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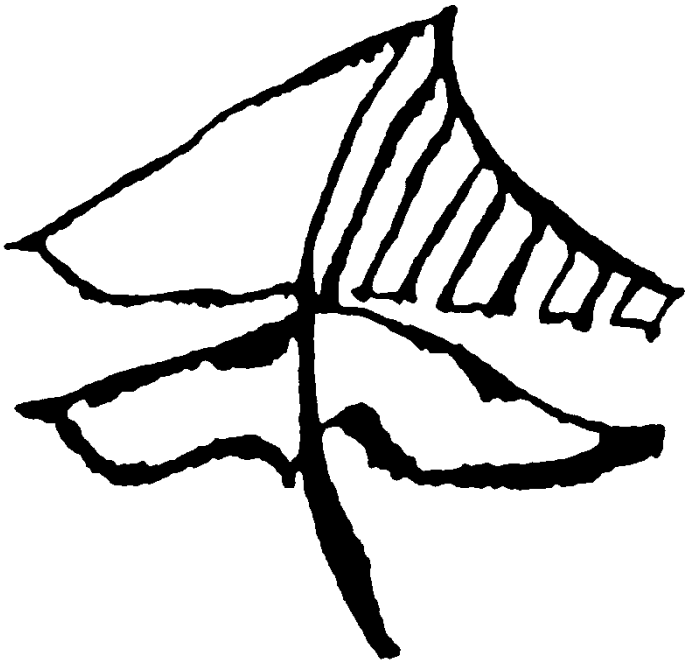

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Wojciech Lis

Viktória Ali Taha[1], Michaela Sirková[2] LuciaBednárová[3]

TALENT MANAGEMENT IN SLOVAK ORGANIZATIONS: INSIGHT INTO SELECTED PRACTICES AND PROCESSES

Abstract: The purpose of this paper is to identify processes and practices of talent management and their implementation in Slovak context. Based on the theoretical knowledge base and current research questionnaire survey was conducted to obtain primary data. The survey examines the array of talent management processes and practices in Slovak organizations. The paper presents partial results of the survey concerning the embeddedness and implementation of talent management, more precisely, declaration of talent management strategy and synchronization of talent management strategy with the overall company strategy. When analysing the data gathered there were used descriptive and inferential statistical methods, specific correlation analysis, ANOVA and Student's t-test.

Keywords: talent, talent management, practices, processes, strategy

TALENT MANAGEMENT: PERSPECTIVES AND CONTENT

Recent researches and volume of scientific papers highlight the growing interest in talent management in organizations and businesses. In order to succeed globally and to retain competitive, organizations must give adequate attention to talents - people who are able to ensure long-term and sustainable prosperity and development.

Talent management is strongly related to human capital. Cappelli (2008, p. 1) indicates that talent management is "simply a matter of anticipating the need for human capital and then setting out a plan to meet it".Hunt (2008, in Nagra, 2011) states that talent management is about getting the right people in the right jobs doing the right things. According Sonnenberg (2010, p. 2) "talent management is the capability to create and continuously optimize the talent resources needed to execute a business strategy. This means attracting and developing them, guiding their performance toward optimal productivity in light of strategic goals and finding new sources of value in their performance through innovation and continuous improvement".

Lewis & Heckman (2006) state that in the literature focused on talent management there is a lack of clarity regarding the definition, scope and overall goals of talent management. Authors distinguish three distinct views / perspectives on talent management: (1) the first defines talent management as a set of typical human resource practices, functions and activities such as recruiting, selection, development, career and succession management; (2) the second focuses primarily on the concept of talent pools; (3) and the third perspective focuses on talent generically - without regard for organizational boundaries or specific positions (Lewis & Heckman, 2006).

The justification and need for talent management in organizations shows the following idea of one of the world leader agencies in the recruitment - Manpower Group: "A new, collaborative approach is required from government, companies and individuals to together find a way to unlock the raw human potential within their reach and then nurture and shape that potential to lead them to

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success" (ManpowerGroup, 2011). We assume that recognition, attracting and retaining skilled people and exploitation of their potential are critical to success ofexisting businesses.

Talent management covers wide range of activities and practices, particularly planning, identifying, recruiting and selection, development, retaining and rewarding of talented people.

The top nine processes i.e. processes most likely to be integrated into existing talent management programs are (Green, 2011):

- compensation and rewards,
- engagement,
- high-potential employee development,
- individual Professional development,
- leadership development,
- learning/training,
- performance management,
- recruitment,
- succession planning.

Stahl et al. (2012) studied talent management practices. Based on their research in which 18 companies were investigated they discovered that there are two different views on how best to evaluate and manage talents. Authors point out that "one group of companies assumed that some employees had more "value" or "potential" than others, and that, as a result, companies should focus the lion's share of corporate attention and resources on them; the second group had a more inclusive view, believing that too much emphasis on the top players could damage morale and hurt opportunities to achieve broader gains" (Stahl et al., 2012, p. 26).

IDENTIFICATION OF TALENTS

Generally acceptable opinion is that human resources are the most important asset of any organization. A single category of human resources that have the greatest impact on organization's performance is the particular group of employees so called "talents". The importance of this category of employees highlights Jim Collins (2006) who considers wrong the popular idea "People are the most important asset" and clarifies that not people, but "right people" are the most important asset. In the context of this idea, we believe that talented people (talents) represent a strategic asset of the organization and their presence is critical to future success of businesses.

Managing talents is commonly a part of HR strategy respectively human capital strategy. First step in forging these strategies is the definition of the organizational talent which means specification of those who are considered talents. However, it is not easy to define "talent". There is no clear and generally accepted definition of talents. Individual organizations perceive talent differently which is which is determined by different conditions and environment they operate in, as well as, different requirements crucial for each employee to perform-a particular job. This is the main reason for the considerable inconsistency and ambiguity of the definitions of "organizational talent". Howe et al. (1998, in Tansley, 2011) in this regard state that people are rarely precise about what they mean by the term "talent" in organisations and the implications of defining talent for talent management practice.

We can conclude that talents are people with high potential i.e. with specific skills, competencies, abilities, attributes, experiences and behaviours who are able to achieve excellent results and thus ensuring good overall performance, viability and competitiveness of the organization.

TALENT MANAGEMENT STRATEGY

The formulation of talent management strategy is critical factor to its effective implementation. Talent strategy means formulation of strategic goals and defining talent needs (Sonnenberg, 2010).

Organisation need to start by looking at its strategic plan, identify knowledge and experience areas that will be important to future success and competitiveness, develop competency models for each of these areas, and design learning paths to develop these competencies in increasing degrees (Human Capital Magazine, 2012).

Alignment with strategy is one of the six key principles that successful companies adhere together with internal consistency, cultural embeddedness, management involvement, a balance of global and local needs and employer branding through differentiation, whilst corporate strategy is the natural starting point for thinking about talent management. Important factor is strategic flexibility since organizations must be able to adapt to changing business environment and revamp their talent approach when necessary (Stahl et al., 2012).

Lance and Dorothy Berger (2011) argue that talent management strategy makes explicit the investments made in the people who are who are expected to by mostly helpful in achieving competitive excellence. Talent management strategy perceive a workforce as a portfolio of human resource assets that are differentiated based on an assessment of each person's actual and potential contribution to success. The talent management strategy of successful and high-performing organizations contains three guidelines: (1) cultivating people who will make the biggest contribution in the present and in the future; (2) retaining key positions backups; (3) allocation of training, education, rewards, assignments, and development based in the actual and potential contribution of people (Berger & Berger, 2011, p. 14-15).

Situation in formulation of talent management strategy in companies all over the world is far from ideal. Manpower's new Workforce Strategy Survey (in ManpowerGroup, 2011) revealed that nearly one quarter of employers across 36 nations concede that their organizations' workforce strategy does not support their business strategy (or don't know if it does). What is more alarming is a fact that among those two subsets of respondents, more than half (53 %) admit that they are not doing anything about it. In too many cases, the emphasis on talent management is tactical and short term when it ought to be strategic and long term. Anyway, "sustained competitive advantage requires not only a smart business strategy but also a workforce that is equipped to execute on that strategy and understands its role in achieving its goals" (Manpower Group, 2011, p. 44 - 45).

RESEARCH METHODOLOGY

The collection of primary data was conducted through questionnaire survey among owners, managers or executives of the companies in the Slovak Republic. The methodology of the survey was based on the methodology created by Dr. William, J. Rothwell (In: Talent Management: Aligning your organization with best practices in strategic and tactical talent management, 2012).

In the research we wanted to determine the situation of talent management implementation in Slovak organizations. In this article we present partial results of the research related to the issues examined. When testing hypotheses several methods of descriptive statistics have been used, namely Student's t-test comparing the means of two samples, correlation analysis detecting statistical relationship between two variables and ANOVA analysing the differences between group means and their associated procedures. The statistical software SPSS was used.

The main outcome of this study is insight into the current state of the talent management processes and practices in Slovak organizations. The study helps us to gain insight into declaration of talent management strategy in Slovak organizations:

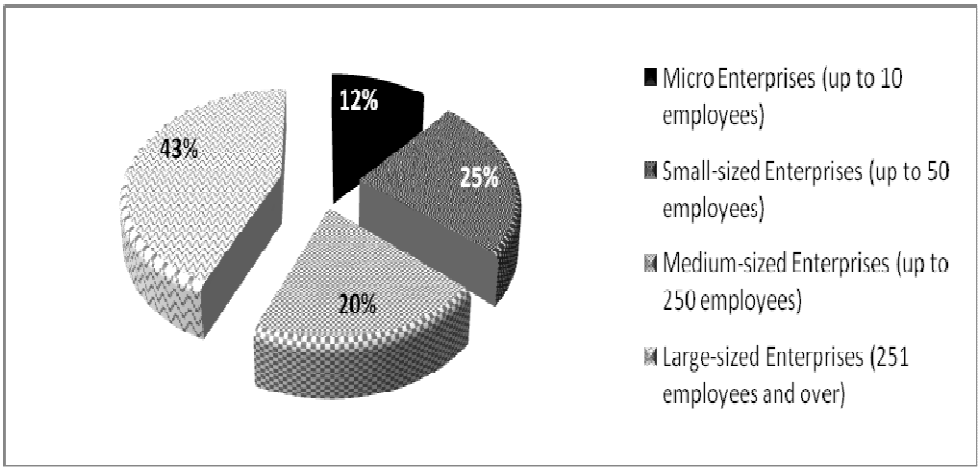
- in terms of the type of organization i.e. its equity participation (domestic/foreign),
- in terms of the size of organization.

SAMPLE CHARACTERISTICS

The research sample consist of 69 organizations operating in the Slovak Republic. The respondents were approached by electronic and written questionnaires. Respondents from all regions of the Slovak Republic were included in the research. Detailed breakdown of the

participating organizations in terms of size, scope of activity and foreign equity participation can be seen in the Figures 1, 2 and 3.

Figure 1. Research sample characteristic in relation to the sizeof enterprise (number of employees)



Source: own processing

Out of the 69 organizations reviewed, 43 % were large companies, 25 % small companies, 20 % medium-sized companies. The remaining 12 % of the sample were micro companies.

Figure 2. Research sample characteristic in relation to scope of activity

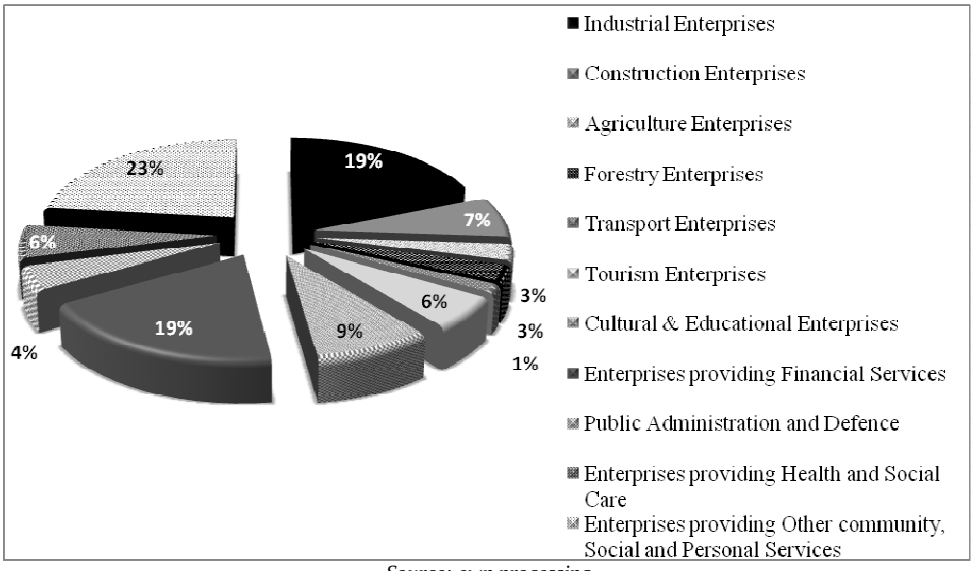


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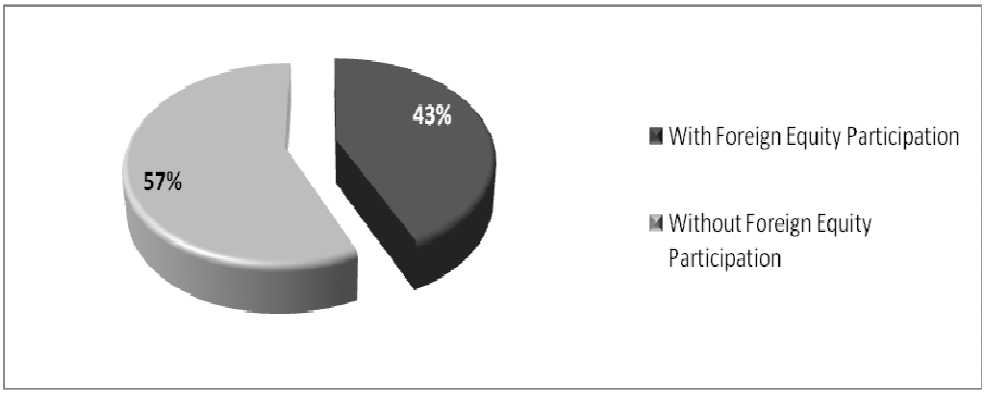
Figure 3. Research sample characteristic in relation to foreign equity participation



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RESEARCH RESULTS

1. Declaration of talent management

The key to successful implementation of talent management is to align and synchronize talent management strategy with overall company strategy. Participants were asked using Likert scale (5 - strongly agree, 4 – agree, 3 – neutral (neither agree nor disagree), 2 – disagree, 1- strongly disagree, 0 – unable to rate/comment) express the level of agreement with a statement.

Table 1. Declaration of Talent Management

Declaration of Talent Management	**Frequency of answers**						
	5	**4**	**3**	**2**	**1**	**0**	**total**
Declared Talent Management as a ideational approach to all interested parties (stakeholders)	7	21	13	13	3	12	69
Declared Talent Management as an important part of the organization	7	19	11	14	7	11	69
Defined Talent Management and Talent	11	28	7	9	5	9	69
Formulated strategy of Human Resources	26	17	12	6	2	6	69
Established a specialized department which deals to the development of Human Resources	21	15	7	10	5	11	69
Formulated strategy of Talent Management	7	20	16	9	6	11	69
Talent Management strategy linked to the strategic objectives of the organization	6	16	15	15	5	12	69
Secured internal consistency of Talent Management with the other management practices	4	15	17	12	8	13	69

Source: own processing

When examining the "embeddedness" of talent management respectively its "alignment with overall strategic planning" in organizations, we discovered that most examined organizations in Slovakia have defined talents and talent management itself. As expected, the majority of Slovak organizations have defined human resource strategy and have specialized department that is dedicated to the development of human resources.

RESEARCH QUESTION SAND HYPOTHESES

Considering that concept of talent management is relatively new in our business environment, it can be assumed that companies with foreign equity participation would be expected to be more likely than Slovak companies to consider declaring the talent management (as part of the strategy).

Hypothesis 1: The declaration of talent management in the organization is related to the type of equity participation i.e. the organization with foreign equity participation are more likely declaring talent management than organizations without foreign capital participation.

The hypothesis was tested by using a statistical method t-test for two independent variables, which compares the averages of the two groups. The t-test compared the item questioned the "existence of foreign equity participation in the organization" and item detecting whether the investigated "organization has declared talent management as mental approach for all stakeholders". The value of the correlation coefficient shows that strength of the linear relationship between variables is high. We can conclude that the *declaration of talent management in organization is associated with the kind of equity participation*. This means that organizations with foreign capital participation to greater extent declare talent management than domestic organization (i.e. organization without foreign capital participation).

Talent management is usually associated with big companies. Most of the successful stories about talent management come from large organizations and companies. Moreover, many processes and practices are very difficult to apply in small and medium-sized companies. In this context, we were interested whether there are any statistically significant differences in the declaration talent management strategy between organizations of different sizes.

Hypothesis 2: The declaration of talent management in the organization is related to the size of the company i.e. large and medium-sized organizations are more likely to have talent management strategy linked to the organization's strategic objectives than small-sized and micro organizations/enterprises.

Using statistical method ANOVA was found that there is no statistically significant relationship between the variables "size of the organization" (size is perceived in terms of number of employees) and "interconnection of talent management strategy with the organization's strategic objectives". Based on the measured value of statistical significance $p = 0,579$ (moderate positive relationship) we can conclude that *the declaration of talent management in organization is not associated with the size of the organization/enterprise.*

CONCLUSION

Because human capital (particularly talented employees) is the most important asset of an organization which can significantly determine the overall performance and success of the organization, the process of managing talents is becoming increasingly important. This tendency influence also Slovak organizations and companies and raises the need to implement talent management. In this paper we presented partial results of the survey, which was conducted within the Visegrad Fund Standard Grant project „Integrated talent management - challenge and future for organisations in the Visegrad countries". The attention was centred on declaration of talent

management strategy in different types of organizations. We have found that the declaration of talent management in organization is associated with the kind of equity participation but not associated with the size of an organization.

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FINANCIAL DETERMINANATS OF CHANGES IN FINANCIAL LIQUIDITY OF WOOD INDUSTRY ENTERPRISES IN POLAND IN 2006-2012

Abstract: The aim of the study is to present the diversity of financial liquidity of the wood industry in Poland in 2006-2012 and to identify the strength and direction of impact of selected factors influencing the variability of financial liquidity. The conducted analyses have proven that wood industry enterprises, regardless of their size and adopted measure, had the ability to meet their current liabilities, although this capacity remained at a fairly low level. In turn, the causal factor analysis has indicated that changes in the level of financial liquidity, measured by static indicators, were in the wood industry largely determined by changes in the structure of current assets and by changes in the degree of coverage of current liabilities with assets.

Keywords: Poland, wood industry, static liquidity ratios, deterministic methods

INTRODUCTION

The primary objective of financial activities of an enterprise in the market economy is to maximise their value, and thus the wealth of the owners. Its implementation requires such a management of the enterprise so that the economic profit or the value of the assets of agricultural entrepreneurs would be maximised in the long term [Waśniewski, Skoczylas 1998]. The value of an enterprise is determined by the influence of the two main groups of factors. To the first one belong the so-called non-economic factors associated with various determinants of political, legal, technical and social character. The second group, determining the enterprise value, comprises economic and financial factors, among which of paramount importance are liquidity and profitability [Kowalczyk 2003]. However, in the economic literature the concept of financial liquidity is used in a various sense, usually as [Gołaś et al 2010]: the positive balance of means of payments, the easiness of converting assets into cash, the degree of coverage of current liabilities with the components of current assets, as well as the ability to settle at any time current liabilities. The last of the mentioned interpretations seems to define the notion of liquidity most adequately. Liquidity is even more accurately defined as the ability of an enterprise to settle its current liabilities [Sierpińska, Jachna 2004].

Financial liquidity ought to be a permanent feature of any enterprise, however, it should not be regarded as the main objective of its activities. Nevertheless, it is one of the main areas of interest in the financial management of an enterprise, and it is due to the effects of excess liquidity and, above all, a lack of it. Maintaining a high level of liquidity limits the development opportunities of an enterprise by reducing its ability to generate profit, however, a significant reduction in financial liquidity may contribute to the loss of long-term solvency and, consequently, lead to bankruptcy. Maintaining financial liquidity is therefore very important both in the short-term – it conditions the ability to meet current liabilities of an enterprise, and in the long-term – it determines the development and an enterprise's ability to survive the crisis.

The purpose of this article is to present the diversity of liquidity of wood industry enterprises in Poland and to identify factors influencing the variability of liquidity in the sector. Determining the factors responsible for the ability of an enterprise to meet its current liabilities and the factors affecting this ability may be useful for executives and foster rational shaping the structure of current assets and sources of funding.

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SOURCE MATERIALS AND RESEARCH METHODS

Financial liquidity is most frequently measured using the so-called static indicators, which include the ratios of [Sierpińska, Wędzki 2001,Sierpińska, Jachna 2004]: current liquidity, the quick ratio (called also the acid-test or liquid ratio) and the cash ratio. However, static liquidity ratios alone do not create opportunities for an extensive causal analysis, they only allow to determine if the achieved financial liquidity is the result of a high level of current assets or short-term investments, or a low level of current liabilities. In contrast, much greater possibilities for interpretation are provided by systems of structural indicators. An example of such a system is a form of a basic and at the same time synthetic measure of liquidity evaluation – the current liquidity ratio – proposed by Sierpińska and Jachna [2004], in which the synthetic indicator is influenced by the following three factors:

$$WPB = \frac{AB}{ZB} = \frac{AB}{AO} \times \frac{ZO}{ZB} \times \frac{AO}{ZO}$$

$$WPB = WAO \times WSZ \times WPZ$$

where:

WPB – current liquidity ratio, AB – current assets, ZB – current liabilities, AO – total assets, ZO – total liabilities, WAO – ratio of current assets, WSZ – ratio of liabilities structure, WPZ – coverage of liabilities ratio.

The presented equation indicates that current liquidity (WPB) is dependent on both the structure of assets (WAO) and the structure of funding sources (WSZ) as well as liabilities (WPZ). In this model, the higher the multiplier, the higher the current liquidity ratio.

A similar system of multipliers can be created for the quick ratio (WPS) and cash ratio (WPN), adding respectively: the liquid assets ratio (WAP) and the cash assets ratio (WAG).

$$WPS = \frac{AB - Z}{ZB} = \frac{AB}{AO} \times \frac{AB - Z}{AB} \times \frac{ZO}{ZB} \times \frac{AO}{ZO}$$

$$WPS = WAO \times WAP \times WSZ \times WPZ$$

$$WPN = \frac{AB - Z - N}{ZB} = \frac{AB}{AO} \times \frac{AB - Z - N}{AB} \times \frac{ZO}{ZB} \times \frac{AO}{ZO}$$

$$WPN = WAO \times WAG \times WSZ \times WPZ$$

where:

WPS – quick ratio, AB – current assets, ZB – current liabilities, AO - total assets, ZO - total liabilities, Z – inventories, N - receivables, WPN - cash ratio, WAO - ratio of current assets, WAP – ratio of liquid assets, WAG – cash assets ratio, WSZ – ratio of liabilities structure, WPZ – coverage of liabilities ratio.

The presented above causal analytical models have been used to analyse financial liquidity of wood industry enterprises in Poland. The analysis uses statistical data of the Central Statistical

Office from the years 2006-2012 relating to the sector of manufacture of wood and products of wood, cork (except furniture); manufacture of articles of straw and plaiting materials; division 16 of the manufacturing section [Bilansowe wyniki …]. The aforementioned data, on one hand, have allowed to analyse the variability in static liquidity, on the other hand, they have been the basis for determining the strength of the impact of the multipliers contained in the model for financial liquidity. For this purpose the logarithmic method has been applied. This method belongs to the group of deterministic methods [Bednarski 1997, Ćwiąkała-Małys, Nowak 2005], which are used for testing economic phenomena in which the size of the analysed phenomenon depends on several factors written in the form of a product.

Assuming that the synthetic indicator of financial liquidity (W_1) of the analysed period t_1 is a function of the product of only three factors (x_1, y_1, z_1), i.e. $W_1 = x_1 \times y_1 \times z_1$, and the synthetic indicator of financial liquidity (W_0) from the analysed period t_0 is a function of the product of three factors (x_0, y_0, z_0), i.e. $W_0 = x_0 \times y_0 \times z_0$ and it is a reference point for the changes, the procedure in logarithmic method is as follows:

1. Calculation of the absolute deviation of the synthetic indicator of liquidity in the wood industry: $\Delta W = W_1 - W_0 = x_1 \times y_1 \times z_1 - x_0 \times y_0 \times z_0$
2. Calculation of partial deviations $(\Delta W_x, \Delta W_y, \Delta W_z)$ informing about the impact of the factor x, y, z on changes of the synthetic indicator of liquidity in the wood industry W:
$$\Delta W_y = \Delta W \times \frac{\log \frac{y_1}{y_0}}{\log \frac{W_1}{W_0}} \qquad \Delta W_z = \Delta W \times \frac{\log \frac{z_1}{z_0}}{\log \frac{W_1}{W_0}}$$
3. Comparison of the absolute deviation of the synthetic indicator of liquidity in the wood industry (ΔW) with the sum of partial deviations of the factors – partial indicators of the system $(\Delta W_x, \Delta W_y, \Delta W_z)$, in order to verify the correctness of the conducted calculations according to the formula:
$$\Delta W = \Delta W_x + \Delta W_y + \Delta W_z$$
4. Substantive interpretation of partial deviations, i.e. determining the impact of changes of the factors (partial indicators of the system) on changes of the synthetic indicator of liquidity in the wood industry: on the basis of partial deviations and/or on the basis of the percentage of individual deviations in the sum of partial deviations.

LEVEL AND DETERMINANTS OF FINANCIAL LIQUIDITY IN WOOD INDUSTRY ENTERPRISES IN 2006-2012

Level of liquidity in 2006-2012

Table 1 provides information on the level of basic static liquidity ratios. Throughout the whole analysed period financial liquidity, measured by the current liquidity ratio, was in the wood industry sector on the level regarded as positive. In the analysed years the current liquidity ratio fluctuated in a narrow range 1.34-1.59, which means that current liabilities were in this sector in 134-159% covered by the value of current assets. However, clearly less favourable is the evaluation of financial liquidity of this industry in the case of the quick ratio, the construction of which includes current assets with high liquidity. In the period 2006-2012 its level ranged from 0.78 to 0.98, which means that the most liquid assets did not cover 100% of liabilities. Furthermore, the large difference between the current liquidity ratio and the quick ratio in the majority of years of the analysed period indicate the importance of inventories in current assets in the wood industry, which is not a favourable situation. Inventories are in fact the least liquid component of current assets, and, in addition, they may generate a number of costs arising from the necessity of their maintenance,

storage losses and opportunity costs, which reduces the level of liquidity and may also result in deterioration of financial results.

Table 1. Liquidity ratios in the wood sector in Poland in 2006-2012

Specification	2006	2007	2008	2009	2010	2011	2012	$\bar{x}$	V (%)
Current ratio	1,53	1,59	1,36	1,34	1,45	1,44	1,49	1,46	5,64
Quick ratio	0,98	0,94	0,78	0,85	0,94	0,88	0,95	0,90	7,36
Cash ratio	0,30	0,27	0,25	0,25	0,30	0,25	0,28	0,27	7,55

Source: own calculations based on CSO

Deterministic analysis of liquidity variability

Presented in the methodical part the extended causal model of the relationships between factors influencing financial liquidity has been used to determine the impact of the multipliers contained in this model on current liquidity, the quick ratio and the cash ratio in the wood industry. Determining which multipliers shaped the changes in the level of liquidity has been based on the logarithmic method.

Table 2 presents the results of factor analysis (the logarithmic method) of financial liquidity of wood industry enterprises for the years 2006-2012, measured by the current liquidity ratio.

Their analysis leads to the conclusion that with a little variable, and thus stable level of this category of financial liquidity were associated generally small changes of the applied multipliers, especially the current assets ratio (WAO). Among these multipliers, a relatively higher variability has been noted in relation to the coverage of liabilities ratio (WPZ), for which the average level of deviation in the analysed period was -0.034. However, considering its increases in particular periods, it may be noted that its negative impact on changes in current liquidity resulted primarily from a decrease in the coverage of liabilities with assets in 2008/2007. In other periods, the changes in the WPZ ratio were marginal. Considering the indicator of liabilities structure (WSZ), it may be noted that its changes generally induced a small increase in the level of current liquidity, as evidenced by the average level of deviations amounting to 0.019. However, also in this case there was a noticeable strong impact of the changes on the average level of deviation in 2007/2006. In this period the structure of liabilities was changed the most (there was an increase of the ratio of total liabilities to current liabilities), as a consequence of which it had a relatively the strongest positive impact on the growth of the current liquidity ratio.

In conclusion, low variability of the level of the financial liquidity ratio in the wood sector was in the analysed period determined by a stable share of current assets in total assets (WAO) and a low variability of the debt structure (WSZ), as well as the rate of coverage of debt with assets (WPZ). The average share of these factors in the variability of the current liquidity ratio was in 2006-2012, respectively 27.6% (WAB), 35.9% (WSZ), 36.4% (WPZ).

Table 3 presents the results of factor analysis of liquidity in wood industry enterprises in the years 2006-2012, measured with the quick ratio. Their analysis leads to the conclusion that with a little variable level of liquidity in this category correspond generally small changes of the applied multipliers. The data presented in Table 3 indicate that on average in the analysed period changes of the quick ratio were positively influenced by the changes in the structure of assets (WAO) and in the structure of liabilities (WSZ), while the ratio was negatively influenced by changes in the share of liquid assets (WAP) and changes in the rate of coverage of liabilities with assets (WPZ).

Table 2. Factor analysis of current ratio changes (WPB) in wood industry in 2006-2012 years[1]

Years	$WAO = \frac{AB}{AO}$	$WSZ = \frac{ZO}{ZB}$	$WPZ = \frac{AO}{ZO}$	$WPB = \frac{AB}{ZB}$
value of ratios				
2006	0,41	1,63	2,27	1,53
2007	0,40	1,81	2,19	1,59
2008	0,39	1,86	1,89	1,36
2009	0,38	1,80	1,94	1,34
2010	0,40	1,86	1,97	1,45
2011	0,42	1,77	1,92	1,44
2012	0,43	1,74	1,99	1,49
average 2006-2012	0,40	1,78	2,03	1,46
partial deviations				
2007/2006	-0,047	0,167	-0,055	0,065
2008/2007	-0,049	0,036	-0,223	-0,235
2009/2008	-0,014	-0,038	0,040	-0,012
2010/2009	0,047	0,041	0,016	0,104
2011/2010	0,091	-0,069	-0,033	-0,011
2012/2011	0,025	-0,026	0,051	0,051
average 2006-2012	0,009	0,019	-0,034	-0,006
structure of partial deviations[2] (%)				
2007/2006	17,58	61,97	20,44	100
2008/2007	15,97	11,80	72,22	100
2009/2008	14,82	41,48	43,70	100
2010/2009	45,53	39,24	15,22	100
2011/2010	47,24	35,86	16,90	100
2012/2011	24,64	25,13	50,23	100
average 2006-2012	27,63	35,91	36,45	100

[1] Designations multipliers included in the part methodical article.
[2] Partial structure of the partial deviations was calculated on the basis of the absolute values of partial deviation.
Source: own calculations

Considering the structure of partial deviations, the variability of the quick ratio was the highest (32.4%), influenced by the variability of the share of liquid assets in current assets (WAP), while the least (19.2%), by the structure of assets, determined by the share of current assets in total assets (WAO).

Table 4 presents the results of factor analysis of financial liquidity of wood industry enterprises in 2006-2012, measured with the cash ratio. Their analysis leads to the conclusion that with a little variable level of liquidity in this category correspond generally small changes of the applied multipliers.

Table 3. Factor analysis of quick ratio changes (WPS) in wood industry in 2006-2012 years[1]

Years	$WAO = \frac{AB}{AO}$	$WAP = \frac{AB - Z}{AB}$	$WSZ = \frac{ZO}{ZB}$	$WPZ = \frac{AO}{ZO}$	$WPS = \frac{AB - Z}{ZB}$
value of ratios					
2006	0,41	0,64	1,63	2,27	0,98
2007	0,40	0,59	1,81	2,19	0,94
2008	0,39	0,57	1,86	1,89	0,78
2009	0,38	0,63	1,80	1,94	0,85
2010	0,40	0,65	1,86	1,97	0,94
2011	0,42	0,62	1,77	1,92	0,88
2012	0,43	0,64	1,74	1,99	0,95
average 2006-2012	0,40	0,62	1,78	2,03	0,90
partial deviations					
2007/2006	-0,029	-0,087	0,103	-0,034	-0,047
2008/2007	-0,029	-0,023	0,021	-0,129	-0,160
2009/2008	-0,008	0,077	-0,023	0,024	0,070
2010/2009	0,030	0,024	0,026	0,010	0,090
2011/2010	0,057	-0,045	-0,044	-0,021	-0,052
2012/2011	0,016	0,037	-0,016	0,032	0,069
average 2006-2012	0,006	-0,003	0,011	-0,020	-0,005
structure of partial deviations[2] (%)					
2007/2006	11,54	34,39	40,66	13,41	100
2008/2007	14,14	11,50	10,45	63,92	100
2009/2008	6,22	57,99	17,43	18,36	100
2010/2009	33,48	26,47	28,85	11,19	100
2011/2010	34,37	27,25	26,08	12,29	100
2012/2011	15,58	36,78	15,89	31,76	100
average 2006-2012	19,22	32,40	23,23	25,16	100

[1] Designations multipliers included in the part methodical article.
[2] Partial structure of the partial deviations was calculated on the basis of the absolute values of partial deviation.

Source: own calculations

The data presented in Table 4 indicate that on average in the analysed period changes of the current liquidity ratio were positively influenced by the changes in the structure of assets (WAO) and in the structure of liabilities (WSZ), while the ratio was negatively influenced by the changes in the share of cash assets (WAG) and the changes in the rate of coverage of liabilities with assets (WPZ). Considering the structure of partial deviations, the variability of the cash ratio was the highest (39.0%), influenced by the variability of the share of cash assets in current assets

(WAG),while the least, (14.6%) by the structure of enterprises assets, determined by the share of current assets in total assets (WAB).

Table 4. Factor analysis of cash ratio changes (WPN) in wood industry in 2006-2012 years[1]

Years	$WAO = \frac{AB}{AO}$	$WAG = \frac{AB - Z - N}{AB}$	$WSZ = \frac{ZO}{ZB}$	$WPZ = \frac{AO}{ZO}$	$WPN = \frac{AB - Z - N}{ZB}$
value of ratios					
2006	0,41	0,19	1,63	2,27	0,30
2007	0,40	0,17	1,81	2,19	0,27
2008	0,39	0,18	1,86	1,89	0,25
2009	0,38	0,18	1,80	1,94	0,25
2010	0,40	0,21	1,86	1,97	0,30
2011	0,42	0,17	1,77	1,92	0,25
2012	0,43	0,19	1,74	1,99	0,28
average 2006-2012	0,40	0,19	1,78	2,03	0,27
partial deviations					
2007/2006	-0,009	-0,033	0,031	-0,010	-0,021
2008/2007	-0,009	0,016	0,006	-0,040	-0,025
2009/2008	-0,003	0,001	-0,007	0,007	-0,002
2010/2009	0,009	0,031	0,008	0,003	0,051
2011/2010	0,017	-0,047	-0,013	-0,006	-0,049
2012/2011	0,005	0,019	-0,005	0,009	0,028
average 2006-2012	0,002	-0,002	0,003	-0,006	-0,003
structure of partial deviations[2] (%)					
2007/2006	10,56	39,97	37,20	12,27	100
2008/2007	12,29	23,03	9,09	55,59	100
2009/2008	14,32	3,36	40,09	42,23	100
2010/2009	18,05	60,37	15,55	6,03	100
2011/2010	20,63	56,34	15,65	7,38	100
2012/2011	12,06	51,05	12,30	24,59	100
average 2006-2012	14,65	39,02	21,65	24,68	100

[1] Designations multipliers included in the part methodical article.
[2] Partial structure of the partial deviations was calculated on the basis of the absolute values of partial deviation.
Source: own calculations

SUMMARY AND CONCLUSIONS

Financial liquidity of enterprises determines their viability and development and is determined by many factors. The conducted analyses have proven that the wood industry enterprises in Poland in 2006-2012 had the ability to meet their current liabilities, although its level – particularly in relation to the quick ratio – remained at a fairly low level.

The causal factor analysis has demonstrated that changes in the level of liquidity measured by static liquidity ratios were in the wood industry largely determined by changes in the structure of current assets and by changes in the rate of coverage of liabilities with assets. This means that in forecasting as well as in controlling financial liquidity in this sector of prime importance is proper shaping of the relationship between the components of current assets and strategies of financing assets with debt.

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Zbigniew Gołaś[6]

PROFITABILITY ANALYSIS OF WOOD INDUSTRY ENTERPRISES IN POLAND 2006-2012

Abstract: The aim of the study is to present the diversity of return on sales, assets and equity of the wood industry enterprises in Poland in the years 2006-2012 and to identify the strength and direction of the influence of selected factors affecting the variability of return on equity. It has been found in the deterministic and stochastic analysis that changes in the level of return on equity in the wood industry were driven primarily by changes in return on sales, while to a lesser extent they resulted from changes in the asset turnover and financial leverage.

Keywords: Poland, wood industry, profitability, DuPont model, deterministic methods, regression analysis.

INTRODUCTION

The level of return on equity of an enterprise is determined by a number of factors concerning its finance and assets as well as macroeconomics, structural determinants of sectors and individual technical and economic characteristics of a particular enterprise. The study of factors which most affect return on equity is important because [Bednarski 1997, Bieniasz et al. 2010, Bieniasz, Gołaś 2014]:

- it is an important basis for an ex-post evaluation of the rationality of the owners' decisions,
- it is a very important indicator to improve the tools of economic policy in the area of business financing,
- it is important to maintain continuity of business activities since each entity, together with maintaining its financial liquidity, it must demonstrate the ability to generate economic surplus perceived as profit,
- accumulation of profit is the basic and most important source of capital growth,
- the level of profitability is a synthetic indicator of financial standing, which fundamentally affects the evaluation of the competitive ability of an enterprise, and thus its ability to continue its operations and prospects of growth.

The purpose of this article is to analyse the return on equity of wood industry enterprises and attempt to identify the strength and direction of the influence of the selected factors of a financial nature which shape this category of profitability. In this article return on equity is perceived with regard to the concepts developed by a theory of financial management, i.e. by the casual analysis using decomposition of the so-called DuPont model (*DuPont System of Financial Control*). This type of study enables a multi-dimensional analysis of the sources of success or failure in the implementation of one of the most important financial goals of any business entity, which is to increase the value of equity. The rate of return on equity (ROE) is a synthetic measure of this achievement.

SOURCE MATERIALS AND RESEARCH METHODS

The profitability analysis in this study uses statistical data of the Central Statistical Office from the years 2006-2012 relating to the sector of manufacture of wood and products of wood, cork

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(except furniture); manufacture of articles of straw and plaiting materials; division 16 of the manufacturing section [Bilansowe wyniki …].

Profitability ratios are widely used in the evaluation of an enterprise and its benefits to the owners; however, their usefulness is largely narrowed due to the synthetic nature and the consequent limited scope of economic content. Hence in the analytical practice the procedures of disaggregation of financial ratios and their inclusion in the systems of indicators are becoming more widely used, which enables a multi-dimensional and casual analysis of various financial issues, including those related to profitability [Bednarski 1997, Bieniasz et al. 2010, Hawawini, Viallet 2007, Bieniasz, Gołaś 2014].

The basis for the analyses has been decomposition of profitability. In the process of decomposition as the starting point the authors have adopted the DuPont model equation in which return on equity (ROE) is recognised as the product of return on assets (ROA) and the equity multiplier (MK) or, more broadly, in the form of the product of return on sales (ROS), asset turnover (ROT) and the equity multiplier (MK):

$$ROE = ROA \times MK = ROS \times ROT \times MK$$

where:

$$ROE = \frac{net\ profit\ (ZN)}{equity\ (KW)}, \qquad ROA = \frac{net\ profit\ (ZN)}{assets\ (A)}, \qquad ROS = \frac{net\ profit\ (ZN)}{revenues\ (P)},$$

$$MK = \frac{assets\ (A)}{equity\ (KW)}, \qquad ROT = \frac{revenues\ (P)}{assets\ (A)}.$$

In order to determine the impact of the multipliers included in the DuPont model there have been used the logarithmic method belonging to the group of deterministic methods [Bednarski 1997, Ćwiąkała-Małys, Nowak 2005, Bieniasz et al. 2010] and the regression analysis. Assuming that the synthetic rate of return on equity from the period is a function of the product of three factors, namely, and the synthetic return on equity from the period is a function of the product of three factors, i.e., and it is also a reference point for changes, the procedure in the logarithmic method is as follows:

1. Calculation of the absolute deviation of the synthetic rate of return on equity in the wood industry:
   $\mathbf{\Delta W = W_1 - W_0 = x_1 \times y_1 \times z_1 - x_0 \times y_0 \times z_0}$
2. Calculation of partial deviations $(\Delta W_x, \Delta W_y, \Delta W_z)$ informing about the impact of the factor on changes of the synthetic rate of return on equity in the wood industry ():
   $$\mathbf{\Delta W_x = \Delta W \times \frac{\frac{\log x_1}{x_0}}{\frac{\log W_1}{W_0}}} \qquad \mathbf{\Delta W_y = \Delta W \times \frac{\frac{\log y_1}{y_0}}{\frac{\log W_1}{W_0}}} \qquad \mathbf{\Delta W_z = \Delta W \times \frac{\frac{\log z_1}{z_0}}{\frac{\log W_1}{W_0}}}$$
3. Comparison of the absolute deviation of the synthetic rate of return on equity in the wood industry ($\mathbf{\Delta W}$) with the sum of partial deviations of the factors – partial indicators of the system $(\Delta W_x, \Delta W_y, \Delta W_z)$, in order to verify the correctness of the calculations according to the formula:
   $\mathbf{\Delta W = \Delta W_x + \Delta W_y + \Delta W_z}$

4. Substantive interpretation of partial deviations, i.e. determining the impact of the changes of the factors (partial indicators of the system) on the changes of the synthetic rate of return on equity in the wood industry on the basis of partial deviations and/or on the basis of the percentage of particular deviations in the sum of partial deviations.

LEVEL AND DETERMINANTS OF PROFITABILITY IN WOOD INDUSTRY ENTERPRISES IN 2006-2012

Level of profitability in 2006-2012

Table 1 provides information on the level of basic profitability indicators of the wood industry. In the analysed period return on sales (ROS) was subject to a strong and diverse in terms of their direction changes, as a consequence, they adopted values of a fairly wide range of 1.40-6.90%. Strong variations in time, and thus instability of return on sales also confirms the level of the coefficient of variation, which for the years 2006-2012 was as high as 52.7%. In general, similar conclusions can be drawn from the analysis of changes in return on assets (ROA) and equity (ROE). The average level of return on assets in the examined period fluctuated in a wide range from 8.75% (2007) to 1.58% (2008), and the rate of return on equity was in the corresponding period respectively 16.08% and 3.37%. Strong variability of these rates of return largely confirm the estimated for these rates coefficients of variation, which definitely exceeded 50%.

The data presented in table 1 and in figure 1 indicate that the changes in the considered profitability ratios did not have a linear character and their lowest level concerned 2008, i.e. the year when a particularly strong global financial crisis occurred. In the following years (2009-2012) all profitability ratios were increasing steadily, reaching in 2012 the level of over twice as high as in 2008.

Table 1. Return on sales, return on assets and return on equity in wood industry in 2006-2012

Year	Return on sales - ROS (%)	Return on assets - ROA (%)	Return on equity - ROE (%)
2006	4,86	6,00	10,71
2007	6,90	8,75	16,08
2008	1,40	1,58	3,37
2009	2,07	2,08	4,28
2010	2,12	2,31	4,70
2011	3,01	3,39	7,06
2012	3,18	3,63	7,29
$\bar{x}$	3,37	3,96	7,64
V (%)	52,70	59,93	54,01

Source: own calculations based on CSO

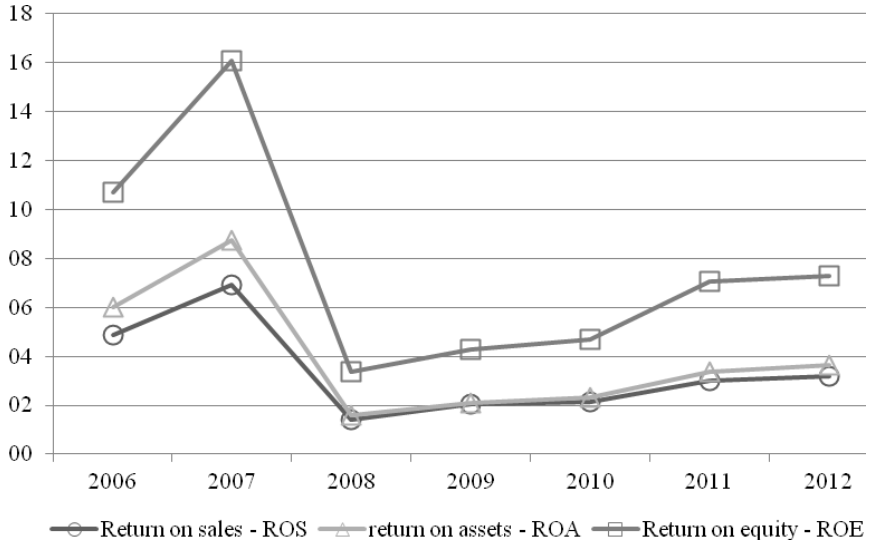

Figure 1. Changes of return on sales, return on assets and return on equity in wood sector in 2006-2012 (%)

Source: own calculations based on CSO

Deterministic analysis of return on equity

Presented in the methodological part the casual model of DuPont has been used to determine the impact of the multipliers of this model on the most important measure of profitability, which is the rate of return on equity (ROE). The logarithmic method has been used to determine the multipliers which influenced the changes in the level of return on equity. Table 2 presents the results of factor analysis (the logarithmic method) of return on equity of enterprises in the wood industry sector for the years 2006-2012, measured by the relationship of net profit to equity. Their analysis leads to the conclusion that a highly variable level of this category of profitability corresponded to significant differences in the level of variability of the applied multipliers, measured by the value of partial deviations. These differences indicate that in the vast majority of the surveyed years the major factors in the variability of return on equity (ROE) were positive or negative changes in the level of return on sales (ROS). Such a conclusion can be drawn both from the analysis of particular years (except for 2010/2009) as well as the whole period in which the positive or negative changes in ROS most strongly influenced the change in ROE. The paramount importance of return on sales in shaping the rate of return on equity indicates the structure of partial deviations presented in Table 2. Its analysis indicates that the share of the variability of return on sales in the variability of return on equity was the largest, except for the period 2010/2009. On average over the entire period 2006-2012 ROE variability was 72.5% due to the variability of return on sales, and in the selected years (2007/2006, 2011/2010) this share exceeded even 85%.

Changes in other multipliers (ROT, MK) of the DuPont system determined the level of return on equity to a clearly lesser extent. Changes in the assets turnover (ROT) significantly affected return on equity only in the period 2010/2009, in which they contributed to the increase in ROE up to 66.8%. Moreover, the impact of the capital leverage (MK) was noticeable primarily in 2012/2011. In this period the negative direction of changes of return on equity was 34.55% determined by the decrease in the capital leverage.

In summary, strong variability of return on equity in the wood sector in the analysed period was mainly conditioned by strong variability of return on sales, however, to a clearly lesser extent by the asset turnover and capital leverage. The average share of these DuPont model factors in the variability of the rate of return on equity amounted in 2006-2012 respectively to 72.49% (ROS), 6.17% (ROT) and 21.35% (MK).

Table 2. Factor analysis of return on equity changes (ROE) in wood industry in 2006-2012 years[1]

Years	$ROS = \frac{ZN}{P}$	$ROT = \frac{P}{A}$	$MK = \frac{A}{KW}$	$ROE = \frac{ZN}{KW}$
value of ratios				
2006	0,049	1,23	1,79	0,107
2007	0,069	1,27	1,84	0,161
2008	0,014	1,13	2,13	0,034
2009	0,021	1,01	2,06	0,043
2010	0,021	1,09	2,04	0,047
2011	0,030	1,12	2,08	0,071
2012	0,032	1,14	2,01	0,073
average 2006-2012	0,034	1,14	1,99	0,076
partial deviations				
2007/2006	0,046	0,004	0,004	0,054
2008/2007	-0,130	-0,009	0,012	-0,127
2009/2008	0,015	-0,004	-0,001	0,009
2010/2009	0,001	0,003	-0,001	0,004
2011/2010	0,020	0,002	0,001	0,024
2012/2011	0,004	0,001	-0,003	0,002
average 2006-2012	-0,007	-0,001	0,002	-0,006
structure of partial deviations[2] (%)				
2007/2006	86,24	6,69	7,07	100
2008/2007	85,97	6,11	7,92	100
2009/2008	72,12	21,83	6,05	100
2010/2009	22,94	66,83	10,23	100
2011/2010	85,95	8,19	5,86	100
2012/2011	51,66	13,79	34,55	100
average 2006-2012	72,49	6,17	21,35	100

[1] Designations multipliers included in the part methodical article.
[2] Partial structure of the partial deviations was calculated on the basis of the absolute values of partial deviation.

Source: own calculations

Return on equity regression analysis

Table 3 presents the parameters of the regression function of return on equity in the wood industry, estimated on the basis of the data from the years 2006-2012. In the construction of the regression model as the explained (dependent) variable there has been adopted:

ROE – return on equity in % (net profit/equity × 100),

and for the explanatory variables (independent):

ROS – return on sales in % (net profit/sales revenue × 100),

ROT – asset turnover (total revenue/total assets),

MK – equity multiplier (total assets/equity).

Moreover, in addition to the structural parameters (B) of the regression model there have been used the beta coefficients (β), which inform about the relative importance of the independent variables in explaining changes in the independent variable [6]. The β coefficients have been calculated according to the formula: , where:

a_j – partial regression coefficient with the independent variable x_j,

s_j – standard deviation of the independent variable x_j,

s_y – standard deviation of the dependent variable y [Goldberger 1972].

Table 3. Parameters of the return on equity regression function in wood industry

Variables	Non-standardized coefficients		Standardized coefficients	*t*	Significance *p*
	B	Standard error	β		
Constant of equation	-13,154	1,006	-	-13,070	0,001
ROS	2,442	0,029	1,048	83,627	0,000
ROT	3,510	0,498	0,068	7,056	0,006
MK	4,304	0,367	0,123	11,735	0,001
R^2=0,978; δ=0,053; F=13763; Durbin-Watson statistics=2,698					

Source: own calculations

The analysis of the parameters of the regression function presented in table 3 leads to the following conclusions:

1. The estimated parameters of regression models describing the variability of return on equity in the wood industry indicate a very good fit of the applied function to the empirical data. The quality of the models measured by the coefficient of determination (R^2 = 97.8%) and the Durbin-Watson statistic (DW = 2,698) is in fact very high.
2. The parameters of the regression function and their significance indicate that the variability of return on equity (ROE) was determined by all the considered factors, such as return on sales (ROS), the asset turnover (ROT) and the capital leverage (MK). The direction of the impact of these variables on ROE was the same, which means that in the analysed period return on equity depended on the increase of return on sales, efficient use of assets and debt management policies.
3. In the considered period the increase in return on sales of 1 percentage point, the increase in turnover of 0.1 and the increase in the equity multiplier of 0.1 were reflected in the increase of

return on equity in the wood industry of respectively: 2.44% (ROS); 0.35% (ROT) and 0.43% (MK). However, considering the β coefficients, it is clear that of paramount significance was here the variability of return on sales. The relative impact of changes in return on sales was in fact over 15 times stronger ($\beta = 1.048$) than the impact of changes in the asset turnover ($\beta = 0.068$) and the equity multiplier ($\beta = 0.123$). Regression parameters thus attest to a high extent the conclusions drawn from the presented earlier deterministic analysis of return on equity.

CONCLUSIONS

Profitability of companies determines their viability and development. It is determined by many factors. The conducted analyses indicate that wood industry enterprises in Poland in 2006-2012 had the ability to generate profits, although – in the light of the profitability ratios – the ability was subject to high variability.

Causal factor and stochastic analyses have proven that changes in one of the most crucial measures of profitability – return on equity – were in the wood industry largely determined by changes in return on sales. This means that in forecasting as well as controlling the return on equity in this sector effective sales are of prime importance, however, relatively less essential is leveraging the rate of return on equity by increased asset turnover or capital leverage.

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Emilia Grzegorzewska[7]

CHANGE TRENDS IN EXPORT OF WOOD INDUSTRY PRODUCTS IN POLAND IN THE YEARS 2008-2012

Abstract: The article presents an analysis of change trends in export of wood industry products in Poland; the paper draws attention to its share in the total value of export. The research covers the years 2008-2012. Comparative analyses have been conducted into the field contrasting Poland with countries of east-central Europe and the EU countries. The paper also presents a ranking of the main customers of Polish wood and wood products. Moreover, the analysis covers export structure of some of the most significant wood products, as well as price indexes as compared to industrial processing.

Key words: Poland, export, wood industry, wood products.

INTRODUCTION

Wood sector is one of the key pillars of Polish economy. According to the Polish Classification of Economic Activities wood sector comprises wood industry, as well as furniture and pulp and paper industries [Grzegorzewska 2013a, p. 9-10]. As regards wood industry, that is the manufacture of wood, cork straw and wicker products, it is divided into two classes: manufacture of sawmill products (class 16.1) and the manufacture of wood, cork and straw articles as well as materials used for weaving (class 16.2).

The recent economic recession appears very clearly in the statistics for the last five years, but has affected markets and regions differently. Most of the impact of the recession was felt in Europe and North America, while the other three main regions of the world were not affected very much [Global Forest Products… 2011, p. 1]. The condition of wood industry in Poland depends on the economic situation in the EU, in the home market, in Europe and also in the world. The global and regional demand for all the goods is dependent on the very situation and is also significant for the industry exporting 70% of its products – exchange rate euro/ PLN [Lis 2012, p. 207], which has been borne out by the events of recent years. Global economic crisis commenced in the United States has influenced to a greater or lesser degree economic situation of different countries, including Poland. It is visible in change trends in foreign trade – a record fall in the value of export and import of Polish products was noted in 2009 and equalled to 20.4% as regards goods sent abroad and 28.9% in the case of imported products [Grzegorzewska 2013b]. The decrease in the value of export of wood industry products was noted in 2009. A similar situation was observed in the furniture industry, though a year earlier. Since 2010 the condition of Polish export and import has improved – in that period its values amounted to 16.9% and 19.1%, respectively.

OBJECTIVE AND RESEARCH METHODOLOGY

The aim of the article is to analyse change trends in the export of wood industry products in Poland. The analysis comprises the years 2008-2012. Data has been obtained from the reports in "Statistical Yearbooks of Industry" and "Polish Forestry" published annually by the Central Statistical Office (GUS). Chosen aspects of trade exchange in wood industry in Poland have been presented as compared to the European Union and countries of east-central Europe.

RESEARCH FINDINGS

From the research conducted by GUS it follows that in the years 2008-2012 the value of Polish export in total increased from 405.4 billion PLN do 603.4 billion PLN. The share of wood industry

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export in total export decreased in the analysed period from 2.2% to 1.9%. However, as regards the export of wood and wood products in total in the years 2008-2012 it increased by 29.7% from 8 979.7 million PLN to 11 652.2 million PLN. Only in the year 2009 a fall in its value was noted, however, a year later the increase rate was positive and exceeded 12%. In the analysed period wood and articles from wood as well as charcoal constituted more than 98% of the value of wood industry export in total. In the years 2008-2012 the value of that export increased by 29.8% to the level of 11 511.8 million PLN. The least share in wood industry export was noted as regards cork and cork products. However, it is the cork articles that enjoyed the greatest increase in the export value over the analysed period (from 14.3 million PLN to 23.7 million PLN]. The dynamic of the value of straw and wicker products sent abroad increased by 20% to the level of 116.7%. It needs to be pointed out that the share of export of cork and cork products as well as articles of straw and wicker in the wood industry export in total in the years 2008-2012 was little and was below 2%.

Table 1. Export of wood and wood products in Poland in the years 2008-2012 [million PLN].

Itemisation	**2008**	**2009**	**2010**	**2011**	**2012**
Total	405 383.1	423 242.0	481 058.2	558 739.0	603 418.6
Wood and articles of wood total	8 979. 7	8 921. 6	9 999 .1	10 940. 3	11 652. 2
Wood and articles of wood; wood charcoal	8 868. 6	8 815. 5	9 876 .2	10 809. 5	11 511. 8
Cork and articles of cork	14. 3	10. 7	12 .5	17. 6	23. 7
Articles of straw and wickerwork	96. 7	95. 2	110 .4	113. 2	116. 7

Source: own study on the basis of Forestry 2009, p.219; Forestry 2012, p.239; Forestry 2013, p.242, Yearbook of Foreign Trade Statistics 2013, p.44

Germany was the main customer of articles of Polish wood industry in 2012 [chart 1]. This tendency has continued for a long time. The value of wood and wood products sent to Germany amounted to 3 507.0 million PLN, which constituted 30% of total wood industry export. Norway ranked second, we sent there products with the total value of over 3 099.8 million PLN, which made up 26.5% of export in total. Other places in the ranking were occupied by: France (1 065.7 million PLN), Great Britain (910.9 million PLN), Denmark (816.3 million PLN) and Sweden (570.7 million PLN). In 2012 in the first 10 of the main customers of Polish wood industry there were as well: Slovakia (402.6 million PLN), Lithuania (349.0 million PLN) and Holland, where we sent wood and wood products with the total value of over 333.0 million PLN.

Important information on the condition of Polish export of wood industry products is also provided by the comparative analyses of the countries of east-central Europe and the whole European Union. Table 2 presents data on the dynamic of export of wood and wood products in the value context expressed in steady prices. According to the research by GUS it follows that at the beginning of the analysed period only in east-central Europe an increase in the value of export in steady prices was noted. The value was at the level of 106.0%. As regards Poland, as well as the EU countries, a decrease of the index was noted to the level of 88.1% and 87.0%, respectively. A year later there was a decrease in the value of export with respect to steady prices in all singled-out economic groups. In 2010 the dynamic of export of wood industry products expressed in the value context excluding inflation slightly exceeded 100%. The situation concerned Poland, countries of east-central Europe and the European Union. In the last two researched years a reverse situation was noted and the greatest fall in the value of wood and wood products export was observed in the EU countries.

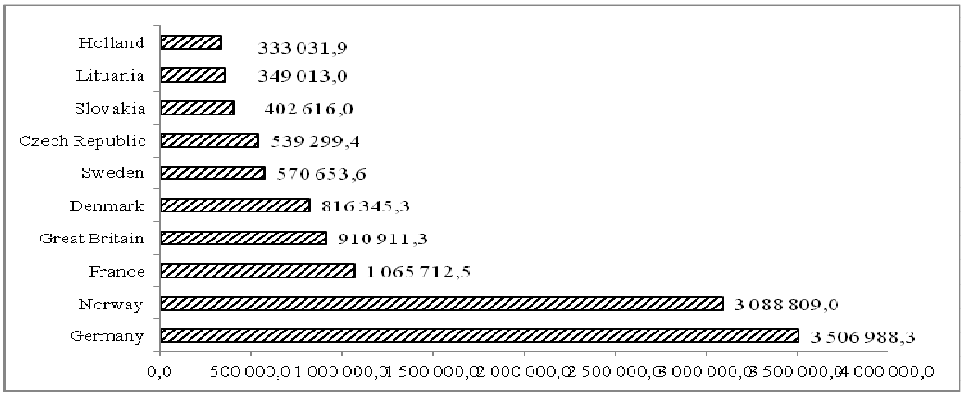

Chart 1. Value of Polish wood and wood products export sent to particular countries in 2012 [thousand PLN]

Source: own study on the basis of Yearbook of Foreign Trade Statistics 2013, p. 510-516.

Table 2. Export dynamic of wood and wood products in Poland in the years 2008-2012 – steady prices [%].

Itemisation	Poland	European Union	East-Central Europe
2008			
Wood and articles of wood total	88.1	87.0	106.0
Wood and articles of wood; wood charcoal	88.1	87.0	106.3
Cork and articles of cork	79.5	68.4	95.8
Articles of straw and wickerwork	91.2	91.5	80.6
2009			
Wood and articles of wood total	87.7	91.3	59.7
Wood and articles of wood; wood charcoal	87.7	91.4	59.2
Cork and articles of cork	67.1	51.9	79.8
Articles of straw and wickerwork	79.5	79.6	112.2
2010			
Wood and articles of wood total	100.7	100.2	100.4
Wood and articles of wood; wood charcoal	101.0	100.5	101.4
Cork and articles of cork	bd.	bd.	bd.
Articles of straw and wickerwork	81.7	77.3	140.8
2011			
Wood and articles of wood total	99.5	99.9	95.2
Wood and articles of wood; wood charcoal	99.5	100.1	95.0
Cork and articles of cork	128.1	201.2	103.7
Articles of straw and wickerwork	89.7	87.6	97.7
2012			
Wood and articles of wood total	95.4	96.3	87.8
Wood and articles of wood; wood charcoal	95.4	96.3	87.5
Cork and articles of cork	120.3	168.1	96.2
Articles of straw and wickerwork	96.0	96.1	109.8

Source: Forestry 2009, p.220; Forestry 2012, p.240; Forestry 2013, p.243.

As it follows from the statistical data by GUS in 2012 fibreboards had the greatest share in the structure of wood industry export. Their value destined for the foreign market was 1608524.7 thousand PLN, which constituted 13.8% of the total wood industry export. A considerable percentage was also noted in the case of wooden packaging. In the year 2012 823.5 thousand tons of wooden packaging with the total value of 1090595.1 thousand PLN were sent abroad, which constituted 9.4% of the export. Other positions in the ranking were occupied by: wood continuously shaped (6.4%), wood in the raw, as well as roughly shaped (5.6%) and chipboards (5.1%)

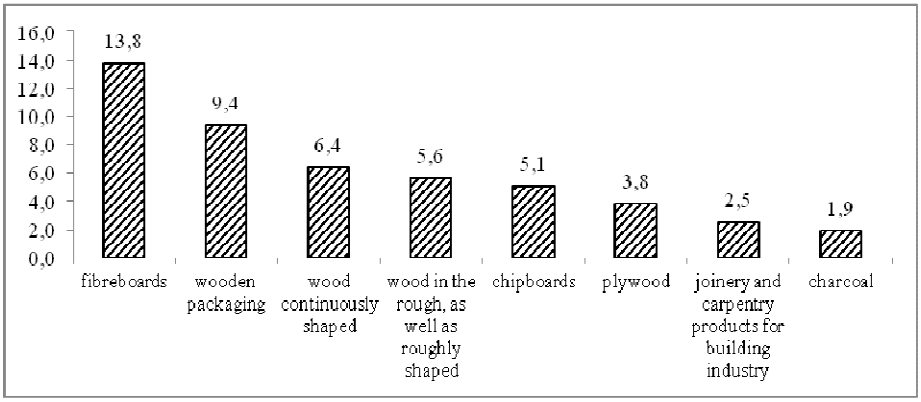

Chart 2. Structure of export of chosen wood industry products in the value context in 2012 [%].

Source: own study on the basis of Yearbook of Foreign Trade Statistics 2013, p. 510-516.

Apart from change trends in the value of exported goods an important element in the evaluation of the condition of foreign trade are price indexes worked out on the basis of a monthly survey of prices of goods obtained from the report C-05 (report on the prices of goods in foreign trade), actually received or paid by operators participating in the Polish trade of the whole industrial processing (chart 3).

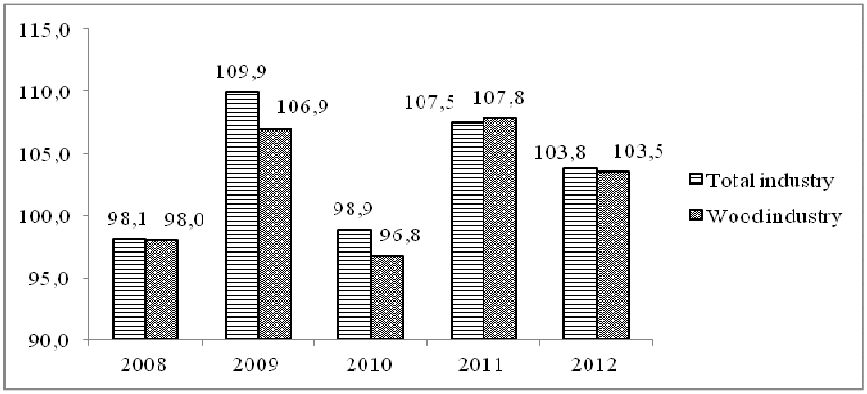

Chart 3. Indexes of export prices in wood industry as compared to processing industry in the years 2008-2012 [%].

Source: own study on the basis of Yearbook of Foreign Trade Statistics 2010, p.198; Yearbook of Foreign Trade Statistics 2012, p.206; Yearbook of Foreign Trade Statistics 2013, p.206.

At the beginning of the analysed period it was observed that level of the index of export prices was below 100%. The situation was characteristic of industrial processing as well as wood industry (98.1% and 98.0%, respectively). It signifies that there was a decrease in average prices of exported goods received by economic subjects. A year later a reverse tendency was observed – the index of export prices in industry in total was 109.9% and was higher than in wood and wood products. The least favourable year for wood industry was 2010. The next years brought in improvement in the field. At the end of the analysed period prices of wood and wood products sent abroad were on average higher by 3.5 percentage points.

CONCLUSION

From the conducted research it follows that in the years 2008-2012 the value of Polish export in total increased from 405.4 billion PLN to 603.4 billion PLN. The increasing tendency was also observed as regards the export of wood and wood products (from 8.9 billion PLN to 11.7 billion PLN). Only in the year 2009 there was a decrease in the value. It may be justified by the negative consequences of the global economic crisis which with a certain delay influenced the condition of Polish economy. A year later, however, the increase rate was positive and exceeded 12%. The share of wood industry export in total export decreased slightly in the analysed period (2.2% to 1.9%).

In 2012 the first position in the ranking of customers of Polish products from the wood industry was occupied by Germany. The value constituted 30% of wood industry export in total. Other places belonged to: Norway (26.5%), France (9.1%) and Great Britain (7.8%).

The analysis of the subject structure of wood industry export proved that its great share is occupied by fibreboards (13.8%). Other places belonged to: wooden packaging (9.4%), wood continuously shaped (6.4%), wood in the rough as well as roughly shaped (5.6%) and chipboards (5.1%).

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THE SELECTED ELEMENTS ALLOTTING COMPETITIVENESS OF FRUIT AND VEGETABLES PROCESSING ENTERPRISES

Abstract: The aim of the paper is to analyse the selected factors determining competitiveness of the fruit and vegetables processing sector. The results of inquiry research conducted in 32 enterprises of the sector located in Wielkopolska Voivodship were presented in the paper. The conducted research proves that, according to the management, the companies have large competitive and developmental potential, particularly in the area of the production resources (mainly knowledge and employees' experience, technological innovation and value of the fixed capital). The return on assets and profit rate are also highly evaluated. The inquired managers indicated advantage in the area of functions and product quality as the main own sources of competitive advantage and product prices, incomes and preferences of purchases as the most important demand factors.

Key words: competitiveness, fruit and vegetable processing, enterprises,

INTRODUCTION

It is commonly believed that competitiveness is the ability to undertake activities assuring stable and long-term development, as well as contributing to building market value [Walczak 2010]. According to Gorynia [2009], competitiveness is a skill to compete and also gain and maintain competitive advantage. In turn, according to the OECD [Stankiewicz 2005] it is the ability of enterprises, regions or trans-national organisations to cope with international competitors as well as assuring relatively high rate of return on the used production factors and relatively high employment on stable base.

The competitiveness of the companies may be considered in three dimensions: micro-, meso- and macroeconomic ones. In the macroeconomic approach, competitiveness is an ability of a country to raise its competitiveness. It is mainly conditioned by factors of natural, social and political character. Meso-competitiveness is an ability to produce goods of a given branch or industry and is based on demand and branch determinants as well as equipment in production factors and conditions of company management. The main elements of company competitiveness in microeconomic approach are competitive position, competitive potential and competitive strategy. The measure of competitiveness is company's market position and assessment by present and future customers. Management, owners and investors may also assess competitiveness. However, each evaluation includes different features, namely: customer – company's offer, in turn, management, owners and investors – microcompetitiveness elements [Makarski 2011, Walczak 2010].

The paper aims to analyse selected factors allotting competitiveness of fruit and vegetable processing companies. The purpose of the publication is also to highlight the adjustment processes of fruit and vegetable sector to competitive situation both on domestic and international market.

MATERIAL AND RESEARCH METHODS

In order to acquire the opinions of the management on companies' competitiveness, the inquiry research was carried out. The obtained results constituted a part of a wider study concerning competitive strategies of companies, conducted between 2010 and 2013 in wielkopolskie voivodship on management of 32 fruit and vegetable processing enterprises. The construction of the inquiry questionnaire was subordinated to the objectives of the study and while designing the

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questionnaire the authors' used the patterns elaborated by other researchers like B. Jankowska, M. Gorynia, E. Łaźniewska, Z. Pierścionek or M.E. Porter.

The inquiry questionnaire consisted of five parts. The first one considered basic data on company legal form, date of foundation, number of employees, average annual rate of profit. In the second part, the inquired answered the questions related to resources and competences of company. They assessed financial situation, sale potential, production resources as well as management system. The third part of the questionnaire referred to the assessment of the competitive power of the company's competitors. In this part, the responders also evaluated the bargaining power of both the purchasers and suppliers. The next part contained questions concerning competitive strategies and company's development. The opinions gathered in the investigation had subjective and evaluating nature.

The instrument used in the research is a non-metric scaling defining the scale of assessment referring to the intensity of the investigated feature. This method was chosen due to multidimensionality of the competitiveness phenomenon connected with its process and attribute meaning, relativity, level character in economic systems hierarchy and cause and effect relationship [Gorynia 2009, Wiśniewska 2012]. It was assumed that the research allows to conduct incomplete statistical induction for a case study, which is related to refusal to participate in the study and insufficient information on competitors. In the selection of the investigated units, the purposeful selection was used. The inquired companies functioned in frames of the 15.3 NACE branch.

THE RESULTS OF THE STUDY

Globalisation and integration with the EU, on one hand enabled the expansion of the Polish companies on new markets but on the other, it increased competitiveness on domestic market. Changes in functioning of companies contributed to conversion of strategic management. Managing through strategy constitutes rational and complex actions of the company management, including macro-competitive surrounding as well as internal conditions, which allow to achieve advantage over competitors (Pierścionek 2003, Dzikowska, Gorynia 2012). Such definition of strategic management is related to the issues of company competitiveness. In this aspect, competitiveness may constitute an aggregate of competitive potential, competitive advantage, instruments of competing and competitive position (fig. 1) [Stankiewicz 2000].

Cause-and effect relations occur between the named factors. The optimal use of all factors contributes to increment of company competitiveness. In turn, inefficient use of one element contributes to reduction of competitiveness. The determinants of competitiveness are the benefits gained from economic activity and most of all – profit and profitability. Current competitiveness is evaluated by comparison of achieved financial outcomes [Kusa, Peszko 2004, Bossak, Bieńskowski 2004]. Pierścionek [2003] by the assessment of competitiveness proposes to use the following assessments:

a) efficiency of company, conducted by estimation of company's market share and level profitability, which results from the level of company's offer adjustment to customers' preferences,
b) quality of resources and competences, namely skills and qualifications of employees, assessment of financial resources as well as company's ability to changes resulting from changes on the market,
c) the most important features from the customer point of view, who decide on choice of company's offer.

The investigated companies assesed profit rate and return on total assets quite well (fig. 2). Most of them believed that those indicators were high and very high (70-80%). Relatively small number of the analysed enterprises indicated that profit and return on assets was low and very low (27% and 19%). The distribution of the answers may result from the fact that large companies with

well-established, strong market position mostly participated in the investigation. Over half of the enterprises were founded in the 90's of the last century.

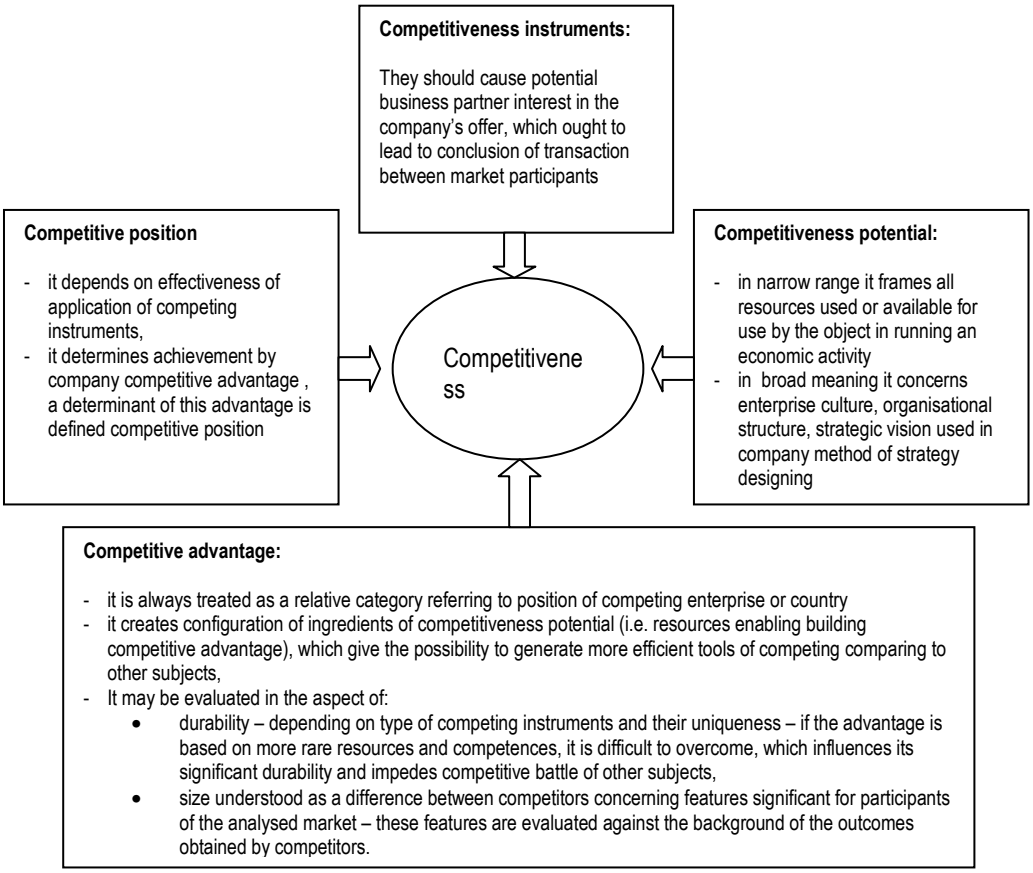

Figure 1. Factors of company competitiveness

Source: authors' own elaboration based on Mazurkiewicz A., Frączek P.: Kluczowe kompetencje a konkurencyjność przedsiębiorstw, Nierówności społeczne a wzrost gospodarczy. Uwarunkowania sprawnego działania w przedsiębiorstwie i regionie, 2011, Zeszyt nr 20, Wydawnictwo UR, Rzeszów, Stankiewicz M.J.: Istota i sposoby oceny konkurencyjności przedsiębiorstwa, Gospodarka Narodowa, 2000, nr 7-8, Gorynia M.: (red.), Luka konkurencyjna na poziomie przedsiębiorstwa a przystąpienie Polski do Unii Europejskiej, Wydawnictwo Akademii Ekonomicznej w Poznaniu, Poznań 2002.

On one hand, the investigated companies evaluated their financial situation high, and on the other – low their market share. Over half of the inquired believed that it was weak or very weak (fig. 3). Simultaneously the conducted research showed that the majority of the enterprises high or very high assessed their own sources of competitive advantage. They evaluated the advantage in the area of functions and product quality the highest. Most of them believed that the advantage in this field was high or very high. This opinion on their own market potential results from the fact that most of the inquired high or very high assess their own advantage over other competitors, which on one

hand may prove that they overestimate their own market position and on the other actually large market advantage of the enterprises participating in the study [Kalinowski et al. 2013].

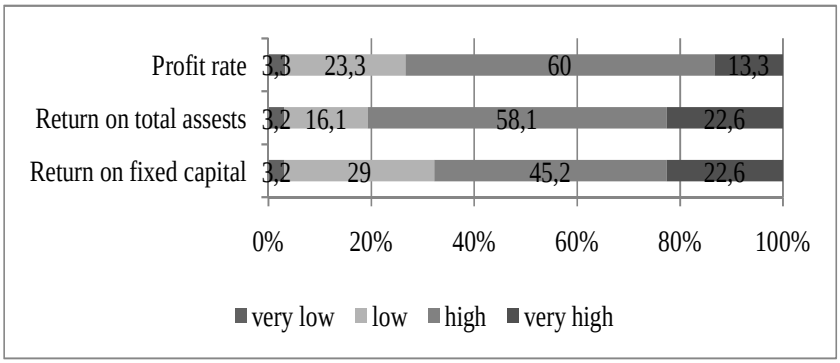

Figure 2. The evaluation of the company's financial situation

Source: authors' own research.b

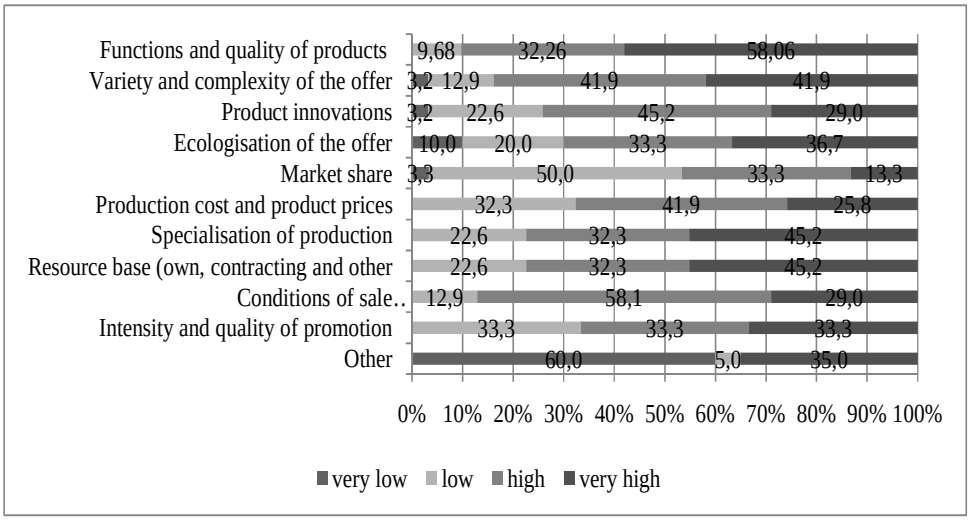

Figure 3. Main sources of enterprise market advantage

Source: authors' own research.

The analysis of the gathered material conducted with the use of network diagram proves that for each element of the investigated set of characteristics the mean is at the level of 3.10-4.48. In the investigated enterprises, among ten main sources of competitive advantage, functions and quality of products, variety and complexity of offer as well as specialisation of production were evaluated the highest on average (fig. 4). According to Wiśniewska [2012] the assessment made by the companies' the management prove the general situation of the branch in the recent years. In her

opinion after joining the EU, in the sector of fruit and vegetables processing, the growth of expenditures on production quality improvement and simultaneous slowdown of sales increase rate were observed.

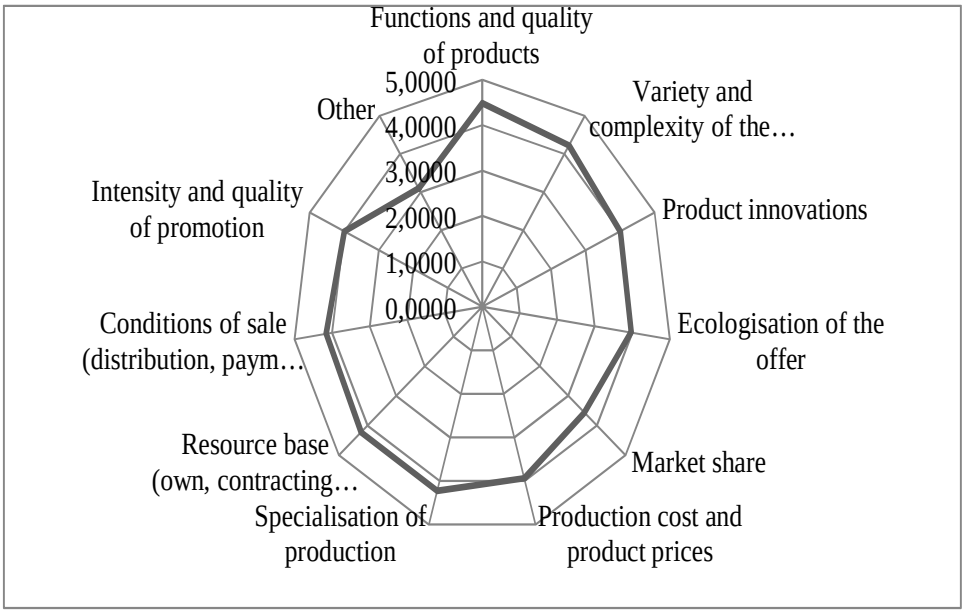

Figure 4. The average assessment of enterprises' competitive advantage

Source: authors' own research.

Skills and appropriate use of resources determine competitive position of company. Enterprises use hard and soft resources. The level of capital, technologies, well-elaborated long-term strategies as well as efficient functioning of organisational structure belong to the first group of resources, while among soft resources one may distinguish socio-economic environment, knowledge and education, which create enterprise's environment [Koźmiński 2004].

The conducted research proved that most companies of fruit and vegetable processing sector evaluate high and very high knowledge and experience of employees (94%) as well as technological innovation (87%) (fig. 5). The responders also had good opinion on value of fixed capital and rate of capital resources growth. Almost every fourth enterprise recognised that both level of fixed capital and labour consumption of production were at very low level. In turn, over 10% of companies claimed that the level of the fixed capital use was very low. It allows to conclude that the investigated enterprises may own resources, which prove quite high competitive potential and development possibilities.

The measure of competitiveness is also customers assessment, who asses the offer of the company. The management of the investigated enterprises claimed that the main determinants influencing the demand growth for their products were the prices, as well as preferences, tastes and incomes of purchasers. Most of the inquired assessed these factors very high (respectively 35.5%, 22.6% and 19.4%) and high (51.6%, 51.6% and 67.7%).

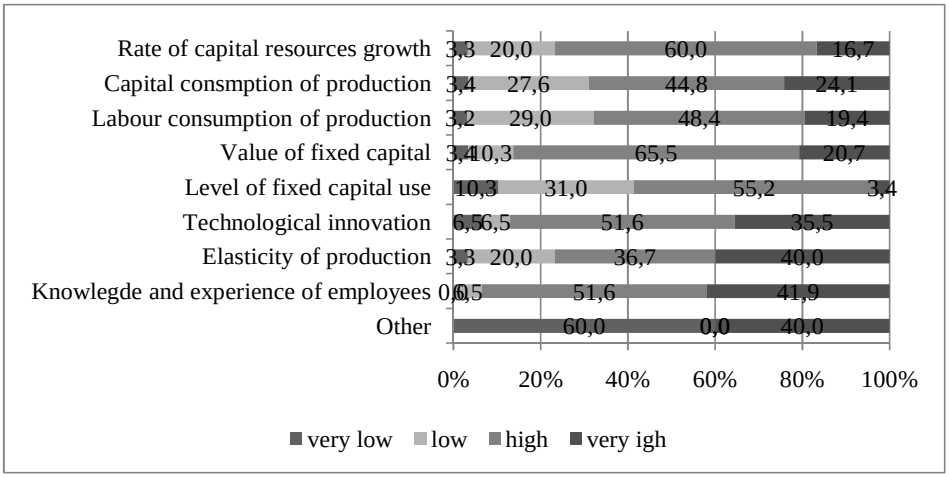

Figure 5. The assessment of production resources of fruit and vegetable processing companies (%)

Source: authors' own research.

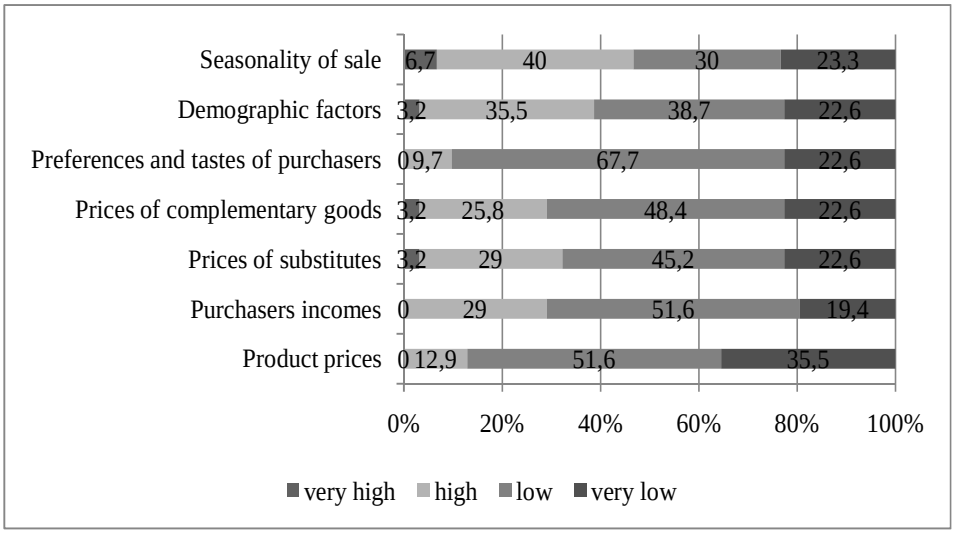

Figure 6. Determinants of demand for company's products (%)

Source: authors' own research.

CONCLUSIONS

Changes and challenges linked to Poland's participation in the common European market forced the fruit and vegetables processing companies to improve their competitiveness. The basic determinants of competitiveness are profits and profitability. The investigated enterprises quite good evaluated the profit rate and return on assets, which mainly results from the fact that large

companies of strong market position mostly participated in the research. The quality of resources and competences is a quite important factor of competitiveness, wherein the investigated enterprises the highest assessed knowledge and experience of employees as well as technological innovation and simultaneously the lowest fixed capital consumption, which may reflect in relatively high competitive potential of companies. Among factors determining the evaluation and competitive position of enterprises, one may distinguish demand conditions, from which, according to the inquired, the most important are: prices, purchasers' incomes and preferences.

The research conducted on enterprises of fruit and vegetables processing sector proves that the management quite high assesses the competitive potential and position of the enterprise. One may expect that the companies participating in the study are able to effectively compete on domestic market and systematically strengthen their position in Europe.

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THE IMPACT OF INFLATION ON WOOD MARKET ECONOMIC SITUATION

Abstract. Economic situation on Polish wood market in the second half of 2014 as well as the impact of deflation processes on the condition of sawmill enterprises was presented here.

Key words: wood market, inflation

INTRODUCTION

Economic situation of Polish wood industry depends on the economic situation of the country as a whole, the European Union, Europe and the whole world. Market economy in which Polish wood industry has been operating since 1989 is of cyclical character (Lis 2013). Its development is based on **business cycle** (or **trade cycle**). Those are fluctuations in production level, employment and prices – in accordance with a short term developmental tendency (trend). During economic processes enterprises activity alternates between expansion and recession.

The situation is significantly influenced by macroeconomic factors. The level of and trends in the development of economy, that is phases of economic cycle are measured using economic indexes and crisis is economic situation which presence is show by economic indicators that is elements characterizing economy. The clearest and most commonly used is GDP – gross domestic product per capita. Economic crisis, so called technical one, happens when the fall in GDP continues for at least ***two quarters of the year.*** In Poland following 1995 there hasn't been any technical economic crisis and there are no signs of it still.

The level of inflation and the direction of its predictable change determine the level of future costs, profits, life standard and social climate. They directly translate onto the level of support in social polls, which are carefully observed by the politicians.

THE LEVEL AND CAUSES OF INFLATION

An important macroeconomic index is inflation. It is a process of increasing prices, causing changes in proportions of national income distribution. In the world economy inflation is commonly present, however it's of different level in various states and periods. This level is determined by inflation rate. It expresses in percentage terms the increase in the level of prices in the period under study in comparison with the period taken as the reference. Depending on the level of inflation we may distinguish:

- creeping inflation – the level of annual inflation equals a few percent, not causing any disruptions in economic processes, it is controllable.
- walking inflation – mainly around a dozen percent annually, inflation expectations result in the business entities behaviours which support that process, when growing, it can no longer stay under control.
- galloping inflation – above 20%, causing increasing disruptions in economic processes, weakening motivational systems, as the result inhibiting economic growth.
- hyperinflation - the intensification of inflation processes hinders rational management there is no possibility of running economic calculation, planning economic activities, motivational systems are ineffective. It leads to gradual anarchization of social life.

Inflation process is complex due to its numerous causes, symptoms and effects. Causes of inflation:

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- demand-pull inflation = driven by demand - is the result of the circulation of excessive amount of money. Its sources are: too high state expenditure, that does not correspond with the level of income (its budget inflation), excessive creation of credit money (credit inflation) or the increase in prices which does not correspond with the increase in production (wage inflation).

-cost inflation = cost-push inflation – it is caused by the increase in production costs.

Table 1. Annual indexes of consumer goods and services in the years 1950-2013

Annual indexes of consumer goods and services in Poland							
Year	CPI	Year	CPI	Year	CPI	Year	CPI
1950	107,5	1970	101,1	1990	***685,8***	2010	102,6
1951	109,6	1971	**99,9**	1991	***170,3***	2011	104,3
1952	114,4	1972	100,0	1992	***143,0***	2012	103,7
1953	***141,9***	1973	102,8	1993	***135,3***	2013	*100,9*
1954	**93,7**	1974	107,1	1994	***132,2***		
1955	**97,6**	1975	103,0	1995	***127,8***		
1956	**99,0**	1976	104,4	1996	119,9		
1957	105,4	1977	104,9	1997	114,9		
1958	102,7	1978	108,1	1998	111,8		
1959	101,1	1979	107,0	1999	107,3		
1960	101,8	1980	109,4	2000	110,1		
1961	*100,7*	1981	***121,2***	2001	105,5		
1962	102,5	1982	***200,8***	2002	101,9		
1963	*100,8*	1983	***122,1***	2003	*100,8*		
1964	101,2	1984	115,0	2004	103,5		
1965	*100,9*	1985	115,1	2005	102,1		
1966	101,2	1986	117,7	2006	101,0		
1967	101,5	1987	***125,2***	2007	102,5		
1968	101,6	1988	***160,2***	2008	104,2		
1969	101,4	1989	***351,1***	2009	103,5		

Source: Central Statistical Office of Poland – Informations Portal (last reading 19.08.2014)

Price index relative to the previous year = 100

deflation ***galloping inflation*** *inflation less than 1%*

Demand-pull and cost–push inflation usually are present together. Mechanism of inflation is visible in the so-called inflationary spiral. It is mutual increasing between: changes in prices, income and cost. Which at some point become the cause and at the other the result of the changes in the remaining parameters.

Among the planes of inflationary spiral one may distinguish: competitive prices – wages, wages- wages (increase in wages in one area of economy induces the increase in prices in other sectors of economy), wages- social benefits (demand for valorisation of social benefits caused by increase in wages), prices- prices (increase in prices of some products persuades the producers to increase the prices of their products in order to keep the previous prices proportions), prices – interest rate and so on.

At the beginning inflation processes were corresponding with the periods of economic recovery. Currently they happen at every phase of economic cycle. The inflation spreading onto the subsequent phases of economic cycle resulted in coining new phrases in the 70-ies of the twentieth century:

Table 2. Annual growing indexes of prices of consumer goods and services between 1950 and 2013

Annual growing indexes of prices of consumer goods and services									
YEAR	CPI	YEAR	CPI	YEAR	CPI	YEAR	CPI	YEAR	CPI
1950	100,00	1970	203,97	1990	**71 595,11**	2010	305,04	1988	**100,00**
1951	109,60	1971	***203,77***	1991	**121 926,46**	2011	318,15	1989	**351,10**
1952	125,38	1972	203,77	1992	**174 354,84**	2012	329,93	1990	**2 407,84**
1953	177,92	1973	209,47	1993	**235 902,11**	2013	332,89	1991	**4 100,56**
1954	***166,71***	1974	224,35	1994	**311 862,58**			1992	**5 863,80**
1955	***162,71***	1975	231,08	1995	127,80			1993	**7 933,72**
1956	***161,08***	1976	241,24	1996	153,23			1994	**10 488,38**
1957	169,78	1977	253,06	1997	176,06				
1958	174,36	1978	273,56	1998	196,84				
1959	176,28	1979	292,71	1999	211,21				
1960	179,45	1980	320,23	2000	232,54				
1961	180,71	1981	388,11	2001	245,33				
1962	185,23	1982	779,33	2002	249,99				
1963	186,71	1983	951,57	2003	251,99				
1964	188,95	1984	1 094,30	2004	260,81				
1965	190,65	1985	1 259,54	2005	266,29				
1966	192,94	1986	1 482,48	2006	268,95				
1967	195,83	1987	1 856,06	2007	275,68				
1968	198,97	1988	**2 973,41**	2008	287,25				
1969	201,75	1989	**10 439,65**	2009	297,31				

Source: own study based on Central Statistical Office of Poland – Informations Portal

Price index relative to the previous year = 100

deflation **galloping inflation and hyperinflation**

- stagflation (simultaneously: high level of inflation, high unemployment and economic stagnation). It is measured with stagflation rate, also called poverty rate. It is the sum of inflation and unemployment rates. It is linked to the phase of depression in economic cycle) and
- slumpflation (slump in economic processes, manifested in the decrease in absolute value of production and national income, rapid growth of unemployment and high and steadily growing inflation. It may be present in all phases of economic cycle).

Limiting or preventing inflation requires adequate state policy regarding the shaping of social income, limiting budget deficit (tax policy), controlling issuing of currency by the central bank and creating credit money by commercial banks (money policy).

The highest level of inflation took place in Zimbabwe. Its value in May 2008 reached - 2,2 million %, in June 11,27 million %, in July - 231 million %. Then the scale in government calculation sheets ended and the data stopped to be published. It has been calculated, however at its peak the inflation reached the level of 500 million %, or even more. Following the reforms and the

money exchange in December 2010 inflation index in Zimbabwe reached 3,2 %, and average annual inflation was 4,5 %.

MEASUREMENTS OF INFLATION

Inflation rate is that economic indicator which is carefully observed by almost all market user: consumers, producers, businessmen, central bank, commercial and investment banks as well as politicians.

There are numerous ways of measuring inflation. Depending on which one is implemented the obtained results might be very different.

Table 3. Annual growing indexes of prices of consumer goods and services between 1949-2013

Annual growing indexes of prices of consumer goods and services									
YEAR	CPI	YEAR	CPI	YEAR	CPI	YEAR	CPI	YEAR	CPI
1950	107,50	1970	219,27	1990	0,00	2010	9 750,26	1988	**100,00**
1951	117,82	1971	***219,05***	1991	0,00	2011	10 169,52	1989	**351,10**
1952	134,79	1972	219,05	1992	0,00	2012	10 545,80	1990	**2 407,84**
1953	191,26	1973	225,18	1993	0,00	2013	10 640,71	1991	**4 100,56**
1954	***179,21***	1974	241,17	1994	0,00			1992	**5 863,80**
1955	***174,91***	1975	248,41	1995	4 085,02			1993	**7 933,72**
1956	***173,16***	1976	259,34	1996	4 897,94			1994	**10 488,38**
1957	182,51	1977	272,04	1997	5 627,73				
1958	187,44	1978	294,08	1998	6 291,81				
1959	189,50	1979	314,66	1999	6 751,11				
1960	192,91	1980	344,24	2000	7 432,97				
1961	194,26	1981	417,22	2001	7 841,78				
1962	199,12	1982	837,78	2002	7 990,78				
1963	200,71	1983	1 022,93	2003	8 054,70				
1964	203,12	1984	1 176,37	2004	8 336,62				
1965	204,95	1985	1 354,00	2005	8 511,69				
1966	207,41	1986	1 593,66	2006	8 596,80				
1967	210,52	1987	1 995,27	2007	8 811,72				
1968	213,89	1988	3 196,42	2008	9 181,82				
1969	216,88	1989	0,00	2009	9 503,18				

Source: own study based on Central Statistical Office of Poland – Informations Portal

Price index relative to the previous year = 100

deflation **galloping inflation and hyperinflation**

The most popular inflation rate is the so called general inflation or the index of price increase of goods and services. General inflation = indicator (index) of the increase in the prices of goods and consumer services is also known under its international English acronym – CPI = Consumer Price Index. CPI shows how much within the given period of time the prices of goods from average household consumer basket have changed. The changes within that basket present how the categories of average household expenditure alter. International scale analysis is carried out by comparing the share of individual groups of goods in the basket.

In case of the inflation that is too high the government of a given country decides to change the currency or denominate it. Following the Second World War money in Poland was changed twice. First time it was done by the Act by PKWN in 1944. The second monetary reform was done on the 30th of October 1950. This change was done unexpectedly. There was also a denomination. The

money in circulation between 1948 and 1950 were exchanged fast just within a few days for the newly issued notes and coins. The exchange was done in such a way that the money deposited in banks was exchanged, all the prices and wages were calculated based on the proportion: old 100 zł for 3 zł. Cash was calculated based on significantly worse proportion: 100 old zł equalled 1 new zł. Simultaneously financial discipline was introduced which stopped previously actively progressing inflation.

Table 4. Annual indexes of consumer prices - inflation

Inflation 1 - calculated relative to the analogical month of the previous year

Year	Month											
	1	2	3	4	5	6	7	8	9	10	11	12
1989		70,3	74,2	77,8	85,4	91,3	103,9	182,7	269,2	457,1	557,0	639,6
1990	*1007,6*	*1183,1*	*1132,8*	*1102,9*	*1076,5*	*1051,2*	994,0	748,5	558,0	356,0	285,9	249,3
1991	94,9	80,0	81,8	71,0	67,8	72,4	68,3	67,6	67,1	64,8	62,7	60,4
1992	45,4	40,1	38,1	40,2	43,2	39,0	41,3	44,3	46,5	46,4	45,4	44,3
1993	37,5	39,7	39,7	38,1	35,8	34,3	34,8	34,4	31,0	29,8	33,0	37,6
1994	32,4	29,9	30,2	31,2	31,2	32,7	32,8	32,2	34,6	36,1	33,5	29,5
1995	32,3	33,6	33,1	32,4	32,3	30,3	27,6	25,7	24,2	22,4	22,0	21,6
1996	21,0	20,4	20,4	20,3	19,8	19,5	20,4	20,5	19,5	19,5	19,1	18,5
1997	17,8	17,3	16,6	15,3	14,6	15,3	14,9	14,5	13,6	13,1	13,2	13,2
1998	13,6	14,2	13,9	13,7	13,3	12,2	11,9	11,3	10,6	9,9	9,2	8,6
1999	6,9	5,6	6,2	6,3	6,4	6,5	6,3	7,2	8,0	8,7	9,2	9,8
2000	10,1	10,4	10,3	9,8	10,0	10,2	11,6	10,7	10,3	9,9	9,3	8,5
2001	7,4	6,6	6,2	6,6	6,9	6,2	5,2	5,1	4,3	4,0	3,6	3,6
2002	3,4	3,5	3,3	3,0	1,9	1,6	1,3	1,2	1,3	1,1	***0,9***	***0,8***
2003	***0,5***	***0,5***	***0,6***	***0,3***	***0,4***	***0,8***	***0,8***	***0,7***	***0,9***	1,3	1,6	1,7
2004	1,7	1,6	1,7	2,2	3,4	4,4	4,6	4,6	4,4	4,5	4,5	4,4
2005	4,0	3,6	3,4	3,0	2,5	1,4	1,3	1,6	1,8	1,6	1,0	***0,7***
2006	***0,7***	***0,7***	***0,4***	***0,7***	***0,9***	***0,8***	1,1	1,6	1,6	1,2	1,4	1,4
2007	1,6	1,9	2,5	2,3	2,3	2,6	2,3	1,5	2,3	3,0	3,6	4,0
2008	4,0	4,2	4,1	4,0	4,4	4,6	4,8	4,8	4,5	4,2	3,7	3,3
2009	3,1	3,3	3,6	4,0	3,6	3,5	3,6	3,7	3,4	3,1	3,3	3,5
2010	3,6	2,9	2,6	2,4	2,2	2,3	2,0	2,0	2,5	2,8	2,7	3,1
2011	3,6	3,6	4,3	4,5	5,0	4,2	4,1	4,3	3,9	4,3	4,8	4,6
2012	4,1	4,3	3,9	4,0	3,6	4,3	4,0	3,8	3,8	3,4	2,8	2,4
2013	1,7	1,3	1,0	***0,8***	***0,5***	***0,2***	1,1	1,1	1,0	***0,8***	***0,6***	***0,7***
2014	***0,5***	***0,7***	***0,7***	***0,3***	***0,2***	***0,3***	**-0,2**	**-0,3**				

Source: own study based on Money Portal (last reading 16.09.2014)

inflation more than 1000% ***inflation less than 1%*** **deflation**

The second zł denomination took place on the 1st of January 1995. Then a new monetary unit called złoty (PLN) was introduced in Poland which replaced a so called “old złoty" (PLZ). When converted 1 new złoty replaced 10 000 old złoty. Denomination was the effect of hyperinflation, which only between 1989 and 1990 (table 2, table 3) reached the level of 2 408%, and between 1989 and 1994 – 10 488% (that is even more than the level of denomination in 1995). It may be said that the denomination from 1995 approximately offset the level of hyperinflation from the period of

constitutional breakthrough (1989 – 1994). Inflation calculated increasingly is illustrated in tables 2 and 3.

Excluding from the list analysis from 1989 – 1994, that is assuming that following inflation from 1988 directly follows 1995 inflation – increase in prices from 1949 to 2013 – amounted to 10 641% (table 4), that is slightly higher than the inflation during the period of constitutional and economical transformation (1989 – 1994).

ANNUAL INFLATION

In table 1 there have been presented systematically calculated by Central Statistical Office of Poland – annual indexes of change in prices of goods and consumer services between 1950 and 2013. 4-times in: 1954 (93,7%), 1955 (97,6%), 1956 (99%) and 1971 (99,9%) – deflation took place in Poland. Most significantly the prices decreased in 1954 by 6,3% in comparison with 1953. In 1972 the prices were stable – annual inflation rate reached 100%. 5-times in: 1961 (100,7%), 1962 (100,8%), 1965 (100,9%), 2003 (100,8%) and 2013 (100,9%) – annual inflation was lower than 1%.

The highest annual inflation took place in 1990 – 685,8%. In addition still twice, in 1989 (351,1%) and 1982 (200,8%) – inflation exceeded 200%, and 10 times it was ranging between 121,2 – 170,3%, so it was higher than 20%, meaning it was galloping inflation. In total during 13 years (out of 64 within the analyzed period) in Poland there was galloping inflation, and it also persisted for 9 consecutive years: 1987 (125,2%) – 1995 (127,8%). Past 1995 the inflation was kept under control and there was no galloping inflation in Poland.

Based on the data systematically published by Central Statistical Office of Poland – Portal Money every month issues 4 inflation indexes:

Inflation 1 – calculated relative to the analogical month of the previous year,

Inflation 2 – calculated relative to the preceding month,

Inflation 3 – calculated relative to December of the previous year,

Inflation 4 – average level of inflation from the last 12 months = average annual inflation index.

Especially economically important indexes of Inflation 1 and Inflation 2 will be thoroughly analysed in the remaining part of this article.

Table 4 presents the indexes of Inflation 1– calculated relative to the analogical month of the previous year between 1989 and 2014. In the first half of 1990 – this index exceeded 1 000%. Inflation 1 was the highest in February 1990 – reaching 1 183,1%. It exceeded 100% in the second half of 1989 and throughout the whole 1990. The index reached 20% for the last time in August 1996. It may be stated that then ended the galloping inflation in Poland.

Inflation 1 was lower and very mild less than 1% over 30 months in the years: 2002, 2003, 2006, 2013, 2014. In August 2014 – for the first time since socio-economic and political changes there came negative inflation, meaning there was deflation in Poland. Rather not high just -0,2% – measured relative to the analogical month of the previous year. Earlier negative inflation (annual) happened 43 years before - in 1971 (table 1).

MONTHLY INFLATION

Deflation relative to preceding month appeared after 1989 in July 1995. It reached -0,9% (table 5) – it was simultaneously the highest within the analysed period. In August 1998 it amounted to -0,6%, and in July of 2002 and 2012 it equalled -0,5%. Following 1995 deflation appears systematically till year 2000 mostly in single months, later – mostly twice (8x) or three times a year. Till 1997 it occurred only in July. In 1998 – apart from July it was also noted in August. In those two months there was monthly deflation in our country mainly in July, over 20 years of the period under study it was noted 15 times, in August – 13 times. In 2005 it happened 6 times, that is the most frequently in the analyzed period of 20 years.

DEFLATION

Deflation which is the opposite of inflation means a long-term decrease in average prices. It is not however expected or desirable fall in prices – often being the result of technological progress or decreasing the costs of production.

Table 5. Monthly indexes of consumer prices - monthly inflation

Inflation 2 – calculated relative to the preceding month

Year	Month												
	1	2	3	4	5	6	7	8	9	10	11	12	
1989		7,9	8,1	9,8	7,2	6,1	9,5	*40*	*34,4*	*54,8*	*22*	*18*	
1990	*79,6*	*23,8*	4,3	7,5	4,6	3,4	3,6	1,8	4,6	5,7	4,9	5,9	
1991	*12,7*	6,7	4,5	2,7	2,7	4,9	0,1	0,6	4,3	3,2	3,2	3,1	
1992	7,5	1,8	2,0	3,7	4,0	1,6	1,4	2,7	5,3	3,0	2,3	2,2	
1993	4,1	3,4	2,1	2,3	1,8	1,4	1,1	2,3	2,5	1,9	4,0	5,6	
1994	1,9	1,1	2,0	2,9	1,7	2,3	1,5	1,7	4,5	2,9	1,8	1,9	
1995	3,9	2,1	1,7	2,3	1,8	1,0	**-0,9**	0,4	3,0	1,7	1,3	1,5	1
1996	3,4	1,5	1,5	2,2	1,4	1,0	**-0,1**	0,5	1,9	1,4	1,3	1,3	1
1997	2,9	1,1	0,8	1,0	0,6	1,5	**-0,2**	0,1	1,4	1,1	1,2	1,0	1
1998	3,2	1,7	0,6	0,7	0,4	0,4	**-0,4**	**-0,6**	0,8	0,6	0,5	0,4	2
1999	1,5	0,6	1,0	0,8	0,7	0,2	**-0,3**	0,6	1,4	1,1	0,9	0,9	1
2000	1,8	0,9	0,9	0,4	0,7	0,8	0,7	**-0,3**	1,0	0,8	0,4	0,2	1
2001	0,8	0,1	0,5	0,8	1,1	**-0,1**	**-0,3**	**-0,3**	0,3	0,4	0,1	0,2	3
2002	0,8	0,1	0,2	0,5	**-0,2**	**-0,4**	***-0,5***	**-0,4**	0,3	0,3	**-0,1**	0,1	5
2003	0,4	0,1	0,3	0,2	***0,0***	**-0,1**	**-0,4**	**-0,4**	0,5	0,6	0,3	0,2	3
2004	0,4	0,1	0,3	0,8	1,0	0,9	**-0,1**	**-0,4**	0,3	0,6	0,3	0,1	2
2005	0,1	**-0,1**	0,1	0,4	0,3	**-0,2**	**-0,2**	**-0,1**	0,4	0,4	**-0,2**	**-0,2**	**6**
2006	0,2	***0,0***	**-0,1**	0,7	0,5	**-0,3**	***0,0***	0,3	0,2	0,1	***0,0***	**-0,2**	3
2007	0,4	0,3	0,5	0,5	0,5	***0,0***	**-0,3**	**-0,4**	0,8	0,6	0,7	0,3	2
2008	0,7	0,4	0,4	0,4	0,8	0,2	0,0	**-0,4**	0,3	0,4	0,2	**-0,1**	2
2009	0,5	0,9	0,7	0,7	0,5	0,2	0,1	**-0,4**	***0,0***	0,1	0,3	***0,0***	1
2010	0,6	0,2	0,3	0,4	0,3	0,3	**-0,2**	**-0,4**	0,6	0,5	0,1	0,4	2
2011	1,2	0,2	0,9	0,5	0,6	-0,4	**-0,3**	***0,0***	0,1	0,7	0,7	0,4	2
2012	0,7	0,4	0,5	0,6	0,2	0,2	**-0,5**	**-0,3**	0,1	0,4	0,1	0,1	2
2013	0,1	***0,0***	0,2	0,4	**-0,1**	***0,0***	0,3	**-0,3**	0,1	0,2	**-0,2**	0,1	3
2014	0,1	0,1	0,1	***0,0***	**-0,1**	***0,0***	**-0,2**	**-0,4**					3
Totality	23,7	10,7	11,4	14,3	11,0	5,2	-3,8	-3,2	13,5	12,0	7,9	6,7	
Deflation	0	1	1	0	3	***6***	**15**	**14**	0	0	3	3	deflation
Inflation = 0	0	2	0	1	1	3	2	1	1	0	1	1	

Throughout what number of months in the year under analysis (in the period under study - from 1995) – deflation took place		
	1	6
	2	**7**
	3	5
	4	0
	5	1
	6	1

inflation more than 10% ***inflation 0%*** **deflation**

Source: own study based on Money Portal (last reading 16.09.2014)

Deflation generally is the effect of the fact that there is not sufficient amount of money in the economy. Small amount of money on the market results in low demand – which means that the producers have problems selling their goods. Growing stocks force them to lower the prices and reduce the production level. Selling the excessive volume of products at lower prices they make loss which they want to limit. They reduce costs. Human related – by two means: decreasing salaries or

reducing employment level. The unemployment which is growing due to that second process decreases the demand much faster. It reinforces the pressure for further price and production reductions.

Then the consumers observing the gradual price decrease - delay purchases they can already afford until later. It leads to systematic decrease in consumption. Then economic growth slows down, as apart from export and investment it constitutes an important element of consumption.

Deflation is regarded as a sign of deepening economic recession. Deflation consequences are not just decrease in prices and increase in unemployment. Lowering prices result in the growth of real interest rates. The situation of companies and persons taking bank credits gets worse: on one hand their income lowers which makes repayment more difficult and on the other the credits become more expensive.

Deflation usually results in the wave of bankruptcies and insolvency, having a significant impact on the whole bank system. Deflation also means loss for state budget: tax income decreases both due to shrinking value of sales of goods and services but also due to deteriorating financial condition of companies and banks. Budget expenditure does not decrease fast or does not decrease at all, the overall sum of unemployment allowances grows. Generally, as the result of deflation budget deficit and public debt grow.

The deepest deflation was in the years of Big Crisis that is the world economic slump between 1929 and 1933. Deflation in Japan between 1995 and 2005 significantly disrupted economic relations.

Long-lasting and persistent decrease in prices, which negatively influences economy that is serious deflation, happens in contemporary economy very rarely.

Deflation is being compared to spilling sand onto a so far effectively working mechanical gear (which increases friction of cooperating elements making their job more difficult). Low inflation is regarded as an adequate level of lubrication of that gear (which decreases friction but only up to an adequate rate without causing sliding).

Generally, coming out from a deep deflation takes a long time and causes serious problems. In most cases it is far more difficult than coming out of inflation.

CONCLUSIONS

During recession of 2008 and 2009 our relatively good economic development was determined by investment financed to a large extend with EU funding. It also stimulated internal market, which became the second source of boosting economy.

Investment resources from EU budget for the period 2007 – 2013 have already finished. So far it has been mostly felt by construction industry. A gradual, however steadily deepening decreasing of internal demand caused by negative and still worsening consumer climate and negative labour market prospects: systematically growing unemployment level, occurred. Quite significant is deepening inflation and Russian restrictions on agricultural market.

Following the whole economy there comes industry including wood industry. The profitability falls, the level of orders falls as well. Problems with round wood supply caused by insufficient offer from the National Forests are further deepened by drastically increasing export to Germany

It is reflected first in wood accessibility and then its prices. Currently wood industry is less concerned with wood price and more with its accessibility on the market. Its level is significantly lower than the needs of wood industry entrepreneurs in the current phase of economic development also causing sudden increase in wood prices on the free market.

Macroeconomic indexes used to determine the tendency on round wood market - show gradual trade recession.

Round wood prices are still, however to a much smaller degree, determined by energy sector, demand for biomass and its subsidizing. In this area the changes in Polish legal regulations

significantly lowered the irrational burning of biomass not just the one made of wood. There are however, necessary essential initiatives to be taken at the level of European Union.

Assigning wood for the production of goods which bring high added value for Polish companies, that is for the production of highly processed goods that have a long term of utilization – will guarantee both economic and ecological effects meaning it'll be effective sozologically. Not just for wood industry. Not just for forest industry. For the whole Polish economy. It will significantly decrease the susceptibility of wood and forest sectors to economic boom and recession. Annual deflation might be the forecast of recession.

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Wojciech Lis, Marek Tabert, Elżbieta Mikołajczak[10]

THE IMPACT OF BURNING WOOD ON AIR POLLUTION

Abstract: The increasing energy consumption not only limits its accessibility but also contributes to the exhaustion of known and examined sources of that energy and the growth of its cost but mostly causes the increased emission of so-called greenhouse gasses – CO_2, SO_x, NO_x, methane and so on. Those gases are responsible for significant climatic changes on our globe. Burning wood even though to a smaller extend than burning coal also contributes to that fact. Coal and wood as the result of burning simultaneously generate toxic substances – cancerogenic benzo(a)pyrene, heavy metals as well as dioxins and furans.

Key words: wood, biomass, air pollution

RENEWABLE ENERGY AND EMISSION OF GASES

Burning of solid fuels, especially coal, but also wood is responsible for ever more frequent and serious, in terms of their impact, natural disasters: draughts, torrential rains, earthquakes and sudden strong winds that bring significant destruction: tornados on lands and tsunami at sea.

Estimates of German insurance Company Munich Re (2013) indicate that due to a so far unrecorded escalation of such disasters – year 2011 is considered to be the most expensive in the history – the loss reached almost 265 billion of US dollars. Up till that year the biggest loss was noted in 2005 when all natural disasters cost 220 billion US dollars (Munich RE 2013).

In 2011 there were recorded 355 natural disasters. The biggest loss was caused by the earthquake which took place on the 11th of March 2011 that registered 9 on the Richter scale, the strongest that ever hit Japan that also evoked tsunami. That natural disaster which was considered to be the most expensive in the entire history was estimated to cost 10 billion US dollars. The previous most cost-generating disaster was hurricane Katrina in 2005. It created loss of 125 billion US dollars and the biggest of them hit south-east states of the USA.

Large damages were also caused by the earthquakes that hit New Zealand on the 22nd of February 2011, numerous tornados in the south and central west of the USA in April, May and September as well as the flooding and cyclone in the Australian State of Queensland at the beginning of 2011 and the flooding in Thailand which lasted from September till November 2011.

If the standards of utilizing and the consumption of primary energy will not change, natural disaster such as hurricane, earthquakes, flooding, volcano eruptions and draughts - will probably be more frequent and dangerous. Munich RE estimates that up till 2050 they may affect 1,5 billion people, especially in large cities and surrounding areas**.**

The loss caused by natural disasters will also be constantly growing Since economic and civilization development concentrate ever more people and material goods on relatively small areas in enormous agglomerations. People as the civilization expanded and accumulated ever more goods which they threat loosing.

Forest areas may be treated as an antidote for the threat. Intense afforestation is recommended – especially of the coast line and mountain slopes. Forests may create a natural protection against tsunami waves, they allow for decreasing flooding, prevent both avalanches and mudslides. Following growth period they provide timber; the one that does not fit the standards for mechanical

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or chemical conversion and suitable to generate immediately and the rest as post production residue and post-consumer wood.

Carbon dioxide is currently the most closely monitored gas both by ecological organizations as well as various authorities, it also has the most environmental restrictions - hence the recommendation for a wider usage of renewable energy sources for generating renewable energy sources - RES. Among the sources of green „energy" – practically the most significant is biomass utilization for generating heat and electricity. Among the sources of biomass - the most widely and easily accessible is wood of various shape and kind that is wood prepared especially to generate energy – slivers or chips come from mechanical conversion – blocks, sawdust, shavings, grit or following chemical processing – paper sediment; there are finally the most highly processed, especially produced wooden briquettes and pellet used to generate energy.

WOOD BURNING

Among solid fuels wood is the one that possesses the highest share of gas particles about 85% in air-dry condition. Wood can be categorized as long-flame fuel which for optimum combustion needs large furnace areas.

Solid fuels: coal and wood – are serious air-pollutants. Their combustion results in the emission of cancerigenic ashes and gases accumulating in the atmosphere [Lis 2011b]. Among those harmful ones there are: suspended ashes (air aerosols, articles). Those are droplets of liquid or solid particles either natural or created as the result of human activity (called pollution).

Due to their origin, phase (liquid or solid), as well as physical and chemical properties atmospheric aerosols are divided into groups:

1) sea salt,

2) mineral ashes (in Europe, especially in the south – the most burdensome are the clouds of sand from Sahara Desert),

3) organic and inorganic coal and graphite compounds, ashes and soot particles,

4) sulfurs.

Suspended ashes are often created based on sulfur oxides (SO_x, especially sulfur dioxide - SO_2) and nitrogen oxides (NO_x). Those gases are converted during chemical and photo chemical processes into atmospheric aerosols.

Practical classification of suspended ashes is often carried out depending on the size of the particles. Those are:

- **PM2.5** (*particulate matter 2.5*) — atmospheric aerosols with particle diameter of 2.5 micrometers or smaller; organic or inorganic compounds of an increased chemical activity (among them there is for example ammonium nitrate),

- **PM10** (*particulate matter 10*) — atmospheric aerosols with particle diameter of 10 micrometers particles or smaller; compounds usually chemically neutral such as silica or metal oxides the most important elements of suspended particles,

- **TSP** (*total suspended particulates*) — all aerosols with particles which diameter is both above and below 10 micrometers.

Measuring suspended atmospheric dust is the basic criteria of air evaluation. It means calculating an average annual number of particles PM10 in the cubic meter of air, that is the number of particles of 10 micrometers in diameter suspended in the air. World Health Organization monitors the quality of air based on measurements of the ratio of PM10 in 1600 cities in 91 countries. Table 1 includes the information regarding the concentration of atmospheric aerosols PM10 in world cities with the highest level of air pollution. Table was created based on the data from WHO report embracing the period from 2008 till 2013.

Table 1. Cities and countries with the highest concentration of suspended articulate matter PM10 in micrograms per cubic meter of air

Position	City	Country	PM10 ug/m^3
1	Delhi	India	280
2	Karachi (Sindhi)	Pakistan	260
3	Dhaka	Bangladesh	170
4	Dakar	Senegal	170
5	Abu Dhabi	United Arab Emirates	160
6	Doha	Qatar	160
7	Ulan Bator (Ulaanbaatar)	Mongolia	150
8	Cairo	Egypt	140
9	Amman	Jordan	130
10	Beijing (Peking)	China	120
11	Kathmandu	Nepal	110
12	Accra	Ghana	100

Source: own study based on information World Health Organization in the years 2008 - 2013

According to WHO each year over 2 million people die as the result of breathing polluted air. The states which are the most exposed to that are, in Asia: India, China, Pakistan, Mongolia, Bangladesh, and in Africa: Senegal, United Arab Emirates Qatar, Egypt.

Poland comes 20 on the list of the most polluted countries. Annual concentration of PM10 in our country reaches 33 ug/m^3. The level of acceptable daily concentration is 50 ug/m^3 and Carnot be exceeded more than 35 days each year. Alarm level of PM10 is 200 ug/m^3.

Air in Poland, apart from suspended atmospheric dust may also include toxic substances – cancerogenic benzo(a)pyrene, heavy metals as well as dioxins and furans.

Acceptable concentration in large cities of our country is often exceeded. For example: 28.02.2014 Poznan recorded 268 µg/m^3 of suspended particulate matter, so the level of pollution was similar to the second most polluted city in the world (table 1) namely located at Arab Sea Karachi that is the biggest city in Pakistan and (since 1966 the capital of this country).

The excessive concentration of atmospheric aerosols may be influenced by for example fog. In standard conditions particles go up high in the atmosphere. Fog makes them stay close to the ground. Due to bad quality of air – on the 25th of November 2013 provincial councilors in Kraków (which comes third on the list of the most polluted cities in Europe) – put a ban on burning coal and wood in the stoves used for heating households in this agglomeration (Lis, Tabert, Popyk 2014)

CONCLUSIONS

In usage chain – the proper hierarchy of meeting the needs for round wood and its residue regardless of the state of economy goes from veneered lumber, through large size material of specific features, then selected sawmill logs, material for constructing wooden houses and elements of buildings constructed using other technologies (roof framing, construction elements, facade coating), sawmill wood of general usage (later during secondary processing used for manufacturing

furniture, wood-working, interior design), wood for packaging (including pallets and packaging boxes) as well as for the production of elements of small garden architecture, wood used for production of panels, wood for pulp and paper industry, households and further wood used to produce briquettes and pellet, yet not necessarily for commercial energy sector. Among bio-ecological energy components there is only that part of woody biomass that is generated from wood residue from wood industry (mainly, yet not exclusively at sawmills, by the producers of pallets and wood packaging and the manufacturers of elements of garden architecture and so on) as well as from post felling residue (arbomass) and round wood that is no longer technologically usable.

In this situation negative impact on the quality of air limited to the areas outside agglomerations would be more justifiable and minimized.

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Erika Loučanová[11]

THE PERCEPTION OF CREATIVITY IN THE MANAGEMENT FIELD

Abstract: The paper is concerned with utilization of creativity in the management and its importance for the management of the company. It represents the results of the use and impact of creativity in the management of a selected company. These results are subsequently generalized and through cluster analysis were used to identify the factors influencing employees' creativity.

Key words: creativity, management, innovation.

INTRODUCTION

Knowledge that creativity in management is an important feature that every good manager should have is a common knowledge. Each of us is born with a certain degree of creativity and it is only up to that person how and whether they will further develop their creativity in the right direction.

This statement is very important for a company which is based on managers' creative thinking, because on it depends whether the company will be profitable or develop in a completely different direction. Every manager works with lots of information that has to be used creatively but mainly responsibly. They have to quickly respond to incurred problems, where their creative thinking is quite helpful, because the lack of creative thinking could result in a wrong solution.

Creativity therefore, has an important role at any level of the company, which led to the processing of this contribution on "the importance of creativity in management", where we focus on a particular enterprise and apply creativity at its various levels of management.

CREATIVITY IN MANAGEMENT

Basic principles and personal culture of each human and their living and being evolves from the concernments which they accept and favor. Wisdom, friendship, life, health, family and good are personality principles and life values of the most successful people on Earth. But besides these values, work also belongs here. Especially work can develop creativity of a human the most.

Work can be considered as the most perfect and most conscious activity of a human. It presents a meaning for almost everyone of us and it is true that boredom hurts more physically and mentally than work.

One of the many recognized means of achieving effectiveness and efficiency in the management is a creative approach to solving a number of tasks that are associated with functions of management.

If one wants to succeed in management or in its performance reach wisdom and leave behind something valuable, it is worth to be active. It is important to become a creative person, but even better to become a character (Kreativita v riadení, 2011).

Creativity is not only an important prerequisite for successful managers and entrepreneurs but also for the teams that they lead. That is why managers must know how to develop this skill within their teams and co-workers. We must understand creativity as a phenomenon that is specific for everybody and is different in its extent and style. We consider creativity to be one of the most important personal characteristics of a successful manager and entrepreneur (Isaksen, 1987).

Everywhere where new tasks are made and where those tasks occur creativity is an inevitable part of it. In management creativity represents the processes of changes in which one can find

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several new components that have an impact on solving technical procedures, resulting in lowering production costs or they can have an influence on leading and managing people.

Changes often bring us the unknown what possibly means higher potential of conflicts and also risk and uncertainty. That is the reason why everybody demands people with different and creative thinking so they can come up with creative procedures and new ideas. In general, we can say that processes of management are also processes of creativity.

Ability to manage creatively usually depends on specific managerial function as every function requires different conditions in order to apply creative behavior.

Innovators, inventors or managers are persons or group of people, who are bearers of creative processes while doing their job according to their managerial and creative skills what represent their multiple characters (Loučanová, Dadová, 2014).

METHODOLOGY

While processing the results with the problematic the perception of creativity in the management field we used the method of public survey so we primarily gathered data using standardized questionnaire. The questionnaire paid attention to respondents´ opinion on using creativity in the management of a given company. Employees on all hierarchical levels where asked the questions and thus we performed aimed research.

Except the quantitative evaluation of our questionnaire we also used the method of clustering in order to process the results. This method helped us generalize the links between observed parameters due to which we could better understand the connection of parameters towards the creativity in management as a whole.

It is the method that classifies objects according to their similar characteristics into the clusters. We used these clusters in order to find out on what is creativity in the given company dependent.

THE PERCEPTION OF CREATIVITY IN THE FIELD OF MANAGEMENT

Creativity in the management field is very important. Under this term we understand process of certain changes, in which we discover several components that we did not known before and which can help us lower the production costs and therefore we observed these aspects in the chosen company.

Based on the results from our research we can state that the managers of the company know about the importance of creativity in managing of the firm and in managing of other managers individually. Hierarchy in usage of creativity is focused mainly on the top management and has a decreasing tendency as with lowering the management level the necessity of creativity decreases (66 % of asked managers agreed).

Employees of the chosen company are aware that creativity in the management is more important than in other functions of the company. 73 % of respondents agreed with this statement. Of course, creativity is necessary everywhere, and the employees should realize that, but creativity in the field of management is unavoidable.

One of the main concerns was if one can really be more creative when being highly motivated (70 % of asked managers agreed). We can certainly proclaim this statement to be true. Every employer should try to motivate its employees as much as possible, mainly in the company of which creativity is an inevitable part (81 % of asked managers agreed).

We were slightly surprised when talking about creativity of the extroverts and the introverts because the managers of the given company expressed neutral attitude to this topic although it is sure that it does not matter whether a person is an extrovert or an introvert because creativity of both can be the same only their presentation of their ideas will be different (53 %). It is very likely that the managers do not realize that differences between those two characters do not influence their creative thinking.

An interesting experiment would be to give the same task to the manager who is an extrovert and to the one who is an introvert to see how creative they would be, how would they differ or if their creativity is on the same level.

To generalize the quantitative results of the importance of creativity in the field of management in the given company we used the method of clustering, what helped us find out the factors on which creativity of employees is dependent.

It is dependent on individual creativity of each manager on any level. Cluster (everybody can be creative) in relation to other parts of creativity in the company and personality of a person refers to it (cluster one and two).

From the first cluster we can see that everybody has creative thinking, but everybody uses it according to individual abilities and working position. Creativity on the particular level of management depends on personal character of the manager; whether the manager is an introvert or an extrovert. It also depends on the position in the hierarchical level of the company, if the manager is in top – level management or in production management in accordance with collective creativity (figure 1).

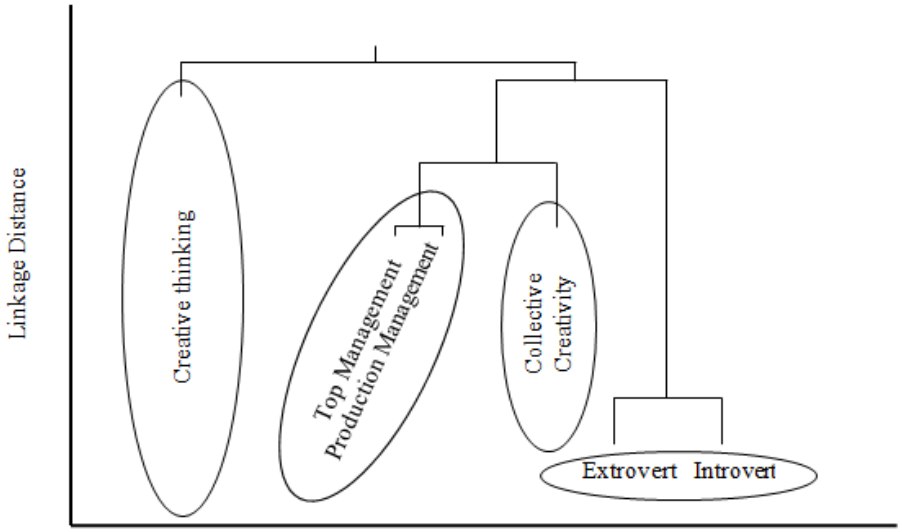

Figure 1. Cluster analyzes – one cluster

As previously stated everybody can be creative but as we can see from the second cluster, the managers in the company are aware of the fact that creativity is dependent on environment that influences their work, memory without which creativity would not be able to develop and also on the barriers that can prevent it. Creativity is dependent also on the difference between an extrovert and an introvert, alongside the returns that can be achieved due to creativity, and also on high level of motivation, that allows managers to be more creative and at the same time it is dependent on good physical and mental condition of a manager. Mental condition of a manager is further dependent on surrounding influences (noise, coldness), that have an impact on creativity of a manager also reliant on its own content of work that he or she performs and on the extent of his awareness of the importance of creativity in his work (figure 2).

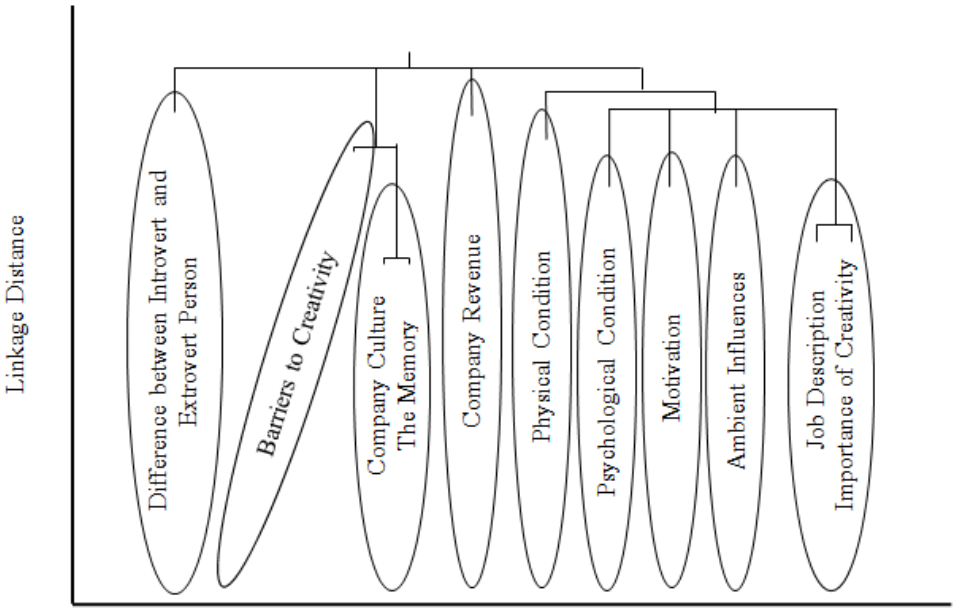

Figure 2. Cluster analyzes – two cluster

Both clusters are connected and at the same time depended on all factors that have an influence on creativity.

CONCLUSION

From research results we can state that creativity is in everybody and it is up to us how much we use it. It is equally important in every field, whether it is science, art or management. Each manager must have some level of creativity in order to react fast, solve the problems and to be successful. Usage of creativity in management plays an important role in every organization, what was also confirmed by the respondents participating in our survey.

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ENERGY EFFICIENCY OF HYBRID RYE CULTIVATION TECHNOLOGY

Abstract: The influence of hybrid rye production technology on the amount and structure of energy inputs and the energy efficiency index of production were compared in a field experiment. The level of energy inputs is mainly determined by materials, including mineral fertilizers, which account for about 85.6% of accumulated energy invested in the production of rye. The required energy inputs in the form of fuel constitute approximately 12.3%, and in the form of aggregates – 2.1%. The amount of energy inputs necessary for the production of hybrid rye totals 17.52 GJ·ha^{-1} on average, while resigning from mineral fertilization in the spring reduces this value to 14.12 GJ·ha^{-1}. The most favourable energy efficiency index in the production of hybrid rye, following winter rape cultivation, was recorded when no nitrogen fertilization was applied in the spring.

Keywords: tillage system, grain yield, energy efficiency index, hybrid rye.

INTRODUCTION

The use of simplified production technologies in modern agriculture is becoming increasingly more common. The number of cultivation treatments and the intensity of their application are being limited. The share of agrotechnical factors in crop shaping is not clear. With the progress of civilization, more and more significance is assigned to varieties and fertilization. Grain crops react very well to mineral fertilization; hence it is considered one of the main harvestogenic factors. Particular relevance is attached to nitrogen fertilization [Wicki 2007]. Productivity in the cultivation of grain crops depends to a large extent on production conditions and species [Nasalski et al. 2004b]. When choosing the optimal technology of production, adjusted to the conditions of a specific habitat, species etc., one may use either its economic or energy evaluation [Szwejkowska, Bielski 2012]. Using energy efficiency evaluation of production is becoming increasingly more common. It is applied to evaluate both plants cultivated for biofuels [Jankowski, Bydzyński 2003] as well as plants destined for consumption. When introducing new varieties of plants into production we should evaluate very thoroughly the usefulness of the proposed technologies of their production [Szwejkowska, Bielski 2012].

Significant cultivation progress in the creation of new varieties of agricultural plants is based among other things on the effect of heterosis. Hybrid rye is an example of species offering many innovative varieties. In comparison with standard rye, hybrid rye is characterised by better exploitation of habitat conditions, higher resistance to illnesses and lower susceptibility to lodging. Those features make it possible to use bigger doses of nitrogen fertilizers, which affect increased yielding [Bujak et al. 2003]. The available literature resources include few reports on the reactions of hybrid rye to tillage systems (ploughing, ploughless) [Piskier, Majchrzak 2013], however, there is no clear information as regards the energy efficiency of the technology of its production.

PURPOSE OF RESEARCH

The objective of the research studies conducted was to analyse the amount and structure of energy inputs incurred in connection with hybrid rye cultivation in production conditions, as well as define and compare the energy efficiency index of the technologies applied.

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METHODOLOGY AND RESEARCH CONDITIONS

A bifactor field experiment was conducted in 2011 and 2012 in an agricultural enterprise in Drzęczewo, near Gostyń, in Wielkopolska Voivodeship. Diverse technologies of cultivation of the Visello variety of hybrid rye were used on selected fields of an area of one hectare each.

The prime factor included ploughing and ploughless tillage systems, while the secondary factor covered technologies of hybrid rye cultivation.

The technologies used differed in terms of density and sowing depth as well as forms of nitrogen fertilization:

1 – without nitrogen fertilization in the spring – sowing grains at 170 seeds·m^{-2} (recommended), sowing depth of 2 cm (recommended), sowing date: 15 November (recommended), without a dose of nitrogen in the spring (not recommended);

2 – recommended technology – sowing grains at 170 seeds·m^{-2} (recommended), sowing depth of 2 cm (recommended), sowing date: 15 November (recommended), nitrogen fertilization in the spring (recommended) – control technology;

3 – excessively deep – sowing grains at 170 seeds·m^{-2} (recommended), sowing depth of 5 cm (too deep), sowing date: 15 November (recommended), nitrogen fertilization in the spring (recommended);

4 – sowing at 110 seeds·m^{-2} – sowing grains at 110 seeds·m^{-2} (too little), sowing depth of 2 cm (recommended), sowing date: 15 November (recommended), nitrogen fertilization in the spring (recommended);

5 – sowing at 250 seeds·m^{-2} – sowing grains at 250 seeds·m^{-2} (too much), sowing depth of 2 cm (recommended), sowing date: 15 November (recommended), nitrogen fertilization in the spring (recommended).

The soil conditions were made equal on the surface area of the entire experiment, i.e. loam-based soils, class IVa. Winter rape was sawn in the second decade of September in the amount of 60 kg·ha^{-1}, which corresponded to sowing at 174 seeds·m^{-2} of germinating seeds (except for objects no. 4 and 5). Winter rape was used as little forerunner every year; mineral fertilization amounted to 161 kg·ha^{-1} N in total (except for technology no. 1, in which fertilization was 121 kg·ha^{-1} N), 69 kg·ha^{-1} of K_2O and 69 kg·ha^{-1} of P_2O_5. According to the guidelines of the Institute of Plant Protection, full chemical protection and retardants were applied.

Results concerning the influence of rye cultivation technologies on the amount and structure of energy inputs, regardless of the applied tillage systems, were presented in this paper.

Post-harvest cultivation was performed with Terrano disc aggregate, sowing was carried out using Rapid RDA 600S seeder, mineral fertilization was conducted with the help of Amazone ZA-M Compackt 1750 spreader, while plant protection agents were distributed and foliar fertilization was conducted with the use of Lemken 4000 sprayer. In the ploughing system, Gregoire Besson plough with 9 furrow-slices was used, while TopDown 400 was exploited in the ploughless system. The machines were aggregated with a tractor (230 kW).

The amount of energy inputs (E_{tech}) invested in winter rye production was calculated using the methodology of accumulated energy consumption [Anuszewski, Pawlak, Wójcicki, 1979; Wójcicki, 2002].

$$E_{tech} = \sum E_{mat} + \sum E_{agr} + \sum E_{pal} + \sum E_r \ [\text{MJ}\cdot\text{ha}^{-1}] \quad (1)$$

Due to the fact that determining the amount of energy brought in, in the form of human labour (ΣE_r) in field conditions was not possible, this component of accumulated energy was omitted and the formula was the same as the one proposed by Piskier [2011]:

$$E_{tech} = \sum E_{mat} + \sum E_{agr} + \sum E_{pal} \quad [\text{MJ}\cdot\text{ha}^{-1}] \quad (2)$$

ΣE_{agr} – sum of energy consumption of the aggregates used [MJ·ha^{-1}],
ΣE_{mat} – sum of energy consumption of the materials used [MJ·ha^{-1}],
ΣE_{pal} – sum of energy consumption of the fuel used [MJ·ha^{-1}],

Machine efficiency was determined using a simplified timing system, whereas fuel usage while performing individual treatment processes was set by direct measurements. The energy brought in in the form of materials was calculated by multiplying the mass of the material used during production by the value of energy included in it, taking the following into account: 9 MJ·kg^{-1} for the sowing material, 77 MJ·kg^{-1} N for nitrogen fertilizers, 10 MJ·kg^{-1} K_2O for potassium fertilizers, 15 MJ·kg^{-1} P_2O_5 for phosphorous fertilizers, 48 MJ·kg^{-1} for diesel oil, 300 MJ·kg^{-1} of active substance for pesticides [Wójcicki 2002].

The energy efficiency index was calculated based on dependence provided by Piskier [2011] by means of dividing the energy efficiency index of rye crop yield (P_e) by the amount of accumulated energy input invested in its cultivation and care (E_{tech}).

$$E_e = P_e / E_{tech} \quad (3)$$

Crop yield was based on the data collected from the harvester. Energy inputs linked with the collection of plants were not included in the calculations.

RESULTS AND DISCUSSION

Accumulated energy inputs invested in the recommended technology of hybrid rye cultivation (technology no.2: sawing seeds at 170·m^{-2}, sowing depth of 2 cm, date of sowing: 15 November, nitrogen fertilization in the spring) totalled 17.52 GJ·ha^{-1}. The application of technology no.3, in which sowing was performed deeper, i.e. at 5 cm, did not bring about any differences in the amount of energy inputs. Minimum differences in the amount of energy inputs were connected with the application of diversified amounts of seeds sown. On the objects were a reduced amount of seeds (110 germinating seeds per square metre, technology no.4) was sown, the accumulated energy inputs were smaller by 1.5%. Whereas, on the field were an increased amount of seeds (250 germinating seeds per square metre, technology no.5) was sown, the accumulated energy inputs were higher by 1.1% (table 1). Such insignificant differences resulted from the fact that the same treatments were performed on all the studied fields, and the differences in energy inputs were determined only by the energy brought in, in the form of a varied quantity of sown seeds. The lowest accumulated energy input was found on object no.1, where nitrogen fertilization in the spring was not performed. This was possible thanks to the resignation from a dose of 40 kg·ha^{-1} of nitrogen (energy brought in, in the form of materials) and not conducting the process of fertilization (energy invested in the form of aggregates and fuel). The total accumulated energy input incurred in this technology (technology no.1 – without nitrogen fertilization in the spring) amounted to 14.12 GJ·ha^{-1} and was smaller from the accumulated energy input recorded on the object where control technology was applied by 19.4 percentage points.

Comparable amounts of accumulated energy inputs were noticed by Nasalski et al. [2004a] based on long-term experiments on spring and winter barley, and by Starczewski et al. [2008] based on studies on spring rye. The average amount of energy inputs totalled 17.7 GJ·ha^{-1} in the cultivation of winter barley, 18.2 GJ·ha^{-1} in the cultivation of spring barley, and 23.9 GJ·ha^{-1} in the cultivation of spring rye. The authors pointed out that the difference was determined by the number of cultivation processes and treatments conducted.

The structure of energy inputs depended to a minimum extent on the applied technology of rye cultivation. In each of the analysed cases, the amounts of accumulated energy inputs were determined by the energy brought in, in the form of materials. This energy constituted on average 85.6%; only in technology no.1 its value amounted to 84.7%. The energy brought in, in the form of direct energy carriers (fuels) constituted 12.3%, while the energy invested in the form of aggregates totalled only 2.1% (table 1).

Table 1. The amount of accumulated energy inputs invested in the cultivation of hybrid rye in different technologies (on average, in the years 2011-2012)

Cultivation technology	Energy brought in [GJ·ha^{-1}]			Accumulated energy input [GJ·ha^{-1}]
	Materials	Aggregates	Fuel	
1	11.96	0.33	1.83	14.12
2	15.04	0.35	2.13	17.52
3	15.04	0.35	2.13	17.52
4	14.79	0.35	2.13	17.26
5	15.23	0.35	2.13	17.71

Source: own elaboration

The parameter enabling to compare the tested technologies was their energy efficiency depending on the amount of accumulated energy inputs and the energy value of crops. The energy value of crops obtained after the application of the control technology (no.2) was on average 61.8 GJ·ha^{-1} for the two-year period. The tested technologies resulted in the differentiation of the energy value of crops to an insignificant extent. The energy value of crops was higher by merely 0.8% for the combination with a reduced amount of plant seeds (technology no.4.–110 seeds·m^{-2}). When testing the technology in which excessively deep sowing was performed (technology no.3) or an increased amount of seeds was used (technology no.5), the energy value of crops higher by approximately 3.5% was observed. Reduction of the energy value of crops resulting from the absence of a dose of nitrogen fertilizer in the spring (technology no.1) totalled 5.2% (table 2).

In the studies of many authors, the energy brought in, in the form of materials, including fertilizers in particular, had the highest share in the structure of accumulated energy inputs [Jankowski, Budzyński 2003; Nasalski et al. 2004a, 2004b]. The structure of inputs was relatively varied depending on the applied technology [Kaszkowiak et al. 2011; Szwejkowska, Bielski 2012]. The energy brought in, in direct energy carriers, in the work of both the authors hereof as well as in the studies of the majority of authors, was the second most important source of energy inputs amounting to as much as 20% [Jankowski, Budzyński 2003]. In some studies, this stream of energy is treated together with the energy brought in, in the form of aggregates and may amount to as much as 26% [Nasalski et al. 2004a].

Table 2. Energy efficiency of hybrid rye cultivation (on average, in the years 2011-2012).

Cultivation technology	Yield of grain dt·ha^{-1}	Energy value of crops GJ·ha^{-1}	Accumulated energy input GJ·ha^{-1}	Energy efficiency index
1	68.6	61.8	14.12	4.38
2	72.5	65.2	17.52	3.72
3	74.9	67.4	17.52	3.84
4	73.1	65.7	17.26	3.81
5	75.1	67.6	17.71	3.81

Source: own elaboration

The energy efficiency index of the recommended technology of production (no.2) totalled 3.72. This means that we obtained 3.72 units per one unit of energy brought in. The use of a deeper sowing technique than recommended resulted in the increase of yield; hence the energy efficiency index went up and totalled 3.84. The value of the energy efficiency index recorded on the objects where reduced (technology no.4) and increased (technology no.5) amounts of seeds were used was greater than the value identified on the control object by 2.4%. The most favourable value of the energy efficiency index was observed after the application of technology no.1, i.e. without the application of a spring dose of nitrogen, and amounted to 4.38 (table 2). Achieving this value was possible by limiting energy inputs invested in nitrogen fertilization, which did not result in the expected production effect on the field after winter rape.

The energy efficiency index of production provides a relatively simple method of comparing and evaluating different technologies of plant production. The index was 2.94 in the studies over the technology of cultivating winter barley conducted by Nasalski et al. [2004a], and 2.37 in case of spring rye. By comparing the reaction of hybrid rye to the ploughing and ploughless tillage system, Piskier and Majchrzak [2013] recorded index values of about 3.14 (irrespective of the tillage system). In typical technologies of barley cultivation with the use of a dose of 90 kg·ha^{-1} of nitrogen, Nasalski et al. [2004b] achieved the energy efficiency index totalling 2.23, which increased to 2.42 after reducing the dose of nitrogen to 60 kg·ha^{-1}. The energy efficiency index values recorded in own experiments are comparable to the values recorded by other authors who performed studies on the technologies of cereal plants cultivation.

CONCLUSIONS

1. The amounts of energy inputs invested in rye production technologies are determined by the inputs brought in in the form of materials, which constitute about 85.6%.
2. On the field after winter rape, the most favourable energy efficiency index for rye cultivation was obtained in the technology, in which the spring dose of nitrogen was not used.
3. The utilised technologies of rye cultivation influenced to an insignificant extent the diversification of energy efficiency of crops. The only exception is the technology without nitrogen fertilization in the spring.

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POSSIBILITIES OF RECOVERING POST- CONSUMER WASTE WOOD FROM MUNICIPAL WASTE IN WIELKOPOLSKA

Abstract: Legal regulations, economic factors and the need to protect forests against excessive exploitation encourage the entrepreneurs who use wood to look for its alternative sources. Among them there are almost fully utilized wooden by-products and wood waste wood, which constitute one of the elements of municipal waste. In the article the sources of post-consumer waste wood have been determined. Detailed analysis embraced one of them, namely – municipal waste generated within the territory of Wielkopolska Voivodeship. Their morphological composition has been given and the share of individual fractions in the total volume of municipal waste has been pointed out. The amount of waste wood possible to recover by 2023 was determined as the sum of those fractions of municipal waste, which contain wooden elements or wood-based elements: fraction wood and fraction bulky waste. Wooden packaging has been also included.

Key words: municipal waste, sources and accessibility of post-consumer waste wood

INTRODUCTION

The ever-growing problem concerning wood deficit could be diminished through rational wood utilization including recovery of wood from waste wood. In Western European countries significant quantities of recycled wood are used as the raw material for the production of chipboards. Already in mid-nineties of the previous century about 70% of the demand for wood in that industry was satisfied with industrial waste out of which 10 % consisted of assortment of post-consumer wood. (Danecki 2007).

The richest source of post-consumer wood is large-size wood. In that fraction the share of wood and wood-based waste is estimated on average at 48,7% (between 23,0-61,7%) [den Boer, den Boer, Szpadt, Górnikowski 2008]. However due to very varied composition and form as well as the lack of adequate machinery and conditions for processing that waste (grinding, segregating, and purifying) this material is often burnt in household heating installations or is deposited directly at landfill sites (Rodzeń 1997). Where it is landfilled unchanged or compacted. Some post-consumer waste wood, yet no more than 30%, is sold solely to individual customers. Those are mainly the employees of landfill sites who use it as energy source in their household heating systems. Post-consumer waste wood is passed onto them free of charge or sold at a symbolic price [Mikołajczak E., Marciniak P. 2014]. Some improvement in that situation may be expected following the implementation of "garbage act" in force as of 1 January 2012 [Act 2011], which obliges communities to build, maintain and use its own or shared regional installations for processing of municipal waste. However, in order to facilitate the usage of post-consumer waste wood on industrial large it is necessary to work out and implement into economic practice additional mechanisms and instruments stimulating such usage [Ratajczak, Szostak, Bidzińska 2003]. Vital element of those arrangements should be balancing post-consumer waste wood contained within the municipal waste. One of the sources of that data may be a national waste management plan (Krajowy plan gospodarki odpadami - Kpgo), which has to be outlined by the minister of

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environment every four years, in accordance with the Act on waste from 27 April 2001 [Act 2001]. Plans for waste management are also passed at the level of voivodeship, incorporating all types of waste (municipal, biodegradable, packaging and hazardous), both generated locally or brought over from other voivodeship.

SOURCES OF POST-CONSUMER WASTE WOOD

Post-consumer waste wood which is the source of post-consumer wood comes from morally or physically used final products. The volume of post-consumer waste wood is the function of the usage of products currently on the market and in circulation. There are however numerous additional factors, difficult to identify, which also significantly influence both the quantity, as well as the quality of the post-consumer waste wood being generated. Among them there are: quality of the final product, conditions of its maintenance, potential forms of substituting it, current level of society prosperity, the level of social culture, current patterns of consumption and the present-day trend (Ratajczak 2008).

Practically all wooden products from which waste wood is formed, which end up at landfill sites as the element of municipal waste are mainly used at households, areas of group consumption (offices, shops, cinemas) as well as in construction and telecommunication sector.

Among final wooden products exploited by individual users there are mainly consumer goods such as furniture, elements of interior design, window and door frames, flooring, elements of small wooden architecture and ever more often wooden houses or summer huts. Some individual consumers are also the users of wooden constructions used in individual building industry. While group consumers both from the production and non-production sphere (schools, offices, banks, theatres, hospitals), just like individual consumers also use consumption goods.

One of the main criteria determining further forms of waste wood utilization is the level of its contamination, which shows its noxiousness for the environment. Depending on the quantity, type and possibilities of separation of the contaminating elements one may distinguish [Ratajczak, Szostak, Bidzińska 2003]

- Waste wood without contamination
- Waste wood with negligible amount of natural substances (such as oils, waxes)
- Waste wood with contaminants that are:
  - Easily removed (such as: metal, glass, plastic, fabrics, sand)
  - Difficult to remove
  - Impossible to remove, yet of low toxicity (such as: varnish, paint, adhesives, films, veneers, facings)
  - Impossible to remove and of high toxicity (such as: wood protecting chemicals)

SHARE OF POST-CONSUMER WASTE WOOD IN THE MUNICIPAL WASTE OF WIELKOPOLSKA VOIVODESHIP

Municipal waste in accordance with article 3 of the Act on waste [Act 2001] is the waste generated at households (excluding end-of-life vehicles) as well as waste with no hazardous contaminants, from other waste producers, which due to its character or composition is similar to waste generated by individual households. The quantity of generated waste, as well as the share of its individual fractions are closely linked to the type of the place where they were created (urban or rural area).

The quantity of municipal waste, generated in Wielkopolska voivodeship in 2010 oscillated around 1,082 mln Mg [Plan gospodarki 2012]. All citizens were included in the waste collection scheme, while in the rural areas 80% of inhabitants had access to segregation containers, which was the result of lack of full control over the contracts signed with companies collecting waste. In the recent years one may notice an increase in the significance of selective waste collection, however still municipal waste is collected mainly in mixed form. In 2008, 88% of municipal waste was

collected without prior segregation while in 2010 the figure dropped to 82%, which means that the level of recovering recyclable materials (paper, glass, plastic and metal) oscillated then around 18%.

Percentage share of various fractions in municipal waste including the division into large and small towns, as well as rural areas was presented in Figure 1, while quantitative composition of individual fractions in generated municipal waste was presented in Table 1.

Table 1. Composition and volume of individual fractions in generated municipal waste 2010.

No.	Type of waste	Volume of generated waste [Mg]			
		In large towns	In small towns	In rural areas	In total
1	Paper and paperboard	77 961	30 666	18 084	126 711
2	Glass	39 991	32 246	36 169	108 406
3	Metals	10 907	4 742	8 680	24 329
4	Plastics	61 804	35 091	37 254	134 149
5	Composite waste	10 099	12 646	14 829	37 574
6	Kitchen and garden waste	115 124	114 442	118 271	347 837
7	Remaining waste:	56 148	61 331	114 293	231 772
8	Mineral waste	12 522	9 168	22 786	44 476
9	Fraction < 10 mm	16 562	21 497	60 401	98 460
10	Textiles	9 291	12 962	7 595	29 848
11	Wood	1 212	948	2 532	4 692
12	Hazardous waste	3 232	2 213	2 893	8 338
13	Other categories	13 330	14 542	18 084	45 956
14	Bulky waste	10 503	8 220	4 702	23 425
15	Waste from green areas	21 409	16 755	9 404	47 568
Generated municipal waste			403 946	316 139	361 685
Unit ratio of generating waste* [kg/Ma]			397	354	240

* volume of waste generated annually by a statistical Pole

Source: Krajowy plan 2010

Significant share of municipal waste that is 55% of it constitutes biodegradable waste that is aerobic or anaerobic degradation of material with an active participation of microorganisms. Among them there are:

- Paper and paperboard,
- Clothing and textiles from natural materials (50% of textile fraction),
- Waste from green areas,
- Kitchen and garden waste,
- Wood

as well as composite waste and fine fraction measuring no more than 10 mm.

Part of generated mass of biodegradable waste is being used by the citizens themselves for example through composting (waste from gardening, kitchen waste), burning in stoves or feeding animals. It is estimated that even as much as 70% of all biodegradable waste in rural areas is utilized in that way and 15% of biodegradable waste in small towns, what in Wielkopolska Voivodeship means 150 000 Mg of biodegradable waste (13% of estimated mass of generated waste).

Important source of post-consumer wood is packaging waste. That is waste generated from paper and paperboard packaging, as well as glass packaging Wooden packaging comes third in the

whole group of packaging waste (Figure 2). In the total volume of packaging waste generated in 2010 (253 076,7 Mg) it constitutes 9,8% (24680,4 Mg).

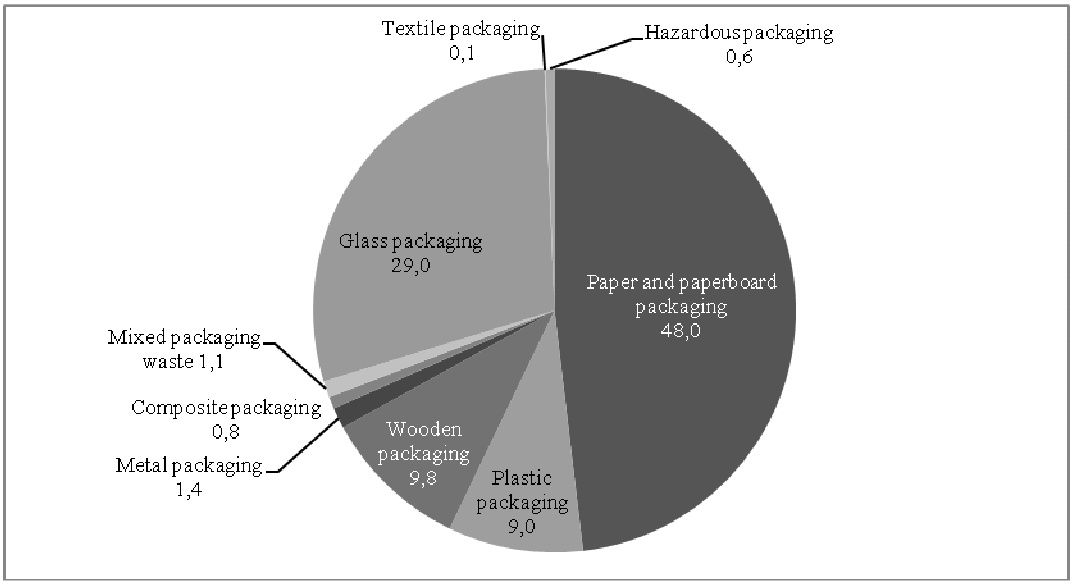

Figure 2. Share of various fractions of packaging waste in 2010 in Wielkopolska Voivodeship [%]

Source: own elaboration based on [Plan gospodarki 2012]

FORECAST OF THE VOLUME OF GENERATED MUNICIPAL WASTE AS THE POTENTIAL SOURCE OF POST-CONSUMER WOOD WASTE

Research carried out within the national waste management plan 2014[Krajowy program 2010] facilitated estimating expected increase in the unit ratio of waste generated by citizens at such a high level that despite forecast decrease in the population figure the overall volume of municipal waste generated by that population is expected to grow. Based on that forecast the authors of national waste management plan for Wielkopolska Voivoideship for the period 2012-2017 [Plan gospodarki 2012], carried out the analysis of current situation and outlined quantitative and qualitative forecast regarding waste managing in Wielkopolska Voivodeship. Its results with unit ratios of generating municipal waste including wood or wood-based materials, as well as the prognosis of this type of waste stream by 2023, in comparison with year 2010, was presented in Table 2. Based on Boer, Boer, Szpadt, Górnikowski [2008] it has been assumed that from that bulky waste one may retrieve 48,7 % of wood and wood-based materials. The prognosis suggests that in 2023, in comparison with 2010, 53,8% more wood and 26,5% more bulky waste will be collected at landfill sites. That increase will be possible as the result of implementation of detailed goals established in national waste management plan [Plan gospodarki 2012], which aim at embracing the whole population in the scheme of selective waste collection by year 2015, as well as excluding bulky waste from the main stream of municipal waste. The plan assumes that the level of selective bulky waste collection in 2013 will reach 25%, and in 2020 50%.

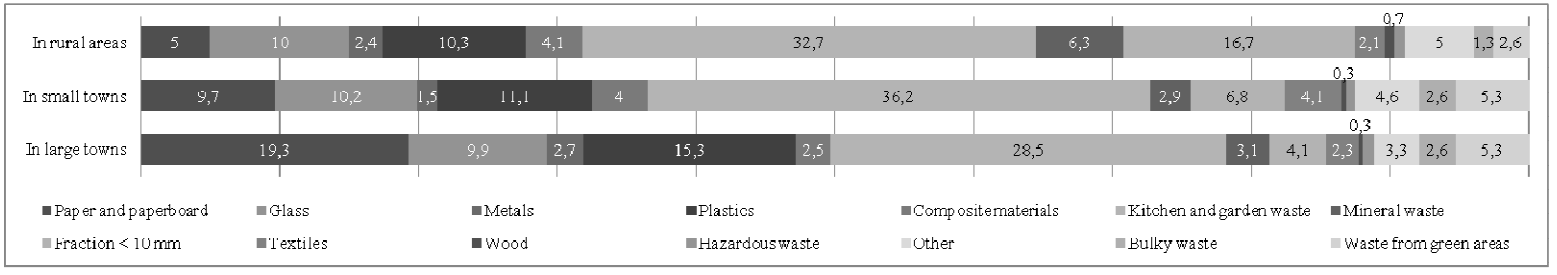

Figure 1. Morphological composition of municipal waste generated in large cities, small towns and rural areas [%]
Source: KPGP

Table 2. Forecast of municipal waste generated in Wielkopolska Voivodeship 2023

Itemization		**2010**		**2012**		**2013**		**2014**		**2017**		**2020**		**2023**	
		[Mg]	[kg/Ma]	[Mg]	[kg/Ma]	[Mg]	[kg/Ma]	[Mg]	[kg/Ma]	[Mg]	[kg/Ma]	[Mg]	[kg/Ma]	[Mg]	[kg/Ma]
Wood	in large towns	1 212	1,0	1 236	1,3	1 249	1,4	1 515	1,5	1 789	1,8	2 044	2,1	2 320	2,4
	in small towns	948	1,0	1 102	1,1	1 119	1,1	1 210	1,2	1 301	1,3	1 423	1,4	1 517	1,5
	in rural area	2 532	2,0	2 761	1,6	2 819	1,6	2 753	1,7	2 977	1,8	3 177	1,9	3 379	2,0
	in total	4 692	-	5 099	-	5 187	-	5 479	-	6 076	-	6 644	-	7 217	-
Bulky waste	duże miasta	10 503	10,0	10 711	10,6	10 828	10,7	10 734	10,7	11 299	11,4	1`1 945	12,2	12 113	12,5
	małe miasta	8 220	9,0	9 552	9,5	9 695	9,6	9 910	9,8	10 441	10,3	10 964	1`0,8	11 316	11,2
	tereny wiejskie	4 702	3,0	5 128	3,2	5 235	3,3	5 341	3,3	5 604	3,4	6 027	3,6	6 219	3,7
	łącznie	23 425	-	25 391	-	25 758	-	25 985	-	27 344	-	28 937	-	29 648	-
Wood + 48,7% of bulky waste		**16 100**	-	**17 464**	-	**17 731**	-	**18 134**	-	**19 393**	-	**20 736**	-	**21 656**	-
Sum of all fractions of municipal waste [Mg]			1 081 770		1 173 809		1 192 034		1 210 048		1 271 055		1 339 914		1 387 346
Total packaging waste including that made of wood (9,8%) [Mg]			253 077		271 000		281 000		290 000		322 000		357 000		396 000
			24 680		**26 558**		**27 538**		**28 420**		**31 556**		**34 986**		**38 808**

Source: own elaboration based on [Plan gospodarki 2012]

CONCLUSION

1. Minimum quantity of post-consumer waste wood is deposited at landfill sites. Most of that material is burnt by individual users (small towns, villages and family houses), or utilized by carpenters shop (for example joinery) – most frequently, also for heating purposes.
2. Precise determination of the share of post-consumer waste wood in municipal waste is very difficult due to the fact that it might be allocated to various groups of waste depending on statistical method: "wood", waste wood packaging, "bulky waste".
3. The richest, out of so far properly used sources of post-consumer wood is bulky waste. Unfortunately, still there is lack of adequate system of acquiring it which would allow the user unproblematic disposal of such waste and adequate strategy of its utilization at landfill sites. Therefore despite assumed increase in the volume of bulky waste, uncontrolled burning of contaminated wooden material which is not indifferent to environment, still remains the most popular form of its utilization.
4. Effective utilization of post-consumer wood requires adequate classification and segregation, which should be carried out at the site of post-consumer waste wood collection. Subsequently, recovered material, in accordance with its end-use should be sent to appropriate companies to be utilized or neutralized.

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PRICE VERSUS NON-PRICE FACTORS OF SECTOR COMPETITIVENESS: CASE STUDY OF THE ROUND WOOD MARKET IN POLAND

Abstract: Sector competitiveness does not constitute a simple sum of factors identified on different levels of economic analysis. It turns out that competitiveness is determined by both measurable and non-measurable factors. A growing influence of behavioural factors inclines to undertake aggregate research attempts of a qualitative nature. The authors of this paper have made an effort to confront the price and non-price factors of competitiveness based on a specific sector of economy, i.e. the round wood market in Poland.

Key words: wood market, round wood, sector, competitiveness, mesoeconomics.

INTRODUCTION

The factors which specify the ability of a given sector to win competitive advantage on the market are considered competitiveness determinants. Those factors, referred to as sources of competitiveness or sources of competitive advantages, are sometimes associated with competitive potential, which means a given sector's actual capabilities of acting in a competitive way.

Therefore, the value chain created by the sector depends on the mutual permeating (of relations and interactions) of competitiveness determinants and competitive potential leading to a competitive position. In that perspective, competition is a process in which competitive factors affect the shaping of the competitive potential of a given branch, and then building of a competitive position. The starting point in the search for competitiveness determinants of a given sector is identification of sources of competitiveness. Such analysis should include and examine many variables and, at the same time, the interrelations occurring between them. In research practice it is highly difficult to identify all variables. Hence, it seems purposeful to determine basic groups of factors which have an influence on an examined object or phenomenon. The scope and method of analysis should be selected with regard to its usability for effective implementation of assumptions in reference to the subject and objective of a study.

Sector competitiveness does not constitute a simple sum of factors identified on different levels of an economic analysis. It turns out that competitiveness is determined by both measurable and non-measurable factors. An increasing influence of behavioural factors on competitiveness of particular entities or sectors inclines to undertake research attempts of a qualitative nature [Wanat and Lis 2012].

OBJECTIVE

A survey of the primary wood market in Poland, i.e. the round wood market, was created for the sake of this paper. The characteristic feature of this market is that it functions at the meeting point of forestry (supply) and the wood industry (demand). A sector competitiveness study was proposed based on the identification of behavioural factors. An attempt to identify those factors as well as their impact was carried out on the basis of intentionally selected measures of competitiveness by formulating survey questions referring directly to every factor. The survey was addressed to a selected group of entities, i.e. participants of the wood industry who have an actual influence on the process of making market decisions within their organisations. The questions were worked out in such a way to include a wide range of issues and, simultaneously, made it possible to

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provide simple and clear answers. The survey was carried out on the entire territory of Poland in 2013 by referring to the rules of wood raw material sale applicable in that period. The objective of the survey was to find out the opinions whether the selected factors (15 in total) – according to the respondents – were significant (or crucial), neutral, or not significant (four levels of significance were determined). A hypothesis was made that sector competitiveness on the examined market was determined not by the price of round wood, but by other non-price factors.

METHOD

A specially compiled questionnaire was used in the survey, which included intentionally selected qualitative factors. An analysis of results was performed using the method of descriptive statistics, by applying first a correlation analysis and then the method of stepwise multiple linear regression. In the final sections, using the method of descriptive analysis, a discussion of the results was conducted and conclusions were drawn [see Kaputa 2013; Kusiak 2012].

Key to achieving the objectives of the research study was adequate selection of the respondents, including both the supply and demand side of the round wood market in Poland. In order to precisely designate the group of respondents, the method of delimitation and aggregation of subjects was used [Lis 2012]. The starting point for the method designed by Lis was the definition of an "average" recipient of round wood from the perspective of the dominating supplier, i.e. The State Forests National Forest Holding (Państwowe Gospodarstwo Leśne Lasy Państwowe), as well as the designation of average demand for round wood. An analysis of the wood sale system, which to a large extent is a regulated system, was carried out. Measurements were made to determine the level below which round wood purchase would be made only on the open market. The recipients were grouped in accordance with their demand for round wood declared during trade negotiations. Then, 30, 12, 10 and 6 consumer groups were selected, appropriately for the declared demand. Demand for wood, corresponding to potential demand, was calculated for every group. Next, mean values based on the declarations were measured in every group, alongside the number of recipients in a given group and the percentage share of the group in the population of customers. Gradual grouping was conducted on the matrix of potential recipients and verified statistically. Depending on the objective and specificity of a study, Lis proposed aggregation or disaggregation of groups of recipients according to the quantitative criterion, which describes potential demand for round wood. In the created matrix the author set the lower limit of demand for wood raw material (buying less than 300 m3) and the upper limit (buying more than 500,000 m3). Lis specified the limits as quantitative criteria corresponding to the structure of the Polish round wood market. It needs to be stressed that the problem of customer grouping based on their demand for round wood is the basis for the regulation of trade relationships in the forest and wood sector [Lis 2012, 2014].

The method worked out by Lis was adjusted to the scope and objective of the study. This corresponds to the synthetic criteria of sector competitiveness provided by Schwarzbauer and Rauch [2013]. Later, the sample size was identified and estimated using the formula proposed by Steczkowski [1995]. Moreover, the following were approved for the sake of the study: confidence level 90%, fraction size 0.5, and maximum error of estimate 10%.

Based on the analysis of the structure of the market of round wood recipients and in order to obtain greater transparency of observations, additional aggregation of the population of subjects into three groups of participants was performed in the designed study, i.e.: large (population: 421; sample: 58), medium-sized (population: 3077; sample: 66) and small (population: 4704; sample: 66). The State Forests National Forest Holding (Państwowe Gospodarstwo Leśne Lasy Państwowe, PGL LP) was identified and selected on the supply side of the round wood market. The remaining marginal market participants were omitted. Seventeen Regional Directorates of State Forests (sample: 14) and 430 forest districts (sample: 59) were singled out within PGL LP for the purposes of the study.

Then, verification was performed to determine whether the sample met the principles of minimum population. The variables were encoded. The methods of descriptive statistics were suggested for a detailed analysis. Multiple regression was applied. Stepwise multiple linear regression was chosen as a technique of model examination. The study was conducted using Statistica software in the following stages:

- delimitation and selection of variables;
- analysis of correlation;
- model building;
- model examination using the stepwise multiple linear regression method;
- regression equation formulation;
- discussion of results.

RESULTS

As a result of the theoretical analysis, the selection of variables for qualitative research was conducted [Adamowicz 2012, Lis 2012, Ratajczak 2013]. Both measurable and non-measurable variables were chosen. All the factors, regardless of their primary features, were given the character of qualitative features (see Table 1).

Table 1. Factors selected for the qualitative research

Factor symbol (F_n)	**Competitiveness factor Characteristics**
$\mathbf{F_1}$	Round wood price;
$\mathbf{F_2}$	Round wood supply (scale of offer accessibility, flexibility of wood acquisition);
$\mathbf{F_3}$	System (rules) of round wood sale;
$\mathbf{F_4}$	Market opening measure (offer for new subject, elimination of barriers to market entry);
$\mathbf{F_5}$	Power of guaranteed offer (transaction reliability factor);
$\mathbf{F_6}$	Assortment structure of round wood supply
$\mathbf{F_7}$	Currency exchange rate
$\mathbf{F_8}$	Export situation measure (round wood and wood products);
$\mathbf{F_9}$	Import offer measure (round wood);
$\mathbf{F_{10}}$	State's sectoral policy;
$\mathbf{F_{11}}$	Power of direct competition (inter-sector interactions, relationships between sector participants);
$\mathbf{F_{12}}$	Power of sector environment's impact (related and supporting sectors);
$\mathbf{F_{13}}$	Innovativeness;
$\mathbf{F_{14}}$	Power of strategy (knowledge, skills and competences application measure);
$\mathbf{F_{15}}$	Power of demand for wood (directions of wood usage, fashion for wood).

Source: own elaboration.

Assuming that the starting point was a view that price was the fundamental determinant of competitiveness on the sector market, the price of round wood was considered an endogenous variable [Strykowski 2009, Ratajczak 2013]. Verification of this view was performed in a statistical study. The authors expected confirmation or negation of the key influence of round wood price on the competitiveness of the sector market. At the same time, the impact of the non-price competitiveness factors was measured with the aim of its verification.

In the first step of the statistical analysis, the connection of variable F1 (price) with the remaining variables, which constituted predictors (endogenous variables), was evaluated. The value of the Pearson linear correlation coefficient was calculated for them. The results, separately for

every group of the examined market (population), were subject to an analysis in separate correlation sheets. It was observed that representatives of the supply side of the round wood market (State Forests) indicated the following as significant criteria of competitiveness: export circumstances with interrelated innovativeness and the impact of related and supporting sectors. Moreover, the power of demand for wood is strongly correlated with the factors pointed out. On the other hand, the buyer's market is determined by the power of guaranteed offer and the measure of market opening. Those criteria were indicated by the respondents who represented small enterprises and also underlined the importance of inventiveness. This state of affairs is affected by a defined pool of 70% of controlled offer sale available through the Forest and Wood Portal (Portal Leśno-Drzewny). Although the respondents indicated the role of price as an important factor of competitiveness, they relatively seldom referred to it as the key factor. Availability of wood raw materials (supply) is the dominating determinant. After aggregating the observations made in the study, the competitive situation of the sector is determined, according to the respondents, by market stability [see Šupín and Kaputa 2013].

In the next research step, an attempt was made to formulate the model used to prognosticate the price of round wood. A model was built, which describes the aggregate influence of the endogenous variables presented previously on the remaining variables. For those purposes, a regression analysis was applied based on the module of multiple regression. Statistica software was used for calculations. The method of stepwise linear regression was chosen. That method consists of introducing to the model (or removing from it) endogenous variables until the best fit criterion is found.

The conducted analysis showed that variables F_3, F_5, F_7, F_9, F_{10} and F_{13} need to be considered insignificant from the perspective of the designed model. Those variables were not included in the structure of the model. The following were excluded: the system of round wood sale, the power of guaranteed offer, currency exchange rate, and measure of import offer. Moreover, the factors that are difficult to measure were omitted like: innovativeness and state's sectoral policy. When analysing the value of the coefficient of determination R^2 it was noticed that the inclusion in the model of the remaining endogenous variables made it possible to explain almost 15% of the dependant variable value (price). Prognosticating the price level of wood raw material, based on the estimated model of regression, is linked with the occurrence of an average error of prognosis totalling 0.27.

The following regression model was obtained:

$$\hat{\mathbf{Y}} = 3{,}014 - 0{,}067\ F_{12} + 0{,}055\ F_{15} - 0{,}04\ F_{14} - 0{,}026\ F_8 + 0{,}022\ F_6 - 0{,}019\ F_{11}$$

Individual symbols mean:
$\hat{\mathbf{Y}}$ – prognosticating (based on the model) of the price of round wood;
F_{12} – power of sector environment's impact (related and supporting sectors);
F_{15} – power of demand for wood (directions of wood usage, fashion for wood);
F_{14} – power of strategy (knowledge, skills and competences application measure);
F_8 – export circumstances measure;
F_6 – assortment structure of the supply offer;
F_{11} – power of direct competition.

The interpretation of the model is presented in table 2. Based on the calculated partial regression coefficients, it is possible to evaluate the influence of particular endogenous variables on the model.

Table 2. The impact of parameter Fn on the value of endogenous variable $\hat{Y}$ in the regression model

Parameter F_n, R^2 (variable)	Impact of parameter F_n on the value of endogenous variable $\hat{Y}$ in the regression model
F_{12}	When F_{12} increases by one unit, the value of variable Y will decrease by 0.067 on average;
F_{15}	When F_{15} increases by one unit, the value of variable Y will increase by 0.055 on average;
F_{14}	When F_{14} increases by one unit, the value of variable Y will decrease by 0.04 on average;
F_8	When F_8 increases by one unit, the value of variable Y will decrease by 0.026 on average;
F_6	When F_6 increases by one unit, the value of variable Y will increase by 0.022 on average;
F_{11}	When F_{11} increases by one unit, the value of variable Y will decrease by 0.019 on average;
R^2	The designed model explains 15% of the variability of predictor Y (endogenous variable). Assuming only the inclusion of the impact of the variable used in the construction of the model to explain the set variable Y, the remaining 85% of Y variability is still not explained.

Source: own elaboration

No stable economic policy in the forest and wood sector, resulting in out of control collision between the intervening regulations and the market mechanisms, does not promote development of the Polish wood sector and its competitiveness level. Still, it directly affects the prices of the wood (see Figure 2), observed in Poland in the recent years [Chudobiecki et al. 2011, p.8 and Wanat, Lis et al. 2013, p.58].

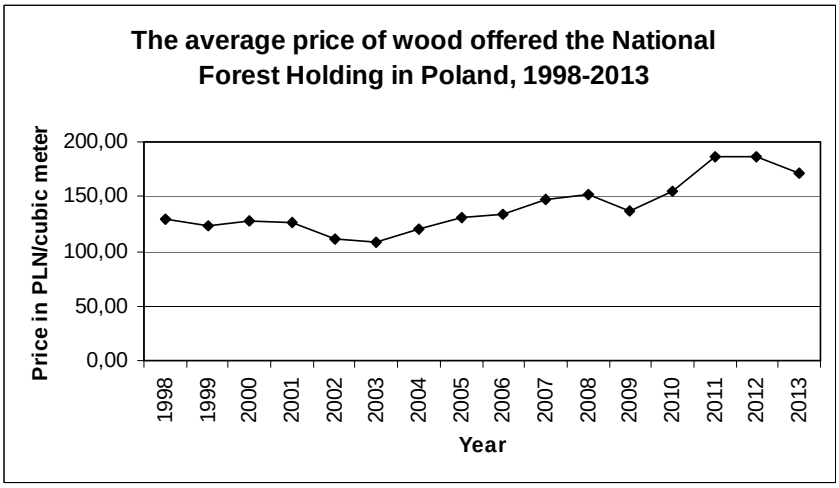

Figure 1. The average price of wood offered the National Forest Holding (PGLLP) in Poland, 1998-2013

Source: own elaboration based on data published by the Central Statistical Office in Poland, 1998-2013 [http://www.stat.gov.pl/gus/ ;access: 07 April 2014].

CONCLUSIONS

The wood market in Poland is a specific market, on which both the ownership relations as well as commercial relations are regulated to a large extent by the state's sectoral policy; therefore, results of the studies referring to the market of round wood should be interpreted in this context. It is

important to pay attention to the similarity of the identified determinants of sector competitiveness in both research stages of the statistical analysis: correlation and regression. However, one may have certain reservations as regards the designed model, which – using the selected variables – explains only 15% of the variability of the price factor considered traditionally to be the key determinant of competitiveness. Moreover, a change in wood raw material price is affected mostly by the relationships with related and supporting sectors, as well as by demand for wood. When agreeing with the opinion formulated by Ostasiewicz [2012], it is worth abandoning the traditional way of thinking in statistical analyses. Despite the apparent statistical weakness of the obtained results, the designed experiment confirms the observations made by Adamowicz [2012] and Lis [2008, 2012, 2014]. The observation that 15% of the round wood market on average is shaped by the variability of price, being a result of various market mechanisms and not institutional regulations, is in conformity with Lis' estimates. The degree of round wood market opening is on a similar level. The remaining part of the market is determined by controlled prices, and its competitiveness is affected by non-price factors to an analogous extent.

One should underline that on the Polish market of round wood, having dominating features of monopoly with elements of monopolistic competition [see Wrzosek 2002, Adamowicz 2012], the identification of non-price determinants of competitiveness becomes significant. The competitive position of the wood market ex-ante may be influenced by the assortment orientation of the wood raw material. Simultaneously, an increase in the role of related and supporting sectors, as well as clusters of cooperation and coopetition may have a significant impact on the reduction of prices of the wood raw material and the increase of competitiveness of its buyers. The dependence observed in the group of small enterprises operating in the wood industry confirms the key role of those entities in income generation by households, regardless of the market economic situation. A similar hypothesis was previously proposed by Lis [2014]. This trend, noticed thanks to the regression model, also inclines to accept group purchases of round wood (a formula already available for example on the electricity market). Working an analogous formula on the primary market of the wood raw material may influence a change of its structure leading to its greater opening and, hence, to an increase in the role of market mechanisms in wood trade.

The results of empirical studies, which identify selected aspects of sector competitiveness of the round wood market, indicate the dominating significance of its non-price factors. A statistical analysis performed on the primary wood market confirms the hypotheses formulated also by other researchers. It seems that from the perspective of sector competitiveness, the price of wood has relatively insignificant importance although it determines the efficiency of industries based on wood. Particularly in the time of market prosperity, the price of round wood becomes less significant when accompanied by wood deficit. Supply and availability of wood are decisive factors, followed by openness and a friendly structure of the market, which is created institutionally. An aggregate evaluation of the examined factors seems to confirm that stability of the wood market is the key determinant of competitiveness, which in mid-term perspective decides on either an increase or drop of the competitive position of the Polish forest and wood sector.

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SELECTED ASPECTS REGARDING THE DEVELOPMENT OF THE PLASTICS MARKET IN POLAND AS ILLUSTRATED BY THE CASE OF THE CONSTRUCTION SECTOR

Abstract: In the face of a permanent increase in the significance of plastics in construction, it is important to find an answer to a question as regards to what extent demand for plastic materials affects financial results of construction companies. In order to identify market trends, a comparative analysis was performed on the relationships between the demand for plastics in the construction industry and the financial condition of construction companies. Secondary data for the years 2007–2012, obtained from selected Polish companies listed on the Warsaw Stock Exchange, were used for the sake of the study.

Keywords: market of plastics, construction industry, stock exchange, financial analysis

INTRODUCTION

Plastics are materials which do not have their equivalents in nature. Their main component is a polymer which modifies their physical properties under the influence of chemical substances, hence leading to the formation of a new material.

Varied classifications of plastics can be found. Most often, thermoplastics and thermosetting plastics are distinguished owing to thermal properties. Thermoplastics are materials which become softer and can be shaped in higher temperature, and keep the set shape and properties after returning to initial temperature. The cycle of their softening can be repeated many times. On the other hand, thermosetting plastics are materials which – under the influence of temperature –irreversibly transform from a plastic form into a set form. It is not possible to change the status of the material by heating it up again.

From the perspective of possible applications, plastics are classified as elastomers and plastomers. Elastomers have an ability to change dimensions even under little stress, demonstrating elastic deformation already in room temperature. They are characterised by high plasticity and tendency for deformations, and are able to return to initial dimensions after stresses subside. On the other hand, plastomers undergo reversible deformations under the influence of small stress and become mechanically damaged when greater stress is used. Plastomers (thermoplastics and duroplastics) are used in the production of items of complicated shapes.

MARKET OF PLASTICS

In literature, more than 20 different assortment groups can be found on the market of plastics. The materials used most often in the economy include [Wilczyński 2000, Żukowska 2000, Piecyk 2003]:

- polyethylene (high-pressure – LDPE, linear high-pressure – LLDPE, low-pressure – HDPE),
- polypropylene (PP),
- polyvinyl chloride (PVC),
- solid polystyrene (PS) and expandable polystyrene (EPS),
- polyethylene terephthalate (PET).

The above-mentioned materials cover nearly 75% of the European demand for plastics.

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The plastics industry is created mainly by manufacturers (entities producing components that are subject to further processing) and processing entities (manufacturing finished products ready for sale). Intermediate and supporting sectors also include entities that serve as intermediaries in the sale of plastics, and companies specialising in recycling. The aforementioned entities are participants of the sectoral market of plastics and form its supply side. Meanwhile, the main sectors participating in the demand side of the plastics market include [1]:

- construction industry (e.g. insulation materials, pipes, window frames) where the usability of plastics is determined by: durability and resistance to the action of weather factors, insulation properties, profitability of use, low costs of maintenance, hygiene and frequency of use, and environmental friendliness;
- automotive industry (manufacturing of vehicles and their parts) where plastics determine energy efficiency (reduction of fuel consumption) as well as lead to comfort improvement and safety increase;
- production of packaging (e.g. plastic bags, plastic containers) where preserving properties (e.g. storing foodstuffs), hygiene, safety of use and environmental friendliness are highly appreciated;
- electrical and electronic industry (e.g. components of computers, television sets, telephones, etc.) where the ease of forming, mass limitation, miniaturisation and quality of electrical and thermal insulation of devices play a significant role;
- other sectors, including medicine and healthcare (e.g. medical instruments, packaging), sport and recreation (e.g. sports clothing, toys), agriculture (e.g. plastic tunnels, farming tools), etc.

The dynamism of changes in the demand for plastics in the Polish economy in the period 2007–2012, as compared to average values for the European Union [see 10,11], is presented in table 1.

Table 1. The dynamism of changes in the demand for plastics in the Polish economy in the period 2007–2012, as compared to average values for the European Union [%].

Years	Construction industry		Automotive industry		Packaging		E&E*		Other	
	EU-27	PL	EU-27	PL	EU-27	PL	EU-27	PL	EU-27	PL
2007	21.00%	30.00%	8.00%	7.00%	37.00%	29.00%	6.00%	5.00%	28.00%	29.00%
2008	21.00%	29.00%	7.00%	6.00%	38.00%	33.00%	6.00%	5.00%	28.00%	28.00%
2009	20.40%	27.00%	7.00%	5.00%	40.10%	35.00%	5.60%	5.00%	26.90%	28.00%
2010	20.60%	28.50%	7.50%	5.70%	39.00%	31.50%	5.60%	5.50%	27.30%	28.80%
2011	20.50%	28.30%	8.30%	8.20%	39.40%	31.60%	5.40%	5.70%	26.40%	26.10%
2012	20.30%	32.00%	8.20%	6.00%	39.40%	32.00%	5.50%	6.00%	22.40%	24.00%

Source: Own elaboration based on: Eurostat, PlasticsEurope Market Research Group (PEMRG), www.plastisceurope.pl [access: 20/09/2013]

**E&E - Electrical and Electronic Equipment.*

The structure of demand for plastics in Poland differs from the European Union as identified in the analysed period. Most importantly, the differences concern the construction industry and the packaging market. In the analysed period, the demand for plastics of the Polish construction industry was higher than average demand in the EU member states by nearly 7.7%. Moreover, considering the financial crisis, the upward trend of plastics usage in the construction sector in Poland may be considered a permanent tendency. In case of the packaging sector, the demand for plastics in Poland was smaller than average demand in EU by 6.6%. The Polish market of packaging made from plastics is still open and has a certain growth potential. Relatively low

demand for plastics was also recorded on the automotive industry and in the electrical and electronic sector, with a permanent tendency for both Poland and EU-27 maintained. Moreover, this area is undeveloped, which should encourage new investments in these sectors of the economy. Meanwhile, in the remaining sectors, including medicine, sport and recreation, the demand for plastics is equal to the total values recorded by the construction industry. Similar values were noticed for Poland and EU-27 on average, with a relatively constant value of demand in the entire period analysed.

SHARE OF THE CONSTRUCTION INDUSTRY IN THE MARKET OF PLASTICS

The significance of plastics in the construction industry is constantly increasing. The plastics offered by the market are durable and do not corrode. They efficiently protect against cold, heat or even noise. Their maintenance is comfortable and they can be cleaned easily. Moreover, they are relatively light, recyclable and ensure energy recovery. Plastics are applied in object constructions both outside and inside buildings. They are used successfully to insulate building façades, manufacture wood joinery (doors, windows), in elements of ventilation installations and systems of heat energy recovery, energy-saving lighting systems, protection of telecommunication engineering wires and cables, as well as in supplying drinking water and collecting waste, etc.

The dynamism of changes in the construction industry's demand for plastics in Poland in the years 2006–2012 is presented in figure 1 [see 2,3,4 and 7,8,9].

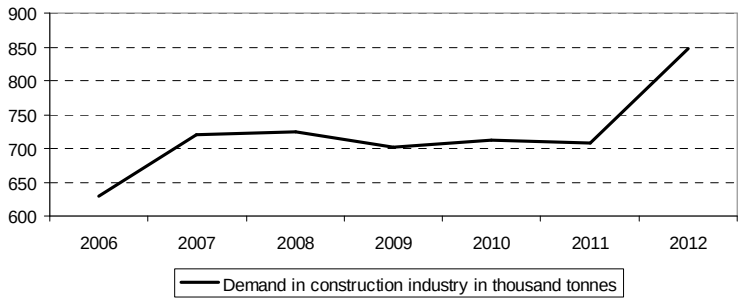

Figure 1. The dynamism of changes in the construction industry's demand for plastics in Poland in the years 2006–2012

Source: Own elaboration based on Eurostat, PlasticsEurope Market Research Group (PEMRG), www.plastisceurope.pl [access: 20.03.2014]

Based on the analysis conducted the greatest increase in demand for plastics was observed in 2006–2007 and 2011–2012. The upward trend in the construction sector was possible mainly owing to the dynamism of new investments linked, among others, with the organisation in Poland of the Euro 2012 European Football Championships. The period of stagnation was affected by the negative influence of the effects of the global financial crisis, which however did not determine the main trend [see 15,16,17]. It seems that in subsequent years the upward tendency will be still observed.

PURPOSE AND METHODOLOGY OF RESEARCH

In order to verify trends identified on the market of plastics in Poland a comparative analysis of the relationships between the demand for plastics in the construction industry and the financial condition of companies operating in the construction sector was performed. Data recorded by companies listed on the Warsaw Stock Exchange were used in the survey, in the researched period

2007–2012. Twelve largest companies from the WIG-Construction subindex were selected, and the share of each company in the WIG index totalled at least 2%.

SELECTED FINANCIAL RATIOS OF CONSTRUCTION COMPANIES, PARTICIPANTS OF THE MARKET OF PLASTICS

In the researched period (2007–2012), the chosen companies formed capital groups operating in different sectors of the construction industry (buildings, roads, building structures, etc.). During the study a simplification was made that the examined companies resembled aggregate market demand for plastics. The earnings before interest and taxes (EBIT, operating profit) ratio was used in the comparative analysis. This ratio indicates the amount of profit generated by companies. Values of extraordinary flows (e.g. one-off sale of shares in a subsidiary or real estate), which may cause distortion of the actual value of EBIT, were omitted. Moreover, taking into account the financial problems of the two leading companies from the construction industry, i.e. PXM and PBG, in the years 2010–2011, their operating profits (EBIT) were not included in the analysis [Sarniak 2014]. That situation was caused by wrong investment decisions (e.g. in the scope of using derivatives after the indicated period), as well as by institutional factors resulting from the state's sectoral policy [Wanat, Kielar 2009]. In case of those companies, the losses suffered in connection with the necessity to sell fixed and current assets significantly reduced the financial situation of the entire sector.

The analysis of relationships between the demand for plastics in the construction industry and the amount of operating profit (EBIT) is presented in figure 2. Additionally, the figure also shows changes of the WIG20 index and the WIG-Construction subindex of the Warsaw Stock Exchange. It was assumed that the trend may be used to evaluate the moods of market participants in relation to both the construction industry and – indirectly – the entire economy.

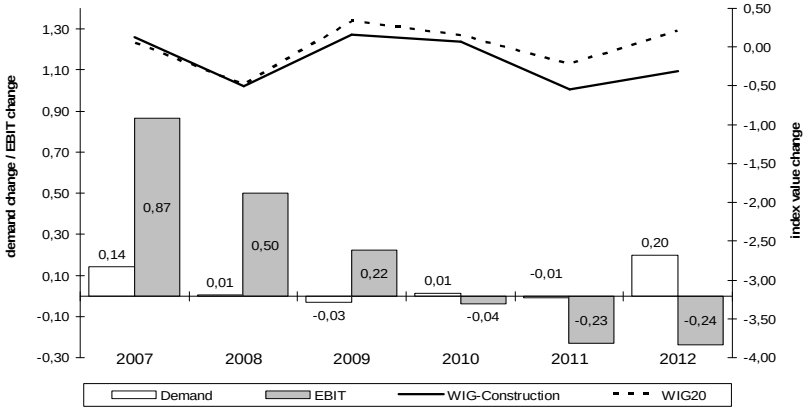

Figure 2. Annual percentage change of demand for plastics in relation to EBIT value of construction companies as compared to the WIG-Construction subindex and the WIG20 index in the years 2007–2012.

Source: Own elaboration based on Eurostat, PlasticsEurope Market Research Group (PEMRG), www.plastisceurope.pl [access: 20.03.2014]

The comparative analysis [Sarniak 2014] showed a significant drop in demand for plastics in the construction industry in 2007, stagnation from 2008 to 2011, and substantial growth in 2012. Against this background a constant drop of the operating profit ratio (EBIT) in the years 2007–2010 was observed, consequently leading to a loss whose relative stability was obtained at the end of the

researched period. It was noticed that changes in demand for plastics in the construction industry were characterised by a tendency similar to changes of the operating profit ratio (EBIT) of construction companies; however, EBIT changes occurred with a delay of two years. One may assume that the observed increase in demand for plastics in the construction industry should in the nearest future improve the financial situation of companies (increase of EBIT). It is also probable that in case of reduced demand for plastics in the construction sector, the loss of companies included in EBIT will be even greater.

Additionally, the analysis proved that the ratios of demand for plastics were characterised by relatively insignificant variability (7.55%). In case of the operating profit ratio (EBIT) for construction companies, the observed variability of the ratio was more than three times greater (24.7%). Every change on the market of demand for plastics may, therefore, affect the financial condition of the construction sector with thrice the force if the results of analysis are considered a leading trend. Thereby, those changes may determine the market of supply in the construction industry.

It was observed that the direction of changes of the WIG-Construction subindex is similar to the direction of changes of WIG20 (the index of the biggest companies on the Warsaw Stock Exchange). This serves as confirmation of the thesis presented in literature, which indicates the construction industry as a determinant of the economic situation. On the other hand, a drop of the operating profit ratio (EBIT), particularly if it is a permanent tendency, is illustrated by a gap between the WIG20 index and the WIG-Construction subindex. It needs to be emphasised that a change of stock exchange indexes is affected also by the behaviour of investors. In the analysed case, this was confirmed by the changeability of the WIG-Construction subindex (53.8%), which was six times higher than the ratio of change in demand for plastics, as well as two times higher than the ratio of change in operating profit (EBIT).

CONCLUSIONS

Based on the comparative analysis performed [Sarniak 2014], dependence between demand for plastics and the financial result of construction companies was noticed. On the basis of the EBIT ratio it seems probable that an increase in demand for plastics causes a simultaneous rise of operating profit among participants of the construction market. At the same time, this dependence serves as confirmation that a potential drop in demand for plastics in the construction industry will make the loss suffered by companies and indicated in EBIT even greater. Those regularities do not rule out variability of EBIT and demonstrate a delay of two years in relation to the ratio of demand for plastics. A period of stagnation as well as the influence of several elements of the financial crisis was observed in the researched period, which explains the delay.

It is worth noticing that the situation on the construction market, which is dependent on demand for plastics, is also determined by changes of the gap between the values of the WIG-Construction subindex and the WIG20 index. Observing the index gap may be an important tool in making investment decisions. Because the tendencies of change of both the indexes are similar, it is possible to claim that – irrespective of the stock exchange situation – the information obtained from an analysis of the index gap using derivatives may be a source of proper and adequate stock exchange decisions [8]. For example, when observing an increase in demand for plastics, it is recommended to assume the so-called "short position" for WIG20 contracts, and the same "long position" for WIG-Construction contracts. Meanwhile, a drop in demand for plastics should incline investors to implement the opposite strategy. Obviously, every investment strategy model should include a potential influence of behavioural factors, which are often hard to quantify.

The conducted studies confirm the growing influence of the market of plastics on the development and results of the Polish construction sector. According to observations, changes on the market of demand for plastics may shape the financial situation of the entire construction

industry with a proportionately greater force. Therefore it seems that an increase of the share of plastics in the offer of materials for the construction industry may in the future determine the market of supply and shape sector competitiveness. Examining the market of plastics may turn out to be an important source of information for working out strategies and taking investment decisions on the capital market.

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Juraj Šebo[20]

ECONOMIC ASSESSMENT OF THE POSSIBILITIES OF USING BREWERS' GRAINS FROM THE PRODUCER VIEW

Abstract: The issue of investment decision making has been described extensively in the literature. The article uses classical evaluation methods to assess two investment options for the treatment of brewers' grains as waste (resp. byproducts). As indicated by the results of the analysis, the considered production of brewers' grains for energy is more economically preferable than selling it.

Key words: investment, net present value, agricultural biomass, cogeneration unit

INTRODUCTION

The issue of using renewable energy sources such as agricultural biomass, to which brewers' grains belong, has been a highly discussed topic. The positive effect of self-sufficient regions, as well as businesses or households, has often been highlighted in relation to the use of renewable energy sources. In addition, for companies in particular, renewable energy could mean an advantage over the competition and also in preventing a company crisis in the event of rising energy prices. Moreover, in EU countries, there are possibilities for financial support when using this type of power. There are a number of known benefits in using energy from biomass products. These are renewability, neutrality in terms of greenhouse gases, an almost negligible sulfur content, the using up of biomass waste and an increasing independence away from imported energy sources. However, there are also certain problems in using biomass energy which must be acknowledged. Biomass energy, in comparison with fossil fuels has a higher price, a less reliable supply, seasonality and the need for storage. There are also unknown risks such as the market price a few years ahead, the fact it is a new and untested technology and the impact of the economy of transport. [Šoltés, 2005]In order to choose the most advantageous technology for the energy use of biomass, investors assess several investment alternatives in the context of the input parameters of the specific conditions. In economic theory, the notion of investment means "capital assets consisting of goods, that are not intended for immediate consumption (capital goods or production goods), but are intended for use in the production of consumer goods and other capital goods" [Synek, 2010].

For assessing investment (resp. investment option) the following criteria can be found in the literature:

- profitability,
- and riskiness.

The return on investment options express the financial benefits, which are promised by the implementation of the project. This return can be classified in different ways. The probability of failure of an investment project is characterized by its risk profile. It is also the probability of not reaching its expected return. These two decision criteria are closely linked. Generally, this means that the higher the rate of return which is promised by a project, the riskier it is. In turn, this also means that the higher riskiness of a project must be balanced by higher returns. [Vlachynský, 1996]

Typically, investment evaluation methods are divided into two groups [Synek, 1996]:

- dynamic methods - the methods which account for the factor of time. This means that they are based on updating (discounting) all input data entering the calculation,
- static methods - disregarding the effect of the factor of time.

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The main difference between these methods is that the static methods are used for minor projects. By this, projects with a short-term life and in cases where the discount factor is low. In other cases, dynamic methods are used [Synek, 1996].

For the evaluation of the investment, the following methods are used [Synek, 1996]:

1. Return on Investment – ROI,
2. Payback Method,
3. Net Present Value of Investment – NPV,
4. Internal Rate of Return – IRR,
5. Cost method

The formulas used for comparison of investment options [modified according to Synek, 1996 and INKAPO, 2014]:

- Simple payback method(T_s)

$$\sum_{t=1}^{T_{sd}} CF_t(1+r)^{-t} - IN_1 = 0$$

- Real payback method (T_{sd}) counted from condition

- Net present value (NPV) $\mathbf{NPV} = \sum_{t=1}^{T_z} CF_t(1+r)^{-t} - IN_1$

- Internal Rate of Return (IRR) counted from condition

$$\sum_{t=1}^{T_z} CF_t(1+IRR)^{-t} - IN_i = 0$$

- Index of Net Value (INV) $\mathbf{INV} = \frac{\sum_{t=1}^{Tz} CF_t x(1+r)^{-t}}{IN}$

COMPARISON OF TWO OPTIONS OF ECONOMIC USE OF BREWERS' GRAINS

In this section, the economic possibilities of using brewers' grains (waste in beer production) have been compared. In the zero option, it can be assumed that the whole volume of brewers' grains is sold to external customers at the market price. In the first option, investment in a biogas plant with a cogeneration unit has been considered. Biogas obtained from the brewers' grains is burned in a cogeneration unit. The result is the production of electricity and heat. In the cogeneration unit, an internal combustion engine with an electric generator is adapted for the combustion of biogas. The heat generated from the combustion of biogas could be used for heating residential and industrial buildings, greenhouses or for drying agricultural products, wood and so on.

Input parameters and conditions

In terms of a brewery, the annual production of brewers' grains is 15,550 tons. This evaluation looks at the alternatives over a time frame of 20 years. The basic interest rate, EURIBOR + 4.5%,(it means 5%) has been chosen. The prices of brewers' grain, electricity and heat have been based on the current market conditions in the Slovak Republic.

Investment option 0: Sale of brewer's grains at market prices

The sale of brewers' grains at the production level of 15,550 tons per year and at an estimated price of €5 per ton (excluding VAT) a company can get € 77,750 a year.

Table 1. Production of electricity and heat from biogas with Jenbacher cogeneration unit

Production of electricity and heat	**Value**	**Unit**
Input material (brewers' grains)	15550	$T.year^{-1}$
Biogas yield [1]	130	$M^3.t^{-1}$
Biogas production	2021500	$M^3.year^{-1}$
Calorific value of biogas[2]	22	$Mj.(nm^3)^{-1}$
Energy in the fuel	44473	$Gj.year^{-1}$
	12353	$Mwh.year^{-1}$
Production electricity and heat in engine efficiency jenbacher[3] (η = 86,4 %)	38425	$Gj.year^{-1}$
	10673	$Mwh.year^{-1}$
E_v (total production of electricity)	18145	$Gj.year^{-1}$
	5040	$Mwh.year^{-1}$
Q_v (total production of heat)	20280	$Gj.year^{-1}$
	5633	$Mwh.year^{-1}$
Reduce of production of electricity and heat due to other effects (10%) [4]		
$E_{v'}$ (total production of electricity)	16331	$Gj.year^{-1}$
	4536	$Mwh.year^{-1}$
$Q_{v'}$ (total production of heat)	18252	$Gj.year^{-1}$
	5070	$Mwh.year^{-1}$
Reduction of production electricity and heat due own consumption (electricity - 600 $mwh.year^{-1}$, heat - 40%) [5]		
E_d (electricity on sales)	14170	$Gj.year^{-1}$
	3936	$Mwh.year^{-1}$
Q_d (heat on sales)	10951	$Gj.year^{-1}$
	3042	$Mwh.year^{-1}$

Source: own calculation

remarks regarding table 1: [1] biogas yield is around 130 $m^3.t^{-1}$ [horbaj, 2007, kušnír, 2010]

[2] calorific value of biogas is around 22 $mj.m^{-3}$ [kušnír, 2010]

[3] Biogas engine JENBACHER AG (NOx < 500 mg.m-3) type J320 (Electric power (kW) 1064, Thermal power (kW) 1238, Electrical efficiency (%) 40.8 Thermal efficiency (%) 45.6 Total efficiency (%) 86.4) [EMES, 2014].

[4] Professional estimates of 10 % reduction in use of fixed time fund of the cogeneration unit, because of the occurrence of operational anomalies and various other influences.

[5] Result of technological solutions is that there is a need to reduce the total produced electricity and heat by their own electricity consumption of 600 MWh.year-1 and heat consumption of 40 %. To determine the volume of electricity and heat for sales to external customers these simple formulas were used: Ed = EV - EVS where Ed - electricity to the electricity distributor (MWh), EV - electricity output from cogeneration unit (MWh), EVS - own electricity consumption (MWh) and Qd = QV - QVS where Qd - heat on sales (GJ), QV - heat output of the cogeneration unit (GJ), QVS - own consumption of heat in the process of fermentation (GJ).

In order to compare the investment options, the Net Present Value of the stream of cash flow from the sale of the brewers' grains over 20 years was calculated. For investment option 0, the Net Present Value of the expected stream of cash flow at an interest rate of 5% is equal to € 1,017,382.

Investment Option 1: Biogas plant with cogeneration unit

The first step in the evaluation of investment option 1 is the calculation of electricity and heat for external customers (Table 1)

The second step is the determination and calculation of revenues and costs.

Investment costs are estimated at € 3.6 million and annual operating costs are calculated to be € 398,700 (Table 2).

Table 2. Operating costs of biogas plant with cogeneration unit

Operating costs (€)	
Personnel costs	70 000
Insurance costs	14 400
Repair and maintenance	122 500
Energy[1]	0
Depreciation	180 000
Other expenses	11 800
Total	398 700

Source: adapted from [Molčan, 2014]

[1] Energy costs are covered by their own production of electricity and heat and the consumption of water is abstracted. Cost of raw materials (brewers' grains) is considered to be zero.

Table 3. Cash Flow calculations

Year	**0**	1	…	11	…	20
Revenues (€)						
Sale of electricity [1]		585 362		585 362		585 362
Sale of heat [2]		197 118		273 775		273 775
Total		782 480		859 137		859 137
Costs (€)						
Investment costs	3 600 000					
Operating costs		398 700		398 700		398 700
Total		398 700		398 700		398 700
Profit before tax		383 780		460 437		460 437
Tax		88 269		105 901		105 901
Profit after tax		295 511		354 536		354 536
Depreciation		180 000		180 000		180 000
Cash flow (€)						
Net cf		475 511		534 536		534 536
Discounted cf (interest rate = 5% 3)		475 511		328 159		211 534
Discounted cf (interest rate = 6% 4)		475 511		298 482		176 671

Source: own calculation

[1] Set price for the electricity supplied to network 148,72 €.MWh^{-1} [URSO, 2009].

[2] Estimated price for heat supplied to external customers in the years 1-10 18 €.GJ^{-1}and in the years 11-20 25 €.GJ^{-1} (estimation based on current market conditions).

[3] Interest rate determined on the basis of EURIBOR + 4,5 %.

[4] Interest rate set higher than the 5% required for calculation of the internal rate of return.

In the last step the Cash Flow (Table 3) was calculated and consequently the indicators for the assessment of the investment are shown (Table 4).

Table 4. Assessment of the investment

Indicator	Value	unit
Simple payback method(ts)	7,13	Year
Real payback method (tsd) [1]	9,17	Year
Net present value (npv)	2 916 012	€
Internal rate of return (irr)	1,81	
Index of net value (inv)	11,11	%

Source: own calculation

[1] calculated by iterative steps

CONCLUSIONS

As indicated by the analysis, for a brewery with an estimated production of 15,550 tons of grains per year, it is preferable to utilize these grains with technology using a biogas plant with cogeneration unit rather than to sell them to external customers. The advantage of investing in energy use is also the increase in brewery energy independence as well as mitigating the impact of increasing energy prices in the company. In terms of the risk connected with the investment options, the limited opportunities to sell generated heat to external customers and also the unpredictable energy prices have been considered. A similar risk is also connected with the zero option and is related to the development of a brewery's grain prices in the market.

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THE RESULTS OF A STUDY OF HEAT RECOVERY AND CONVERSION FROM COWSHED VENTILATION AIR

Abstract: The heat obtained and converted from cowshed ventilation air was studied using an installation for heat recovery composed of a 3 kW fan coil unit with an output of 100 $m^3 \cdot h^{-1}$ and heat pumps with a capacity of 8 kW. The heat amounting to 0.346 GJ · day^{-1} was used to heat water in a 200dm^3 buffer tank. Energy inputs averaged 47.34 kWh per day, and the efficiency index during the period was COP = 2.005. Measurements were performed from August to October and data from the heat meter and the thermometer were read at the same time every day. To increase the installation's efficiency (COP), it is necessary to increase the removal of heat. This is possible by means of additional heaters or a boiler for hot water, and by reducing the performance of the fan coil's circulation pump and decreasing the fluid flow rate to 0.3 $m^3 \cdot h^{-1}$.

Key words: energy, barn, welfare, heat, heat pump, heat exchange

INTRODUCTION

Ensuring adequate welfare in farm animals is associated with significant energy inputs. The use of renewable energy in agriculture is an opportunity to reduce the costs of livestock production. In large-scale production, solutions based on a heat pump using renewable energy sources, as reported Nawrocki [2003], is justified. Livestock buildings for cattle produced a significant amount of heat , especially in the summer, which before deleting can be recovered. For this purpose an intermediate medium device is used, which includes a heat pump [Adamski 2011]. Air from the cowshed is a heat source for heat pump. Heat obtained can be used on the farm. This systems lowers the temperature in a building, improving the microclimate in the cowshed, and is also a renewable source of heat for the farm.

Ensuring a suitable microclimate in a livestock building is of great importance and has in impact on productivity. Reducing welfare conditions in the production environment has a direct effect on the condition and resistance of animals, which in effect minimizes the effects of production [Mroczkowski 2006]. The most important microclimate factors in cowshed include: temperature and humidity, air velocity, dust and hazardous gases, light and noise. According to the Council Directive 98/58/EEC, these elements of the microclimate should be maintained at a level not harmful to animals. Microclimatic requirements for livestock buildings take the needs of animals into consideration. In addition, different requirements for temperature and humidity apply in winter, while in summer they concern mainly ventilation [Romaniuk, Overby 2005].

Temperature constitutes one of the most important factors influencing the microclimate in livestock building, although it is not particularly important for dairy cattle as pigs. The optimum temperature for dairy cows are respectively 6-16 °C in the cowshed and 16-20 °C in the delivery [Rozporządzenie… 2003; Solan, Jozwik 2009]. At temperatures above 25 °C cows, eat less, decreasing weight gain and milk production [Romaniuk, Overby 2005]. The optimal value of the relative humidity in the cowshed is 60-80%. Efficient ventilation is of importance in ensuring proper conditions in the livestock buildings [Solan, Jozwik 2009]. Manure, especially when the animals are kept on deep litter, emits significant amounts of water vapor and carbon dioxide [Romaniuk, Overby 2005]. Ventilation should remove excess water vapor and gases from the air and bring fresh air into the building. The correct replacement air for dairy cows is at a level of 90

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m^3/animal/h during the winter and summer 350-400 m^3/animal/h [Rozporządzenie… 2003; Solan, Jozwik 2009]. As inadequate conditions in livestock buildings may cause stress in cattle and impair their general health, a high air exchange and maintaining the lowest temperature during hot weather are therefore recommended [Romaniuk, Overby 2005].

In agricultural production and food processing there are considerable and amounts of varied unconventional energy resources [Cleat 2007]. One such source is heat accumulated in livestock buildings. Domagalski et al. [2010] and Domagalski et al. [2011] present studies carried out on installations for recovering heat from deep litter. Conducted in farm conditions, the research findings show that the heat obtained can be used to heat in houses and provide hot water. Nawrocki and Myczko [1998] conducted research on heat recovery from pig farms, with heat exchangers located in the floor and connected to a heat pump. Myczko, Karłowski, Aarnink [2006] carried out a study on heat production from a deep litter piggery, where the heat was recovered and accumulated in the geothermal wells and was used in the winter to heat the rest and refreshment rooms. Recovering heat from deep litter reduces the temperature of the litter, as well as odors and emissions of harmful substances from the surface, thereby improving the microclimate in the building. In addition, litter constituted a renewable heat source for the pump.

The heat accumulated in livestock building air is an efficient heat source. The excess heat removed by ventilation is not used, especially in summer. The simultaneous use of heat recovery systems and ventilation equipment enables the user to have an impact on the microclimate prevailing in the barn and also to provide heat that can be used on-farm.

Heat recovery from cowshed ventilation air during the summer, using a fan coil unit with a heat exchanger and heat pump, is also an unconventional heat source. There is a lack of information in the literature about this way of using renewable heat, even despite the fact that on a farm it can provide an inexhaustible source of heat and have a positive impact on the profitability of production.

RESEARCH PROBLEM

Based on an analysis of the literature, the following research problems were formulated:

1) How much heat can be obtained from ventilated air in cowsheds and to what degree can this be used to to power the heating system?

2) Does the use of a fan coil unit in the cowshed improve the microclimate?

THE AIM AND SUBJECT OF STUDIES

The main aim of the study was to determine the exploitation and energy-production aspects of the installation for heat recovery from cowshed ventilation air at the Department of Experimental Institute of Technology and Life Sciences – Poznań Branch.

The studies were conducted in the "Ecobuilding" renewable energy laboratory , used to obtain heat from a variety of unconventional energy sources, such as vertical ground heat exchangers, liquid solar panels and fan coil units. It is equipped with a heat pump and the necessary test equipment (fig.1.). The main subject of the study is the system for recovering and converting heat from cowshed ventilation air and using it to power a heating system.

METHODOLOGY OF STUDIES

The studies were conducted from August to October 2012 at the Department of Experimental Institute of Technology and Science (Poznań Branch). The subject of the study was a cowshed with a capacity of 4107m^3 for dairy cattle (about 69 animals), which was equipped with a fan coil unit working as part of a system with a heat pump. The fan coil unit has a liquid/air heat exchanger and a fan with a power of 3kW and an efficiency of 100m^3/ h. The system also has a 8kW heat pump and a buffer tank with a capacity of 200 dm^3. The installation is filled with 15 dm^3 of the technical glycol "ECO" .

The study was conducted on the basis of the methodology set out by the Łaska, Szulc, Karwacka [2012]. Measurements were taken every day at a fixed time. The temperature inside the cowshed at four selected locations (at a height of about 1.5 m from the ground) was noted and readings from heat meters situated on installation consisting of fan coil unit and heat pump in the "Ecobuilding" were verified. The measurements allowed to following to be determined: the air temperature in the cowshed, the amount of heat gained from cowshed ventilation air and transferred to the heated building, the flow through the installation, the temperature of the heating medium leading to the heated buildings and to the heat pump, the momentary power of the system and the amount of energy acquired.

The energy consumption of installations for heat recovery are set based on the consumption of electricity (kWh) by the heat pump and circulating pump at a certain time.

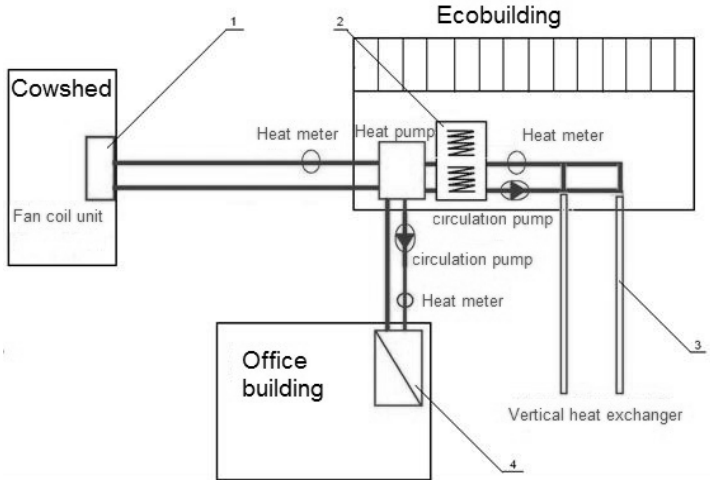

Figure 1. Scheme of the system for acquisition and use of renewable energy.

1 - fan coil unit; 2 - buffer tank; 3 – boreholes; 4 – heated building; Source: own study.

Figure 2. Part of the renewable energy laboratory and cowshed with the fan coil unit.

Source: own study.

RESULTS

Table 1 shows details results of the measurements of the heat obtained from the cowshed ventilation air. The most important data was the amount of heat recovered by the fan coil unit per day. during the two months of the research, the highest value noted was 0.275 GJ·day^{-1}, while the average value amounted to 0.172 GJ·day^{-1}. Cowshed ventilation air heated the installation fluid to an average of 12.5 ° C, and was returned through the heat pump to the fan coil unit at a temperature of 7.2 ° C, thus giving ΔT= 5.6 K, which is a satisfactory value.

The heat pump converted heat and raised its energy level by about 19%, the average value was 0.346 GJ·day^{-1}, of which 0.256 GJ·day^{-1} was directed to heat an office building and 0.09 GJ·day^{-1} heated the "Ecobuilding".

The average flow rate of fluid in the fan coil unit was 0.583 m^3· h^{-1}, which seems to be too high a speed in terms of the heat exchanger's efficiency in transferring heat, compared with the circulation between the storage tank and radiator of - 0.368 m^3· h^{-1}. A previous study [Szulc, Łaska 2012] noticed that a reduction of the heating fluid flow rate improved heat dissipation in the liquid-air system, and the intention is therefore to reduce the technical performance of the circulation pump's fan coil system to approximately 0.3 m^3 ·h^{-1}. This will result in greater efficiency of heat transfer from the cowshed ventilation air to the fluid in the heat exchanger, as the reduced power of the heat pump will lead to its energy consumption also being reduced.

While the fan coil unit in the cowshed was in use, a decrease in the temperature inside the livestock building by about 2 ° C was noticed. This is very important for maintaining the welfare of dairy cattle, especially in the case of high-performance dairy cows which are sensitive to high temperatures in the cowshed. This can often lead to heat stress and further consequences for the health of the cattle.

The amount of heat obtained from cowshed ventilation air was moderately correlated with the air temperature inside the livestock building. This correlation was r = 0.535.

The study showed that the heat pump coefficient of performance was an average COP = 2.008, which is in fact a low value. The reason for this state of affairs is most likely to have been the current lack of additional heating units besides the existing radiators,the late-summer/ early autumn season, and the resulting low heat consumption. This is confirmed by the low temperature difference between T_1 and T_2 of the heating medium (Table 1, column "heat meter reservoir") Δ T = 7.67K, which means that hot water returning from buildings had an average temperature of 39.17 °C. This value acts as a signal to the heat pump that the supply of heat is lower. A far more beneficial situation, in which the efficiency of the heat pump system would be higher, would arise when heat consumption increased and temperature T_2 was lowered to 20-25°C. This can be achieved by installing additional radiators or a hot water tank.

The air temperature of heated buildings was on average 26.9 °C in the "Ecobuilding" and 22.3 ° C in the office building. At the same time, the average outdoor temperature was 17.8 °C.

Table 1. Fragment of findings for an installation for recovering heat from cowshed ventilation air. *[Source: own study].*

		Heat meter in cowshed								Buffer tank								Basement		Heat pump								
Date	Air temp. (°C)	Air temp.in cowshed (°C)	Heat meter (GJ)	Daily heat gain (GJ)	T1 (°C)	T2 (°C)	Δ T (K)	Fliud flow (m³/h)	Moment. power (kW)	Air temp. in Ecobuilding (°C)	Heat meter (GJ)	Daily heat gain (GJ)	T1 (°C)	T2 (°C)	Δ T (K)	Fluid flow (m³/h)	Moment. power (kW)	Air temp. (°C)	Radiator temp. (°C)	Fluid flow (m³/h)	Moment. power (kW)	T_1 (°C)	T_2 (°C)	Δ T (K)	Heat meter (GJ)	*Daily amount of heat (GJ)*	*Daily electricity consumption (kWh)*	COP
31.07. 2012	15	21	0,005		18,6	20,0		0,000		20,0	42,828		54,11	43,33	***10,78***	0,379	4,66	18,0	22,0	0,91	6,42	55	49,2	***5,8***	265,966			
1.08.2012	20	28	0,245	***0,240***	12,5	9,2	***3,3***	0,591	4,35	27,5	43,233	***0,405***	53,20	44,40	***8,80***	0,361	3,28	22,0	40,0	0,902	1,023	48,7	48,6	***0,1***	266,342	***0,376***	***51,90***	2,012
2.08.2012	26	27	0,467	***0,222***	21,6	15,8	***5,8***	0,600	4,89	36,0	43,569	***0,336***	53,10	44,28	***8,82***	0,355	3,58	25,0	42,0	0,899	0,134	56,4	48,7	***7,7***	266,695	***0,353***	***46,40***	2,113
3.08.2012	27	28,5	0,672	***0,205***	14,6	8,2	***6,4***	0,609	4,5	25,0	43,882	***0,313***	53,56	42,47	***11,09***	0,372	4,76	25,0	40,0	0,898	7,1	55,2	48,1	***7,1***	267,02	***0,325***	***40,40***	2,235
4.08.2012	b.d.	b.d.	0,880	***0,208***	b.d.	b.d.	b.d.	b.d.	b.d.	b.d.	44,204	***0,322***	b.d.	b.d.	b.d.	b.d.	b.d.	b.d.	b.d.	b.d.	b.d.	b.d.	b.d.	b.d.	267,365	***0,345***	***45,10***	2,125
5.08.2012	b.d.	b.d.	1,070	***0,190***	b.d.	b.d.	b.d.	b.d.	b.d.	b.d.	44,508	***0,304***	b.d.	b.d.	b.d.	b.d.	b.d.	b.d.	b.d.	b.d.	b.d.	b.d.	b.d.	b.d.	267,705	***0,340***	***45,10***	2,094
6.08.2012	28	26	1,311	***0,241***	29,6	21,6	***8,0***	0,638	0,82	36,0	44,864	***0,356***	56,26	44,53	***11,73***	0,375	3,49	24,0	43,0	0,901	0,1	50,6	50,4	***0,2***	268,056	***0,351***	***45,10***	2,162
7.08.2012	25	31	1,554	***0,243***	27,3	20,4	***6,9***	0,652	3,84	31,0	45,25	***0,386***	53,36	45,21	***8,15***	0,375	3,38	25,0	44,0	0,899	0,48	46,8	46,3	***0,5***	268,450	***0,394***	***55,30***	1,979
8.08. 2012	24	29	1,714	***0,160***	23,6	18,6	***5,1***	0,662	5,42	29,0	45,600	***0,350***	54,50	44,02	***10,48***	0,376	3,43	23,0	36,0	0,897	6,2	57,5	51,4	***6,1***	268,800	***0,350***	***47,70***	2,038
9 .08. 2012	23	20	1,892	***0,178***	23,7	19,1	***4,6***	0,620	5,41		45,910	***0,310***	50,00	43,10	***6,90***	0,372	2,95	22,0	30,0	0,898	6,4	48,7	42,1	***6,6***	269,100	***0,300***	***44,95***	1,854
10.08.2012	23	17	2,071	***0,179***	10,0	1,9	***8,0***	0,582	5,4	25,0	46,137	***0,227***	34,10	27,84	***6,26***	0,380	2,73	22,0	28,0	0,888	6,995	35,3	28,5	***6,8***	269,397	***0,297***	***44,95***	1,835
11.08.2012	b.d.	b.d.	2,29	***0,219***	b.d.	b.d.	b.d.	b.d.	b.d.	b.d.	46,445	***0,308***	b.d.	b.d.	b.d.	b.d.	b.d.	b.d.	b.d.	b.d.	b.d.	b.d.	b.d.	b.d.	269,735	***0,338***	***49,30***	1,904
12.08. 2012	b.d.	b.d.	2,471	***0,181***	b.d.	b.d.	b.d.	b.d.	b.d.	b.d.	46,753	***0,308***	b.d.	b.d.	b.d.	b.d.	b.d.	b.d.	b.d.	b.d.	b.d.	b.d.	b.d.	b.d.	270,073	***0,338***	***49,30***	1,904
13.08.2012	16	18	2,650	***0,179***	11,5	7,0	***4,5***	0,566	2,94	24,0	47,062	***0,309***	54,42	43,57	***10,85***	0,377	4,63	23,0	38,0	0,905	0,075	49,5	49,5	***0***	270,413	***0,340***	***49,40***	1,912
14.08. 2012	16	18	2,837	***0,187***	19,4	11,2	***8,2***	0,626	5,00	22,0	47,375	***0,313***	40,03	36,55	***3,48***	0,383	1,53	23,0	33,0	0,901	0,169	39,0	38,8	***0,2***	270,735	***0,322***	***45,90***	1,949
15.08.2012	17	18	3,046	***0,209***	18,5	11,0	***7,5***	0,624	4,50		47,709	***0,334***	43,50	37,00	***6,50***	0,373	2,11	23,0	35,0	0,902	0,23			***0***	271,095	***0,360***	***50,40***	1,984
16.08.2012	18	19	3,256	***0,210***	17,6	10,7	***6,9***	0,581	3,54	24,5	48,044	***0,335***	50,59	45,01	***5,58***	0,357	2,24	23,0	41,0	0,904	0,204	52,0	47,8	***4,2***	271,455	***0,360***	***50,40***	1,984
17.08.2012	18	22	3,465	***0,209***	17,1	12,8	***4,2***	0,623	2,92	25,0	48,380	***0,336***	53,93	44,87	***9,06***	0,373	3,84	24,0	43,0	0,900	0,191	49,8	49,8	***0***	271,813	***0,358***	***49,50***	2,009
18.08. 2012	b.d.	b.d.	3,660	***0,195***	b.d.	b.d.	b.d.	b.d.	b.d.	b.d.	48,685	***0,305***	b.d.	b.d.	b.d.	b.d.	b.d.	b.d.	b.d.	b.d.	b.d.	b.d.	b.d.	b.d.	272,133	***0,320***	***42,63***	2,085
19.08.2012	b.d.	b.d.	3,855	***0,195***	b.d.	b.d.	b.d.	b.d.	b.d.	b.d.	48,990	***0,305***	b.d.	b.d.	b.d.	b.d.	b.d.	b.d.	b.d.	b.d.	b.d.	b.d.	b.d.	b.d.	272,453	***0,320***	***42,63***	2,085
20.08. 2012	27	23	4,050	***0,195***	18,7	12,7	***6,0***	0,623	4,42	31,0	49,297	***0,307***	50,23	43,02	***7,21***	0,379	3,13	24,0	41,0	0,886	7,978	54,5	46,6	***7,9***	272,775	***0,322***	***42,64***	2,098
21.08.2012	22	25	4,242	***0,192***	15,4	9,2	***6,2***	0,609	4,38	29,0	49,583	***0,286***	53,51	43,07	***10,44***	0,378	4,46	25,0	42,0	0,898	0,277	48,7	48,5	***0,2***	273,075	***0,300***	***37,10***	2,246
22.08.2012	21	24	4,434	***0,192***	15,4	9,2	***6,2***	0,609	4,38	27,0	49,880	***0,297***	52,37	42,50	***9,87***	0,353	3,95	28,0	41,0	0,898	0,444	47,6	47,6	***0***	273,384	***0,309***	***39,60***	2,168
23.08. 2012	20	22	4,614	***0,180***	11,7	5,5	***6,2***	0,600	4,32	26,0	50,151	***0,271***	49,51	39,95	***9,56***	0,378	4,12	24,0	38,0	0,898	6,732	50,1	43,5	***6,6***	273,670	***0,286***	***37,30***	2,130
24.08.2012	17	20,5	4,786	***0,172***	29,6	22,0	***7,6***	0,671	0,00	22,0	50,420	***0,269***	44,37	40,48	***3,89***	0,382	1,68	24,0	36,0	0,898	-0,315	43,0	43,0	***0***	273,954	***0,284***	***39,00***	2,023
25.08.2012	b.d.	b.d.	4,982	***0,196***	b.d.	b.d.	b.d.	b.d.	b.d.	b.d.	50,728	***0,308***	b.d.	b.d.	b.d.	b.d.	b.d.	b.d.	b.d.	b.d.	b.d.	b.d.	b.d.	b.d.	274,283	***0,329***	***45,10***	2,026
26.08. 2012	b.d.	b.d.	5,178	***0,196***	b.d.	b.d.	b.d.	b.d.	b.d.	b.d.	51,036	***0,308***	b.d.	b.d.	b.d.	b.d.	b.d.	b.d.	b.d.	b.d.	b.d.	b.d.	b.d.	b.d.	274,612	***0,329***	***45,10***	2,026
27.08.2012	15	19,5	5,374	***0,196***	9,4	4,0	***5,4***	0,593	3,67	25,0	51,346	***0,310***	49,92	40,69	***9,23***	0,382	4,04	23,0	36,5	0,902	5,902	51,4	45,6	***5,8***	274,942	***0,330***	***45,10***	2,033
28.08. 2012	16	18	5,528	***0,154***	19,4	13,5	***5,9***	0,671	5,16	21,0	51,619	***0,273***	27,85	26,92	***0,93***	0,379	0,00	22,0	26,0	0,892	0,104	27,7	27,6	***0,1***	275,222	***0,280***	***42,60***	1,826
29.09. 2012	17	20,5	5,725	***0,197***	9,6	4,0	***5,6***	0,591	3,84	24,0	51,930	***0,311***	48,93	39,67	***9,26***	0,379	4,01	24,0	37,0	0,895	6,178	50,0	43,9	***6,1***	275,569	***0,347***	***48,80***	1,975
27.09.2012	14	18	11,746	***0,067***	6,8	0,3	***6,4***	0,577	4,26	24,0	59,609	***0,076***	39,63	33,17	***6,46***	0,357	2,64	18,0	26,0	0,888	6,111	40,6	34,5	***6,1***	287,714	***0,149***	***20,70***	1,999
28.09.2012	18	17	11,814	***0,068***	6,8	0,9	***5,9***	0,579	3,93	27,0	59,711	***0,102***	42,81	35,82	***6,99***	0,360	2,88	20,0	31,0	0,887	5,996	43,5	37,6	***5,9***	287,941	***0,227***	***30,10***	2,095
29.09. 2012	b.d.	b.d.	11,824	***0,010***	b.d.	b.d.	b.d.	b.d.	b.d.	b.d.	59,746	***0,035***	b.d.	b.d.	b.d.	b.d.	b.d.	b.d.	b.d.	b.d.	b.d.	b.d.	b.d.	b.d.	288,013	***0,072***	***13,30***	1,504
30.09.2012	b.d.	b.d.	11,834	***0,010***	b.d.	b.d.	b.d.	b.d.	b.d.	b.d.	59,781	***0,035***	b.d.	b.d.	b.d.	b.d.	b.d.	b.d.	b.d.	b.d.	b.d.	b.d.	b.d.	b.d.	288,085	***0,072***	***13,30***	1,504
1.10.2012	14	16	11,844	***0,010***	5,3		***5,3***	0,602	0,00	24,0	59,818	***0,037***	40,53	34,02	***6,51***	0,357	2,67	19,0	31,0	0,888	5,921	41,3	35,6	***5,7***	288,159	***0,074***	***13,40***	1,534
2.10. 2012	19	17	11,886	***0,042***	8,2	2,7	***5,5***	0,585	3,68	29,0	59,923	***0,105***	46,45	37,60	***8,85***	0,378	3,81	20,0	34,0	0,892	6,194	47,3	41,6	***5,7***	288,415	***0,256***	***33,50***	2,123
3.10.2012	20	17,5	11,938	***0,052***	7,9	1,6	***6,3***	0,616	4,43	28,0	60,027	***0,104***	42,41	35,30	***7,11***	0,369	2,98	20,0	33,0	0,892	6,344	43,1	37,0	***6,1***	288,604	***0,189***	***25,70***	2,043
4.10. 2012	19	19	12,005	***0,067***	9,8	3,4	***6,4***	0,589	4,35	28,0	60,141	***0,114***	43,12	36,00	***7,12***	0,372	3,05	20,0	33,0	0,900	0,236	37,5	37,4	***0,1***	288,802	***0,198***	***27,50***	2,000
5.10.2012	16	14	12,042	***0,037***	4,9	0,0	***4,9***	0,534	0,00	26,0	60,333	***0,192***	40,64	34,02	***6,62***	0,363	2,75	20,0	30,0	0,896	5,747	41,4	35,9	***5,5***	289,175	***0,373***	***52,10***	1,989
6.10.2012	b.d.	b.d.	12,044	***0,002***	b.d.	b.d.	b.d.	b.d.	b.d.	b.d.	60,446	***0,113***	b.d.	b.d.	b.d.	b.d.	b.d.	b.d.	b.d.	b.d.	b.d.	b.d.	b.d.	b.d.	289,435	***0,260***	***37,50***	1,926
7 .10.2012	b.d.	b.d.	12,046	***0,002***	b.d.	b.d.	b.d.	b.d.	b.d.	b.d.	60,559	***0,113***	b.d.	b.d.	b.d.	b.d.	b.d.	b.d.	b.d.	b.d.	b.d.	b.d.	b.d.	b.d.	289,695	***0,260***	***37,50***	1,926
8 .10.2012	12	13	12,048	***0,002***	3,6	0,0	***3,6***	0,560	0,00	23,0	60,673	***0,114***	37,07	31,91	***5,16***	0,359	2,11	17,0	26,0	0,893	5,724	38,8	33,2	***5,6***	289,957	***0,262***	***37,70***	1,930
9.10.2012	13	13,5	12,049	***0,001***	2,9	0,0	***2,9***	0,522	0,00	22,0	60,766	***0,093***	37,31	31,19	***6,12***	0,356	2,49	18,0	27,0	0,895	5,600	38,2	32,8	***5,4***	290,188	***0,231***	***31,60***	2,031
SUM				12,044								17,938														24,222	3313,50	
min	8,0	13,0	0,005	0,001	2,9	0,0	2,9	0,000	0,00	20,0	42,828	0,035	27,85	26,92	0,93	0,346	0,00	17,0	20,0	0,886	-0,315	27,7	27,6	0,0	265,966	0,056	11,20	1,389
max	28,0	31,0	12,049	0,278	29,6	22,0	8,2	0,671	5,42	36,0	60,766	0,405	56,26	45,21	11,73	0,385	4,76	28,0	44,0	0,910	7,978	57,5	51,4	7,9	290,188	0,488	67,30	2,246
Arithmetic mean	**17,8**	**19,9**	**7,059**	**0,172**	**12,5**	**7,2**	**5,6**	**0,583**	**3,32**	**26,9**	**53,233**	**0,256**	**46,83**	**39,17**	**7,67**	**0,368**	**3,14**	**22,3**	**34,8**	**0,896**	**4,516**	**46,7**	**42,1**	**4,5**	**278,510**	**0,346**	**47,34**	**2,008**
Standard deviation	4,8	4,1	4,015	0,086	6,8	6,5	1,2	0,092	1,75	3,6	5,607	0,091	6,35	4,76	2,09	0,011	0,88	2,3	5,6	0,005	2,804	6,2	6,1	2,7	7,618	0,106	13,81	0,158
Correlation coefficient		r		0,535																								

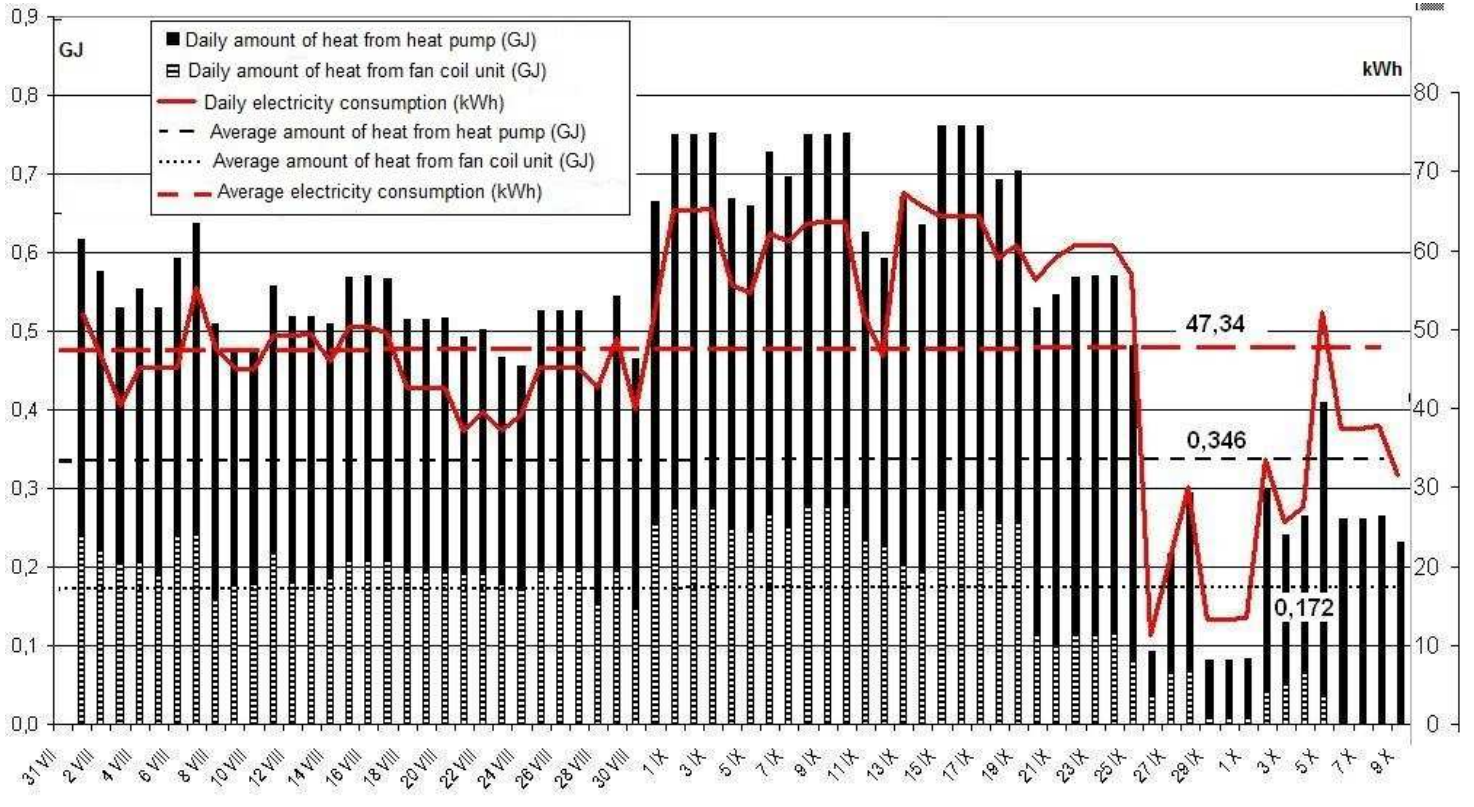

Figure 3. Daily amount of heat recovered from cowshed ventilation air and converted by heat pump

Source: Own study

CONCLUSIONS

1) The average level of heat obtained from the cowshed air ventilation was 0.172 GJ · per day^{-1}.
2) The heat recovered and converted by the heat pump was on average 0.346 GJ· per day^{-1}.
3) Electricity consumption in the installation (heat pumps and circulation pumps) was on average 47.34 kWh per day.
4) The performance coefficient was COP = 2.005.
5) It is necessary to increase the heat removal to an additional heater or boiler for hot water.
6) The relationship between the livestock building air temperature and the amount of heat obtained was expressed by the correlation k = 0.535
7) It is necessary to reduce pump performance of the fan coil system, and reduce the fluid flow rate to 0.3 $m^3 \cdot h^{-1}$.

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PLANNING UNITS APPLIED IN PRODUCTION PLANNING

Abstract: Types of planning units applied in medium-sized and bigger furniture making enterprises are characterised in this paper. Planning units are used to construct production plans at different levels of the organisational structure in an enterprise. A diagram was prepared for the explosion of orders for final products into production orders for lots of elements. An example was presented for the application of planning units in furniture production planning.

Key words: jednostki planistyczne, planowanie produkcji, produkcja mebli

INTRODUCTION

In production planning, different planning units (objects) are used to control discrete (non-continuous) processes of product manufacture (Muhlemann i inni 2001, Griffin 2013). They constitute separate sets of information with specific levels of detail, characterising objects of work (final products and their parts) included in planning. The concept of a planning unit was used by Wróblewski (1993), while the term object was applied by Krawczyński (1990). In this paper the concept of a planning unit is used, since this term better characterises the discussed problem.

The process of production planning for products consists in the explosion of a sale order – from the level of the group of products covered by this order to the level of production orders for the manufacture of product parts (components, details). Explosion of the order is performed in connection with the organisational structure of the enterprise and the manufacturing process. Levels of order explosions are the basis for the formation of a hierarchical system of production plans with an increasing degree of specificity of information required in controlling the manufacturing process of products. At each level of explosions different planning units are used, containing a specific set of information. This set comprises information required for the manufacture of a specific object of work at the assumed deadline (Waters 2002, Rogowski 2010, Pająk 2011, Grandys 2013).

The aim of this paper is to discuss and systematise planning units and principles of their application in production planning of products in discrete manufacturing processes. The manner of application of planning units is presented based on an example of furniture production planning.

CLASSIFICATION OF PLANNING UNITS

We may distinguish the following types of planning units used in planning of product manufacture in enterprises with discrete manufacturing processes:

- an order for final products,
- an item in a sales plan or operations plan (annual, quarterly, monthly) for the manufacture of a final product,
- an order for a final product,
- a production lot of a final product,
- a job order for a batch of parts (elements, subassemblies, assemblies).

Planning units are characterised by ascribing sets of information to them. Table 1 presents a characteristic of planning units in terms of the related information ascribed to them.

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Table 1. Characteristic of planning units

Type of planning units	Information content of planning units			
	Number of types of products or parts	Number of products or parts of a specific type	Date of beginning of manufacture	Date of termination of manufacture
Order for final products	One or more types of products	Different or the same for each type of product	Unspecified	Different or the same for each type of product
Item in sales plan or operations production plan	One type of product	As in order for final products	Unspecified	As in order for final products
Order for final product (unit may not be applied)	One type of product	As in the plan item or total from several plan items for the same final date	It is the difference between the date of completion and the normative length of cycle for a batches of products	As in plan item or earlier
Production lot of final products	One type of product	Equal or similar to normative lot volume	It is the difference between the date of completion and the normative length of cycle for a batches of products	As in order or production plan or earlier
Production order for a lot of a specific type of parts	One type of parts	It is a product of the number of products in the batch and the number of elements in the product or it is equal to the normative size of the lot of parts	It is the difference between the date of completion and the normative length of the production cycle for a lot of parts	specified for individual types of parts based on the product cycle graph

Source: Own study

DISCUSSION OF INFORMATION CONTENT OF PLANNING UNITS

The order for final products is a document, on the basis of which the ordering party (buyer) declares to the producer (supplier) demand for specific types and numbers of final products with specified parameters and indicates dates of their acceptance (delivery) arranged with the producer. Every order is placed by one ordering party and may concern more than one type of product, while for the same types of products different numbers of their requisitions and different delivery dates may be specified. The basic information placed on orders include:

- the type (symbol) of the order,
- name (symbol) of the consignee,
- names (symbols) of ordered types of final products,
- the order volumes for individual types of products,
- dates of acceptance of individual types of final products.

Different types (categories) of orders are applicable in enterprises manufacturing final products. Figure 1 presents a division of orders in terms of selected criteria.

Basic types of orders for final products include **external and internal orders**, distinguished in terms of the source of their issue. The former is created by external entities in relation to the enterprise. The date of completion for an external order is generally established based on arrangements between the ordering party and the manufacturer. Most frequently the market for final products is the buyer's market, thus this date is less and less often determined solely by the producer. Such a situation may potentially happen in relation to orders coming from one's own

chain of retail outlets. In the other cases the determination of the acceptance date is significantly influenced by the ordering party.

Moreover, in some enterprises external cooperating orders (cooperating services) are accepted for the manufacture of elements, subassemblies, assemblies with a varied degree of completion and for individual final products, which are components of multiple products manufactured or assembled in other enterprises.

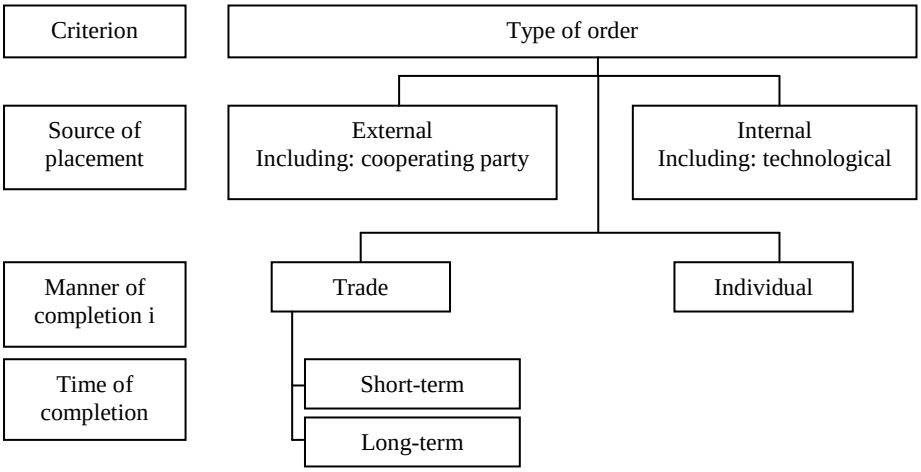

Figure 1. Types of orders

Source: Own study

The second type of orders comprises internal orders. They are placed by organisational units belonging to the enterprise (shops, plants, departments or warehouses of final products). Internal orders first of all supplement stocks of final products in these units to the standard level. Internal orders may also be technological orders. In such a case they concern performance of a specific assembly operation on a group of parts or refer to the performance of auxiliary processes supporting the primary production of the enterprise. Technological orders are particularly numerous if internal cooperation is developed in an enterprise.

Depending on the method of order completion we distinguish sales and individual orders. Commercial orders refer to products, which are manufactured based on typical patterns and engineering design specification, prepared earlier by the specific enterprise in the form of a sales offer. At the request of buyers slight changes may be introduced in product designs. Generally such changes concern different finishing elements, e.g. the type of used finishing materials or hardware.

Commercial orders may be completed based on contracts for individual deliveries to be completed at short notice (short-term orders), or they may take the form of a long-term contract (long-term orders), stipulating multiple deliveries of final products, e.g. every month in a year or a longer period. Typically long-term orders have the framework form, regulating basic contract terms, e.g. methods of payment and terms and conditions of acceptance of ordered products. They may also preliminarily determine the types of products, as well as their approximate number and expected delivery dates (e.g. at the end of each month). Precise volumes and dates of deliveries are established in shorter time periods, frequently on an on-going basis depending on the current

demand for individual types of products. Long-term orders are searched for and appreciated by enterprises, since they stabilise future production. This type of orders concerns first of all contracts with retail outlets or a retail chain as well as bigger, long-term trade partners.

Individual orders concern final products, which characteristics are arranged each time in agreement with the customer. This is connected most often with their manufacture based on the design and engineering specification supplied by the customer or the development of a new design of the product and manufacturing documentation following the requests of the customer.

Upon placement by the buyer of an order for final products it is processed by the respective units of the enterprise. The aim of these activities is to include the order in the sales and production plans. The circulation of commercial and individual orders by the enterprise department is presented in table 2.

Table 2. Schema for the circulation of a commercial order and individual order in an enterprise

Organisational unit processing the order	Route of order circulation	Types of actions performed in relation to the order
Ordering company	1	1. Order issue
Sales department	2, 8, 9	2. Recording of order 8. Arrangement of price and dates of order completion and confirmation of its acceptance 9. Incorporation of the order in the sales plan
Engineering department	3	3. Determination of the time of performance of the engineering documentation and its labour intensity
Technological department	4	4. Determination of the time of performance of the technological documentation and its labour intensity
Procurement department	5	5. Determination of costs and cycles of material deliveries
Production set-up department	6	6. Balancing of order volume with production capacity and determination of the completion cycle for individual order items
Economic department	7, 10	7. Determination of order performance costs 10. Recording of respective information based on the order in the assortment file and in the customer file

Numbers 1-10 in the second column refer to the numbers of actions described in the third column.

Source: based on Wróblewski K.J.: Podstawy sterowania przepływem produkcji. Wydawnictwa Naukowo-Techniczne. Warszawa, 1993, modified by the author.

The route for the order (individual order) for a new type of products is different from that of the order (commercial order) for products, which have been manufactured before. Table 2 indicates

departments, through which individual orders for products not manufactured previously are processed and the types of actions undertaken in these departments. In Table 2 these are items from 1 ÷ 10. For such products the enterprise units prepare a specific manufacturing documentation.

In the case of products previously manufactured (contained in the commercial offer) the route of a commercial order is shorter and leads only through certain departments performing actions listed in Table 2 as items 1 and 5 ÷ 10. Based on commercial and individual orders a sales plan is created for final products and next production plans are prepared – the plant plan and internal (operating) plan. While preparing the sales plan and the production plan orders are transformed (exploded) in the plan items. Each item of the plan comprises the number of pieces of a product of one type, accepted for completion at the same final date for one customer (see tab. 1). Individual items of the plan are denoted by individual numbers (identifiers).

Based on the plan items an order is issued for one type of final product. Not always orders are issued based on one plan item. If plan items concern orders for small quantities of products, these plan items are combined into one order which refers to the same products and the same admissible final completion dates (see tab. 1).

The order specifies the date of its initiation (onset of manufacture), which is calculated as the difference between the date of order completion and the normative duration of the manufacturing cycle of the product (see tab. 1). The final date of order completion is identical with the date of order completion specified in the plan item referring to the same product and planning period. The enterprise during production planning may not use orders for final products, as a planning unit, then plan items are the immediate basis for the creation of production batches, i.e. explosion of orders in the production batch.

The production batch of a product constitutes the whole or part of the plan item or the order to the final furniture product. It includes the number of pieces, which generally is equal to the volume of the normative batch, specified as the production parameter in the enterprise for products of a specific type. The batch volume, adopted in the operating production plan may differ from the normative volume if the size of the order included in the plan item is not equal to the normative batch or if it is not its multiplicity. The volume of the plan item or the order for final products and the batch volume may be identical if the order volume is identical or similar to the normative batch volume. In such a case the batch has the same planned dates of initiation and completion as the order for final products.

The production order for a lot of parts is issued for a single lot of parts of the same type, which belong to a specific batch of the final product. Production orders are the explosions of the total batch of the final product into its structural components and next their numbers being divided into production lots. The process of transformation of the batch of final products into production orders is referred to as explosion of a batch into production orders for lots of parts.

In order to determine the volume of the production order for lots of parts first the number of parts of a specific type is calculated based on the product of the volume of the batch of the final product and the number of the occurrence of these parts in the product. The established number of components is generally increased to include the planned spoilage. Next such a specified number of parts is divided by the normative lot volume, assumed in the enterprise for a specific type of parts, calculating the number of production lots per batch. For each established lot volume separate production orders are issued. It is attempted to have an order size equal or similar to the normative volume of the production lot.

While planning production an approach may also be adopted, in which the volume of the production lot corresponds to the number of elements, specified only on the basis of the product of batch volume and the number of parts in the final product. In such a case the commissioned lot volume is typically different from the normative value.

The production order provides the planned dates of initiation and completion of this order. The date of order completion is determined based on the position of specific parts on the cycle graph of the final product. The date of initiation (activation of the production order) results from the difference between the date of order completion and normative length of the production cycle of parts.

Among production orders we may distinguish machining orders, which refer to machining processes of individual elements and parts of complex final products and assembly orders, which refer to the assembly of elements into subassemblies, assemblies or final products.

In the course of performance of manufacturing processes production orders may have the following status: planned, to be opened, open, interrupted and closed.

An order, which has specified realisation dates (initiation and completion) and has not been initiated is the planned order. An order is to be opened if the planned date of its initiation falls in the current or the next planning period. An order is open if it has been transferred to realisation. If the performance of an order was stopped in progress, it becomes an interrupted order. An order is closed if its realisation was completed and settled.

THE DIAGRAM FOR THE EXPLOSION OF ORDERS FOR PRODUCTS INTO PRODUCTION ORDERS FOR LOTS OF PARTS

Planning units used in furniture manufacturing enterprises and their relationships are presented in Fig. 2.

Planning units shown in Fig. 2 create a hierarchical, five-level system. Orders for final products (level 1) are found at the highest level of the system. At the same time they are the most complex units in terms of the planning object. Orders are exploded successively into units located at lower levels. The lowest (fifth) level of the hierarchy comprises production orders for lots of parts. In production planning they constitute elementary planning units.

Individual types of planning units are applied at various stages of production planning – depending on the manufacturing unit which planning concerns and on the specificity of data used in planning. Figure 2 presents also possible principles for the establishment of planning units located below in the hierarchical system based on units found higher up in this system.

Orders for final products are exploded into plan items following two principles. In the first case an order is divided into several items in terms of the types of products and different delivery dates. An example of such a situation is provided by order no. 1 for final products, which was divided into four items of the production plan. In the second case an order is shown, which directly constitutes one plan item (one type of product and one delivery date). Such a situation is presented by order no. 2, which was used to create item no. 5 of the production plan.

At the second level of the hierarchical system of planning units the items of the plan may be exploded into orders for final products following three principles. In the first case the plan item is the basis for the issue of one order. In Fig. 2 such a situation is observed for item 1 of the production plan, in which the information content of the item overlaps with the order for final products A. The second possibility to create orders is illustrated based on order no. 2. In this case two plan items, nos. 2 and 3, were combined and they constitute order no. 2 for final products B at the specified common date of their delivery. The last case is a situation when a batch of production is established directly based on the plan item, skipping the stage of placement of an order for final products. In Fig. 2 such a case is presented by plan item no. 4, based on which batch no. 4 of final products C was created. If plan items are formed following such a principle, then the resulting batches at the same time receive the status of orders for final products.

At the third level orders for final products are exploded into production batches. There are two possible procedures. In the first case an order is exploded into several batches, which in Fig. 2 is

illustrated by the explosion of order no. 1 in production batches nos. 1 and 2. In turn, in the second case an order is also a batch, as evidenced by order no. 2 and batch no. 3.

At the fourth level production batches are exploded into production orders for lots of parts. The explosions of orders are based on structural designs of final products. One batch may provide several orders for production lots for the same type of parts and/or one order. The first situation is described by batch no. 1, which was divided into three production lots nos. 1 - 3 for elements AA. In turn, the other case is shown by production batch no. 1, but in relation to another element (here: AB), belonging to the same final product. The batch became the basis for the creation of one production lot (no. 4) for parts AB.

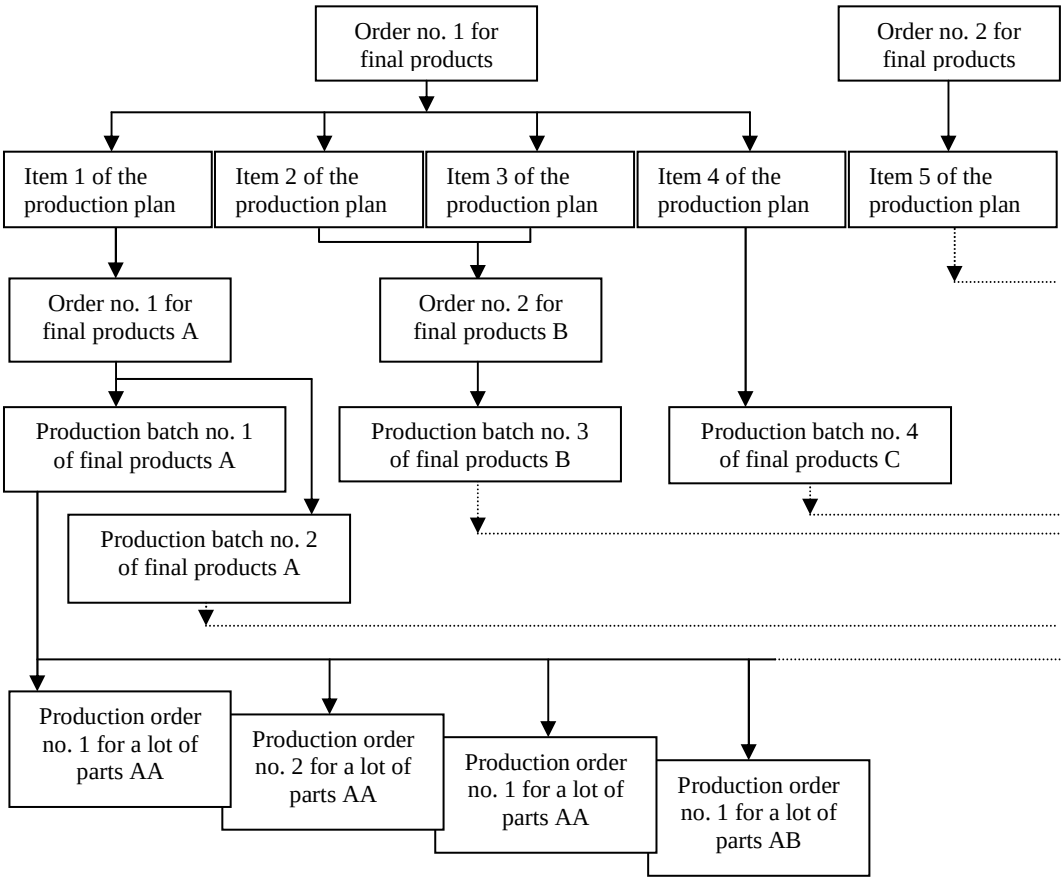

Figure 2. Planning units used in planning of furniture production

A broken line marks a potential further explosion of a specific type of planning units.

Source: based on Krawczyński R.: Sterowanie przepływem produkcji z zastosowaniem reguł priorytetu w zakładach przemysłu meblarskiego. Wydawnictwo SGGW-AR, Warszawa 1990, modified by the author.

AN EXAMPLE FOR THE EXPLOSION OF ORDERS FOR PRODUCTS INTO PRODUCTION ORDERS FOR LOTS OF PARTS

The manner of application of planning units is illustrated by an example shown in Fig. 3.

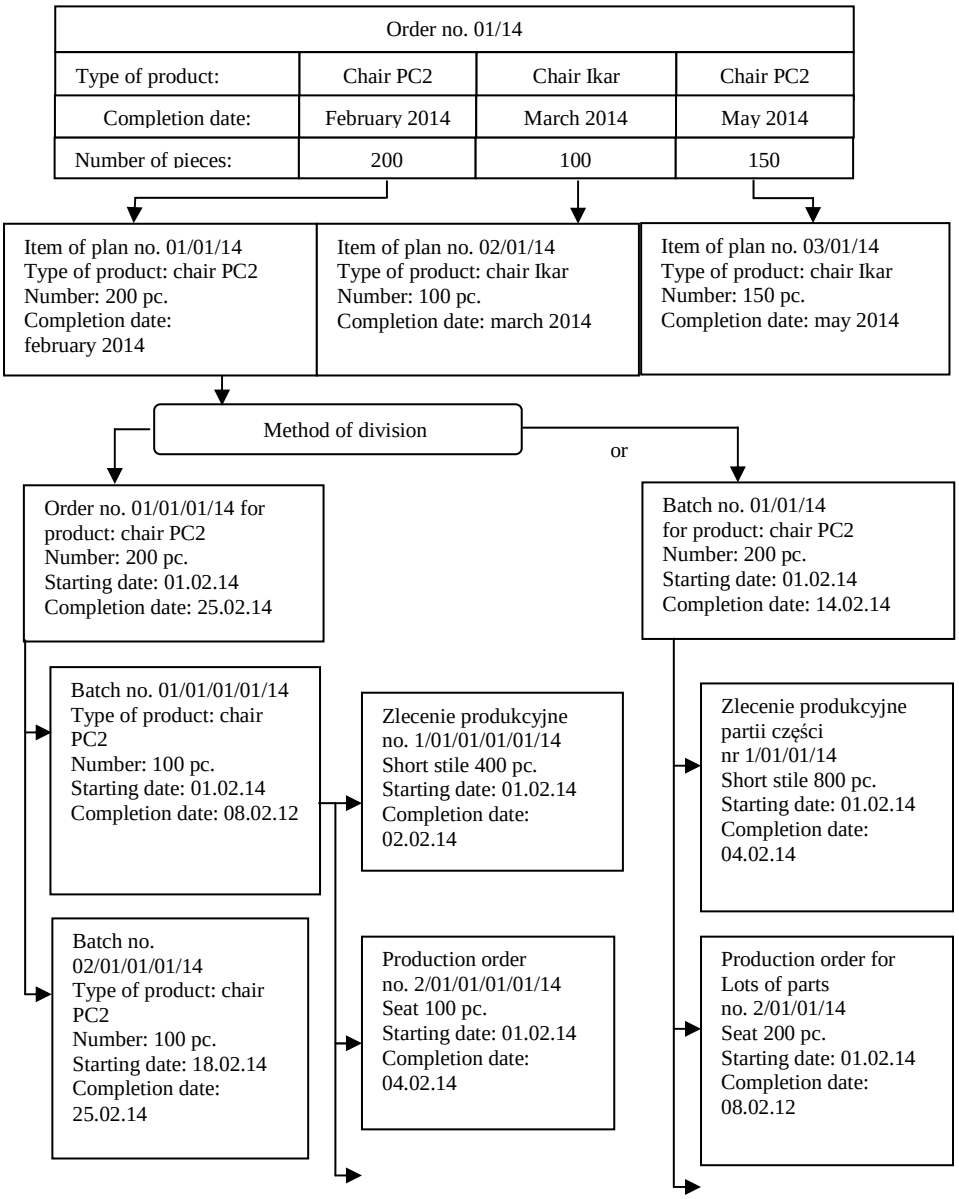

Figure 3. An example of connections between planning units

Source: based on Wróblewski K.J.: Podstawy sterowania przepływem produkcji. Wydawnictwa Naukowo-Techniczne. Warszawa, 1993, modified by the author.

In order no. 01/14 a customer commissions the manufacture of two types of chairs (PC2 and Ikar) for three different delivery dates (February, March, May 2014) and in three different quantities (200, 100, 150).

As a result of explosion of the order it is transformed into three items of the production plan, following the principle that each item in the plan may concern only one type of products manufactured for the same delivery date. As a result the order was divided into three items nos. 01/01/14, 02/01/14 and 03/01/14.

Next the plan items are exploded into orders for final products or into a production batch, depending on the principle adopted in the enterprise. Figure 3 shows for example item no. 01/01/14, which may be transformed into order no. 01/01/01/14 or a batch with the same number. In the former case order no. 01/01/01/14 is divided into two batches nos. 01/01/01/01/14 and 02/01/01/01/14, with the number of products specified based on the normative batch volume (100 pcs.) adopted for the PC2 chairs. In the latter case the plan item becomes batch no. 01/01/14, identical to the plan item. Both the batch specified directly based on the plan item and the batch formed as a result of the division of the order are next divided into production orders for lots of parts as a result of explosion of the structural design of the product belonging to a specific batch. Each production lot refers to one type of parts. As an example of such a procedure Fig. 3 presents two production orders nos. 1/01/01/01/01/14 and 2/01/01/01/01/14. These orders result from the explosion of production batch no. 01/01/01/01/14 and concern two selected parts: a short stile and a seat. Analogously, based on batch 01/01/01/14 two production orders nos. 1/01/01/14 and 2/01/01/14 are prepared.

CONCLUSIONS

Planning units used during production planning form a hierarchical skeleton for the explosion procedure for an order for products. Each planning unit has its own specific set of information. In this form, as sets of information, planning units are used to create respective production plans for individual levels of the administrative and production structure of the enterprise. In this way a hierarchical system of production plans is created with an increasing degree of specificity of the contained information. Depending on the type of enterprise – its size and the degree of complexity of manufactured products, certain planning units are selected, comprising the planning procedure. Thus the procedure is specific to individual enterprises.

Due to the dynamically changing market environment the enterprises are forced to undertake frequent actions, which adapt their operations to new conditions, including also a change in the production planning procedure. Developing such a procedure for a specific enterprise is possible based on a general scheme for the explosion of an order for final products, presented in this paper. The discussed scheme may be used in the development of an IT module supporting the implementation of changes in the production planning procedure. Then such a module would constitute an auxiliary component of existing computer programmes, which are used in the processes of production planning, thus increasing their flexibility and applicability.

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