The Impact of the Application of Business Intelligence Tools on the Company's Performance

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Abstract Business intelligence (BI) has become very popular in the business environment because of its ability to transform huge amount of data into relevant information, important for decision making. Based on the sample of 52 small to large companies from the Republic of Serbia we tested the impact of BI implementation on company's performance. The research shows that foreign owned companies have higher level of the BI tools implementation than the domestic owned. The main obstacle to the higher level of the BI tools implementation is the lack of skilled and qualified staff. Companies that use BI tools have better performances than companies that use only financial statements data for decision making. The implementation of BI has the strongest impact on the level of company profits related to other partial components of the performance.

Keywords: • business intelligence • performance indicator • profit

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1 Introduction

Performance monitoring requirements are increasing over time in the global business environment. Large business systems cannot monitor performance and make business decisions based on information exported from the company's ERP system due to its incompleteness and volume. Excel has a limited ability to import data from the accounting system. This gap is covered by development of Business Intelligence that is defined as an integrated set of tools and technologies that are used to collect, analyze, and make data available (Reinschmidt & Francoise, 2000). The former system of recording business transactions has been replaced by a modern one, which includes an automatic recording of business transactions. Information technologies (IT) are improved on a daily level. This is the reason why key topics such as: "supply chain management," "information system" and "information technology" have been interesting for research in the last twenty-five years (Chao et al., 2019). Companies have to adapt very fast to new trends and to apply innovative technologies if they want to retain their market share and competitive advantage (Perdana et al., 2022). This is one of the most important reasons for applying BI. Certainly, working with historical data is often highlighted as the main barrier to making timely and relevant business decisions. Therefore, a distinction should be made between Business Intelligence and Performance Management (PM). BI uses data collection to analyze and evaluate historical data, while PM uses data collection to evaluate and improve the process and methodologies of an organization (Leveleleven, 2019). First of all, accurate and up-to-date data is a prerequisite. The aim of the paper is to research whether a higher degree of application of BI tools has a positive effect on the performance of companies. Also, we will take into account the degree of application of BI tools depending on the ownership structure of the companies. Adequate BI solutions require large investments that are often not available to smaller companies. Also, we will research the most common reasons why BI tools are not applied in certain companies or are not applied to a sufficient extent. The research was conducted on the basis of questionnaire distributed to small, medium and large companies operating in the Republic of Serbia.

2 Literature review

Business Intelligence has become significantly important in the last twenty years (Chen et al., 2012:1165). BI tools can be applied in various industries and professions. Appelbaum et al. (2017) have suggested a framework based on BI which can be used in the Management Accounting. Su et. al. (2020) have explained the application of BI technologies in the gaming industry. Business Analytics (BA) also has its application in the retail sector. As a result of the application of BA, the performances of companies have improved (Ramanathan et al., 2017). Business Intelligence tools can also be applied in the construction industry. It is important for engineers to know the degree of completion of the project. Therefore, it is necessary to monitor data from various sectors. The applied BI system in the construction management enables greater reliability of the decisions

made, as well as a reduction in errors and input consumption (Rodrigues et al., 2022). The benefits of using BI tools are numerous: shortening the time required for reporting, availability of timely and relevant information needed for making business decisions, segment reporting, and preparation of consolidated financial reports. The benefits that companies can accomplish from the implementation of the BI system depend on how effectively the system is used (Trieu et al., 2022: 645). Before using, it is necessary to adequately implement the BI system. In that part, cooperation between programmers, managers, accountants and other professionals who will use BI tools is very important. Numerous authors have concluded that the critical success factors for implementing Business Intelligence Systems are: adequate management support and commitment, compatibility with organizational goals, adequate BI infrastructure, and the existence of a clear vision (Purvis et. al., 2001; Yeoh & Popovič, 2016; Paradza & Daramola, 2021; Fu et al., 2022). Critical success factors are also led predominantly by "soft" factors such as organizational culture, behavior, and leadership (Dijkstra, 2022). Having on mind rapid technological changes, accounting and finance experts will increasingly be required to improve their IT competencies (Sun et al. 2020). One of the most important obstacles to the adequate implementation of BI and performance monitoring is the absence of standardized key performance indicators (Vallurupalli & Bose, 2018). When a company doesn't have strictly and in advance defined KPI, employees won't be able to measure them. Comparison between industries is also impossible. In the research conducted by Trieu et al. (2022), 433 respondents out of the total of 437, have said that they are making business decisions relying on the data collected from the BI system. Because of that, it is very important that the data entered in the BI system is correct. Otherwise, information based on that data is useless and leads to wrong business decision.

As we previously said, BI tools can be applied in various sectors. The sales department should monitor the achievement of the defined sales volume, the procurement department should monitor the stock level production should follow consumer requirements. Recording of business transactions by accountants has to be accurate so that the finance sector can monitor the achieved business results. Special attention in professional literature is devoted to the impact of the application of BI analytics on the performance of companies such as impact on: revenues, profit, reduction in different types of costs, such as salary costs, inventory costs, administrative costs, production costs (Akter et al., 2016; Rajnoha et al., 2016; Ramanathan et al., 2017; Torres et al., 2018; Aydiner et al., 2019; Yiu et al., 2021). Companies prepare Cost benefit analyses and expect that the benefits of implementing new technologies will exceed the cost of their implementation, manifested in the hardware and software investment, cost and time of training of employees, etc. Regardless of the accomplished performances, discussing both positive and negative is of the great importance to the success of Business Analytics (Kerklaan, 2022). In the research conducted by (Aydiner et al. (2019), the implementation of business analytics positively affected business process performance and firm performance. BA adoption has also had a positive effects on profitability, risk reduction, organizational performance, financial performance, market performance (Elbashir et al.,

2008; Rajnoha et al. 2016; Maroufkhani et al., 2020; Yiu et al., 2021). Implementation of Business analytics in the supply chain has also had positive effects on performance (Trkman et al., 2010). Companies with a more mature level of BI tools implementation have better performance (Bach et. al., 2018). The most common used control variables in the research are: the company's size, age, industry, experience, IT capital accessibility (Aydiner et al., 2019; Maroufkhani et al., 2020; Paradza & Daramola, 2021). When we are talking about a company's size, it can be measured by different criteria: the number of employees, total revenues, and value of total assets. Regardless of the applied criteria, the common is that larger companies have greater financial strength and can invest more in BI tools. Small and medium-sized companies have no sufficient internal expertise, and because of that new technology adoption is more difficult (Asiaei & Rahim, 2019). Therefore, Maroufkhani et al. (2020) have suggested outsourcing of Business Data Analytics implementation as an option. Another advantage of the creation and development of BI tools is the development of new jobs. Modern technological changes are gradually transforming the economy and the society, creating new ways of working (Njegomir et al., 2021:1797). When demand for some new profession, usually related to the IT, emerges and increases, the supply of competent and enough qualified employees on the labour market is usually insufficient, which push their salaries up.

3 Research

We have opted to use the questionnaire method to study the extent to which BI tools are implemented in Serbian companies as well as to examine the relations between certain firm characteristics and the level of BI tools implementation. A broad range of tools and concepts can be applied. Regardless of the applied tools companies can derive positive effects. In the research are included all BI tools. In this regard, we have developed the questionnaire that consists of two broad parts – first, stating the main and general firm characteristics and second, examining the BI tools implementation. The questionnaire was originaly made in Serbian language. The structure of the questionnaire was based on a previous research by numerous authors (Akter et al., 2016; Ramanathan et al., 2017; Aydiner et al., 2019; Yiu et al., 2021). The questions in the questionnaire are primarily focused on impact on performance such as: level of profit, increase in revenues from the goods sold, reduction in production costs, reduction in inventory holding costs, improvement in competitive position. Respondents marked the level of agreement with the listed statements described above related to the effects of the application of BI tools on the performance using scales from 1 to 5 where 1 indicates "strongly disagree" and 5 "strongly agree". The sampling frame was formed randomly. Financial information is usually analyzed in the financial sector. Because of that the questionnaire was primary sent to Financial Controllers, Analysts, Financial directors etc. The positions of the respondents are described in table 1. The questionnaire was sent to 150 companies and received 52 feedbacks, thus making the response rate of 34,67%. The questionnaire is distributed in the September 2022.

The sampled company must have no more than one response, so 52 respondents are employed in 52 different companies. The sample structure is presented in Table 1 and shows that most of the respondents are employed as controllers in their companies. In addition, the vast majority of the sampled companies are large and majority foreign owned. The questionnaire was sent to the companies who organized financial department. At the moment of sampling, the size of the company and ownership structure were unknown. The industry structure of the sampled companies is highly diversified, though more than twenty percent of the sampled companies primarily operate in food and beverages industry.

H1: Majority foreign owned companies have a higher level of the BI tools implementation than the majority domestic owned companies.

H2: Level of the BI tools implementation positively impacts company performance.

Table 1: Sample structure

Panel A. Position of the respondent in the company[^]	
Controlling	29
Finance	21
Planning and Analysis	8
Other	6
Panel B. Size of the respondent's company	
Small	4
Medium	13
Large	35
Total	52
Panel C. Ownership structure of the respondent's company	
Majority domestic owned	18
Majority foreign owned	34
Total	52
Panel D. Main industry of the respondent's company	
Automotive	2
Construction and real estate	6
Food and beverages	11
Information systems	5
Investments, banking and finance	6
Pharmacy	1
Textile industry	2
Trade	5
Transport, telecommunication and media	5
Other	9
Total	**52**

Note: [^] denotes question with more than one answer permitted.

The first research hypothesis is tested by comparing the level of the BI tools implemented between majority domestic owned and majority foreign owned companies. In this regard, we have employed statistical tests for independent groups to test the significance of the difference in the level of the BI tools implementation between two groups of companies. We have firstly examined whether the distribution of the level of the BI tools implementation follows the normal distribution curve and employed parametric statistical test if this assumption holds or nonparametric test on the contrary.

The second research hypothesis is tested using the multiple regression analysis to examine the impact of the level of the BI tools implementation (BI) on the change in company performance after the BI tools implementation (PERF) in general. A specific period in performance monitoring was not observed, but whether the application of BI tools leads to improvements in listed performance. PERF is tracked with the six answers of the respondents, as they had to assess the change in company profits, sales, market share, reduction of costs of holding inventory, reduction of production costs, and competitive position, (Akter et al. 2016, Ramanathan et al. 2017, Aydiner et al., 2019) on the Likert scale, with 1 representing the slightest improvement and 5 representing the largest improvement. Variable PERF is calculated as a sum of the answers on each of the six questions, there having a minimum possible value of 5 and a maximum possible value of 30.

Since company size and ownership structure may influence the company performance (Greenaway et al., 2014), we have controlled the impact of the BI on PERF for the variations in company size (SIZE; 1 for small company; 2 for medium company and 3 for large company) and ownership type (OWN, 0 for majority domestic owned and 1 for majority foreign owned company). Therefore, for the company *i*, the following regression model may be developed:

$$PERF_i = \alpha + \beta_1 BI_i + \beta_2 SIZE_i + \beta_3 OWN_i + \varepsilon_i \quad (1)$$

4 Discussion

4.1 The extent of the BI tools implementation

We begin the presentation of the results with an analysis of the extent to which BI tools are implemented in sampled companies. We have asked respondents to assess the level of BI tools implementation, with 1 representing the lowest level and 5 the highest level of BI tools implementation. The results for this question are presented in Table 2.

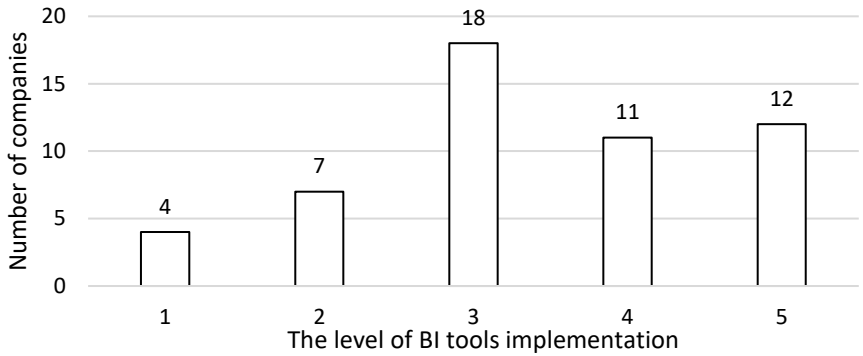
Table 2: The level of BI tools implementation

Arithmetic mean	3.38
Median	3.00
Minimum	1.00
Maximum	5.00
Standard deviation	1.21

Data from Table 2 shows that arithmetic mean of the level of the BI tools implementation is only 3.38, thus being only slightly higher than the average level of the implementation. In addition, arithmetic mean is higher than median, indicating that there are more companies with higher levels of the implementation than the companies with lower levels.

This is confirmed in Figure 1, showing that twelve companies assess the highest level of the BI tools' implementation, while only four companies assess the lowest level. Further, most of the companies (18 from 52, or around 35%) assess the level of the BI tools' implementation as moderate. Relatively low standard deviation (compared to the arithmetic mean) implies that the sampled levels of BI tools implementation are relatively clustered around the arithmetic mean.

Figure 1: Distribution of sampled companies by the level of BI tools implementation



We have also analyzed the environment of the BI tools implementation in the sampled companies. In this regard, we have analyzed the obstacles for the higher implementation of the BI tools and current practices of the implementation. The results are presented in Table 3. It is worth noting that most of the respondents argued that lack of the skilled and qualified staff is the main obstacle for the higher level of the BI tools' implementation, though many respondents (9 from 52) identified other obstacles not offered in the questionnaire (such as lack of the software solutions like data warehousing solutions, or lack of necessity of the BI for maintaining company operations). The important share of respondents also did not give any answer on such obstacles, which may imply that they are yet to identify the obstacles. This may represent a particular problem for the richer BI tools implementation. In addition, slightly more than half of the respondents answered that the KPIs are tracked on the monthly basis, though the portion of the respondents that track the KPIs on a daily basis is also large. Furtherly, more than seventy percent of the respondents (37 from 52) argue that available BI solutions in Serbia are well fitted to the needs of their companies. The rest of the 15 respondents stated that available BI solutions in Serbia are not adapted to the needs of the company. The reason for that is the difference between financial statements in European countries and countries from other continents. Because of the numerous companies which are mainly foreign owned, the applied BI solution is primarily adjusted to the foreign companies.

Table 3: The environment of the BI tools implementation

Panel A. Obstacles for the higher level of BI tools implementation	
Lack of the funds	7
Lack of the staff	13
Lack of the top management support	5
Inadequate organizational structure	9
Other	9
No response	9
Total	52
Panel B. How often the KPIs are tracked?	
Daily	16
Weekly	7
Monthly	27
Yearly	2
Total	52
Panel C. Available BI solutions in Serbia are adapted to the needs of the company	
Yes	37
No	15

4.2 Ownership structure and the BI tools implementation

We have compared the assessed levels of the BI tools implementation in majority domestic owned and majority foreign owned sampled companies. Results of the comparison are presented in Table 4. Both arithmetic mean and median of the level of BI tools implementation are higher in the majority of foreign owned companies. In addition, only three of sampled 18 majority domestic owned companies assessed the level of the BI tools implementation as the highest. On the other hand, as much as nine of sampled 34 majority foreign owned companies assessed this level as the highest.

Table 4: The comparison in the level of BI tools implementation between domestic and foreign owned companies

	Majority domestic owned	***Majority foreign owned***
Arithmetic mean	2.78	3.71
Median	3.00	4.00
Minimum	1.00	1.00
Maximum	5.00	5.00
Standard deviation	1.26	1.06
Number of companies	18	34

To examine the statistical significance of the difference in the level of the BI tools implementation between majority domestic owned and majority foreign owned companies, we have conducted statistical test for independent samples. However, we have

firstly tested whether the distribution of the assessed level of the BI tools' implementation follows the normal distribution. We have relied on Shapiro-Wilk test instead of Kolmogorov-Smirnov test of normality due to the relatively small sample size. In fact, both tests of normality showed that the distribution of the analyzed variable does not follow the normal distribution. Therefore, we have opted to use the nonparametric Mann-Whitney test as the better alternative than parametric Independent Samples t-test.

The results of the Mann-Whitney test are presented in Table 5, showing that the difference between majority domestic owned and majority foreign owned companies in the level of the BI tools implementation is statistically significant. In other words, the difference significant at the 1% level shows that majority foreign owned companies have higher level of the BI tools' implementation than the majority domestic owned. Therefore, the first research hypothesis cannot be rejected.

Table 5: Results of the Mann-Whitney test

Mann-Whitney U	172.000
Z-statistic	-2.667
p-value	***0.008

Note: Statistically significant at the level of 10% (*), 5% (**) and 1% (***).

It is widely known that BI tools have origins in most developed countries of the world (Hassan, 2019). On the other side, foreign direct investments in Serbia primarily come from developed European countries, such as The Netherlands, Austria or Germany. Leading Investors by Value (%) are Germany, USA, Italy, France, Austria, China, etc. (Ras, 2022). Regarding this, it could be expected that Serbian subsidiaries of multinational companies whose headquarters are located in above mentioned countries, invest more in BI tools implementation. Such multinational companies have the know-how for the BI tools implementation and may transfer it to the subsidiaries in developing countries.

Although it is often assumed that benefits of the BI tools adoption exceed the costs of it (Puklavec et al., 2018), the costs of BI tools may be an important obstacle for its implementation. In this regard, it is rational to assume that multinational companies have more funds to finance (sometimes highly expensive) BI tools implementation. Such foreign funds may be distributed to the subsidiaries of multinational companies in order to implement BI tools compatible with the tools implemented in parent companies. Companies may adopt a free (demo) version of the BI tool, but free software has a limited data storages and limited possibilities for reporting. Therefore, the free version of BI tools could only satisfy the information needs of micro and small companies. Medium and large-sized companies realize huge investments in data integration, consolidation of data and reporting. Some of the free versions are: Birt, ClicData, Jedox, Microsoft Power BI etc.

4.3 BI tools implementation and company performance

Table 6 presents the descriptive statistics for the change in company performance after the BI tools implementation. Both arithmetic mean and median are only at the moderate level of the increase in company performance, implying that there is a significant room for improvement in both BI tools implementation and company performance. We have also tracked each performance component separately – the change in profits (PERF1), sales (PERF2), market share (PERF3), reduction of costs of holding inventory (PERF4), reduction of production costs (PERF5) and competitive position (PERF6). The results indicate that PERF1 has the highest arithmetic mean, meaning that profits are the component mostly increased after the implementation of the BI tools.

Table 6: Descriptive statistics for PERF and its components

Variable	***PERF***	***PERF1***	***PERF2***	***PERF3***	***PERF4***	***PERF5***	***PERF6***
Arithmetic mean	17.06	3.02	2.98	2.81	2.60	2.65	3.00
Median	18.00	3.00	3.00	3.00	3.00	3.00	3.00
Minimum	6.00	1.00	1.00	1.00	1.00	1.00	1.00
Maximum	30.00	5.00	5.00	5.00	5.00	5.00	5.00
Standard deviation	6.32	1.21	1.21	1.16	1.26	1.34	1.12

Figure 2 shows the scatter diagram, analyzing the relationship between the level of the BI tools implementation and the change in the company performance. In other words, such diagram shows the estimates of the simple Ordinary Least Squares regression. A positive trendline shows that the companies with higher level of the BI tools implementation experienced larger increase in the performance. However, it is necessary to include control variables to reach a more reliable conclusion. Therefore, we have run the multiple regression analysis.

Figure 2: The relation between the level of BI tools implementation and the change in company performance

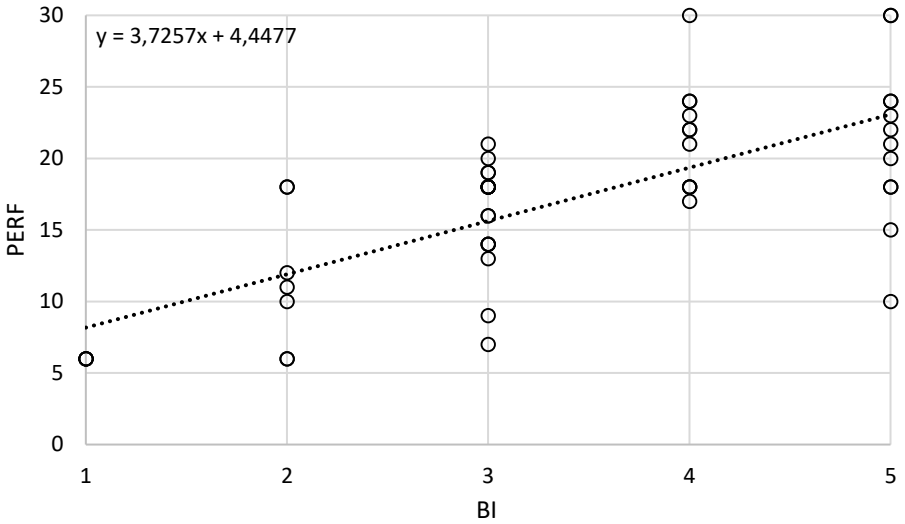


Table 7 reports the regression analysis results. It may be concluded that the implementation of the BI tools leads to the significant change in a company performance. As the level of the BI tools implementation is higher, the change in a company performance is significantly higher, with the results significant at the 1% level. Therefore, the second research hypothesis cannot be rejected. Research results are robust to some changes in the research model. We have eliminated observations with low level of the BI tools implementations, leaving in the sample only 41 observations that assessed the level with at least 3 on the scale from one to five. However, the impact of the employed independent variables remains the same, though the adjusted R^2 lowers to the 0.209. Research results for such modified research sample are not tabulated due to the reasons of space.

Table 7: Regression estimates

Variable	***Beta coefficient***	***t-statistic***	***p-value***
Constant	1.031	0.372	0.712
BI	3.231	5.678	***0.000
SIZE	1.543	1.509	0.138
OWN	1.660	1.202	0.235
Adjusted R^2	0.516		
F-value	***19.147		
Observations	52		

Note: Statistically significant at the level of 10% (*), 5% (**) and 1% (***).

Research results dominantly confirm theoretical assumptions about the positive impact of the BI tools on the company performance. Therefore, it may be concluded that implemented BI tools in Serbian companies facilitate more accurate, timely and data-driven decision-making process. In addition, the implementation of the BI tools improves organizational efficiency. Although its implementation may be costly, it is obvious that BI tools enable valuable benefits for Serbian companies. In other words, companies that use BI tools have better performance than companies that use only financial statements data, as pointed out in some previous research (Rajnoha et al., 2016, Akter et al. 2016, Torres et al., 2018, Aydiner et al., 2019). Business intelligence tools vary in robustness, integration capabilities, ease of use (from a technical perspective), and pricing (Gilliam. H, 2022). Some of the most commonly used BI tools are Sap Business Objects, Datapine, MicroStrategy, Microsoft Power BI, Oracle BI etc. Companies with limited financial potential cannot afford expensive software. It has to be noticed that implementation and use of BI tools in the decision-making process is still the privilege of companies that have financial capacity and budget for this type of investment. Previous research about BI tools implementation in the Republic of Serbia is limited. There is not enough empirical data about the industries within companies perceive the importance of implementing BI tools. There is no transparent data about cost benefit analysis of implementing BI tools, as well as there is no deep analysis of key enabling factors important for higher level of implemented BI tools in the companies operating in Serbia. The positive effects of BI implementation are explained in the example of tolling system. The effects of applying BI technology primarily include time savings in evaluating and analyzing performances, improvement in business processes (Radivojevic et al., 2015: 52).

We have also run the regression analysis with partial components of company performance (PERF1, PERF2, PERF3, PERF4, PERF5 and PERF6) as dependent variables. Therefore, we have estimated six additional regression models and their results are reported in Table 8. Since the beta coefficient for the impact of the level of BI tools implementation on company performance is the strongest in the first additional regression model, it may be concluded that the implementation of BI has the strongest impact on the level of company profits related to other partial components of the performance.

Table 8: Additional regression estimates

Variable	***Dependent: PERF1***			***Dependent: PERF2***		
	Beta coeff.	**t-statistic**	**p-value**	**Beta coeff.**	**t-statistic**	**p-value**
Constant	0.639	1.067	0.291	0.364	0.610	0.545
BI	0.639	5.212	***0.000	0.614	5.022	***0.000
SIZE	0.080	0.365	0.717	0.199	0.908	0.368
OWN	0.012	0.041	0.968	0.035	0.116	0.908
Adjusted R^2	0.390			0.395		
F-value	***11.867			***12.087		
Observations	52			52		
Variable	***Dependent: PERF3***			***Dependent: PERF4***		
	Beta coeff.	**t-statistic**	**p-value**	**Beta coeff.**	**t-statistic**	**p-value**
Constant	0.021	0.037	0.970	-0.056	-0.085	0.932
BI	0.523	4.517	***0.000	0.420	3.099	***0.003
SIZE	0.351	1.689	*0.098	0.342	1.404	0.167
OWN	0.158	0.564	0.576	0.528	1.606	0.115
Adjusted R^2	0.401			0.308		
F-value	***12.397			***8.554		
Observations	52			52		
Variable	***Dependent: PERF5***			***Dependent: PERF6***		
	Beta coeff.	**t-statistic**	**p-value**	**Beta coeff.**	**t-statistic**	**p-value**
Constant	0.087	0.128	0.899	-0.022	-0.043	0.966
BI	0.546	3.935	***0.000	0.489	4.638	***0.000
SIZE	0.117	0.470	0.641	0.453	2.391	**0.021
OWN	0.636	1.889	*0.065	0.290	1.134	0.262
Adjusted R^2	0.363			0.472		
F-value	***10.673			***16.172		
Observations	52			52		

Note: Statistically significant at the level of 10% (*), 5% (**) and 1% (***).

5 Conclusions

The goal of this paper was to analyze the impact of BI implementation on a company's performance. It is concluded that the majority of foreign owned companies have higher level of the BI tools implementation. The companies with higher level of the BI tools implementation have higher increase in the performance.The strongest impact of BI implementation refers to the level of company profits. Although is expected that the main obstacle to the higher level of BI implementation is a lack of resources, 25 % of the respondents said that the main reason is a lack of qualified staff. One of the suggestions to companies might be to organize workshops and enable their employees to get additional knowledge and improve their competence in the field of data analysis, reporting, etc. Also, companies should not wait until the end of the year to analyze financial results. Of the total of 52 respondents, 27 have said that they analyze performance on a monthly basis and 16 respondents analyze performance daily.

One of the limitations of our study is it that is based on a relatively small sample. Also, limited variables were tested. The level of BI implementation could be expanded to different sectors. The impact of an accountant's year of experience, accounting knowledge and competencies could be tested as moderating variables. That is very important because accountants play a fundamental role in supplementing data to Power BI when we are talking about accounting data. In the construction sector that might be engineers. The fundamental role depends on the type of sector or type of information that we need to analyze. That will be the direction of further research.

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