# Improvements to the Production Management System of Wood-processing in Small and Medium Enterprises in Southeast Europe

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Small and Medium Enterprises (SMEs) make up over 99% of all industrial enterprises in southeast Europe. A similar percentage of SMEs can be found within southeast Europe's wood-processing and furniture manufacturing companies. This research aimed to investigate the current situation in the production management systems of SMEs in wood-processing companies in select Southeast European countries and to suggest possible improvements according to the results. A total of 30 small and medium companies from different countries in the region were surveyed to investigate the advantages and disadvantages of their production management systems. This research aimed to propose a model to create better systems within SMEs in the wood-processing branch and, therefore, achieve better production and business results. In addition, a total of 10 experts who work with management systems in wood-processing from the examined countries were surveyed with the same purpose. The Analytical Hierarchy Process (AHP) analysis of experts' opinions showed that the managers in small and medium enterprises for wood-processing and furniture manufacturing should pay the most attention to the conditions of the market, promotion, marketing, range of products, and product quality.

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## INTRODUCTION

Small and medium enterprises (SMEs) represent a significant part of the economy and industrial system of every country (Bumgardner *et al.* 2011; Buehlmann *et al.* 2013), and southeast European countries are no different in regards to the participation of SMEs within their economy. Recently, research shows that the numbers for SMEs increase annually (Bistričić *et al.* 2011). According to European laws, micro enterprises are those that employ less than 10 employees and whose income is less than €2 million per year. Small enterprises are those that employ less than 50 employees with an annual revenue of less than €10 million. Medium enterprises have an annual revenue of less than €50 million, with less than 250 employees (European Commission 2015).

Using Croatia as the average representative of southeast European countries, over 100,800 small and medium enterprises existed in 2014, representing 99.6% of all industrial subjects in Croatia. In 2015, the number of SME's increased to over 104,100 enterprises (99.7%). Out of those 99.7% of all industrial subjects in Croatia, 98.5% were micro and

small enterprises, and 1.2% were medium enterprises (SMEs and Enterpreneurship Policy Centre 2016).

In 2014, small and medium enterprises had over a 52% participation rate in the total Croatian Gross Domestic Product (GDP) and over a 53% participation in 2015 (35% small enterprises and 18% medium enterprises). In 2014, approximately 68% of Croatia's employees were employed by SMEs, and by 2015 that number was 50.9% in small enterprises and 17.5% in medium enterprises).

In total, 48% of Croatian exports in 2014 were by small and medium businesses, and in 2015 that share of participation increased to 48.5% (25.2% for small enterprises participation and 23.3% medium enterprises).

In Macedonia SMEs were 99.7% (or 70,453 enterprises) of the total number of enterprises in 2014. Additionally, there were 70,659 active business entities, out of which 64,187, or 90.8%, were micro enterprises employing up to 10 persons. Enterprises employing between 10 to 49 persons and from 50 to 249 persons generated a share of 7.0% and 1.8%, respectively. In 2014, the Macedonian SME sector had a share of 75.6% of total country employment, and the share has been increasing on an average annual rate of 2.2% since 2010. In 2014, SMEs' contribution to total turnover and value added was 67.7% and 65.5%, respectively (European Investment Bank 2016).

In 2013, 99.8% of all Serbian enterprises (315,906) were SMEs, employing almost 65% of the labor force. Out of total number of SMEs, 99.8% were micro, 3.0% were small, while only 0.7% were medium enterprises. Additionally, SMEs accounted of 54.1% of total gross value added of non-financial sector and for 43.2% of total exports of non-financial sector in 2103. At the same time, only 4.4% of all Serbian SMEs recorded net income from export activities (OECD 2016).

In Slovenia, in 2014, out of total 59,856 enterprises 99.6% (59,620) were SMEs, out of which 98.1% were micro and small enterprises, and 1.9% were medium enterprises (OECD 2016). According to European Commission (2016) data, in Slovenia more than 62% of value added and over 72% of employment are generated by SMEs, and they provide over one third of all jobs. In 2015, SMEs employment was still 12% below what it had been in 2008. At 30%, the manufacturing sector contributes the largest share of SMEs value added, and a similarly high share of SMEs employment. In 2012-2015, as a result of increases in value added and employment of 11% and 3%, respectively, SMEs had almost attained their pre-crisis levels for both of these two indicators.

The study is an accurate representation for the average situation and percentages of small and medium enterprises in southeast European wood-processing and furniture manufacturing companies as a whole. Because most of the companies are situated in rural areas of southeast Europe, small and medium enterprises make up a large percentage of all wood industry companies. Wood-processing and furniture manufacturing companies are highly export oriented; thus the percentage of SMEs' exports exceeds the above numbers that represent total Croatian exports (Dušak and Jelačić 2016).

However, most of the research was conducted and implemented in large companies and, in some cases, medium companies. This fact especially applied for wood-processing companies, because large companies have the equipment, personnel, and financial assets for providing the necessities and for implementing such research (Dasmohapatra 2009; Motik *et al.* 2010; Faletar *et al.* 2016). In contrast, to be able to survive in the market, small and medium enterprises have to be innovative in all possible aspects.

Baković and Ledić-Purić (2011) researched the role of innovations in SMEs, while Pirc Barčić *et al.* (2016) gave the perspective of innovations and their links to management

activities in the furniture industry. Wu *et al.* (2015) researched the work systems and workplace performances in small, medium, and large companies, and Neira *et al.* (2009) studied the interaction of innovations and performances in small and medium furniture enterprises. The possibilities of the implementation of an integrated approach to safety in small companies was presented by Nielsen *et al.* (2015), while Koprolčec *et al.* (2012) tried to establish the best insurance models for wood sector companies.

This research aimed to examine the current situation in production management systems in SMEs of wood-processing and furniture manufacturing companies in four southeast European countries. The study hoped to establish parameters for enterprise owners and managers in SMEs should consider to improve their business and production results in the future. The questionnaire aimed to establish the advantages and disadvantages associated with SME's production management systems. Also, to suggest a model to create better production and management systems within SME's in the wood industry sector, and for use in other industries.

## EXPERIMENTAL

### Materials

A survey was provided to the company managers of 130 micro/small and medium companies from four southeast European countries (Croatia, Macedonia, Serbia, and Slovenia). Sample of sent questionnaires to enterprises was defined by percentage of small and medium enterprises within each country. A total 117 questionnaires was sent to micro/small enterprises and a total 13 questionnaires was sent to medium enterprises, according to number of enterprises in each county (Croatia 25%, Serbia 50%, Macedonia 15%, and Slovenia 10%). However, mostly because of the number of employees in management, medium enterprises almost all responded to survey, while small enterprises mostly did not respond at all or their responses were incomplete and were not considered.

In total, only 30 enterprises responded to the survey in full, and these responses were taken into further analysis. Of the responded questionnaires, 27% were from macro enterprises, while 33% were from small enterprises, and 30% were from medium enterprises.

An emailed survey, based on methods recommended by Dillman (2000), was the approach used in this study.

The questionnaire consisted of 40 questions with several statements concerning each question. The managers had to choose a statement related to different production management parameters that were either more or less important for the companies' production management system. Within the questionnaire, the conditions of key presumptions of different management parameters were checked.

The questionnaire was divided into two parts. The first part consisted of 11 questions and was dedicated to general information about the company. The second part consisted of 29 questions directly connected to production management system parameters. Those 29 questions gave several statements for each question marked 1 through 5 (1- not important at all, 5- most important).

The same questionnaire was given to 10 experts from the same four countries, who had to give answers to the second part of the questionnaire (questions 12 through 40). The goal of having both experts and managers answer the questions was to establish the differences between opinions of managers in the companies and experts not working in the companies.

In the second survey, different questionnaires for the purpose of an AHP analysis were used. The production management system parameters were grouped into seven categories and those categories were placed in relationships. The questionnaire was given to the same experts who had to grade the relationships among the categories, according to their own opinion.

**Methods**

The differences in the frequency of answers given by the managers and experts were tested by a $\chi^2$-test for each individual question (the hypothesis, $H_0$, was the distribution of answers to the same question that were equally given by both groups). The test showed that there was a statistically significant difference between the distribution of all answers given by company managers and those given by experts (for all tested values p < 0.01). Thus, this study aimed to establish which production management system category of parameters, according to the experts' opinions, should be considered. Therefore, the authors conducted the AHP method.

The AHP method is a multi-criterion decision making method that helps decide among suggested alternatives. Seven categories of parameters were established and placed to make x·(n-1)/2 pairs. The questionnaire condition that should receive most consideration during the analysis was for the Consistency Ratio (CR) to be less than 10% (CR $\leq$ 0.10), meaning that less than 10% of given answers (values) should be inconsistent. All statistical analysis and graphical presentations were conducted using Microsoft Excel software (Microsoft EMEA, Issy-les-Moulineaux, France).

**RESULTS AND DISCUSSION**

The first 11 questions in the questionnaire were dedicated to general information about the companies. The micro companies surveyed in the research were manufacturing furniture or joinery (windows and doors), while small and medium companies were sawmills, furniture, or joinery manufacturers. Two thirds (67%) of the companies manufacture products exclusively through known customers, while 33% of the companies have their own shops, enabling them to combine their production for known customers and to that of the shop (unknown customers). Of enterprises responding to the questionnaire, 26.7% were small craft companies, usually family businesses that manufactured unique products ordered by a single customer who came to the company to order furniture or joinery by reputation (they gathered the information about the company from a friend or by chance). The other companies functioned through a type of legal entity. One fifth (20%) of surveyed companies used classic production technology and hand tools only, while 13% exclusively used computer aided technology, and two thirds (67%) used a combination of both.

Tables 1 to 7 present the $\chi^2$- Pearson's chi-squared test and the p-values (p <= 0.001 – the differences are "very highly significant" (99.9%); 0.001 < p <= 0.01 – the differences are "highly significant" (99.0%); 0.01 < p <= 0.05 – the differences are "significant" (95.0%), p > 0.05 – the difference is "non-significant" in less than 95.0%)   for questions 12 through 40 offered in the questionnaire. The questions and answers given in Tables 1 to 7 were grouped into seven main parameters and used in the AHP analysis.

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**Table 1.** $\chi^2$ - Pearson's Test and p-Values for Statements Regarding Leadership, Policy, and Organizational Structure of the Company (LPOSC)

| Questions/Statements | $X^2$ | p |
|---|---|---|
| **Statements about leadership, goals, and objectives of SMEs** | | |
| Continuous business improvement with IT | 13.7 | 0.0082 |
| Complementary goals to implement strategy | 14.7 | 0.0053 |
| Employees familiarity with strategic goals | 15.4 | 0.0040 |
| Plans required for process improvement | 13.9 | 0.0078 |
| Innovation of the processes | 14.1 | 0.0069 |
| **Statements about management and errors in production** | | |
| Complexity of production management | 14.2 | 0.0068 |
| Attention to information and material flows | 14.2 | 0.0067 |
| Control of errors and products | 13.9 | 0.0077 |
| Production losses dependent on technical preparation | 14.5 | 0.0059 |
| Adapting to customers' wishes | 14.6 | 0.0056 |
| **Importance of SMEs' organization** | | |
| Smooth organizational structure | 15.2 | 0.0043 |
| Employees from different units from the same teams | 14.3 | 0.0063 |
| Organized workplaces for various tasks | 20.9 | 0.0003 |
| Owner role definition for implementation | 13.9 | 0.0077 |
| **Criteria at the level of organization within the enterprises** | | |
| Providing necessary workplace materials | 13.9 | 0.0075 |
| Working conditions | 20.8 | 0.0003 |
| Motivation | 14.6 | 0.0057 |
| Labor productivity | 15.8 | 0.0033 |
| **Importance of customers and relationships with suppliers** | | |
| Frequent market research | 26.8 | < 0.0001 |
| Constant customer contact | 16.9 | 0.0020 |
| Managers monitor the competition | 17.6 | 0.0015 |
| Quick response to competition | 16.3 | 0.0027 |
| Partnership with customers and suppliers | 13.8 | 0.0078 |
| Company associated with customers | 13.6 | 0.0086 |
| Suppliers familiarity with company | 14.8 | 0.0051 |
| **Importance of the following statements related to production** | | |
| Meet customers' demands | 13.5 | 0.0091 |
| Increase productivity for better results | 15.8 | 0.0034 |
| Customers successfully retained | 14.8 | 0.0052 |
| Production program attractive to customers | 14.5 | 0.0058 |
| Innovations introduced to market | 17.4 | 0.0016 |
| Strategies implemented into plans | 14.5 | 0.0060 |
| **Importance of the following criteria** | | |
| Suitability | 14.0 | 0.0074 |
| Reputation | 14.2 | 0.0066 |
| Price | 13.6 | 0.0087 |
| Payment terms | 13.9 | 0.0076 |
| Availability of material | 14.3 | 0.0063 |
| Delivery deadlines | 13.5 | 0.0092 |
| High level of service | 13.4 | 0.0097 |

Notes: For all answers in Tables from 1 to 7 the size of the sample for companies was $N_A = 30$, size of the sample for experts was $N_B = 10$, and the degree of freedom was $df = 4$

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**Table 2.** $\chi^2$ - Pearson's Test and p-Values for Statements Regarding Marketing and Market Activities of the Company (PCMPPD)

| Questions/Statements | $X^2$ | p |
|---|---|---|
| **Importance of product distribution** | | |
| Intensive distribution system | 15.2 | 0.0042 |
| Selective distribution system | 14.8 | 0.0051 |
| Own shops | 17.9 | 0.0013 |
| **Methods of selling the products** | | |
| Personal sale | 19.5 | 0.0006 |
| Phone or internet sale | 14.6 | 0.0056 |
| Sales through adverts | 15.3 | 0.0041 |
| **Product promotion** | | |
| Fairs | 14.9 | 0.0050 |
| Verbal information | 18.4 | 0.0010 |
| Catalogues | 20.2 | 0.0004 |
| Newspaper ads | 15.1 | 0.0044 |
| Discounts and sales | 15.4 | 0.0040 |
| Internet- e-mails | 14.9 | 0.0049 |
| Company website | 15.1 | 0.0044 |
| **Storage process** | | |
| Stocks needed for continuity of production | 16.5 | 0.0025 |
| Predetermined material flow | 13.9 | 0.0076 |
| Stocks should be at low cost stock | 13.8 | 0.0080 |
| No waste or failures | 13.6 | 0.0087 |
| Stocks should rationally accelerate material flow | 13.7 | 0.0083 |
| Increase competitively Increasing competitiveness of the company | 16.3 | 0.0026 |
| **Statements about the market** | | |
| Produce by customers' requirements | 15.6 | 0.0036 |
| Sell what the company can produce | 22.6 | 0.0002 |
| Market research by customers' demands | 22.8 | 0.0001 |
| Packaging as a mean of protection | 25.6 | < 0.0001 |
| Packaging impacts the products sale | 13.5 | 0.0091 |
| Stocks to meet customer requirements | 14.2 | 0.0067 |
| Stocks to meet production requirements | 21.0 | 0.0003 |
| **Importance of innovation in SMEs** | | |
| Product innovations | 13.9 | 0.0075 |
| Process innovations | 13.8 | 0.0079 |
| Business innovations | 13.3 | 0.0098 |

**Table 3.** $\chi^2$ - Pearson's Test and p-Values for Statements Regarding Process Culture, Management Processes, and Production Deadlines (PRQP)

| Questions/Statements | $X^2$ | p |
|---|---|---|
| **Importance of business processes in SMEs** | | |
| Documented processes | 16.3 | 0.0027 |
| Documentation defines responsibilities | 14.2 | 0.0068 |
| Business process is well understood | 14.4 | 0.0060 |
| Other methods of defining process | 13.7 | 0.0082 |
| Graphically described process | 15.4 | 0.0039 |
| **Importance of production system processes** | | |
| Research and development | 15.7 | 0.0034 |
| Marketing | 16.2 | 0.0028 |
| Purchasing | 13.7 | 0.0084 |

| | | |
|---|---|---|
| Production | 13.7 | 0.0084 |
| Quality assurance | 13.3 | 0.0097 |
| Accounting and finances | 16.3 | 0.0026 |
| Human Resource Management | 14.4 | 0.0060 |
| **Importance of process culture in the company** | | |
| Business as a series of related processes | 15.4 | 0.0040 |
| Employees from different units work together | 13.4 | 0.0096 |
| Process owners are responsible for its success | 13.8 | 0.0081 |
| **Quality and organization management system** | | |
| Quality defined by technology | 15.7 | 0.0034 |
| Quality is more important than deadlines | 19.5 | 0.0006 |
| Each process should be equally distributed | 18.5 | 0.0010 |
| Organized system for realistic deadlines | 14.4 | 0.0060 |
| Clear division of a process is a key to success | 17.6 | 0.0014 |

**Table 4.** $\chi^2$ - Pearson's Test and p-Values for Statements Regarding Range of Products and Quality of Products (MPM)

| Questions/Statements | $X^2$ | p |
|---|---|---|
| **Impact of the market on production program** | | |
| Market impacts on production program | 14.4 | 0.0060 |
| Single product is a quality program | 16.6 | 0.0023 |
| Narrow product range is easier for business | 16.2 | 0.0028 |
| High quality means longer products life cycle | 36.2 | < 0.0001 |
| **Statements about the importance of the inputs** | | |
| Quality | 13.5 | 0.0093 |
| Price and deadlines | 13.8 | 0.0078 |
| Material on time | 13.8 | 0.0081 |
| Production requirements on time | 13.5 | 0.0093 |
| **Statements about the importance of the outputs** | | |
| Quality | 13.5 | 0.0089 |
| Meeting customers' demands | 14.0 | 0.0074 |
| Output evaluation | 14.1 | 0.0071 |
| Deadlines | 13.4 | 0.0097 |
| **Importance of production efficiency** | | |
| Effectiveness measurement system | 14.1 | 0.0071 |
| Adopted standards for effectiveness | 14.9 | 0.0049 |
| Results are basis for objectives | 15.0 | 0.0047 |
| Employees are informed | 14.4 | 0.0061 |
| Employees are familiar with changes | 13.7 | 0.0082 |
| **Importance of quality assurance in SMEs** | | |
| Product quality assurance | 13.6 | 0.0088 |
| Process quality assurance | 13.9 | 0.0078 |
| System quality assurance | 13.5 | 0.0091 |
| **Quality management system according to ISO 9001** | | |
| There are benefits from ISO 9001 (yes/no) | 13.8 | 0.0002 |
| **Importance of quality control in the company** | | |
| ISO 9001 | 17.3 | 0.0017 |
| Total quality management | 17.0 | 0.0019 |
| Lean production | 19.6 | 0.0006 |
| 20 keys system | 17.1 | 0.0019 |
| 6 Σ  Six Sigma System | 17.0 | 0.0020 |

**Table 5.** $\chi^2$ - Pearson's Test and p-Values for Statements Regarding Human Resources (HR)

| Questions/Statements | $X^2$ | p |
|---|---|---|
| **Evaluation of human resources in the company** | | |
| Management support to employees | 14.8 | 0.0052 |
| Employees trained for improvements | 13.3 | 0.0097 |
| Managers to motivate employees | 13.4 | 0.0094 |
| Knowledge and experience through work | 15.5 | 0.0038 |
| Awards for employees competences | 14.7 | 0.0054 |
| Salaries based on skills | 14.0 | 0.0072 |

**Table 6.** $\chi^2$ - Pearson's Test and p-Values for Statements Regarding Information Technology and Modern Production Technology (ITMPT)

| Questions/Statements | $X^2$ | p |
|---|---|---|
| **Company information system** | | |
| IT as a support to managers | 14.0 | 0.0073 |
| IT for process modification | 13.9 | 0.0078 |
| IT as a connection to partners | 14.9 | 0.0049 |
| **Importance of conducting computer training** | | |
| IT as support to strategic management | 14.7 | 0.0053 |
| IT literacy for various programs | 13.6 | 0.0087 |
| Company needs to invest to IT training | 14.0 | 0.0073 |
| **Importance of the following criteria** | | |
| Involvement of all employees in new product development | 15.4 | 0.0039 |
| Research as a basis for new product development | 14.2 | 0.0067 |
| Cost as crucial part of new product development | 19.3 | 0.0007 |
| Company should have research and development department | 14.0 | 0.0073 |
| Necessary market research for product development | 20.3 | 0.0004 |

**Table 7.** $\chi^2$ - Pearson's Test and p-Values for Statements Regarding Environmentally friendly production (ECP)

| Questions/Statements | $X^2$ | p |
|---|---|---|
| **Statements about environmentally friendly production** | | |
| Attention to energy consumption | 13.8 | 0.0080 |
| Attention to waste disposal | 13.7 | 0.0084 |
| Provide environmental information on product | 14.9 | 0.0049 |
| Environmental protection as priority | 14.4 | 0.0061 |
| Saving money over environmental impact | 16.3 | 0.0026 |

As can be seen in Tables 1 to 7, every single p-value was less than 0.01 ($H_0$: $p>0.05$ was rejected), which indicated that that all differences between answers given by the company managers and those given by the experts were highly significant. To be able to help the managers in the decision-making processes, it was necessary to establish which of the seven groups of production management parameters to pay the most attention. Therefore, an AHP analysis method was performed.

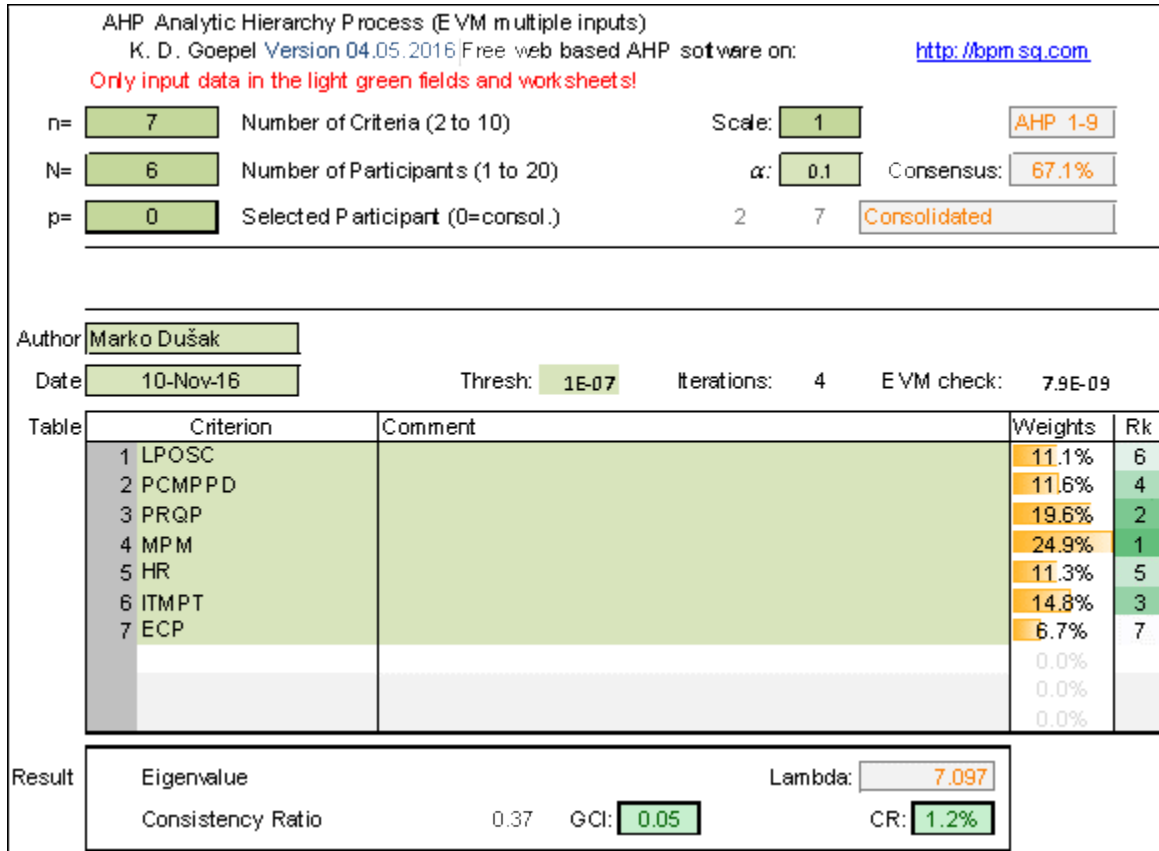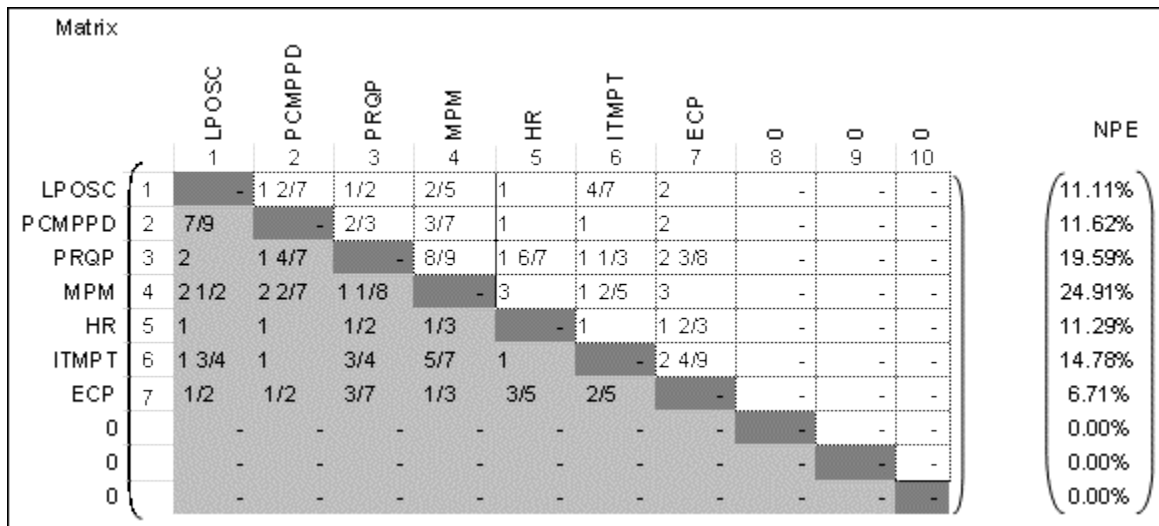Figures 1 and 2 show the results of the AHP analysis of the answers given by the experts.

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**Fig 1.** AHP Analysis on the seven groups of production management parameters



Note: Normalized Principle Eigenvector (NPE)

**Fig 2.** AHP Analysis – Matrix of answers by the seven groups of production management parameters

The same 10 experts from the four southeast European countries answered the AHP questionnaire to compare the importance of each group of production management parameters in grading each particular pair of the seven groups of parameters. Each expert's questionnaire was analyzed to calculate if the Consistency Ratio (CR) was less than 10%.

Those questionnaires in which the CR was higher than 10% were considered non-consistent and were removed from the analysis. Therefore, 6 out of the 10 questionnaires were taken into consideration, thus why the overall analysis depicted the number of participants as N = 6.

The AHP analysis showed that CR = 1.2%, which designated that the analysis was valid. By the results of the analysis and by the ranking given according to the weight of each of the seven groups of parameters, the managers in SMEs in wood-processing and furniture manufacturing should pay the most attention to the conditions of the market activities and marketing (weight = 24.91%), followed by range of products, quality of products (weight= 19.59%), and information technology *versus* modern production technology (weight = 14.78%).

This research was first to use an AHP analysis for purposes of the decision-making process within the production management system. For instance, Feng *et al*. (2016) used an AHP and cluster analysis for a dynamic assessment of forest resources quality, while Oblak and Glavonjić (2014) used the AHP method for an evaluation of radio advertisements for the sale of timber products. Kies *et al.* (2008) used a cluster analysis in their research on the forest sector in Germany, and Michinaka *et al*. (2010) used a cluster analysis to estimate prices and GDP elasticity of the demand for sawn wood. Kivijärvi and Tuominen (1996) gave different methods of decision aid processes in the strategic planning of a wood-processing company. Jelačić *et al.* (2015) focused their research on quality cost monitoring in SMEs for wood-processing, Nowduri (2014) focused only on management information systems, while Ren *et al.* (2015) tried to establish how marketing, research, and development affect innovation performance of SMEs. Wielgorka (2015) focused on environmental management for the sustainable development of micro, small, and medium enterprises. Economic issues were the focus of two previous SMEs-related research studies. In Sedliacikova *et al.* (2015b), they tried to establish how SMEs in Slovakia perceives financial controlling, while Sedliacikova *et al.* (2015a) investigated how to improve the performance of SMEs in wood-processing. However, none of these studies used the AHP analysis for purposes of the decision-making process within the production management system.

## CONCLUSIONS

1. The aim of this research was to establish the differences in opinions on different production management system parameters between managers in different small and medium wood-processing and furniture manufacturing companies in four southeast European countries and experts dealing with production management issues within the same countries. By using a $\chi^2$-test, the research indicated that the differences between all given questions and statements were significantly different. This stipulated that the AHP analysis was conducted to establish the ranking among the production management system parameters as a tool in the decision-making process.

2. It was discovered by the AHP method that managers in wood-processing and furniture manufacturing SMEs in Southeast European countries should pay the most attention to conditions on the market activities and marketing  Knowing the needs and demands of the customers could help in improving production and business results of SMEs in this particular branch.

3. A second group of production management system parameters that SMEs' company managers should pay attention to are the range of products available and quality of products. Customers welcome quality products, and even prefer quality over price.

4. This research and analysis can help managers in SMEs in wood-processing and furniture manufacturing improve their decision making process, improving their production and business results.

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