESS IN A FURNITURE COMPANY

Abstract: Strong competition on the wood and furniture market forces enterprises to pay attention not only to quality of products but also to quality and performance of internal business processes. The paper deals with the issue of identification of main business processes and their parameters which are a base for process performance valuation. Methods and indicators for process measurement play an important role in measurement and valuation of the total business performance.

Key words: business process, performance management, process performance indicators, furniture company.

INTRODUCTION

Business process can be characterized as a complex of activities which due to one or more inputs create output, bearing value for the internal or external customer. Business processes are the object of the process approach to management based on enterprise search and analysis from the view of business activities and activities performed by managing staff. The basic idea of the process approach is that some of the reasons of low business performance are ineffective internal processes, which should be changed towards efficiency increase and the highest added value for the customer. Process management presents systems, procedures, methods and tools for sustainable securing of maximum performance and continual improvement of business processes with the aim to fulfil determined strategic goals. The base for business process performance valuation is the identification of parameters and internal structures in each internal business process.

IDENTIFICATION OF BUSINESS PROCESSES

Process identification means determination of key value-making processes and main supporting processes, visualization of processes in their internal structure, including sub-processes and activities within each sub-process. The aim of process identification is to analyse their course of action and mutual connections, and to visualise these flows in process maps. It is recommended to make the following classification of business processes: [3,7]

A. Main processes: these processes directly conduce to fulfilling the mission of a company, their final output is addressed to the external customer and they directly contribute to the added value for customers.

B. Supporting management processes: their role is to create possibly most effective and simple system for management of main processes corresponding to the goals determined by process owners.

C. Supporting service processes present functional processes necessary for the functioning of main processes, they are addresses to the internal customer and they can be outsourced.

After creation of a business processes list for each process, its parameters are defined as follows [7,8].

- Process purpose: key factors are determined through which the process conduces to achieve stated strategic success factors and to achieve competitive advantage.
- Inputs used by the process: material, financial, information, human resources, management including knowledge needed for operating the process.
- Process costs: amount of resources needed for process inputs.

[38] *Assoc. prof. Andrea Sujová, PhD., Department of Business Administration, Faculty of Wood Sciences and Technology, Technical University in Zvolen, Masarykova 24, 960 53 Zvolen, Slovakia, sujova@tuzvo.sk .*

- Outputs produced by process and information on who is the external or internal customer.
- Indicator of process performance: is a measurable parameter for process evaluation.
- Process owner is a person responsible for optimal running, output and development of process.
- Relations between processes: determination of previous and following process, point where the process enters into its concluding phase.

For each identified basic process its internal structure can be distinguished as follows: [4,8]

Identification and visualization of: particular sub-processes and activities within each sub-process, sequential steps within activities of sub-processes; determination of: each activity duration, interactions between activities, inputs and outputs between activities; Identification of sources and limiting for activity realization.

In the chosen Slovak furniture company, first, business processes have been identified (see Table 1). Then, these business processes were analyzed with the aim to identify their internal structure. As an example, the authors present the structure of the main production process with identification of its basic parameters (see Table 2).

Table 1. Processes in a furniture company

Main processes	Supporting management processes	Supporting service processes
Supply process	Quality management	Material-technical supply
Production process	Management of information systems	Technical maintenance
Sale process	Management of health safety and protection	Facility management

MEASUREMENT AND VALUATION OF PROCESSES

After parameters and internal structure of processes have been identified, a measurement of each process follows with the aim to establish parameters achieved in the process. Data collection about processes and its following evaluation brings integrated view on company behaviour. According to several authors three main areas of process measurement exist: [1,5]

A. Effectiveness: rate of ability of process output to fulfill customer needs and expectations.

B. Efficiency (performance): rate of inputs minimalisation by effort to reach high effectiveness.

C. Adaptability: ability of flexible reactions to satisfy changing customer requirements.

Each business process should have defined measurable indicators enabling process evaluation known as key performance indicators (KPIs). The total key indicator should be customer satisfaction. The purpose of process valuation is to assign to a process the value it ultimately brings to the customer. [6] Methods for process valuation and determination of target and desired values of performance indicators are: process analyses, process benchmarking and process digitalization [2,3].

For process measurement and valuation in the chosen furniture company, process indicators were determined (see Table 3). Consequently, the valuation of processes' level was performed using simplified form of benchmarking with stated reference values of indicators. In Table 4 we present the valuation of the main production process

Table 2. Structure of the production process in a furniture company

PRODUCTION PROCESS			
Indication of process:			VYR
Indication of activity:			VYR01
Indication of previous activity:			ZAS11
	Limitation		
	Period flow of fixed plan		
Input	Activity	Alternative activity	Output
Order form on external delivered material	Material requisition	xxx	External delivered production material
	Sources		
	warehouse MTS		
Indication of process:			VYR
Indication of activity:			VYR02
Indication of previous activity:			ZAS11
	Limitaion		
	Internal production capacity		
Input	Activity	Alternative activity	Output
Order form on internal delivered material	Material requisition	xxx	Internal produced material
	Sources		
	Warehouse MTS		
Indication of process:			VYR
Indication of activity:			VYR03
Indication of previous activity:			VYR01, VYR02
	Limitation		
	Stock availability/ machine fault		
Input	Activity	Alternative activity	Output
Wood-based panels	Formatting in machine workshop	Direct purchase from supplier (AVYR03)	Worked product for packaging or surface finishing
	Sources		
	warehouse MTS / external supplier		
Indication of process:			VYR
Indication of activity:			VYR04
Indication of previous activity:			VYR01, VYR02
	Limitation		
	Machine fault		
Input	Activity	Alternative activity	Output
internal and external delivered materials	Material surface finishing	xxx	Worked product for packaging
	Sources		
	warehouse MTS / external supplier		
Indication of process:			VYR
Indication of activity:			VYR05
Indication of previous activity:			VYR03, VYR04
	Limitation		
	Pack material availability		
Input	Activity	Alternative activity	Output
Worked product for packaging	packaging	xxx	Packaged product
	Sources		
	Warehouse of finished products		
Indication of process:			VYR
Indication of activity:			VYR06
Indication of previous activity:			VYR05
	Limitation		
	Labells availability		
Input	Activity	Alternative activity	Output
Packaged product	labelling	Sorting without labelling (AVYR06)	Labelled product
	Sources		
	Warehouse of finished products		
Indication of process:			VYR
Indication of activity:			VYR07
Indication of previous activity:			VYR06
	Limitation		
	Palette availability		
Input	Activity	Alternative activity	Output
Labelled product	Sorting to palletes	combining (MIX palettes - AVYR07)	Products sorted on palettes
	Sources		
	Warehouse of finished products		
Indication of process:			VYR
Indication of activity:			VYR08
Indication of previous activity:			VYR07
	Limitation		
	Customer orders		
Input	Activity	Alternative activity	Output
Products sorted on palettes	Removal from warehouse	Long-time warehousing (AVYR08)	Products prepared to expedition
	Sources		
	Information system		

Table 3. Indicators of the main processes in a furniture company

Process name	Indication	Responsibility	Priority of process
Supply process	ZAS	Purchasing officer	1
Process indicators			Unit
Stock turnaround time			day
Stock turnaround speed			day
Average value of stocks			EUR
Average daily consumption			EUR
Stock share on property			%
Process name	Indication	Responsibility	Priority of process
Production process	VYR	Production manager	1
Process indicators			Unit
Labour productivity			pc / EUR
Machine productivity			pc / EUR
Capital productivity			pc / EUR
Average profitability per employee			EUR
Average costs per product			EUR
Fulfilment of labour output norms			%
Fulfilment of machine output norms			%
Number of days of stocks remaining in production			day
Total effectiveness			%
Value of semi-finished production			EUR
Number of defective products			pc / EUR
Share of defective products in total production			%
Inputs utilization			%
Numbers of hours worked on outputs			hour
Ratio of hours worked on outputs			%
Number of proposals for innovations and improvement			pc
Effectiveness of transformation of inputs into outputs			%
Process name	Indication	Responsibility	Priority of process
Sale process	ODB	Sales manager	1
Process indicators			Unit
Value of finished products in warehouse			EUR
Average number of orders			pc
Average period of finished products storage			day
Average period of customer cycle			day
Share of returned and reclaimed products in finished products			%
Rate of successfully processed reclamations			%
Share of promotion costs on value of stored products			%
Sale effectiveness			%

Table 4. Valuation of production process in a furniture company

Indicator	Unit	Trend	Strength	January	February	March	Reference value	Average value 4/4 2011
Labour productivity	Pc	1	15	0,8	0,8	1,0	1,0	0,9
				12,0	12,0	15,0	15,0	13,5
Machine productivity	Pc	1	10	0,9	0,9	1,0	1,0	0,9
				9,0	9,0	10,0	10,0	9,0
Capital productivity	Pc	1	10	0,9	0,9	1,0	1,0	0,9
				9,0	9,0	10,0	10,0	9,0
Fulfilment of labour output norms	%	1	15	0,8	0,8	1,0	1,0	0,9
				12,0	12,0	15,0	15,0	13,5
Fulfilment of machine output norms	%	1	10	0,9	0,9	1,0	1,0	0,9
				9,0	9,0	10,0	10,0	9,0
Number of days of stocks remaining in production	Day	0	10	0,8	0,8	1,0	1,0	1,0
				8,0	8,0	10,0	10,0	10,0
Number of defective products	Pc	0	5	0,9	1,0	0,9	1,0	0,9
				4,5	5,0	4,5	5,0	4,5
Share of defective products in total production	%	0	5	1,0	1,0	1,0	1,0	1,0
				5,0	5,0	5,0	5,0	5,0
Inputs utilization	%	1	5	0,8	0,8	0,9	1,0	0,9
				4,0	4,0	4,5	5,0	4,5
Number of proposals for	Pc	1	5	1,0	1,0	0,7	1,0	0,7
				5,0	5,0	3,5	5,0	3,5
Effectiveness of transformation of inputs into outputs	%	1	10	0,8	0,9	0,9	1,0	0,9
				8,0	9,0	9,0	10,0	9,0
Process valuation			100	85,5	87,0	96,5	100,0	90,5

Valuated indicators achieve relatively high rates in reference values. The space for improvement exist in indicators of productivity and innovations. Level of production process in the chosen furniture industry can be considered positive.

CONCLUSIONS

Identification of business processes in a company and the construction of a process map can help use principles of process management in a higher rate in order to make processes better, to create higher added value for the customer and also to provide better control of operating processes. Correct identification of areas needed to be analysed and determination of adequate process indicators allows the implementor to uncover critical points in processes, when it is possible to indentify changes required for process improvement. This allows for implementation of the process approach into management. to Managing business performance requires systematic process measurement, analysis and valuation.

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Marek Tabert[39]

IMPLOSIONS OF MATERIALS AND COMPONENT STRUCTURE OF PRODUCTS FOR THE NEEDS OF PRODUCTION PLANNING AND CONTROL IN ENTERPRISES

Abstract: The paper presents algorithms for the collection of information on the component structure in complex products. Lists of such information are discussed in the form of implosions: single-level, multi-level and aggregated. Bills of materials and components were developed using the concepts of the immediate master and immediate slave components. Proposed algorithms for information gathering may be coded in selected programming languages and in this form used in data bases supporting production management processes in industrial enterprises manufacturing assembled products. Application of algorithms was illustrated using an example of a furniture product.

Key words: bill of materials and components of a product, process of implosion for a product, immediate master component, immediate slave component, algorithms for the creation of lists on products structure.

INTRODUCTION

When realizing processes of production planning and control lists of products, components (typically referred to as a Bill of Material – BOM) are frequently used [Mather 1987]. They constitute ordered lists of components of final products, generally with information on the technology of their realization. In relation to lists of components other terms are also applied: lists of materials, structural lists, assembly lists, lists of parts, lists of components or component lists. Components (parts) included in such lists may be basic and auxiliary materials, elements, subassemblies, assemblies and final products.

Lists of components comprise first of all information on the component structure of final products and on the order (hierarchy) of components' assembly . Moreover, lists may be supplemented with data on the properties of components, which is applied in production management. In particular, descriptions of technological and assembly operations are added for all parts. Lists of components are constructed firstly based on drawings, produced in the course of structural design of the products. Drawings contain data on elements, subassemblies, assemblies and final products, particularly their numbers and assembly connections as well as types and amounts of materials, from which parts and final products are to be made of. Further technological data presented on the lists is then supplemented in the course of production planning [Wacker and Miller 2000].

In a minimal form, a list of components contains at least three types of information:

- name (identifier) of the immediate master component or the final product,
- names (identifiers) of immediate slave components,
- amounts (materials consumption standards) for immediate slave components, required for the manufacture of the immediate master component [Mather 1987, Tabert and Błażczak 1996].

Lists of components may be presented in two basic forms: a table or a tree (dendrite), called the Gozinto graph. In the theory of graphs a tree is characterized as an acyclic and coherent graph [Wilson 2000, Grygiel 2007].

In industrial plants bills of materials and components (BOM) of products are used in production management processes. Such documents are applied in the method of Material Requirement Planning (MRP). MRP is used, first of all, in applications classified as Manufacturing Resource

[39] *Poznan University of Life Sciences, Department of Economic and Wood Industry Management, Wojska Polskiego 38/42, 60-627 Poznań, Poland, mtabert@up.poznan.pl .*

Planning (MRP II) and Enterprise Resource Planning (ERP/ERPII) [Monk and Wagner 2009, Auksztol et al. 2011].

In literature on the subject the problem of how to obtain different scopes of information on bills of materials and components of products has been discussed in a limited number of publications [Krawczyński 1991, Tabert and Błażczak 1996, Gawroński 1998, Chen et al. 2012]. It was referred to in more detail in a paper by Tabert and Błażczak [1996], where the basic principles of collecting information on the design structure of furniture products are presented.

The aim of this paper is to present algorithms, thanks to which it will be possible to obtain lists of information on the material structure of products in the form of implosions. Proposed selection procedures will facilitate generation of three different types of bills of materials and components in the form of implosions, covering not only structural elements (unit products, expressed e.g. in the number of pieces), but all material components (bulk and homogeneous - i.e. those expressed in units of measure, e.g. m2) required for the manufacture of a final product.

Algorithms presented in this article may be coded in a selected programming language and included in applications in the form of data bases serving production management processes. The problem of obtaining bills of materials of products was illustrated with examples on the structure of design products, which may be good representatives for any type of products with a complex bill of materials.

1. TABLE OF IMMEDIATE PAIRS OF MASTER AND SLAVE COMPONENTS OF A PRODUCT

Relations of inclusion, which occur between components and the final product, may be presented as a result of two methods of action. In the first case it is an analytical division of a product or a complex component, defined as 'explosion'. It progresses from the most complex component or the final product to the least complex component. It is a procedure defined as 'top-down'. In this way we may obtain three types of ordered lists of slave components, of which a complex component or a final product is made. We distinguish explosions of the following types: one-level (assembly lists, component lists), multi-level (structural lists) and summary (lists of materials) [Krawczyński 1991, Tabert and Błażczak 1996, Czuchnowski and Orłowski 2011].

In the other case, we are dealing with a synthetic division of the final product or a complex component referred to as 'implosion'. This procedure progresses in the opposite direction in comparison to the approach presented above. Implosions progress from the least complex component to the most complex component or the final product, i.e. it is a bottom-up procedure. As a result, we may obtain three types of lists of complex components or final products, comprising a specific slave component. We distinguish the following types of implosions: one-level (assembly), multi-level (structural) and summary (materials) [Krawczyński 1991, Tabert and Błażczak 1996, Czuchnowski and Orłowski 2011]. Such lists provide an answer to the question of where a given slave component was applied.

The starting point for the creation of implosion bills of materials and components of a product (e.g. furniture) is a MSC listing of all pairs of its immediate master (IMC) and slave (ISC) components. Master and slave components are found at two successive levels of the bill of materials and components of a product, component IMC on level p and component ISC on level p+1, respectively. Moreover, inclusion and ordering relations occur between these components.

Such a MSC bill of materials and components may be constructed on the basis of a design drawing of a product, a graph for its bill of materials and components cross tabulation (a contingency table of components) or a list of components. Both master and slave components may be identified by their names (full or abbreviated), numerical codes (indexes) or alphanumeric codes, depending on the principles applied in a given enterprise. In case when numerical codes are assigned to components in an ordered, accrual manner, it is possible to use algorithms connected

with sorting of identifiers in the form proposed by Gawroński [1998]. In other situations, generalized algorithms described in this paper are recommended for use.

Moreover, in the Item Master bill of material (MSC) the quantity (or multiplicity) and a unit of measure for each slave component, comprising a direct master component, are given. Table 1 presents an example of a list of all master and slave pairs, comprising a cabinet of a corner desk. Thus said, MSC contains a basic characteristic of a bill of materials and components of a specific final product and all of its components.

The desk is composed of two types of cabinets: a door cabinet (D) and a drawer cabinet (S). In Table 1 as well as Tables 3, 4, 6 components of these cabinets were denoted with letters D or S, respectively, if such a distinction of component affiliation to a specific cabinet type was needed in the presented BOM examples. In the above mentioned tables types of artificial veneer panels used to manufacture the door cabinet were denoted with factory symbols BW, BN, PP, C and E in order to distinguish them in terms of their use and grain direction.

Table 1. An example of the listing of immediate pairs of master and slave components (MSC) for a cabinet of a corner desk

No.	Name (identifier) of immediate master component (IMC)	Name (identifier) of immediate slave component (ISC)	Quantity of slave component (QSC)	Unit of measure of tslave component (UMC)
1.	Desk	Cabinet with doors	1	pc*
2.	Desk	Cabinet with drawers	1	pc
3.	Desk	Top panel	1	pc
4.	Desk	Right back wall	1	pc
5.	Desk	Left back wall	1	pc
6.	Desk	“Häfele” angle plate - Mini joint	6	pc
7.	Desk	“Häfele” confirmat screw	20	pc
8.	Desk	Wood screw, short	12	pc
9.	Cabinet with doors	Cabinet case D	1	pc
10.	Cabinet with doors	Doors	1	pc
11.	Cabinet case D	High side wall D	1	pc
12.	Cabinet case D	Low side wall D	1	pc
13.	Cabinet case D	Base	1	pc
14.	Cabinet case D	Horizontal partition wall	2	pc
15.	Cabinet case D	“Häfele” confirmat screw	15	pc
16.	High side wall D	Particle board	0,386	m^2
17.	High side wall D	Artificial veneer panel BW - wide surface	2	pc
18.	Artificial veneer panel BW - wide surface	Artificial veneer - wide surface	0,386	m^2
19.	High side wall D	Urea formaldehyde resin	92,5	g
20.	High side wall D	Artificial veneer -narrow surfaces	2,52	lm**
21.	High side wall D	Hinge guide	2	pc
22.	High side wall D	Wood screw, short	4	pc
23.	High side wall D	PCV glide	2	pc
24.	Low side wall D	Particle board	0,353	m^2
25.	Low side wall D	Artificial veneer panel BN - wide surface	2	pc
26.	Artificial veneer panel BN - wide surface	Artificial veneer - wide surface	0,353	m^2
27.	Low side wall D	Urea formaldehyde resin	84,6	g
28.	Low side wall D	Artificial veneer - narrow surfaces	2,41	lm
29.	Low side wall D	PCV glide	2	pc
30.	Horizontal partition wall	Particle board	0,131	m^2
31.	Horizontal partition wall	Artificial veneer panel PP - wide surface	2	pc
32.	Artificial veneer panel PP - wide surface	Artificial veneer - wide surface	0353	m^2
33.	Horizontal partition wall	Urea formaldehyde resin	31,4	g
34.	Horizontal partition wall	Artificial veneer - narrow surfaces	0,26	lm

No.	Name (identifier) of immediate master component (IMC)	Name (identifier) of immediate slave component (ISC)	Quantity of slave component (QSC)	Unit of measure of tslave component (UMC)
35.	Base	Particle board	0,025	m^2
36.	Base	Artificial veneer panel C - wide surface	2	pc
37.	Artificial veneer panel C - wide surface	Artificial veneer - wide surface	0,025	m^2
38.	Base	Urea formaldehyde resin	6,0	g
39.	Base	Beech pin	4	pc
40.	Base	"Wikol" wood adhesive	6,0	g
41.	Door	Particle board	0,176	m^2
42.	Door	Artificial veneer panel E - wide surface	2	pc
43.	Artificial veneer panel E - wide surface	Artificial veneer - wide surface	0,176	m^2
44.	Door	Urea formaldehyde resin	42,3	g
45.	Door	Artificial veneer -narrow surfaces	1,79	lm
46.	Door	Concealed hinge	2	pc
47.	Door	Wood screw, short	4	pc
48.	Door	Wooden knob	1	pc
49.	Door	Wood screw, long	1	pc

*pc - piece ; **lm – linear meter

Source: own study.

In the MSC bill of materials, components may be arranged in any order. A single row in Table 1 contains a pair composed of two direct furniture components - master and slave, belonging to the same final furniture product (in the example from Table 1 – a cabinet of a corner desk). In the example row 16 provides the name (identifier) of the master component – the high wall D and the name (identifier) of its immediate slave component - particle board. Moreover, the quantity is indicated (0.386 m2) for a particle board, from which the side wall is made. All component pairs, contained in rows 1 - 49 of Table 1, comprehensively describe the material and components structure of the analyzed cabinet of a corner desk.

The listing presented in Table 1 may also contain pairs of furniture components, which belong to different furniture products. Such a possibility leads to the creation of an extended version of the MSC bill of materials and components. It includes a bill of materials for all products and their components, which are manufactured in the enterprise. From the extended MSC bill of materials and components, using an appropriate procedure, we may select all pairs of components, which form the material and components structure of a given final product or any of its complex components. Bills of materials and components created on the basis of such selections take the form of implosion bills of materials and components.

2. IMPLOSION BILL OF MATERIALS AND COMPONENTS OF PRODUCTS

The process of implosion for a bill of materials and components of a product runs from its lower to higher levels. Principles for the creation of implosion BOMs are presented in the form of algorithms, which are given in Tables 2 and 3. The list of components in the implosion form presents information on the bill of materials and components of a specific final product or a complex component from its lower level (i.e. not necessarily from the zero level) to a higher level and covers the number of levels of the bill of materials, which results from the adopted scope of implosion.

The produced listing in the form of an implosion bill of materials and components requires supplying one pair of names (identifiers) out of two, i.e. the name of the final product and one of its components or the name of two components, of which one is the master and the other is its slave. The first name from each pair denotes either the final product or the master component (the imploded component N). The implosion process is to be run within the structure of the final product or the master component N. The final product or component N determine the position, at which the

implosion process is completed. If such a product (or component) is not indicated, the process of implosion of a bill of materials and components is not specifically defined, since the imploding component P may belong to many master components and to many final products. The other name from each pair refers to a slave component (imploding component P), comprised in the final product or the imploded master component N. Supplying component P means the identification of the position, from which the implosion process for the bill of materials and components is to start with. The imploding component P may be an assembly, subassembly, element or a specific material (a solid or bulk product).

The basic type of implosion bills of materials and components of a final product or a master component is the single-level implosion (SLI). It supplies information on all master components (belonging to the final product or the imploded component N), whose immediate component is a specific slave component P (imploding component), and it indicates its multiplicity or quantity in the final product or master component. Master components specified in the single-level implosion belong to the specific component or the imploded final product N. The algorithm for the creation of a single-level implosion of a furniture component is presented in Table 2.

Table 2. Algorithm for the creation of a single-level and a multi-level implosion of a component

Step number	Description of procedure
Single-level implosion	
1	On the basis of contents of the MSC listing for a specific imploded final product or component *N*, a listing is created in the form of a multi-level explosion (MLE) of this product or component.
2	Such a created MLE set is searched in terms of the ISC field. All rows are selected, for which the content of the ISC field is equal to the name (identifier) of the imploding component (component *P*). Selected rows create the listing in the form of a single-level implosion of a product (SLI).
Multi-level implosion	
1	On the basis of the MSC listing, a multi-level explosion (MLE) is created for the indicated component or imploded product *N*.
2	In such a created set (MLE) those rows are searched for, in which the content of the ISC field is equal to the name (identifier) of the imploding component (furniture component *P*). In this manner the single-level implosion is created (SLI).
3	The content of the IMC field in the selected SLI rows is compared with the ISC field in the MLE set. Those rows are selected, for which contents in the above mentioned fields are equal. Selected rows are added to SLI.
4	The content of the IMC fields in such selected rows is again compared with the content of the ISC fields in the MLE set, continuing the selection of the rows recurrently and adding them to the SLI, until the depletion of rows meeting the above mentioned conditions. Selected rows form a listing in the form of a multi-level implosion of a product (MLI).

Source: own study based on Tabert and Błażczak [1996].

Table 3 shows a single-level implosion of a component based on a particle board (the imploding component P), comprised in the subassembly - the cabinet case D (imploded component N).

Table 3. An example of a single-level implosion of a particle board belonging to a subassembly of a cabinet case

No.	Name of immediate master component (IMC)	Name of immediate slave component (ISC)	Quantity of slave component (QSC)	Unit of measure of slave component (UMC)
1.	High side wall D	Particle board	0,386	m^2
2.	Low side wall D	Particle board	0,353	m^2
3.	Horizontal partition wall	Particle board	0,131	m^2
4.	Base	Particle board	0,025	m^2

Source: own study.

A one-level (assembly) implosion presented in Table 3 lists four subassemblies: tall side D, low side D, a horizontal partition and a base, which are produced directly from a particle board. Such a list makes it possible e.g. to identify components fast and specifically (see Table 3, column IMC),

in which previously used material (particle board) is to be replaced with another (e.g. Medium Density Fibreboard). It also indicates in which production processes of components (see Table 3, column IMC) manufacture disturbances may occur, if the date of delivery of the material (particle board) is delayed. In case the price for the material (particle board) increases, components may be identified (see Table 3, column IMC) on the basis of the assembly implosion in order to establish which costs will be influenced by this price change.

The second type of implosion bills of materials and components of a product or its complex component is the multi-level implosion of the product (MLI). The algorithm for the creation of a multi-level implosion for a slave component (component P) is given in Table 2. Multi-level implosion supplies information on what master components and in what quantities contain the specified slave component belonging to the bill of materials and components of an imploded component or product N. Table 4 presents an example of a multi-level implosion of a particle board (component P), belonging to the cabinet case D (component N).

Table 4. An example of a multi-level implosion of a particle board belonging to the cabinet case

No.	Name of immediate master component (IMC)	Name of immediate slave component (ISC)	Quantity of slave component (QSC)	Unit of measure of slave component (UMC)
1.	High side wall D	Particle board	0,386	m^2
2.	Low side wall D	Particle board	0,353	m^2
3.	Horizontal partition wall	Particle board	0,131	m^2
4.	Base	Particle board	0,025	m^2
5.	Cabinet case D	High side wall D	1	pc
6.	Cabinet case D	Low side wall D	1	pc
7.	Cabinet case D	Horizontal partition wall	2	pc
8.	Cabinet case D	Base	1	pc

Source: own study.

A structural multi-level implosion presents all series of master components, found at successive levels of the product structure, in which the specific slave component is included. Table 4 comprises of four series of components. One of them is a series: particle board – low side D – base of the cabinet D. Each of the series presented in Table 4 begins with the same slave component (here: particle board), found at the lowest level of the component structure of the product. In turn, it ends with the final product or a complex component (here: the base of the cabinet D), located at the (relatively) highest level of the product structure. On the basis of a multi-level implosion we may obtain an analogous set of information as in case of a one-level implosion, but this time it concerns a series of master components, and not only immediate master components.

The third type of implosion bills of materials and components of a product or its complex component is represented by the aggregate implosion of a product (MI). The algorithm for the creation of an aggregate implosion of a slave component is presented in Table 5.

Table 5. Algorithm for the creation of an aggregate implosion for a slave component of a product

Step number	Description of procedure
1	Multi-level implosion (MLI) is created for an indicated master component for an imploded product *N*.
2	On the basis of a multi-level implosion (MLI) rows are identified, of which ISC fields contain the name (identifier) of the imploding component *P*.
3	Pairs of rows are formed in this way that the first row comes from the group, which was established in step 2, while the other row is selected from among the other MLI rows. The value of the IMC field in the first row is compared with that of the ISC field in the second row from the pair.
4	If values of both fields are equal, the quotient of values is determined for the QSC fields in both rows forming the pair.
5	In the row (the other of the pair), of which the value of the ISC field is equal to the value of the IMC field, a new value of the QSC field is determined by: a) entering the value of the quotient (step 4), if so far no changes in the entry in that field have been made, b) adding the value of the quotient in the QSC fields (step 4) to the previous values of the QSC field, if at least one change has been made in that field.
6	The value of the UMC field from the row (first), of which the value in the IMC field is equal to the values of the ISC field (according to step 4) is entered in the UMC field of the second row from the pair replacing the previous value, if for the analyzed rows values of the UMC fields are different.
7	The procedure according to steps 5 - 6 is run until the depletion of all combinations of pairs of rows.
8	In the created set all rows are surveyed in terms of the equality of the IMC fields. If the IMC fields are equal, then in the QSC field of one of the rows the total of the QSC fields in both rows is entered, while the other row is deleted.
9	The name of the component, from which the structure is imploded (component *P*), is entered in the ISC field of all rows in the formed set. Changed rows form a listing in the form of an aggregate implosion of a slave component (MI).

Source: own study based on Tabert and Błażczak [1996].

Aggregate implosion supplies comprehensive information on master components, including a specific slave component and its joint (total) number or quantity of this component in master components. Table 6 presents aggregate implosions for a particle board, belonging to a cabinet case (a subassembly of a corner desk).

Table 6. An example of the aggregate implosion of a particle board belonging to a cabinet case

No.	Name of immediate master component (IMC)	Name of immediate slave component (ISC)	Quantity of slave component (QSC)	Unit of measure of slave component (UMC)
1.	High side wall D	Particle board	0,386	m^2
2.	Low side wall D	Particle board	0,353	m^2
3.	Horizontal partition wall	Particle board	0,131	m^2
4.	Base	Particle board	0,025	m^2
5.	Cabinet case D	Particle board	1,026	m^2

Source: own study.

The example presented in Table 6 shows what amounts (see the ISP column) of the particle board comprise individual components of the door cabinet body. The value 1.026 m2 , given in the last row (5), provides information on the total amount of particle board in the door cabinet body. Master components listed in items 1, 2 and 4 of Table 11 are used as single pieces in the cabinet body. In turn, the horizontal partition is found in the body in the form of a two-piece component (see Table 1). For this reason in the calculation of the total value the proportion of particle board (0,131 m2) in the partition is doubled (see Table 5, step 4).

CONCLUSIONS

Algorithms proposed in this paper for the collection of information concerning bills of materials and components if complex products facilitate the creation of listings of their components in three primary aspects, i.e. single-level, multi-level and aggregated, for the implosion of structure in these

products. Lists of this type make it possible to find answers to questions concerning the effects of changes in components, delays in dates of material delivery and increased material prices.

Recipients of information on material composition may include processes at the production planning level – planning of material requirements as well as manufacturing control – calculation of materials consumption as well as costing. Depending on the needs such listings may be presented in a tabular and graphic form, illustrating the hierarchical system of structural components in a product.

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Andrea Vadkertiová, Kristína Štefančiková[40]

THE IMPROVEMENT OF QUALITY MANAGEMENT IN WOOD INDUSTRY COMPANIES THROUGH COOPERATION WITH THE UNIVERSITY SECTOR

Abstract: The cooperation of industry with universities currently nay be described as unsatisfactory. And quality management in wood-processing companies is one of the areas where cooperation with universities is not only necessary for solving research problems, but also for transfering new knowledge into practice. This paper deals with the possibilities of cooperation of universities with corporate sectors in the field of quality management and business activity and is part of a grant project solution. It also lists the latest forms of cooperation between these entities and provides practical suggestions for improving cooperation of universities and enterprises in the future.

Key words: quality management system, cooperation, woodworking industry

INTRODUCTION

The article highlights the positive impact of university-enterprise cooperation in the process of achieving improvement of company activities in the woodworking industry. We believe that although this issue has been given considerable attention, knowledge is not always understood and used in practice. The quality production is a crucial phenomenon in present-day business. It is not only fundamental for achieving commercial success on the market, but also due to being a carrier of general business prosperity, because at present only improvement in quality can guarantee effective price of sold products on competitive markets. In the various grant projects there seem to beno linkings between university work and public information or the work of specialists. There are no general rules for effective collaboration and dissemination of knowledge in the business world.

It is understandable that it is not possible for us to cover all areas that are be worth mentioning. Therefore, at least we may try to highlight the links between universities and enterprises in the field of scientific activities and that of quality management in economic and social practice.

GENERAL BACKGROUND - THE QUALITY MANAGEMENT OF BUSINESSES IN THE WOOD-PROCESSING INDUSTRY

Quality management is an important component of production management. Its ultimate goal is to satisfy customers with desired products and also to ensure economic prosperity of the company. Quality management includes interconnection between commercial, technical, economic, personal, IT, organizational, social and other tools that ensure quality products. And to reach the best product quality, quality management assumes top-level design and state-of-the-art technological solutions (technical quality of the product) and of the production itself (quality of design) and of the post-production services (product quality in use). The quality of production is formed in a multi-step process and its ending is provided by production management. Key issues for quality development should be solved, however before the manufacturing process.

The requirements of quality are increasing worldwide and that's why it is also necessary to continue in up-lifting demands for quality management. This strategy is also used in current development management activities of the wood-processing industry. The latter two require total reliability and quality of products on a level where the need of future maintenance by users is almost completely minimized. The quality management system is therefore trying to extend quality assurance throughout the enterprise in all its sections, and to all employees on all stages of its activities. In this context it is important to note that our universities can significantly help

[40] *University of SS. Cyril and Methodius, 2 J. Herdu Square, 917 01 Trnava, Slovakia, andrea.vadkertiova@ucm.sk, kristina.stefancikova@haas.fr*

companies with many tasks, which are related to management quality. The European Community has taken the principle that producers who do not have a certified quality management system according to ISO 9000 - 9004, will not be able to export goods into the European Community in the future. Based on ISO standards 9000 – 9004, the level of quality management systems is considered. Their purpose is to show the customer that the manufacturer is able to ensure continued product quality under the required conditions. The normative documents contain methods and tools that were mainly developed and refined for these quality systems and are in fact useful in solving many different problems related to quality assurance in the company's production. Based on a detailed analysis of the actual situation and the causes of problems, these standards help to develop an effective process change and its evaluation. These methods are important because they are simple and , effective.

The basic structure of the currently valid ISO 9000 series of standards, which needs to be complied with in quality management processes, is as follows:

- BS EN ISO 9000:2005 / Quality Management Systems. Foundations and vocabulary. The standard contains the introduction to the terms of quality based on ISO philosophy and specifies the basic requirements for the form of a quality management system that is suitable for certification.
- BS EN ISO 9001:2008 / Quality Management System. Requirements. This is a standard that is used to implement a quality management system and also to revise an already established quality management system. It's also known to be the certification standard, which can be verified by independent external institutions.
- BS EN ISO 9004:2000/Quality Management Systems. Instructions for efficiency improvement. The standard is an extension of 9001 and recommended to the companies that already hold a certificate.

Since quality improvement resources are limited, it is necessary to focus on 20% of problems or opportunities - the most important problems, that can bring the company 80% of the expected effect. For this reason, the process of quality improvement cannot be viewed as isolated processes in the enterprise, but should be optimized in cooperation with other organizations, for example with universities.

THE PRESENT-DAY MISSION OF UNIVERSITIES AND THEIR IMPORTANCE FOR QUALITY ENHANCEMENT

The third role of universities has been defined by several authors. Here are important roles for the universities to be active in:

- Zelený talks about the "capitalization of knowledge" and recommended creation of entrepreneurial universities,
- Etzkowitz argues that it is an "academic entrepreneurial behavior",
- Rucinsky describes universities as "resounders of knowledge" in a regional context,
- Several authors (eg, Gunasekara, Bilsky, Kuzmišin, Výrostová, and others) specify the role as co-operation with business, creation of innovative partnerships and new technologies.

We conclude that the formation of university-industry partnerships is a long and difficult task, but its effects are beneficial for both parties. The EU Commission identifies, in its broad-based innovation strategy for the EU, the importance of improving knowledge transfer between public research institutions and third parties, including industry organizations and civil society as one of ten key areas where more activity is needed.

University activities may promote quality growth in business with the creation of knowledge, human capital, transfer of existing know-how, technological innovations, capital investment and so on. The cooperation can be successful if priorities and strategic objectives are implemented in all these institutions. One practical example of such cooperation between universities and businesses is the innovation voucher.

INNOVATION VOUCHER AS A REFERENCE TOOL FOR COLLABORATION

Innovation voucher (voucher research) is characterized as a grant that enables SMEs to establish contacts with organizations whose core skills are in research, development and innovation (research and educational institutions), in order to buy the technical results of conducted research and development. These vouchers were first introduced in Holland in 1995 by the Limburg Development Agency and Investment Company. The pilot project was launched at a regional level in 1997. The purpose of the implementation was to increase the competitiveness of SMEs through the expansion of their innovative capacity and to improve knowledge transfer in the region of Limburg. These measures have become so popular in the region that it has been innovated in 2006 and implemented as a permanent way to promote knowledge transfer to SMEs on national scale. Bills are currently being successfully used in other countries such as Austria, Ireland, Portugal, Hungary, Great Britain, Germany and even in the Czech Republic (particularly in the South Moravian region).

The use of innovation vouchers solves three problem areas:

- Lack of cooperation between public and private institutions in sharing knowledge,
- Lack of research and teaching focused on market needs and practices,
- Encourages companies toward innovation.

The proper use of innovation vouchers for business is that it can take advantage of new knowledge to improve product quality, production processes or services. Businesses can therefore use innovation vouchers in public research institutions and universities authorized by the implementing agencies. Essentially, all projects related to innovation can be supported. Mostly technical problems are solved, but also project management, marketing difficulties and uncertainties in the field of intellectual property rights. The major advantages of using innovation vouchers include low administrative and financial burden on businesses, because these only want to briefly describe the demand without need for detailed design. The role of the Agency's project manager is to manage the application process and provide innovation vouchers. The evaluation of the Dutch support schemes showed that 8 out of 10 coupons were used for a project, which otherwise would not have been realized. In addition to the positive experience after completion of the project, most companies started to invest more in research and development, which continues to disseminate their innovation activities.

CONCLUSION

One of the basic principles of quality management is continuous improvement. And in this area there is plenty opportunities for cooperation of wood industry enterprises with external organizations, particularly with universities. Transferring results of scientific activity is not possible without high-quality scientific research and analyses. One of the possible tools in the cooperation of woodworking businesses with universities on a regional basis is the use of innovation vouchers. Universities could cooperate with the business sector in the provision and implementation of training focused on quality management systems for companies. Also, universities can further carry out expert work, professional advice and process scientific studies related to the quality of management in the business and, finally, initiate the formation of clusters and other joint regional groupings.

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Daniel Wilusz[41]

DETERMINANTS OF INTERNET USE IN THE EUROPEAN UNION (ECONOMETRIC APPROACH)

Abstract: Although the IT revolution contributes to the development of the Information Society, a part of citizens is excluded from this society because they have neither the possibility nor need to use the Internet. This paper focuses on statistical determination and analysis of factors influencing the increase of the percentage of European Union citizens often using the Internet. The ordinary least square method has been used to estimate an econometric model describing the change in percentage of EU-27 citizens frequently using the Internet. Additionally, the paper applies the model to simulate the effects of political decisions concerning the development of the Information Society.

Keywords: statistics, econometrics, Information Society, digital exclusion

INTRODUCTION

The IT revolution has been causing a huge qualitative change in modern economics. A new way of providing goods and services such as e-commerce, electronic supply chains, e-banking and virtual organisations, together with development of e administration, social networks and electronic education has contributed to the creation of the Information Society [2]. On one hand, information technology influences economic growth. On the other hand, a part of society is not able to apply, use and benefit from IT, especially the Internet [8]. This problem often leads to the digital exclusion, which may be caused by three factors [1]:

- technical – no technical possibility to establish connection to the Internet;
- economical – financial barriers in establishing connection to the Internet;
- cultural – lack of awareness of benefits coming from the ability to use the Internet.

Broad research concerning the Information Society has been conducted by international organisations and statistical offices. The Organisation for Economic Co-operation and Development has published the Guide to Measuring the Information Society, which describes indicators measuring the development of the Information Society [7]. Moreover, the Eurostat conducts yearly surveys concerning the Information Society with cooperation of national statistical offices, accordingly to established common methodology [5]. The mentioned methodology allows the Eurostat to collect, to aggregate and to compare statistical data from all member states. Besides raw statistical data, reports on the Information Society are also available. For example, the European Commission issued an analytical report on the Information Society [3] and the International Telecommunication Union published a report on measuring the Information Society [6]. The above mentioned reports contain descriptions and visualizations as well as concise interpretation of statistical data and trends. However, no statistical relationships and dependencies have been determined or described.

The aim of this paper is to identify the factors determining the relative change of percentage of European Union (EU 27) citizens often (at least once a week) using the Internet. Moreover, the econometric method applied to statistical data reveals the influence strength of these factors. The outcome of research proves that prevention of technical and economical factors of digital exclusion is not sufficient to overcome this social problem. The proposed econometric model reveals the importance of the cultural factor of digital exclusion, which is often forgotten in the policies aiming at the development of the Information Society.

[41] *Poznan University of Economics, Department of Information Technology, ul. Mansfelda 4, 60-854 Poznań, wilusz@kti.ue.poznan.pl*

RESEARCH METHODOLOGY

In order to determine the factors influencing the relative change of percentage of EU-27 citizens who often use the Internet, statistical tests for correlation were applied. The ordinary least square method was used to propose an econometric model presenting the direction and influence strength of these factors on the examined phenomenon.

The yearly statistical data used in research covers the years 2004 to 2011 and was obtained from the Eurostat database on Information Society statistics [4]. The following indicators were taken into account:

• percentage of EU-27 citizens accessing the internet once a week;
• percentage of EU-27 citizens having Internet access at home;
• percentage of EU-27 citizens who made their last online purchase in the last 12 months;
• percentage of EU-27 citizens using e-banking;
• percentage of EU-27 citizens using the Internet for seeking health information;
• percentage of EU-27 citizens using the Internet for finding information about goods and services;
• percentage of EU-27 citizens booking travel and holiday accommodation over the Internet in the last 12 months.

As the raw statistical time series were not stationary, an adjustment has to be made in order to apply the least square method. For research purposes, the relative changes of percentage of citizens were calculated for all of the time series. The relative changes were calculated according to the formula:

$$o_{i(t+1)} = \frac{w_{i(t+1)} - w_{it}}{w_{it}}$$

where:

o – relative change of percentage, i - number of variable, t – observation period.

The application of the above described formula allowed the production of the following time series:

- relative change of percentage of EU-27 citizens accessing the Internet once a week (Inter1WeekPrInc);
- relative change of percentage of EU-27 citizens having Internet access at home (InterHomePrInc);
- relative change of percentage of EU-27 citizens who made their last online purchase in the last 12 months (Ecom12MonthPrInc);
- relative change of percentage of EU-27 citizens using e-banking (EbankPrInc);
- relative change of percentage of EU-27 citizens using the Internet for seeking health information (SeekHealthInfPrInc);
- relative change of percentage of EU-27 citizens using the Internet for finding information about goods and services (SeekGoodsServInfPrInc);
- relative change of percentage of EU-27 citizens booking travel and holiday accommodation over the Internet in the last 12 months (EtravelPrInc).

Table 1. Descriptive statistics

Variable	Average	Standard. Deviation	Coefficient of Variance	p ADF(1)	Ljung Box Q(1)
Inter1WeekPrInc	0.096192	0.053219	0.55326	1.9E-118	0.8827
Ecom12Month PrInc	0.116597	0.052452	0.449856	0.008596	2.3348
SeekGoodsServInf PrInc	0.075062	0.054502	0.726097	7.41E-68	0.5339
EbankPrInc	0.128551	0.058454	0.454714	0.06982	0.2055
InterHome PrInc	0.107945	0.062197	0.576193	0.06165	1.719
EtravelPrInc	0.209582	0.125775	0.600124	0.03154	0.2014
SeekHealthInf PrInc	0.126432	0.108319	0.85674	5.96E-24	0.0005

Source: Own work

The descriptive statistics, presented in Table 1, indicate that the least square method can be applied for the adjusted time series. Firstly, the coefficient of variance is of pretty high value for every variable, which determines that any variable can be treated as constant. Secondly, the probability (p) of the Augmented Dickey-Fuller test with trend and constant term tells us that for every variable the chance that the time series are not stationary is less than 7%. As the statistical significance is assumed at a 10% level, the time series can be described as stationary. Thirdly, the time series auto-correlation was verified by the use of the Ljung-Box test. The critical value of the chi-squared test for our data equals to 12.59. As we may notice in Table 1, the result of the Ljung-Box test for none of our time series exceed the critical value. In result we may accept the hypothesis that times series taken into account in the research are not auto-correlated.

ECONOMETRIC MODEL

In order to estimate the ordinary least square model, the independent variables have to be significantly correlated with dependent variables and should not to be significantly correlated with each other. The correlation coefficients of time series used in the research are presented in Table 2.

Table 2. Correlation coefficients for time series

	Inter1Week PrInc	Ecom12 MonthPrIncr	InterHome PrInc	Ebank PrInc	SeekGoods ServInfPrInc	SeekHealth InfPrInc	Etravel PrInc
Inter1Week PrInc	1.0000						
Ecom12Month PrIncr		1.0000					
InterHomePrInc		0.7856	1.0000				
EbankPrInc		0.6702	0.7844	1.0000			
SeekGoodsServ InfPrInc		0.6808	0.7407	0.8383	1.0000		
SeekHealthInf PrInc	-0.3776	-0.2508	-0.3413	0.0627	-0.1932	1.0000	
EtravelPrInc	0.2878	0.5479	0.1025	0.3673	0.3378	-0.1522	1.0000

Source: own work

The critical value for correlation at a 5% significance level equals 0.7545. The Table 2 indicates that there are four independent variables significantly correlated with dependent variables, namely:

- Relative change of percentage of EU-27 citizens who made their last online purchase in the last 12 months (Ecom12MonthPrInc);
- Relative change of percentage of EU-27 citizens having Internet access at home (InterHomeInc);
- Relative change of percentage of EU-27 citizens using e-banking (EbankPrInc);

• Relative change of percentage of EU-27 citizens using the Internet for finding information about goods and services (SeekGoodsServInfPrInc).

Three not significantly correlated pairs may be distinguished from the variables listed above, namely: EbankPrInc and Ecom12MonthPrInc, SeekGoodsServInfPrInc and Ecom12MonthPrInc, SeekGoodsServInfPrInc and InterHomePrInc. However, as the research revealed, the EbankPrInc and Ecom12MonthPrInc as well as SeekGoodsServInfPrInc and Ecom12MonthPrInc pairs cannot be used to estimate a statistically significant econometric model. In result, there is only one statistically significant ordinary least square model that may be proposed.

The result of estimation of the least square model with SeekGoodsServInfPrInc and InterHomePrInc as independent variables is presented by Table 3.

Table 3: The estimation of the ordinary least square model

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Model 1: OLS, using observations 2005-2011 (T = 7)
Dependent variable: Inter1WeekPrInc

                  coefficient   std. error   t-ratio   p-value
  ---------------------------------------------------------------
  InterHomePrInc     0.674754    0.0749692     9.000    0.0003  ***
  SeekGoodsServIn    0.295634    0.101409      2.915    0.0332  **

Mean dependent var   0.096192   S.D. dependent var   0.053219
Sum squared resid    0.000416   S.E. of regression   0.009117
R-squared            0.994917   Adjusted R-squared   0.993900
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Source: Own work - estimation generated by GNU Regression, Econometric and Time-series Library

The empirical t-ratios of both variables are less than the statistical critical value of Student's t-test, which amounted to 2.57. This result indicates that the coefficient by the InterHomePrInc variable as well as the coefficient by SeekGoodsServInfPrInc is statistically significant. In result, we obtain a model described by the following function of two variables:

$$\text{Inter1WeekPrInc} = 0.30 \cdot \text{SeekGoodsServInfPrInc} + 0.67\ \text{InterHomePrInc}$$

The above presented model shows that a 1% increase in percentage of EU-27 citizens having Internet access at home will cause a 0.67% increase in percentage of EU-27 citizens accessing the internet once a week. Moreover, the 1% increase in percentage of EU-27 citizens using the Internet for finding information about goods and services will cause a 0.3% increase in percentage of EU-27 citizens accessing the internet once a week. The R-squared coefficient tells us that the proposed model explains over 99% of dependent variable variations. The standard error of regression informs us that theoretical values of dependent variables may have been wrongly calculated in the range of ±0.0091. The reality is well described by the model, as it is consistent with the theory on factors influencing digital divide. Technical and economical factors affecting the possibility to use the Internet are contained in the InterHomPrInc variable. The cultural factor is reflected by the SeekGoodsServInfPrInc variable.

APPLICATION OF THE MODEL

The policy of European governments is strongly focused on provision of high end telecommunication infrastructure and decrease of Internet access prices. Let us assume that government actions increase the percentage of EU-27 citizens having Internet access at home to 100% and the use of Internet for finding information about goods and services will stay at the same level. In 2011 67% of EU-27 citizens had Internet access at home, so we assume that number to increase by 49% (so that almost all citizens have Internet access). According to the model, the increase in percentage of EU-27 citizens frequently using the Internet should amount to:

$$\text{Inter1WeekPrInc} = 0.30 \cdot 0 + 0.67 \cdot 0.49 = 0.3283$$

As in 2011 68% of EU-27 citizens used the Internet at least once a week, this number in the above simulation should increase by 32.8% to about 90%.

In the second simulation we tried to predicts what would happen if European governments changed their policy to educate the citizens on using the Internet for finding information on goods and services. Let us assume that government actions increasethe percentage of EU-27 citizens using the Internet for finding information about goods and services to 100% and Internet access at home will stay at the same level. In 2011 56% of EU-27 citizens used the Internet for finding information about goods and services so we assume that number to increase by 78.6% (so that almost all citizens use the Internet for finding information about goods and services). According to the model, the increase in percentage of EU-27 citizens frequently using the Internet should amount to:

$$\text{Inter1WeekPrInc} = 0.30 \cdot 0.786 + 0.67 \cdot 0.0 = 0.2358$$

As in 2011 68% of EU27 citizens used the Internet at least once a week, this number in the above simulation should increase by 23,6% to almost 84%.

The model reveals that focusing only on technical and economical factors of digital exclusion is not enough, because even if the Internet is accessible in every home, about 10% of citizens would still not use it. That is why sustainable policy is required to prevent digital exclusion and a fair development of the Information Society.

CONCLUSIONS

The proposed econometric model shows that the relative change in percentage of EU-27 citizens using the Internet at least once a week depends on the relative change in the percentage of EU-27 citizens having Internet access at home and the relative change in the percentage of the EU-27 citizens using the Internet to find information about goods and services. Moreover, the econometric model proposed in this paper indicates that the increase in Internet availability at home will strongly influence the frequency of Internet use among EU-27 citizens. This finding justifies the actions of EU governments, which include: support in building telecommunication infrastructure, tax reliefs and antitrust actions against Internet service providers. The model shows that conscious use of the Internet (possibility to decrease information asymmetry about goods and services) also positively impacts the frequency of its usage. The estimated model shows that the increasing availability of the Internet and educating the public about its usefulness will contribute to the development of the Information Society.

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