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Original Scientific Paper

THE ROLE OF INFORMATION TECHNOLOGY IN THE IMPLEMENTATION OF LEAN CONCEPT

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Abstract. *Achieving and strengthening competitive advantage represents the key factor for survival and success of the modern businesses. It is a fact that successful implementation of lean management leads to increased productivity and competence. However, in order to maintain profitability and business stability, it is necessary to support lean concept, which can be provided, above all, by the application of modern information technology. In that sense, by applying the ERP system, it is possible to adapt basic lean principles to the requirements of a modern environment characterized by constant change of demand and needs of the consumers/users. The main goal of the research is to examine the existing level of application of modern information technologies, as well as the level of attention paid to the integration of lean concept and software solutions in enterprises in the Republic of Serbia. Theoretical aspect of the research is related to finding appropriate grounds for making conclusions on the basis of the existing literature. In this paper, research gaps and proposed further research directions have been identified. By applying the appropriate statistical methods (descriptive statistics, cluster analysis, correlation analysis, χ2 test) it was finally concluded that the enterprises which have substantially implemented the practice and principles of lean management are at the same time those which implement IT in their business, i.e. the information systems which support the implementation of lean practice.*

Key words: *lean management, information technology, software solutions, ERP system*

JEL Classification: M11, M15

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INTRODUCTION

The rapid growth of world markets as well as the application of modern information technologies force companies to change, representing the factor of their survival and growth. In the environment characterized by intense competition, survival is guaranteed only to those companies which realize the importance of constant innovation and introduction of new methods in the area of process quality improvement.

A large number of researchers is focused on continuous improvement of business processes. The instrument that has shown remarkable efficiency for the purposes of continuous improvement is lean management. Its essence is to add value and eliminate losses by reducing inventory, improving quality and reducing time, while reducing costs is a logic consequence.

Today, companies have to connect lean practice with the existing technology platform. Combining lean philosophy with new technologies gives them the chance to outperform their competitors with business processes designed to quickly respond to changes in consumer demand. This creates greater level of flexibility, too. It is desirable to make the most of the new technologies' creative power. For the companies facing incompatible information systems and inconsistent business practices, the ERP system is the best solution. In this way, companies are given the opportunity to standardize and automate business processes throughout the organization, as well as to incorporate automated error detection (to improve quality), thereby increasing productivity and reducing cycle duration (Wang & Nah, 2001).

The advancement of lean concept by information technology in Serbia is still an underdeveloped area. So far, this topic has not been given special attention and similar research has not been carried out. All this additionally enhances the scientific justification of this work.

1. LITERATURE REVIEW

Even though there are many definitions of lean management (LM), it might be said that it represents a systematic approach to identifying and eliminating activities that do not add value to business processes (Radosavljević et al., 2015). However, the benefits of lean management for an enterprise, possibly to a greater extent, are related to the management of product and information flow. Lean management describes a set of management principles and methods in order to differentiate between *loss* and *value* in organizations (Stone, 2012). Apart from exceptional success achieved within the production function, there is an increasing interest in exploring the application of lean management and non-productive functions (Arlbjørn & Freytag, 2013), since the acceptance of lean philosophy does not imply respecting lean principle only in production but in all processes taking place in the company. According to Rother and Shook (1999), the basic principles of lean management are value for the customer, value stream, continuous flow, pull strategy and continuous perfection.

Tanasić (2012, p. 310) also points to several axioms which lean as a modern concept is based on:

- The customer represents the essential condition for the existence of an enterprise and therefore should exist in the basis of all business functions;
- In order to be fully committed to customers and their needs and wishes, the enterprise must continuously eliminate the waste in everything it does;

- The enterprise becomes the organization that learns, putting emphasis on intellectual rather than material capital;
- Transparency represents the tool of timely response to both internal and external change;
- Innovation and gradual, continuous improvement become the integral part of the business culture and business philosophy of a modern enterprise;
- The enterprise must insist on creating the quality of products at the very source, or at every step of the value stream, at each stage of the business process;
- The application of an appropriate measurement system helps the enterprise and employees to stay on the right track, and repair and eliminate any omissions that disturb or slow down their pace.

The key elements for the successful implementation of standardization in LM are - operations, time, tools and accessories (Ősterman & Fundin, 2014). By formulating lean strategy, companies tend to differentiate themselves from competitors. In addition, as one of their goals, as has already been pointed out, is providing greater value for consumers, by concentrating on value and by eliminating losses and activities that do not add value, these companies are simultaneously increasing profit. It can be said that LM is actually an approach that allows elimination of nine types of losses - waiting, overproduction, unnecessary transport, inefficient process, supplies, unnecessary movement, defects, unused potential, absence of employees (Radosavljević et al., 2015). Each of these losses can be removed or at least minimized by careful planning of lean initiative and by setting goals related to continuous improvement. At the heart of these initiatives and goals is information technology.

Ghobakhloo and Hong (2014) conducted a study in order to determine whether the application of information technology and the principle of lean management were interdependent or mutually exclusive. Based on the data collected (230 leading Iranian and Malaysian auto parts manufacturers participated in the study), the conclusion was that lean management and information technology are mutually dependent, and that the value of IT investments can be effectively transformed into improving business performance if there is a higher degree of implementation of lean management system. Pillai et al., (2014) also conclude that information technology and lean management are extremely complementary and that their effective combination continuously improved business processes.

Together, lean and IT can increase efficiency and improve the effectiveness of the process by observing certain principles (EPA, 2015, p. 2):

- Inclusion of IT staff at all stages of the project related to the improvement of business processes (even as consultants, to help with the project plan);
- Using creativity instead of capital with the aim to solve problems (maximize improvement of processes that can be achieved by small, inexpensive changes, and consider whether additional resources are required to be invested in order to generate additional benefits);
- Rationalization/simplification of the process prior to their automation (otherwise there is the possibility of retention and deterioration of errors, which leads to inefficiency of the process);
- Monitoring the results of undertaken actions, identifying and addressing previous problems, evaluating the performance of the process with the help of software tools.

A large number of organizations implement document management and content management systems, trying to secure safe and fast storage of documents, as well as

undisturbed access to relevant information. By using software, companies can respond to the needs and demands of consumers in real time, and at the same time all feedback received from consumers can be organized in one database (Dubbaka & Dadkhah, 2009). The applications use structured information that exists in databases to automate business processes (Bell & Orzen, 2011). One study shows that lean principle needs to be adopted first, and then business activities that add value should be automated, since the information technology leads to further improvements already achieved by using lean principles (Bortolotti & Romano, 2012).

The effects of traditional lean concepts advancement with information technology are most evident in the field of monitoring and organizational performance improvement. By using technology, it is possible to generate highly effective, proactively targeted indicators that will signal managers and others where their attention is necessary (Bell & Orzen, 2011). A well-established measurement system provides managers, supervisors or expert associates with the opportunity to oversee the field of special interest for them and, if need be, they can get more detailed information. Focusing on processes requires a more frequent measurement of expected results over a shorter period (monthly/quarterly). This will enable the intervention to be undertaken as needed, before the negative impact on the outcome is reached.

Moyano-Fuentes et al. (2012) analysed in a case study the link between information technology and lean concept based on data from the automotive industry. The results of the hierarchical regression analysis have shown that the degree of internal IT use had a significant impact on the level of the lean concept implementation, while external IT had decisive influence only when internal IT systems are controlled. In this way, it has been proven that there is a positive link between the level of IT usage and the level of lean implementation. The use of IT tools mainly involves process automation or their importance in reflected both in providing necessary information for the implementation of advanced lean management and in supporting the decision-making system, in order for managers to choose the appropriate approach at the right time (Kobus & Westner, 2015). Similar conclusions came from Ward and Zhou (2006), who, in their study, inter alia, empirically investigated the connection between the integration of IT and lean practices and their positive impact on the shortening of process implementation time. Wan and Chen (2009) in their work pointed to web tools that can support the decision-making process and can help managers in implementing the lean principles. By using a web-based program, each user is enabled to evaluate the current status of the business system, to identify the segments where urgent reaction is required, and also to develop appropriate techniques and tools for the purpose of formulating a plan. Owing to this, the lean concept can be implemented more effectively and systematically. Ker et al. (2014) discussed how the application of lean principles and information technology can improve the process of drug/medicine distribution. The results of statistical analysis have shown that the introduction of digital scanning technology has led to a significant reduction in the duration of the process, and at the same time the reduction of costs.

Confronted with competition and rising consumer expectations, as well as with the need to significantly improve the performance of the process and achieve competitive advantages in the market, companies are nowadays increasingly choosing to apply modern software solutions, primarily for the ERP system (Harmon, 2014). Most companies take their existing processes into account when deciding on the implementation of the ERP system. After that, the attention is paid to the ERP modules that companies intend to install. The interfaces for the ERP applications are links to documents that are in the database. It is necessary to

determine the desired architecture of the process, then look at the specificities of each process and select the activities that need to be implemented (Harmon, 2014).

When consumers and suppliers request information fully integrated through a value chain, or when executives formulate strategies and tactics in areas such as manufacturing, procurement and accounting, the ERP system analyses the data and transforms them into useful information used by companies to support the decision-making process (Wang & Nah, 2001). Riezebos et al. (2009) indicate that ERP systems can significantly reduce the time needed to collect information related to products and processes and can help managers in delivering timely and quality information while at the same time costs are being reduced. Al-Mashari (2002) points out that the use of the ERP system can stimulate the adoption of standardized business processes throughout the organization. Packowski & Francas (2013), Riezebos et al. (2009) also point to the importance of increasing the presence of ERP systems, the main focus of which is to support internal processes. The examples of the ERP support to lean management include planning to improve the responsiveness due to variability of demand and to allow measuring the costs of products per order (Webb et al., 2009, p.222). The following figure summarizes the most significant benefits of the ERP system application.

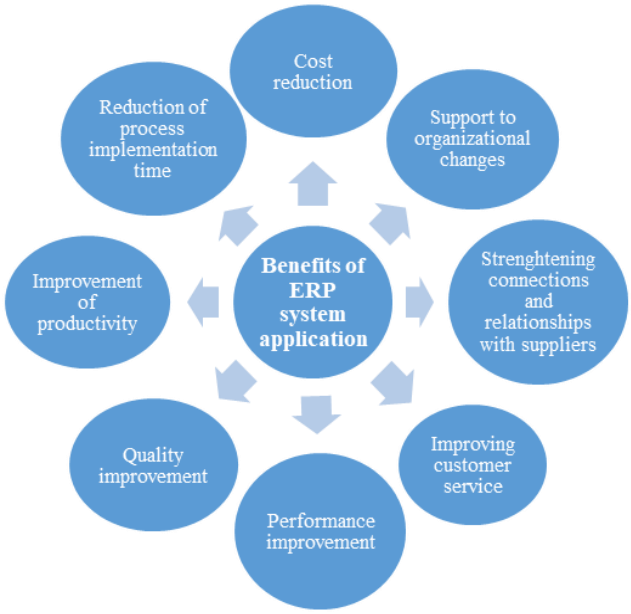

Fig. 1 The most significant benefits of ERP system application
Source: Authors, based on: Powell, D. (2012). Investigating ERP support for Lean production, Ph.D. Thesis, Norwegian University of Science and Technology

Powell (2012) has formulated fifteen ways in which the modern ERP system supports lean production. Firstly, five key principles of lean concept (value, value stream, flow, pull and perfection) were identified and within them the way in which the ERP system can provide support. Some of these support modes primarily relate to planning, then to

control (e.g. support to the production control system - Kanban), while the others relate simultaneously to planning and control (e.g. support to Customer Relationship Management - CRM, support for the exchange of information through the entire chain) (Powell, 2012, p. 78).

Table 1 The ways in which ERP supports lean production

No	Principle	An ERP system for lean production should:	Reference:
1		Support customer relationship management	(Chen and Popovich, 2003)
2	*Value*	Automate necessary non-value adding activities (e.g. backflushing)	(Hamilton, 2009)
3		Enable process-modelling to support standard work processes	(IFS, 2008, Prediktor, 2010)
4	*Value stream*	Provide a source for easy-to-find product drawings and standard work instruction	(Houy, 2005, Tjahjono, 2009)
5		Support information sharing across the supply chain	(Bjorklund, 2009, Kob et.al., 2008)
6		Create synchronized and streamlined data flow (internal & external)	(Hamilton, 2003)
7		Support line balancing	(Steger-Jensen and Hvolby, 2008)
8	*Flow*	Support demand levelling	(Hamilton, 2009)
9		Support order less rate-based planning (e.g. tact-time)	(IFS, 2010)
10		Provide decision support for shop floor decision making	(Hamilton, 2009)
11		Support kanban control	(Hamilton, 2009, Masson and Jacobson, 2007)
12	*Pull*	Support production levelling	(Masson and Jacobson, 2007)
13		Support JIT procurement	(Masson and Jacobson, 2007)
14		Provide a system to support root-cause analysis and for the logging and follow-up of quality problems	(Bjorklund, 2009)
15	*Perfection*	Provide highly visual and transparent operational measures (e.g. real time status against plan)	(Prediktor, 2010)

Source: Powell, D. (2012). Investigating ERP support for Lean production, Ph.D. Thesis, Norwegian University of Science and Technology, p. 77.

2. RESEARCH METHODOLOGY

The goal of the empirical research is to determine the direction and intensity of the impact of information technologies on the performance of business processes in enterprises in Serbia. In this sense, one of the tasks of empirical research is to discover whether the postulates according to which lean concept operates are present in the Republic of Serbia's enterprises. It is expected that the research results will reveal these relations, and the discussion of results will explain the obtained results.

2.1. The assumptions and research methods

The survey was conducted on included enterprises from the territory of the Republic of Serbia that are registered in the Serbian Business Registers Agency. The selection of sample enterprises was done randomly. The research was carried out using the survey method based on a structured questionnaire. The questionnaires were distributed to 180 e-mail addresses of managers who evaluated the state of information technology in their enterprise. The response rate was 25.5% (46 enterprises). The main limitation is that the results were obtained by interviewing a limited number of respondents. A five-point Likert scale was used to examine the degree of respondents' agreement with the provided claims. Data analysis was performed using appropriate statistical methods, which are: descriptive statistics, correlation analysis and cluster analysis, $\chi 2$ test, applying the IBM SPSS statistical package software. The application of these statistical methods should enable the testing of the following hypotheses:

1. Doing business in the enterprises in Serbia rests on the postulates of the lean management,
2. Elements of the lean management are mutually correlated
3. The application and usefulness of IT is at a high level in the enterprises in Serbia,
4. The effects of IT implementation are mutually correlated,
5. There is statistically significant interdependence between the application and effects of IT and the lean practice in enterprises in Serbia.

Bearing in mind the research goal related to determining whether the enterprises in Serbia apply lean concept, the appropriate lean claims have been defined:

L1: The customer represents the essential reason for the existence of an enterprise and therefore should exist based on all business functions,

L2: In order to be fully committed to customers and their needs and wishes, the enterprise must continuously eliminate the waste in everything they do,

L3: The enterprise becomes the organization that learns, putting emphasis on intellectual rather than material capital,

L4: Transparency represents the tool of timely response to both internal and external change,

L5: Innovation and gradual, continuous improvement become the integral part of the business culture and business philosophy of a modern enterprise,

L6: The enterprise must insist on creating the quality of products at the very source, or at every step of the value stream, at each stage of the business process,

L7: The application of an appropriate measurement system helps the enterprise and employees stay on the right track, and repair and eliminate any omissions that disturb or slow down their pace.

In order to create an image of the state of information technologies in the observed enterprises, 12 claims (on the basis of theoretical considerations and corresponding aspects of the application of information technologies) have been defined:

IT1: Employees in the enterprise are trained to use modern information technologies,
IT2: In the enterprise, software tools are used to a large extent,
IT3: The ERP system is used in the enterprise,
IT4: Employees in the enterprise are trained to use the ERP system,
IT5: Using the ERP system contributes to reducing the process implementation time,
IT6: Implementation of the ERP system leads to the reduction in costs,
IT7: The ERP system supports organizational changes,
IT8: The ERP system contributes to strengthening connections and relationships with suppliers,
IT9: The ERP system provides improvement of the services provided to consumers,
IT10: Performance improvements were made after implementation of the ERP system,
IT11: The ERP system contributes to quality improvement,
IT12: The ERP system leads to increased productivity.

The first four claims directly concern IT implementation, while the purpose of the other 8 claims is to evaluate the effects and usefulness of IT, seen from the interviewed managers' perspective.

2.2. Results and discussion

The analysis of the significance of certain lean claims has shown that in enterprises the highest importance is attributed to product quality creation at the source, that is, at every step of the value stream, at each stage of the business process (LM6 average score 4.13, standard deviation 1.05). The LM7 claim has the lowest average rating It states that the application of an appropriate measurement system helps the enterprise and employees stay on the right track, and repair and eliminate any omissions that disturb or slow down their pace. Consequently, it can be said that the first hypothesis can be accepted since the average value of the claims concerning the LM implementation are all at least 3.5.

Table 2 Descriptive statistics for lean issues

	N	Minimum	Maximum	Mean	Std. Deviation
LM1	46	1.00	5.00	3.6087	1.20145
LM2	46	1.00	5.00	4.0217	1.14483
LM3	46	1.00	5.00	3.9565	1.11468
LM4	46	2.00	5.00	3.9783	.88164
LM5	46	1.00	5.00	3.7609	1.19601
LM6	46	1.00	5.00	4.1304	1.04581
LM7	46	1.00	5.00	3.4783	1.69626

Source: Authors' calculation, SPSS output

Table 3 provided the descriptive statistics overview of the claims regarding the application of information technology. In the context of descriptive statistics, the average estimates were made. Especially positive is the fact that the best-rated claims are IT2: In the enterprise, software tools are used to a large extent (average score 4.24) and IT9: The ERP system provides improvement of the services provided to consumers (average score 4.28). This is also confirmed by the low standard deviations. It is very important to notice the significance of using modern IT, which is a key factor in the success and survival of modern enterprises. Accordingly, there is a chance to increase the use of software solutions, in particular the ERP system in enterprises in Serbia and generate benefits based on their application. The weakest rated claim is IT4: Employees in the enterprise are trained to use the ERP system (average score 3.35). In this way, the weakness, which is still characteristic of the enterprises in Serbia, is reflected and it refers to insufficient training of employees for the work with software tools. Identical results were achieved by another research, which concluded that better results and overcoming of this problem should be expected in the upcoming period, as in time the change of generation among the employees will happen, and younger people, as a rule, are better at working with modern information technologies (Mitić, 2016, p. 82). The research results of the Republic Statistical Office show that in 2016 only 11.8% of enterprises provided training of ICT experts, while 30.2% of the enterprises enabled training for other employees to develop ICT skills (Republic Statistical Office, 2017). As in case of the first hypothesis, it can be said that the average values of the IT implementation and effects indicate that the third hypothesis can also be accepted.

Table 3 Descriptive Statistics for IT issues

	N	Minimum	Maximum	Mean	Std. Deviation
IT1	46	1.00	5.00	3.5870	1.55744
IT2	46	1.00	5.00	4.2391	1.15825
IT3	46	2.00	5.00	4.1739	.99564
IT4	46	1.00	5.00	3.3478	1.36979
IT5	46	1.00	5.00	3.7609	1.21445
IT6	46	2.00	5.00	4.0435	1.07407
IT7	46	1.00	5.00	3.9783	1.54185
IT8	46	1.00	5.00	4.1087	1.05889
IT9	46	1.00	5.00	4.2826	1.00362
IT10	46	1.00	5.00	3.6957	1.19014
IT11	46	1.00	5.00	3.9130	1.24412
IT12	46	1.00	5.00	4.1304	1.10772

Source: Authors' calculation, SPSS output

In order to check the consistency in implementation of lean management, it can be useful to inspect if there is a correlation between the observed claims. The correlation between the claims was investigated by the Spearman's correlation coefficient.

When it comes to mutual correlation between the lean claims presented in Table 4, it is noted that there is a lower or higher degree of correlation, but anyhow, it is positive. Therefore, the second hypothesis can be accepted. This means that the postulates, which lean concept relies on, are interconnected and that their synergetic effect can be ensured.

Table 4 Correlation analysis between lean variables

		LM1	LM2	LM3	LM4	LM5	LM6	LM7
LM1	Correlation Coefficient	1.000	.676**	.446**	.563**	.595**	.403**	.679**
	Sig. (2-tailed)	.	.000	.002	.000	.000	.005	.000
	N	46	46	46	46	46	46	46
LM2	Correlation Coefficient	.676**	1.000	.543**	.666**	.640**	.551**	.824**
	Sig. (2-tailed)	.000	.	.000	.000	.000	.000	.000
	N	46	46	46	46	46	46	46
LM3	Correlation Coefficient	.446**	.543**	1.000	.432**	.320*	.475**	.545**
	Sig. (2-tailed)	.002	.000	.	.003	.030	.001	.000
	N	46	46	46	46	46	46	46
LM4	Correlation Coefficient	.563**	.666**	.432**	1.000	.481**	.468**	.541**
	Sig. (2-tailed)	.000	.000	.003	.	.001	.001	.000
	N	46	46	46	46	46	46	46
LM5	Correlation Coefficient	.595**	.640**	.320*	.481**	1.000	.373*	.551**
	Sig. (2-tailed)	.000	.000	.030	.001	.	.011	.000
	N	46	46	46	46	46	46	46
LM6	Correlation Coefficient	.403**	.551**	.475**	.468**	.373*	1.000	.521**
	Sig. (2-tailed)	.005	.000	.001	.001	.011	.	.000
	N	46	46	46	46	46	46	46
LM7	Correlation Coefficient	.679**	.824**	.545**	.541**	.551**	.521**	1.000
	Sig. (2-tailed)	.000	.000	.000	.000	.000	.000	.
	N	46	46	46	46	46	46	46

** Correlation is significant at the 0.01 level (2-tailed).

Source: Authors' calculation, SPSS output

Since claims from IT5 to IT12 concern the effects of the implementation of the ERP system and the benefits it brings to the enterprise, these claims are used for further analysis, first correlation and then cluster.

Table 5 presents the results of the correlation analysis for IT. The results show that the correlations of claims are positive, but not all statistically significant. This leads to the conclusion that enterprises are not consistent in implementing the ERP system or that not all effects of IT implementation lead the enterprise in the same direction. This is the case of the claims IT6: Implementation of the ERP system leads to a reduction in costs, IT10: Performance improvements were made after implementation of the ERP system, IT11: The ERP system contributes to quality improvement, and IT12: The ERP system leads to increased productivity. Consequently, the fourth hypothesis cannot be accepted.

Table 5 Correlation analysis between IT variables

		IT5	IT6	IT7	IT8	IT9	IT10	IT11	IT12
IT5	Correlation Coefficient	1.000	.475**	.542**	.433**	.281	.179	.301*	.164
	Sig. (2-tailed)	.	.001	.000	.003	.058	.235	.042	.276
	N	46	46	46	46	46	46	46	46
IT6	Correlation Coefficient	.475**	1.000	.492**	.426**	.467**	.191	.252	.095
	Sig. (2-tailed)	.001	.	.001	.003	.001	.203	.092	.529
	N	46	46	46	46	46	46	46	46
IT7	Correlation Coefficient	.542**	.492**	1.000	.614**	.488**	.313*	.269	.223
	Sig. (2-tailed)	.000	.001	.	.000	.001	.034	.071	.136
	N	46	46	46	46	46	46	46	46
IT8	Correlation Coefficient	.433**	.426**	.614**	1.000	.381**	.305*	.203	.343*
	Sig. (2-tailed)	.003	.003	.000	.	.009	.039	.176	.020
	N	46	46	46	46	46	46	46	46
IT9	Correlation Coefficient	.281	.467**	.488**	.381**	1.000	.034	.016	.147
	Sig. (2-tailed)	.058	.001	.001	.009	.	.823	.917	.329
	N	46	46	46	46	46	46	46	46
IT10	Correlation Coefficient	.179	.191	.313*	.305*	.034	1.000	.170	.061
	Sig. (2-tailed)	.235	.203	.034	.039	.823	.	.260	.690
	N	46	46	46	46	46	46	46	46
IT11	Correlation Coefficient	.301*	.252	.269	.203	.016	.170	1.000	.388**
	Sig. (2-tailed)	.042	.092	.071	.176	.917	.260	.	.008
	N	46	46	46	46	46	46	46	46
IT12	Correlation Coefficient	.164	.095	.223	.343*	.147	.061	.388**	1.000
	Sig. (2-tailed)	.276	.529	.136	.020	.329	.690	.008	.
	N	46	46	46	46	46	46	46	46

*Correlation is significant at the 0.05 level (2-tailed).
** Correlation is significant at the 0.01 level (2-tailed).
Source: Authors' calculation, SPSS output

In order to test the last hypothesis, the cluster analysis and χ^2 test have been used. The idea is to classify the enterprises into two clusters based on the LM implementation and, also into two clusters based on the IT effects, and then to compare the cluster membership of the enterprises based on χ^2 test. According to the answers related to 7 lean claims, enterprises are classified into two clusters. Also, according to the benefits that IT brings to the enterprise, the enterprises are also classified into two clusters, thus creating the possibility for appropriate comparison. The cluster analysis is performed based on the Hierarchical cluster analysis (cluster method - With-in groups linkage, interval – Squared Euclidean distance). Based on χ^2 test, the relationship between cluster membership based on IT and LM claims has been analysed. The results of χ^2 test are presented in the following table.

Table 6 χ^2 test statistics

	Value	df	Asymp. Sig. (2-sided)	Exact Sig. (2-sided)	Exact Sig. (1-sided)
Pearson Chi-Square	4.403	1	.036		
Continuity Correction	2.781	1	.095		
Likelihood Ratio	6.638	1	.010		
Fisher's Exact Test				.078	.038
Linear-by-Linear Association	4.308	1	.038		
N of Valid Cases	46				

Source: Authors' calculation, SPSS output

Based on the significance level, which is 0.036 according to the Pearson Chi-Square and 0.038 according to the Fisher's Exact test, it can be concluded that there is a statistically significant relationship between clusters based on IT and LM claims. Consequently, based on this, it can be concluded that enterprises that have substantially implemented LM practices and principles are at the same time those which consider implementation of IT in their business as useful, which consequently means that the information systems represent the support for the implementation of the lean practice. Consequently, this means that there is statistically significant interdependence between the application and effects of IT and the LM implementation in enterprises in Serbia. Therefore, the fifth hypothesis can be accepted.

CONCLUSION

In this paper, the current business practice of the enterprises in the Republic of Serbia has been analysed. Based on this, the existing level of modernity and application of information technologies has been determined, as well as the level of attention paid to software solutions, and especially the ERP system. The analysis of the research results confirmed all three hypotheses that represent the starting point of the research. Precisely, based on Table 2, the first hypothesis was confirmed. The analysis has shown that there is an acceptable level of LM principles implementation, since lean claims have high average scores (especially L6: Enterprise must insist on creating the quality of products at the very source, at each stage of the business process and L2: Enterprise must continuously eliminate the waste in everything they do). Doing business in the enterprises in Serbia rests on the postulates of lean management, but the results in Table 4 (correlation between lean variables) indicate that there is a group of enterprises that implement LM principles, while, at the same time, there is another group of enterprises whose implementation of LM principles is not at an enviable level.

According to Table 3, the analysis has shown that there is an acceptable level of IT implementation effects. However, Table 5 shows that there is a high correlation coefficient between cluster membership and IT claims, indicating that there is a group of enterprises that characterises IT implementation, while, at the same time, there is another group of enterprises whose IT implementation is not at a high level. One must also have in mind that the enterprises in Serbia are in different stages of the ERP system implementation, so they are faced with different costs, depending on the current stage. In addition, after the ERP

system implementation, certain costs related to its maintenance, additional training of employees and the use of consulting services will certainly occur.

When it comes to the correlation between the cluster's affiliation to IT and LM claims, the significance of 0.036 and 0.038 shows that, in this case, there is a positive relationship that is statistically significant. This precisely points out to the conclusion that in the coming period, there is a chance for even greater application of modern information and communication technologies providing necessary support for the implementation of lean principles in the enterprises in Serbia.

In order to monitor the variability of the research results, it is necessary to repeat the research after a while, and include even more respondents, as well as to expand the subject of the research. Based on the analysis presented in this paper, potential improvements and recommendations can be proposed. First of all, it is necessary to provide additional training to employees in order to reduce the gap between their skills and the requirements imposed by the use of a modern ERP system. The recommendation to enterprises is to continuously invest in purchase and maintenance of modern information technologies, since the level of their application in an enterprise has both direct and indirect impact on business performance. Further research could involve deeper analysis of the enterprises that have been implementing LM and IT, for example, concerning the following independent variables: size, capital origin, managers' orientation, managers' origin and so on.

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ULOGA INFORMACIONE TEHNOLOGIJE U IMPLEMENTACIJI LEAN KONCEPTA

Postizanje i jačanje konkurentske prednosti predstavlja ključni faktor opstanka i uspešnosti poslovanja savremenih preduzeća. Činjenica je da uspešna primena lean menadžmenta dovodi do povećanja produktivnosti i kompetentnosti. Međutim, u cilju održavanja profitabilnosti i poslovne stabilnosti, neophodna je podrška lean konceptu koja se ogleda pre svega u primeni savremene informacione tehnologije. Primenom ERP sistema omogućava se prilagođavanje osnovnih lean principa zahtevima savremenog okruženja koje karakteriše konstantna promena zahteva i potreba potrošača/korisnika. Osnovni cilj istraživanja je da se ispita postojeći nivo primene savremenih informacionih tehnologija, kao i nivo pažnje koji se poklanja integraciji lean koncepta i softverskih rešenja, u preduzećima u Srbiji. Teorijski aspekt istraživanja odnosi se na pronalaženje odgovarajuće osnove za zaključivanje na bazi postojeće literature. U radu su identifikovani istraživački jazovi i predloženi dalji pravci istraživanja. Primenom odgovarajućih statističkih alata (deskriptivna statistika, klaster analiza, korelaciona analiza, χ2 test) konačno je zaključeno da preduzeća koja su u značajnoj meri implementirala praksu i principe lean menadžmenta, jesu istovremeno i ona koja u svom poslovanju primenjuju IT, odnosno informacione sisteme za podršku implementaciji lean prakse.

Ključne reči**:** *lean menadžment, informacione tehnologije, softverska rešenja, ERP sistem*