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Analysis of Operational Efficiency of Wooden Chair Manufacturing Companies in Serbia using DEA

Analiza učinkovitosti poslovanja tvrtki za proizvodnju drvenih stolica u Srbiji primjenom DEA metode

ABSTRACT • *This paper deals with the operational efficiency of companies engaged in the production of wooden chairs using selected statistical and DEA (Data Envelopment Analysis) methods. Indicators that typically characterise the supply chain in the production of selected companies were taken as input and output variables for the DEA method. They included three input variables: inventories, material costs and production services costs and one output variable: company's net profit. The obtained coefficients of correlation pointed to a high degree of correlation between the variables, which justified the performance of an efficiency analysis using the DEA method. The study included 12 companies engaged in the production of wooden chairs. The results of the conducted analyses show that only one company had a relatively satisfactory operational efficiency (efficiency coefficient of 0.83) for the nine-year period. All other companies, especially micro and small enterprises, had unsatisfactorily low operational efficiency. Micro enterprises had the lowest operational efficiency, with an efficiency coefficient of only 0.14. Small enterprises reached the value of 0.3, and large companies 0.67. Medium companies had the most favourable efficiency coefficient of up to 0.83.*

KEYWORDS: *value chain; chair; suppliers; DEA; efficiency; operation; enterprises*

SAŽETAK • *U radu je analizirana učinkovitost poslovanja tvrtki za proizvodnju drvenih stolica primjenom odabranih statističkih metoda i DEA (Data Envelopment Analysis) metode. Kao ulazne i izlazne varijable za DEA metodu izabrani su tipični pokazatelji koji su karakteristični za lanac opskrbe u proizvodnji odabranih tvrtki. To obuhvaća tri ulazne varijable: zalihe, materijalne troškove i troškove proizvodnih usluga te jednu izlaznu varijablu – neto dobit tvrtke. Dobiveni koeficijenti korelacije pokazali su visok stupanj međusobne povezanosti odabranih varijabli, što potvrđuje opravdanost primjene DEA metode za analizu učinkovitosti poduzeća. Istraživanje je obuhvatilo 12 tvrtki koje se bave proizvodnjom drvenih stolica. Rezultati provedene analize pokazuju da je samo*

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jedna od njih u posljednjih devet godina imala relativno zadovoljavajuću učinkovitost poslovanja (koeficijent učinkovitosti 0,83). Sve ostale tvrtke, posebice mikropoduzeća i mala poduzeća, imale su nezadovoljavajuće nisku učinkovitost poslovanja. U mikropoduzećima je zabilježena najmanja učinkovitost poslovanja, s koeficijentom učinkovitosti 0,14. Mala poduzeća postigla su koeficijent učinkovitosti od 0,3, a velika poduzeća od 0,67. Srednja poduzeća imala su najbolji koeficijent učinkovitosti: 0,83.

KLJUČNE RIJEČI: *lanac vrijednosti; stolica; dobavljači; DEA metoda; učinkovitost; poslovanje; poduzeće*

1 INTRODUCTION
1. UVOD

The wood industry is one of the most developed industries in Serbia, thanks, among other things, to the domestic raw material resources on which it builds its production.

Due to the dramatic growth in the demand for raw wood material in the world's leading centres for the production of furniture and other final wood products, its exports from Serbia in the form of sawlogs and sawn timber have risen substantially (Glavonjić *et al.,* 2020). This growth has particularly marked the last six years. Analyses and calculations related to the wood and wood products flows in Serbia for 2015 showed that only 48 % of the total quantities of hardwood sawlogs were processed into high-value-added products, and 52 % were exported as low-value-added products, i.e., sawlogs and sawn timber. One of the conditions to be met to change this situation is to increase the finalisation of raw wood materials that Serbia has at its disposal. (Glavonjić, 2016). Due to increased exports, domestic producers of final wood products have been increasingly facing a lack of good-quality raw wood material, especially oakwood. As a result, many of them are forced to import sawn timber. Considering the mentioned problems faced by the companies in the wood industry of Serbia, the research presented in this paper aimed to analyse the segment of the value chain that relates to suppliers (hereinafter referred to as the supply chain) in wooden chair manufacturing companies. We chose the manufacturers of wooden chairs because chairs are high-value-added products. Another reason is that Serbia was an internationally recognised manufacturer of wooden chairs thirty years ago and is aspiring to regain this reputation in the global trade of these products in the coming years.

Every company strives to achieve maximum efficiency in production and business processes. In order to be successful in the market and increase competitiveness, the main role of a company is to come up with product innovations. An economic aspect is another non-negligible challenge, too (Potkány *et al.,* 2019). The economic mission of every company, including companies in the wood industry, stems from the requirement to use the limited resources carefully to meet the ever-growing needs of customers. According to the general principle of the economy, the value of needs being satisfied should exceed the value of resources being used (Stevanović *et al.,* 2007). In this regard, the value chain has recently come into the focus of experts in practice due to the need to optimise and improve all its segments in order to increase the competitiveness of companies in the market and achieve better business results. According to Porter (2007), value-creating activities are interconnected within the value chain, as the way one of such activities is performed may affect the costs or performance of other activities.

Given the complexity of the value chain in the production of wooden chairs, the analysis presented in this paper focuses on the supply chain as the initial segment of the value chain. The main reason to choose the supply chain (supplier) as the subject of the research lies in the fact that the efficiency of the entire value chain largely depends on the quality of raw materials procured, security of delivery, prices, payment deadlines and other elements that suppliers are responsible for. To assess the efficiency of the supply chain, the following two key indicators were selected: the accounts payable turnover ratio and the number of days a company needs to cover the liabilities to suppliers.

Having this in mind, the main goal of the research presented in this paper was to create a model to quantify parameters that can be used to assess the efficiency of companies for the production of wooden chairs in Serbia using the DEA method. Another goal of the research was to select and apply appropriate tools that can be used to answer the question of how much it is necessary to increase the efficiency of the supply chain in order to achieve a satisfactory level of operational efficiency.

The analyses cover the period from 2011 to 2019. This is the period for which data from balance sheets and income statements of selected companies were available. There are 25 companies engaged in the production of wooden chairs in Serbia, 12 of them of which submit financial reports to the appropriate institution. The largest number of selected companies belong to the categories of micro, small and medium enterprises, while one company belongs to the category of large enterprises. Small and medium enterprises (SMEs) represent a significant part of the economy and industrial system of every country (Buehlmann *et al*., 2013; Bumgardner *et*

al., 2011). This is certainly the case with the companies in the wood industry in Serbia.

2 MATERIALS AND METHODS
2. MATERIJALI I METODE

The research presented in this paper used official data from the balance sheets and income statements of selected companies for the period from 2011 to 2019 obtained from the Business Registers Agency of Serbia, as follows: the value of inventories, costs to suppliers in the country and abroad, material procurement costs, production services costs and net profit.

The collection of data in the selected companies was performed in a period of one year. The data collected using the technique of interviews and direct recording were processed using qualitative content analysis of documents.

The collected data formed the basis for the application of appropriate scientific methods and techniques for the analysis of supply chain efficiency. They were used to calculate the values of the accounts payable turnover ratio and the number of days needed to cover the liabilities to suppliers as selected indicators. The accounts payable turnover ratio also shows how many times a year the company pays off its suppliers. Suppliers can be in the country and abroad. This ratio determines the period a company is "credited" by the supplier, i.e., how long it usually takes the company to cover the liabilities to suppliers after the material / goods have been procured. The following Eq. (1) was used to calculate the accounts payable turnover ratio:

$$APT = \frac{(Ix - Iy) + (Cm + Cp)}{\left[\frac{(Lsx + Lasx) - (Lsy + Lasy)}{2}\right]} \quad (1)$$

Where:

APT – accounts payable turnover ratio; Ix – inventories at the end of the year; Iy – inventories at the beginning of the year; Cm – material procurement costs; Cp – production services costs; Lsx-liabilities to suppliers in the country at the end of the year; $Lasx$ – liabilities to suppliers abroad at the end of the year; Lsy – liabilities to suppliers in the country at the beginning of the year; $Lasy$ – liabilities to suppliers abroad at the beginning of the year

The following formula was used to calculate the number of days needed to cover the liabilities to suppliers:

Number of days needed to cover the liabilities to suppliers = 365 / APT

Where: APT – accounts payable turnover ratio.

The collected data that relate to inventories, material costs, production services costs and company's net profit were used to calculate the operational efficiency coefficient (Ce) of companies engaged in the production of wooden chairs in Serbia.

The supply chain efficiency coefficient was calculated for each company individually and each year in the selected period using the DEA method (*Data Envelopment Analysis*). DEA is a linear programming technique for evaluating the efficiency of decision-making units (DMUs) under multiple inputs and outputs (Kropivšek *et al*., 2019). This method is based on mathematical and operational research methods. The Data Envelopment Analysis (DEA) is a nonparametric approach based on linear programming, which allows for the calculation of the efficiency of decision-making units within a group of organizations (Mimović and Krstić, 2016). Therefore, DEA is considered one of the most successful methods of operational research used in business analysis of economic entities (Popović and Martić, 2005).

According to Tekić *et al*. (2020) DEA (*Data Envelopment Analysis*) is used in efficiency analysis when data is available on several inputs and outputs for each of the *n* DMU (*Decision Making Units*). For each DMU, the maximum performance score is calculated relative to all other units in the observed sample that must meet the condition of being at or below an extreme limit called the efficiency limit (Savić, 2016).

The measure of efficiency provided by the DEA method is relative because it depends on the kind and number of DMUs included in the analysis, as well as the number and structure of inputs and outputs (Vukelić, 2014). In the output-oriented DEA model, which was used in the analysis presented in this paper, the analysis is aimed to determine the input and output weights at which a DMU unit has the highest relative efficiency and the weighted sum of inputs of the observed DMU unit is equal to one. The input and output units do not have to be uniform. They can include the number of working hours, the area of the workplace, the degree of utilisation of a resource, monetary values, etc.

This paper analysed the efficiency of 12 companies as DMUs out of 25 companies engaged in the production of wooden chairs. We analysed 12 instead of all 25 companies because some companies did not submit financial reports to the Agency for Business Registers of Serbia. These are companies that belong to the category of micro companies that are not obliged to have the double-entry bookkeeping system.

Indicators that characterise the supply chain in the production of selected companies to the greatest extent were chosen as input and output variables for the DEA method. These indicators included:
- three input variables: inventories (x_1), material costs (x_2) and production services costs (x_3),
- one output variable: company's net profit (y).

Before the DEA model was created, we had established the correlation between the selected variables by testing the statistical significance of their correlation coefficients.

We used the econometric modelling methods to project future net income values depending on the changes in selected independent variables. The obtained values of indicators were analysed and discussed using the methods of analysis, induction and synthesis.

3 RESULTS AND DISCUSSION
3. REZULTATI I RASPRAVA

The research results are presented through the obtained values of selected indicators by applying the methods and techniques described above with accompanying analyses and evaluations.

Before creating the DEA model, the statistical significance of the correlation between the selected variables (inputs and outputs) had been examined by calculating their correlation coefficients at the level of statistical significance $p < 0.01$. The obtained results are shown in Table 1.

Based on the obtained values of correlation coefficients, it could be concluded that there was a high degree of correlation between the selected variables, and

the DEA analysis was justified. The second step in conducting the analyses was to calculate the key indicators of descriptive statistics of selected variables. The obtained values of the variables are shown in Table 2.

The average value of inventories in selected companies in the study period was 5,773,131.7 RSD, material costs 112,765,231.5 RSD, and production services costs 18,179,465.7 RSD. The average net profit amounted to 23,980,933.3 RSD.

Most companies have the values of selected variables below the average, which can be observed by looking at the minimum values of the variables and high values of the coefficient of variation. High values of the coefficient of variation in all variables indicate that they are highly variable, i.e., there are substantial differences in the business of selected companies. The value of the coefficient of variation in the variable related to inventories is markedly high.

The results of the analysis of operational efficiency of companies engaged in the production of wooden chairs in Serbia using the DEA method are presented through the values of the efficiency coefficient (Ce) individually for each year of the study period (Table 3). The standard values of the efficiency coefficient range from 0 to 1. The values closer to 1 point to higher efficiency and vice versa. The software MaxDEA 8 Basic

Table 1 Correlation coefficients of selected variables and net profit
Tablica 1. Korelacijski koeficijenti promatranih varijabli i neto dobiti

	Inventories (x_1) Zalihe (x_1)	Material costs (x_2) Materijalni troškovi (x_2)	Production services costs (x_3) Troškovi proizvodnih usluga (x_3)	Net profit (y) Neto dobit (y)
Inventories (x_1) / Zalihe (x_1)	1.000***	0.433***	0.267***	0.283***
Material costs (x_2) / Materijalni troškovi (x_2)	0.433***	1.000***	0.933***	0.917***
Production services costs (x_3) Troškovi proizvodnih usluga (x_3)	0.267***	0.933***	1.000***	0.900***
Net profit (y) / Neto dobit (y)	0.283***	0.917***	0.900***	1.000***

***The correlation is significant at the level of 0.01. / ***Korelacija je značajna pri razini od 0,01.

Table 2 Indicators of descriptive statistics for selected variables of enterprises engaged in the production of wooden chairs in Serbia in the study period
Tablica 2. Pokazatelji deskriptivne statistike za ispitivane varijable poduzeća za proizvodnju drvenih stolica u Srbiji u promatranom razdoblju

Indicator / Pokazatelj	Inventories, RSD* Zalihe, RSD*	Material costs, RSD* Materijalni troškovi, RSD*	Production services costs, RSD* Troškovi proizvodnih usluga, RSD*	Net profit, RSD* Neto dobit, RSD*
Average / srednja vrijednost	5,773,131.7	112,765,231.5	18,179,465.7	23,980,933.3
Minimum / minimum	50,000.0	37,000.0	92,000.0	12,000.0
Maximum / maksimum	122,457,000.0	758,295,000.0	85,687,000.0	216,075,000.0
Coefficient of variation koeficijent varijacije	114.73	52.81	52.63	67.61

*The Serbian dinar/ srpski dinar

Table 3 Coefficient of operational efficiency of companies for the production of wooden chairs in Serbia in 2011-2019 (Authors' calculations based on the data from the balance sheets and income statements of selected companies)
Tablica 3. Koeficijent učinkovitosti poduzeća za proizvodnju drvenih stolica u Srbiji za razdoblje 2011. – 2019. (izračuni su utemeljeni na podatcima iz bilance i računa dobiti i gubitka odabranih tvrtki)

Enterprise / *Poduzeće*	2011	2012	2013	2014	2015	2016	2017	2018	2019	**Average** *Srednja vrijednost* **2011-2019**
E1	0.15	0.08	0.16	0.00	0.00	0.00	0.00	0.24	0.06	0.08
E2	0.12	0.00	0.00	0.00	0.00	0.00	0.00	0.30	0.02	0.05
E3	0.79	1.00	0.00	0.00	0.00	0.00	1.00	0.00	0.00	0.31
Average micro enterprises *srednja vrijednost za mikropoduzeće*	0.35	0.36	0.06	0.00	0.00	0.00	0.33	0.18	0.03	0.14
E4	0.00	0.00	0.00	0.00	0.00	0.11	0.01	0.00	0.09	0.02
E5	0.72	1.00	0.99	0.00	1.00	1.00	0.09	1.00	0.96	0.75
E6	0.23	0.10	0.02	0.24	0.50	0.30	0.01	0.02	0.03	0.16
E7	0.59	0.71	1.00	0.00	0.00	0.74	0.06	0.40	0.22	0.41
E8	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.39	0.34	0.08
E9	0.02	0.05	0.23	0.26	0.39	0.40	0.18	1.00	0.90	0.38
E10	0.46	0.63	0.51	0.00	0.50	0.59	0.07	0.00	0.03	0.31
Average small enterprises *srednja vrijednost za malo poduzeće*	0.29	0.36	0.39	0.07	0.34	0.45	0.06	0.40	0.37	0.30
E11 (medium enterprise *srednje poduzeće*)	0.85	0.76	1.00	1.00	0.78	0.79	0.25	1.00	1.00	0.83
E12 (large enterprise *veliko poduzeće*)	0.50	0.77	0.99	0.99	1.00	0.73	0.08	0.00	1.00	0.67

was used to analyse the efficiency of companies. The analysis of the company efficiency in the study period is structured by company categories because, in that way, the changes in the operational efficiency and the impact of the supply chain (supplier) on the net profit can be best seen.

The obtained values of the efficiency coefficient were analysed separately for each enterprise category. When it comes to micro enterprises, it can be concluded that their business operation was very variable in the study period. This conclusion applies even to those companies that had the maximum value of the efficiency coefficient in certain years, while in the following years, their efficiency was equal to zero because they were operating at a loss. Most companies in the micro category had serious business problems in most years of the study period because they were operating at a loss (efficiency equal to zero). The situation was a little better from 2017 to 2019 when two companies from this category made a profit. However, the profit accounted for a small percentage of the total revenue due to extremely high costs, primarily material and production services costs, in the total expenditures.

Due to the above, the average efficiency coefficient of micro enterprises in the study period was only 0.14. It was 2.1 times smaller than the average efficiency coefficient of small enterprises and 5.9 than the medium enterprise. Such a low coefficient of efficiency of micro enterprises revealed that these enterprises

were still far from satisfactory and very far from maximum efficiency.

The key recommendation for micro enterprises derived from the obtained DEA analysis is that they must significantly improve the efficiency of procurement and consumption of materials and reduce production services costs in the total operating costs. However, an important characteristic of these companies, which is also a positive aspect of their business, is the small share of inventories. This is somewhat logical having in mind that micro-companies procure the necessary raw materials in small quantities, usually as needed for each contracted job. The reason for this approach is the lack of working capital since most of these companies procure materials with the money customers pay in advance after they have made an order. In such a situation, the prices at which materials are procured in small quantities are significantly higher than the prices when materials are purchased in bulk.

The companies categorized as small enterprises had slightly better business results than the companies in the category of micro enterprises as their average efficiency coefficients ranged from 0.02 to 0.75. The total average efficiency coefficient for this group of companies was 0.30 for the study period. Out of seven companies in this category, one company had a satisfactory level of efficiency coefficient that amounted to 0.75. All other companies had an average efficiency coefficient below 0.5, which shows that the average ef-

ficiency coefficient in this category was still far from a satisfactory level. The analysis results show that material costs were the main cause of low efficiency in most small enterprises. The efficiency was less affected by the production services costs, while most small enterprises had inventories significantly above optimum values. High material costs indicate a low degree of their utilisation, on the one hand, and high prices at which they were procured on the other hand.

Observed by years, the average value of the efficiency coefficient shows that 2017 was the most difficult year for the companies in this category because their average efficiency coefficient was as small as 0.01. The highest value of the efficiency coefficient in that year was only 0.18 for one company in this category. In all other years, the average efficiency coefficient was relatively stable and ranged from 0.37 (2019) to 0.45 (2016). As with companies in the category of micro enterprises, the basic conclusion that can be drawn from the results obtained is that small enterprises also have room to increase the efficiency of the supply chain, especially in the segment of reducing material costs.

The situation was significantly better in the only medium enterprise engaged in the production of wooden chairs in terms of efficiency compared to micro and small enterprises. In the study period, its efficiency ranged from 0.25 (2017) to 1.00. The average efficiency coefficient in this category of companies was 1.00 in as many as four out of nine years of the study period. Consequently, its average efficiency coefficient was 0.83, representing the highest average efficiency for all observed categories of companies. This result indicates that this company had significantly lower values of inventories, as well as material and production services costs compared to micro and small companies. One of the reasons is that this company had a larger production volume, which enabled the procurement of a larger amount of required material at more reasonable prices. Considering that this medium enterprise used, in most cases, beechwood for the production of its products, there was no need to form large stocks because this type of wood is available in the domestic market at any time. However, although the average efficiency of 0.83 is the best for all categories of companies, there is still room to reduce costs in order to increase its efficiency and thus raise the profit as the ultimate goal of every company.

With regard to the only large company that manufactures wooden chairs in Serbia, 2017 and 2018 were very difficult years. In 2017, its efficiency coefficient was 0.04, and in 2018, this company operated at a loss.
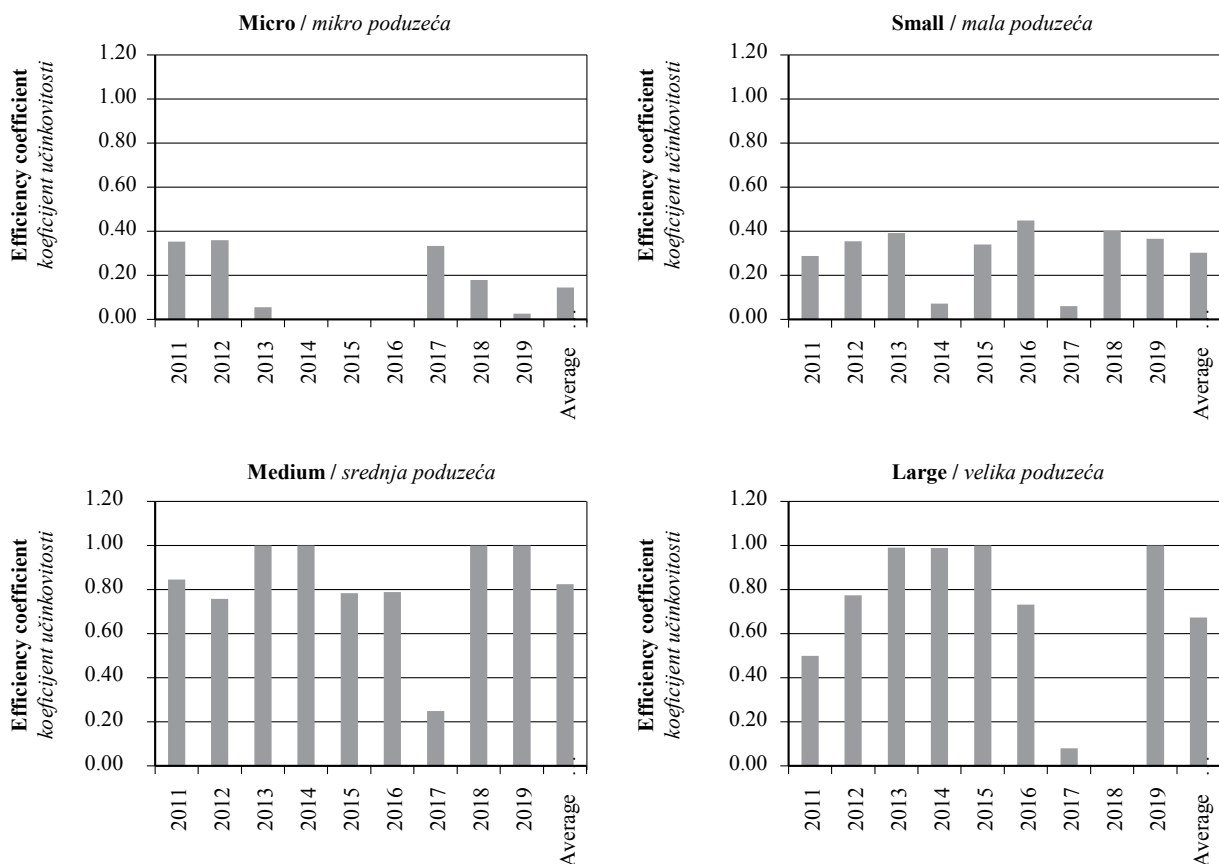

Figure 1 Average values of efficiency coefficient of certain categories of wooden chair manufacturing companies in Serbia from 2011 to 2019
Slika 1. Srednje vrijednosti koeficijenta učinkovitosti pojedinih kategorija poduzeća za proizvodnju drvenih stolica u Srbiji za razdoblje 2011. – 2019.

Table 4 Average values of output and input variables based on the results of the DEA method in the study period (Author's calculations based on data from the balance sheets and results of the DEA method)
Tablica 4. Srednje vrijednosti izlaznih i ulaznih varijabli prema rezultatima DEA metode u promatranom razdoblju (izračuni su utemeljeni na podatcima iz bilance i rezultata DEA metode)

	Average values / *Srednje vrijednosti*			
	Inventories *Zalihe* (1,000 RSD)	**Material costs** *Materijalni troškovi* (1,000 RSD)	**Production services costs** *Troškovi proizvodnih usluga* (1,000 RSD)	**Net profit** *Neto dobit* (1,000 RSD)
Moderately efficient companies (efficiency coefficient 0.3- 0.7) *Srednje učinkovite tvrtke (koeficijent efikasnosti 0,3 – 0,7)*	10,099.1	184,945.1	27,550.9	41,609.2
Efficient companies (efficiency coefficient 0.7-1) *Učinkovite tvrtke (koeficijent efikasnosti 0,7 – 1)*	1,794.0	65,139.1	15,519.7	25,850.8

Thanks to the good results achieved in 2013, 2014, 2015 and 2019, when its efficiency coefficient was as high as 0.99 and 1.00, the average efficiency coefficient for the observed period of nine years was 0.67. This company had 4.7 times higher efficiency than micro and 2.2 times higher efficiency than small enterprises, but also 1.2 times lower average efficiency than the medium enterprise. The analysis of the efficiency coefficient of this company also indicates that the company increased costs of inventories, as well as material and production services costs. Since this company produces oakwood seating furniture, whose domestic supplies are insufficient, the company was forced to import raw materials. Therefore, there was a need for larger stocks of raw and other materials that are in short supply on the domestic market. Figure 1 shows the average values of the efficiency coefficient by individual categories of enterprises in the study period.

Table 4 provides an overview of the average values of the selected input and output variables for the companies that, according to the results of the DEA method, had a medium efficient and efficient business operation.

It made no sense to make comparisons with the companies that according to the DEA method operated inefficiently, since they had very high average values of the analysed parameters. Companies that according to the DEA method operated efficiently had an average of 5.6 times lower value of inventories, 2.8 times lower value of material costs, and almost 1.8 times lower value of production services costs compared to companies that were determined to operate in the category of medium-efficient companies. On the other hand, the company that operated efficiently had 1.6 times lower net profit compared to the average net profit of the company in the category of medium efficiency.

The general conclusion that can be drawn based on the efficiency coefficients of wooden chair manufacturing companies in Serbia is that only one company had a relatively satisfactory operational efficiency (efficiency coefficient of 0.83), as observed collectively for the nine-year period. All other enterprises, especially in the category of micro and small enterprises, had unsatisfactorily low operational efficiency. In order to increase the efficiency of companies that operated inefficiently, it is necessary to enhance the management of inventories, material costs and production services costs, which points to the need to establish more efficient channels in the supply chains of required materials.

How much it is necessary to increase the efficiency of the supply chain in order to achieve a satisfactory level of operational efficiency is one of the major issues for the management of every company. Regarding the selected companies, the answer to that question is presented below using the results obtained by the DEA method.

The greatest possibility and need to reduce costs is in the category of material costs in all categories of companies, given that these costs are the highest. For instance, according to the DEA results, micro enterprises can reduce material costs by 80.7 % or as much as 99.6 % in some enterprises. This confirms the conclusion that reduced material costs in this category of companies are a crucial factor in increasing their efficiency. It should be noted that a reduction in any category of costs in practice can hardly reach the values obtained by the DEA method. However, every company should strive to get as close as possible to the obtained values. It is these values that represent the target and reference point for the management of the companies to strive for in their future business.

The largest fluctuations in the material costs in the study period were recorded in the category of small enterprises. The results of the DEA method show that material costs in small enterprises should be 73.4 % lower on average in order to obtain a satisfactory coefficient of efficiency. This fact points to the irrational use of materials and thus the high inefficiency of supply chains of most companies in this category. One of

the elements that can be enhanced is the utilisation of materials, another being the price at which materials are procured. The material purchase price depends on the market. In the medium and large enterprise, the efficiency exceeds the value of 0.9 and affects the costs that correspond to their production volume.

The production services costs in micro enterprises were higher by an average of 91.1 % and in small enterprises by 72.4 %. As in the category of material costs, there are some possibilities for reducing the production services costs in the medium and large company.

Regarding the value of inventories as the third variable in the observed model, the medium and large enterprise need significantly higher stocks that entail high inventory costs. The results of the DEA analysis show that there is still some room for reducing inventory costs in these two categories of companies. However, the instability of the domestic market in terms of the supply of basic materials forces these companies to keep stocks in order to ensure continuity of production. One of the solutions to this problem could be to stimulate domestic sawn timber producers to be included in the supply chain of domestic companies engaged in the production of final wood products (Glavonjić, 2018). Until the market stabilises in this respect, companies will be forced to build up stocks and have an unsatisfactory level of supply chain efficiency. The cost of inventories in the category of small enterprises was also extremely high. The results of the DEA method show that the same profit could be realised even if the costs of inventories were lower by an average of 68.4 %.

As can be concluded from the results obtained, the values of all three input variables are significantly higher than they really should be for the realised value of net profit as the output variable. This finding confirms the previously stated assessment of the inefficiency of the supply chain in most of the companies engaged in the production of wooden chairs in Serbia. This assessment was further confirmed by analysing the value of two additional indicators: the accounts payable turnover ratio (*APT*) and the number of days needed to cover the liabilities to suppliers for selected companies in the study period.

Companies engaged in the production of wooden chairs in Serbia usually procure raw and other materials from several suppliers to whom they have to cover liabilities within a certain period of time. The analysis of data for selected companies in the nine-year study period shows that the average annual accounts payable turnover ratio amounted to 5.4 for micro enterprises and 15.4 for small enterprises. It means that micro enterprises, on average, covered their liabilities less than six times a year and small enterprises a little less than 15 times, i.e., more than once a month. Although this is not so bad for small enterprises, they should strive for

better results and higher turnover ratios. Regarding the medium and large company, the accounts payable turnover ratios were 16.4 and 27.8, respectively. Compared to micro and small enterprises, these results are significantly better.

Looking at the number of days companies need to cover liabilities to suppliers, it can be concluded that micro and small enterprises have very high values of this indicator. In other words, many days pass from the moment they take over the goods from the supplier to the moment when they settle their obligations to them. In micro enterprises, the average value of this indicator exceeds 100 days. It is 60 days on average for small enterprises and 27 and 20 days for medium and large enterprises. The situation was somewhat better with the medium and large company, but they also found it difficult to cover liabilities to the suppliers who sell their goods with maturity below 20 days or advance payment.

Based on the above analysis, the question arises as to what impact the selected independent variables could have on the value of the output variable (net profit). It can be answered by creating a model for each category of selected companies. Having in mind the goals of this study and the limitation in terms of its size, the results of the multifactor econometric model for all selected companies are collectively presented below.

The forecast of the future net profit based on changes in selected independent variables was made using the multiple regression Eq. (1) that included average values of independent variables. The multifactor regression model of average values of inventories, material costs, production services costs and net profit is represented by the following linear logarithmic Eq. (2):

$$\ln y = -4.927 - 0.026 \cdot \ln x_1 + 1.961 \cdot \ln x_2 - 0.840 \cdot \ln x_3$$
or in the transformed form:
$$y = 0.00724 \cdot x_1^{-0.026} \cdot x_2^{1.961} \cdot x_3^{-0.840} \tag{2}$$

The basic statistical parameters of this regression model are presented in Table 5.

The high correlation coefficient (*R*) and its significance, as well as the fact that 92 % of the variation of the dependent variable (*y*) is explained by changes in the factors entered into the model, clearly show a very large influence of selected factors on net profit. The parameter (x_1) related to inventories shows that a 1 % decrease in the value of inventories can be expected to increase net profit by 0.026 %. As for the parameter (x_2) related to material costs, a 1 % increase in material costs can increase the net profit by 1.9 %. It is understandable, bearing in mind that an increase in the production volume entails an increase in material costs. The parameter (x_3) related to production services costs shows that a 1 % decrease in production services costs is expected to increase net profit by 0.84 %.

Table 5 Model parameters
Tablica 5. Parametri modela

Variables *Varijable*	y **Net profit** *Neto dobit*	x_1 **Inventories** *Zalihe*	x_2 **Material costs** *Materijalni troškovi*		x_3 **Production services costs** *Troškovi proizvodnih usluga*
Statistical characteristic / *Statistička obilježja modela*					
R	R^2	R^2 cor	$F(3,6)$	F test $_{(0.05)}$	Sq
0.92	0.85	0.87	11.477	+	0.326

* R – correlation coefficient / *koeficijent korelacije*; R^2 – coefficient of determination / *koeficijent determinacije*; Sq – standard error / *standardna pogreška*; F – F-statistics / *F-statistika*

Based on the results obtained by applying the multiple regression equation, growth can be expected at an average annual rate of 8.02 % for all selected groups of companies in the period 2020-2025. The relatively high value of the growth rate is largely the result of the expected production growth in the categories of medium and large enterprises.

4 CONCLUSIONS
4. ZAKLJUČAK

The results of the analyses of operational efficiency of wooden chair manufacturing companies in Serbia show that in the selected companies in the study period the average value of inventories was 5,773,131.7 RSD, material costs 112,765,231.5 RSD, production services costs 18,179,465.7 RSD and the average net profit amounted to 23,980,933.3 RSD. According to input and output parameters, all analysed companies had significantly higher values of inventories, material costs and production services costs, which reflected the low average efficiency of companies. Observed by categories, the efficiency coefficients of companies by individual categories were as follows: micro 0.14, small 0.30, medium 0.83 and large 0.67. The obtained results of the DEA analysis show that only companies from the category of medium and large companies operated with relatively satisfactory efficiency. The analysed companies that operated efficiently in the study period had an average of 5.6 times lower value of inventories, 2.8 times lower value of material costs and almost 1.8 times lower value of production services costs than the companies that operated in the category of medium-efficient enterprises. Consequently, it can be concluded that medium-efficient companies must significantly reduce operating costs to achieve higher profits and to move from the category of medium-efficient to efficient companies. The same applies to inefficient companies. In order to survive in the market at all, they must significantly reduce operating costs. The above finding was additionally confirmed by analysing two additional indicators: the accounts payable turnover ratio (*APT*) and the number of days needed to cover liabilities to suppliers. The turnover ratio in the study period amounted to 5.4 for micro and 15.4 for small

enterprises, while it was 16.4 for the medium and 27.8 for the large enterprise. Regarding the number of days needed to cover liabilities to suppliers, it can be concluded that micro and small enterprises found it very difficult to pay off suppliers on time. The situation was somewhat better with the medium and large company, but it varied significantly from year to year. Based on the obtained results of the multifactor regression analysis, it can be concluded that a 1 % reduction in input variables would significantly increase the net profit of companies. According to the model obtained, if the average values of input variables (inventories and costs) were reduced by only 1 %, the average annual rate of expected net profit growth of selected companies could be 8.02 % from 2020 to 2025.

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