

Denis Delismajlović, MSc in Economics, PhD Candidate / Doktorant
University of Mostar “Džemal Bijedić” /
Univerzitet „Džemal Bijedić” u Mostaru
Faculty of Economics / Ekonomski fakultet
Prof. Dr. Elvir Čizmić
University of Sarajevo / Univerzitet u Sarajevu
School of Economics and Business / Ekonomski fakultet

UDK 65.011.3

Izvorni naučni članak

**SITUATIONAL RISK MANAGEMENT IN ENTERPRISE
RESOURCES PLANNING SYSTEMS (ERP) IMPLEMENTATION:
AN EMPIRICAL STUDY**

**SITUACIONO UPRAVLJANJE RIZICIMA KOD
IMPLEMENTACIJE INTEGRIRANIH POSLOVNIH
INFORMACIONIH (ERP) SISTEMA: EMPIRIJSKO ISTRAŽIVANJE**

Summary

Implementation of enterprise business information systems, due to their complexity and integration, requires many resources and is often unsuccessful. To reduce the number of unsuccessful implementation and improve their results, it is necessary to manage risks actively during the implementation, which involves adapting the process to the implementation context. This paper proposes a model for a situational approach to risk management based on the context of implementation, i.e. implementation approach and the characteristics of organizations where the system is implemented. An empirical study has been conducted based on a survey sent to experts from a number of countries involved in enterprise system implementation to test and analyze differences related to different characteristics and contexts.

Keywords: Enterprise systems; ERP; Integrated Business Information Systems; Risk Management, Situational methodology.

Sažetak

Implementacije integriranih poslovnih informacionih sistema (ERP), zbog svoje složenosti i integracije, zahtijevaju mnogo resursa i često su neuspješne. Da bi se smanjio broj neuspješnih implementacija i poboljšali njihovi rezultati, potrebno je aktivno upravljati rizicima u toku realizacije projekta, što uključuje prilagođavanje

procesa upravljanja rizicima kontekstu implementacije. U ovom radu je predložen model za situacioni pristup upravljanju rizicima na osnovu konteksta implementacije, u zavisnosti od pristupa (metode) implementacije i karakteristika organizacije u kojoj se implementira sistem. U okviru toga, kao glavni dio, urađeno je empirijsko istraživanje među konsultantskim kućama i ekspertima iz većeg broja zemalja uključenih u implementacije ERP-sistema, a radi testiranja i analize razlika koje nastaju zbog različitih karakteristika implementacije.

Ključne riječi: *integrirani poslovni informacijski sistemi, ERP, upravljanje rizikom, situaciona metodologija*

Introduction

Risks are a constitutive part of an ERP project implementation. However, with planning and a systematic approach to the risk management during the project implementation, the possibility of failure is reduced. To avoid the consequences of implementation failure and achieve the most benefits from it, actively managing risks should be firmly embedded in the implementation process of integrated business information systems and of high importance for organizations that strive to create additional business value and competitive advantage from the implemented system. ERP projects risk management was a subject of research conducted by various authors who tried to understand the ERP project risks systematically. By creating situational risk management methodology in the ERP system implementation, through identification of the risk factors, their qualitative, and quantitative analysis, and behavior in the context of different aspects of the implementation and organization in which they are implemented - the results of the implemented system could be significantly improved. Regarding that, this research conducts an identification of risk factors and their qualitative and quantitative valorization. Different type and characteristics of the implementation are taken into consideration aiming to identify and analyze the specifics of particular models of the implementation. Also, the influence of characteristics of the organization where the ERP system implementation is conducted is examined as one of the possible enlargement or reduction factors of the implementation's risk.

1. Situational methodology of risk management model

Various approaches to the project and risk management are found in the literature. The situational or contextual approach is used in this paper which means that different situations or contexts affect the process of project management and that there is no single methodology for all circumstances. It indicates that various contexts or situations of the ERP project implementation more or less emphasize some of the risks and therefore dictate different approaches to their management. This understanding is contained in the concept which is in literature called *Situational method engineering* because it implies methodology engineering for a certain situation. ‘Engineering’ means either creating that methodology from scratch and/or supplementing existing methodologies; respectively, starting point can be either a set of methodology pieces that comprise it or existing, usually predefined, methodology. Simplified situational risk methodology creation model (created based on Henderson-Sellers et al., 2014):

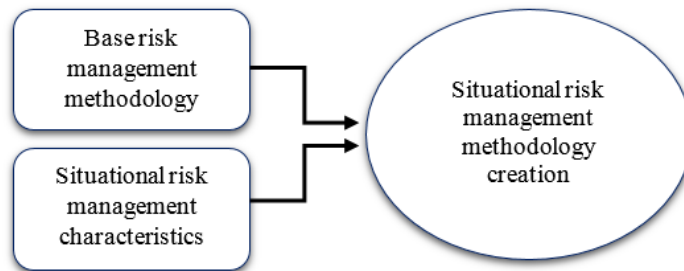


Figure 1. Simplified situational risk management methodology creation model

This approach includes 1) determining the base risk management methodology or segments of methodology as the basis and 2) the situational risk management characteristics which bring in a context in which implementation unfolds. In this research, PMBOK methodology is used as the base methodology, as it represents the universally accepted approach to project management, and therefore risk management. Based on that, a model for the situational approach to risk management based on the context of implementation is created:

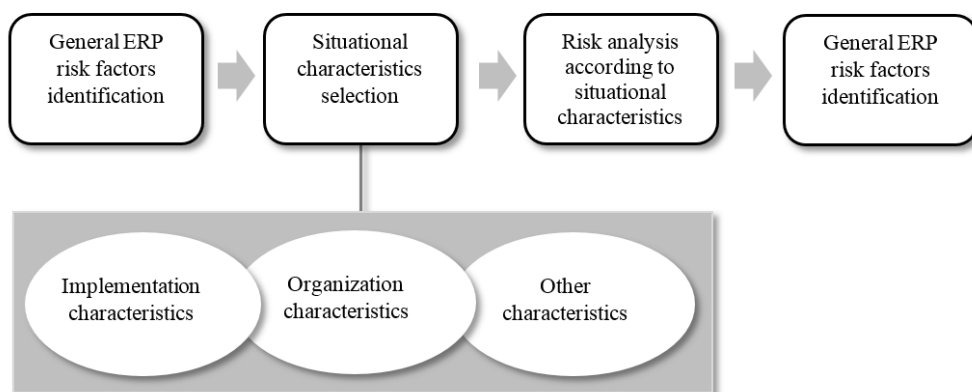


Figure 2. Research model

The difference of this model compared to the PMBOK is that it also takes situational characteristics into consideration: (1) implementation characteristics, (2) organization where implementation is performed characteristics and (3) other characteristics.

2. Risk factors

The foundation of risk management is the identification and analysis of risk factors which emerge in a certain type of project. Different varieties of projects have different risk factors. Sumner (2000) identifies the IT project risk factors and singles out those that are specific to ERP system implementation. Implementation risk factors of ERP systems were a subject of choice of many other authors (for example Scott and Vessey, 2002; Ravasan and Mansouri, 2014; Aloini, et al., 2007, Camara et al. 2006; O'Leary, 2000, Huang et al., 2004, Wright and Wright, 2001). Aloini et.al. (2007) can be particularly distinguished, as they completely analyzed all available literature in the risk management of the ERP system implementation, and then summarized it in 19 generic factors by the frequency of their appearance in literature. On the other hand, some authors single out the factors specific to the certain context of implementation or organization type. Zeng (2010) analyzes risk factors of ERP system implementation in the project-oriented organization; whereas Kraljic et al. (2011) distinguish the specific factors of ERP system implementation in state owned companies in Bosnia and Herzegovina. By available literature analysis with a special emphasis on the works of Aloini et al. (2007), as well

as Ravasan and Mansouri (2014), who were already engaged in other authors' risk factor gathering and analysis - a modified risk factor list is created for this research:

Table 1. Identified risk factors in ERP system implementation

Factor	Description
<i>R1</i>	<i>High fluctuation of project team members or lack of people within the project team during the ERP implementation</i>
<i>R2</i>	<i>Low competence of the project team (including consultants)</i>
<i>R3</i>	<i>Unclear or poorly defined goals, objectives and scope of implementation</i>
<i>R4</i>	<i>Inadequate organization's top management support and involvement</i>
<i>R5</i>	<i>Lack of adequate management structure in the project</i>
<i>R6</i>	<i>Inefficient communication and reporting system towards stakeholders (especially to users)</i>
<i>R7</i>	<i>Problems in communication and cooperation among organization's departments and functions involved in the implementation</i>
<i>R8</i>	<i>Inadequate user involvement in the implementation process</i>
<i>R9</i>	<i>Inadequate user training</i>
<i>R10</i>	<i>Inadequate business process reengineering in order to adapt the organization to the new ERP system</i>
<i>R11</i>	<i>Inefficient or inadequate ERP system project management methodologies, techniques and practices</i>
<i>R12</i>	<i>Inadequate change management during the implementation</i>
<i>R13</i>	<i>Data migration and data integration problems</i>
<i>R14</i>	<i>Poor budgeting, evaluation, and cost control of the project</i>
<i>R15</i>	<i>Inadequate behavior of middle and lower managers in the organization during the implementation</i>

As the research focus of this paper is implementation alone, not the stages before or after, the risk factors are related to that part of the ERP system implementation process.

3. Situational characteristics of research

The second aspect of the situational (contextual) methodology creation is the situational characteristics which, essentially, make a difference between projects. Apart from the ERP system specifics which have certain characteristics, which differentiate it from other information systems, situational characteristics are specified in this paper: 1) implementation characteristics, 2) organization where the implementation is performed characteristics and 3) other characteristics.

Implementation characteristics as a determinant of the risk management. There are various approaches to the ERP system implementation, and they are used depending on the available time, budget, size and breadth of the organization and other factors. Implementation characteristics are shown in the next table:

Table 2. Implementation characteristics as a determinant of risk management

<i>Implementation characteristics</i>	<i>Situational characteristics</i>	<i>Description of the characteristic</i>
Implementation method (strategy)	„Big bang“	Implementation is performed simultaneously in the whole organization, bigger impact on business.
	Phased implementation (including "Roll-Out")	Implementation is performed in smaller, logically linked, phases/steps. Smaller impact on business.
System modification level	„Vanilla“	Implementing standardized ERP system, with minimal customization.
	Substantial customization	Substantial standard ERP customization (modification).

Organization characteristics as a determinant of the risk management. Aside from the approach to the implementation, it is necessary to analyze the characteristics of the organization itself where the system is implemented. Organization characteristics are shown in the next table:

Table 3. Organization characteristics as a determinant of risk management

<i>Organization characteristics</i>	<i>Situational characteristics</i>	<i>Description of the characteristic</i>
Territorial organization types	One location	Organization territorial widespread on multiple locations or countries can largely affect the ERP system implementation, and there is an assumption of the risk increase and a possibility of project failure.
	Multiple locations	
Proprietary organization types	State owned/public companies	According to earlier research, the proprietary organization type can also play a role in certain risk increase, and therefore, this aspect can be noted in the risk factor analysis as one of the determinants.
	Private companies	
Organization size	SMEs	Organization size is also found in research as relevant to the selection of the implementation approach, so this characteristic can lead to different risk level that appear during the implementation.
	Large enterprises	

In the next chapter, the research results according to the different characteristics are presented.

4. Data analysis and research results

The survey was international and the final list of 107 experts from 36 countries were surveyed. The participants were mostly recognized by their LinkedIn profile, activities in the ERP communities, and previous work with the author on ERP project implementations.

4.1 Risk factors evaluation according to situational characteristics

The research results are analyzed in various contexts. These contexts included implementation characteristics („Big bang“, Phased approach, „Vanilla“ and substantial customization), as well as characteristics of

organization where the implementation is performed (territorial and proprietary organization types, and organization size). To analyze this, 5 weights are defined: Substantial risk increase (+30%), Lesser risk increase (+10%), Without change (0%), Lesser risk reduction (-10%) and Substantial risk reduction (-30%). After processing the results, by increasing or reducing by respective weights, the following differences regarding the general risk rating are obtained:

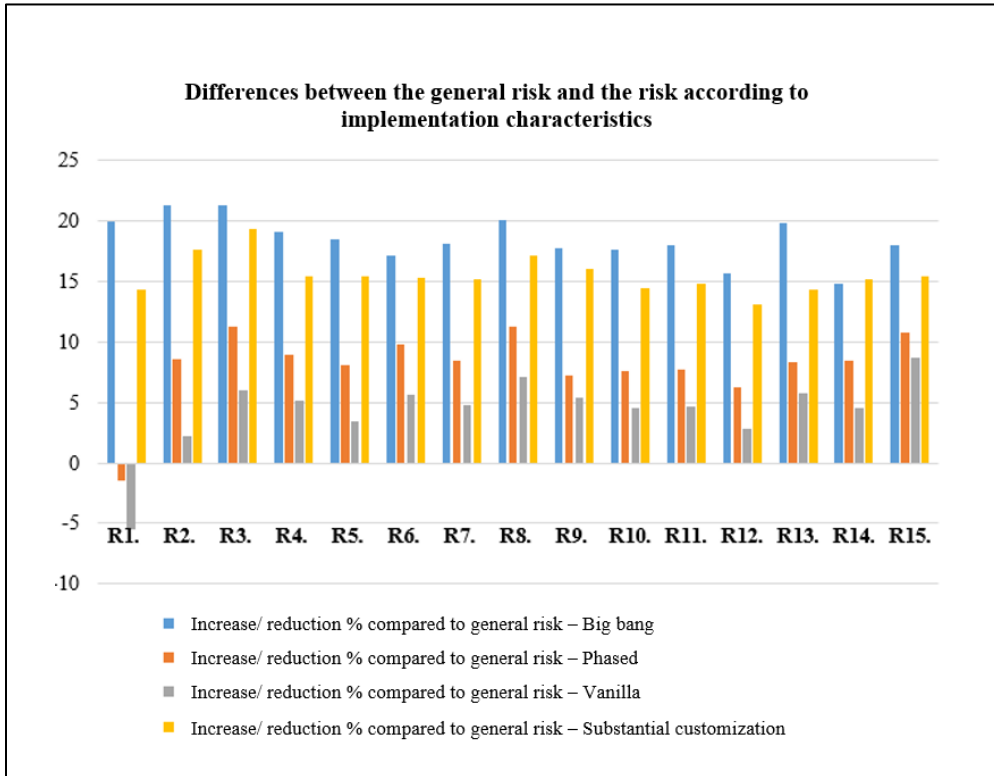


Figure 3. Differences between the general risk and the risk according to implementation characteristics

According to the survey results, implementation characteristics lead to smaller or greater changes in risks compared to the general rating. The changes happened in both, factor values (% increase/reduction), as well as in their mutual ranking.

The "big-bang" approach lead to the greatest increase of risks, which is reasonable since the complete implementation takes place instantaneously and there is not much time for reaction or revision of the mistakes as in the phased approach. Even when the risk factors' ranking is observed, this approach yields the most changes, where as much as eight factors have

changed ranks, either by increase or reduction. Hence, not even a single factor reduced, whereas several have increased more than others. It is interesting that factor *R3 - Unclear or poorly defined goals, objectives and scope of implementation*, which is normally rated with the highest rating in the general sense - had the biggest increase. Also, *R2 - Low competency of the project team members (including consultants)* had a large increase, because, in this implementation approach, the project team has to have plenty of experience to deliver the required functionalities by the agreed deadline.

On the other side, phased approach had far lesser results, where the factor *R8 - Inadequate user involvement in the implementation process* – had the most increase which is probably a consequence of the implementation process centralization. As the phased implementation is mostly executed in large enterprises, there is not often much space to engage the users in the implementation process, and the more or less predefined implementation solution is given in all organizational units where the system is implemented. Further, with phased approach the factor *R1 - High fluctuation of project team members or lack of people within the project team during the ERP implementation* - even had a reduction regarding the general rating, which could be a consequence of the better organization of the implementation team because of mutual experience in the previous phases of implementation, lesser stress concerning deadlines, and more time to engage additional members. It could be concluded that this part of the results is coherent with the previous researches, which means that the risk is generally greater with the "big-bang" approach rather than the phased approach.

With the system modification on mind as a characteristic of implementation, it can be noticed that the substantial system modification is at the same time far riskier approach to the implementation, which is accordant with the ERP system implementers' logic where the standard system implementation approach is usually sought to be used (even often the "vanilla" as its extreme). The reason for this is because the standard system is often easier for implementation, was many times tested previously, used as the best practice by many organizations - so there is no surprise with its implementation, usage, and further upgrading.

Regarding the approach with the substantial system modifications, again the largest increase had the factor *R3 - Unclear or poorly defined goals, objectives and scope of implementation* - which was rated the highest mark in the general sense, but also had the biggest increase with the "big-bang" approach. If the goals and the implementation size are not clearly defined with the substantial system modification approach, then modifications could be performed endlessly, which would extend the implementation time as well as expenses. There were not many increases with the "vanilla"

approach, and similarly with the phased approach, the factor *R1 - High fluctuation of project team members or lack of people within the project team during the ERP implementation* - had a decrease regarding the general rating, which could be linked to the fact that the implementation of the standard system requires less experience and knowledge.

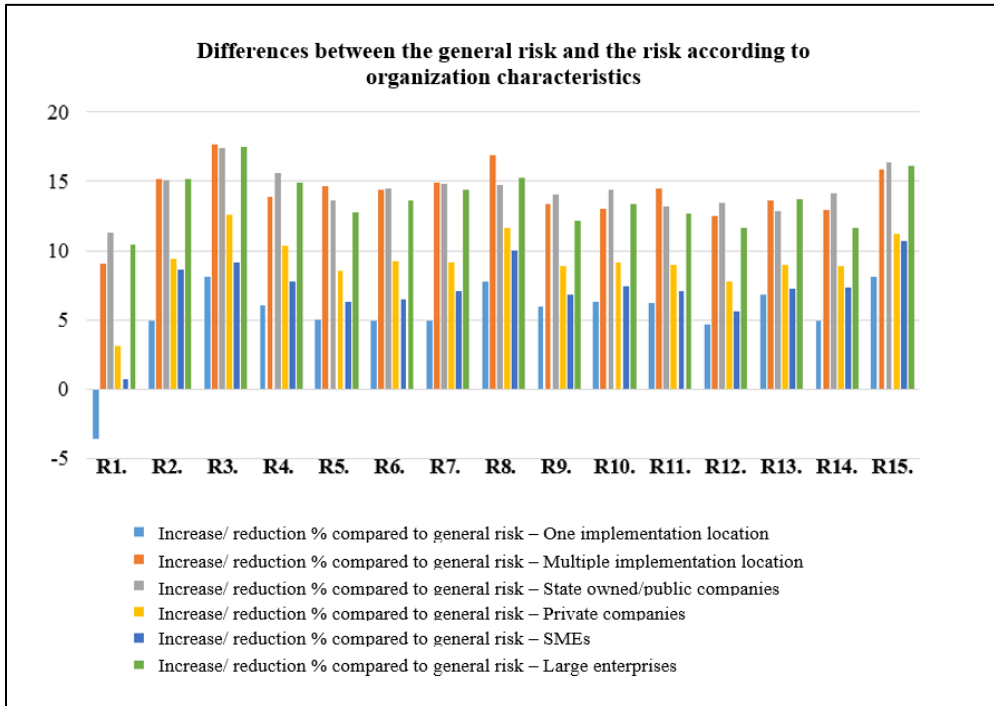


Figure 3. Differences between the general risk and the risk according to organization characteristics

According to the research results in general, the implementation which takes place in organizations on multiple locations leads to greater risk, than those in one place. The greatest increase again had the factor *R3 - Unclear or poorly defined goals, objectives and scope of implementation*, which can be associated with the greater impact on the project if the scope is not defined precisely. Furthermore, in that case, could, in different locations, the functionalities for implementing be differently defined, which could lead to a lesser unification of the work processes and the system itself, more difficult decisions making on how to perform the work, different problems from location to location, etc. The second most affected factor is the *R8 - Inadequate user involvement in the implementation process*, also second with the total risk results too. As with the phased approach, the implementation on multiple locations is usually performed in large enterprises as well, so it

normally does not leave much room to involve users in the implementation process - therefore a unique solution for implementation in all locations is usually predefined.

The proprietary organization type also plays a role in determining different risk levels between the particular risk factors. Implementation is therefore in state/public organizations, according to the research results, riskier than those in private organizations. In both cases, the biggest increase was with the factor *R3 - Unclear or poorly defined goals, objectives and scope of implementation* - which follows the previous results, although, at state/public organizations, that increase is considerably larger. Furthermore, with state/public businesses the factor *R15 - Inadequate behavior of middle and lower managers in the organization during the implementation* - is also important, which could be linked to the deficiency of the formal and real authority of the top management towards the lower levels. On the other hand, the factor *R8 - Inadequate user involvement in the implementation process* - is prominent in private companies.

The size of the organization as an implementation characteristic puts greater emphasis on risk increase in large enterprises, rather than SMEs. Even with large enterprises, the most increase happens in the factor *R3 - Unclear or poorly defined goals, objectives and scope of implementation* - which could be due to greater consequences in great enterprises in case of this risk's occurrence. The most distinguished in SMEs is the factor *R15 - Inadequate behavior of middle and lower managers in the organization during the implementation*. The reason behind this could be in the fact that in smaller organizations the middle and lower managers do many different jobs, or have more functions at the same time, unlike those in large organizations so that can decrease their engagement and engagement of their inferiors. This is especially evident if there does not exist a clearly defined role of every participant in the project, so managers always put their regular business roles first, neglecting the project. Regarding the rank change, most factors are changed in implementation characteristics in multiple locations and implementations in private organizations (6 factors each). It is especially important to note the factors *R7 - Problems in communication and cooperation among organization's departments and functions involved in the implementation*, and *R10 - Inadequate business process reengineering in order to adapt the organization to the new ERP system* - which, in some cases, change positively, and in other negatively.

4.2 Situational approach - combination of characteristics

After reviewing the results individually by the characteristics of implementation and the organization where implementation was performed, results according to combined characteristics are shown in this part. The reason for this approach is to show the existence of differences between groups of participants and their answers, which were the constitutive part of one unique average. In the survey, every participant specified the ERP they usually implement, and these answers were combined with results on implementation approach. In this example the analysis for implementation approach of SAP is shown, to see the differences in relation to general risk results. The distribution of the risk by implementation approach for SAP implementations is presented in the next table:

Table 4. Evaluation of the risk by implementation approach for SAP implementations

Risk factor	General risk				Increase/decrease of risk for SAP implementation			
	Big bang	Phased approach	Substantial customization	Vanilla	Big bang	Phased approach	Substantial customization	Vanilla
R1	2,619	2,153	2,064	2,496	5,82%	6,57%	29,22%	-10,35%
R2	3,324	2,977	2,802	3,225	3,04%	3,04%	20,29%	-9,55%
R3	3,824	3,506	3,339	3,762	4,99%	4,93%	17,22%	-6,85%
R4	3,077	2,816	2,716	2,984	5,57%	6,61%	16,51%	-2,42%
R5	2,846	2,597	2,486	2,774	12,09%	12,28%	24,64%	1,94%
R6	2,797	2,622	2,522	2,754	13,95%	14,31%	23,23%	4,20%
R7	3,139	2,883	2,785	3,060	5,20%	6,65%	15,82%	-3,19%
R8	3,296	3,053	2,937	3,214	11,64%	11,05%	20,84%	2,63%
R9	2,687	2,446	2,403	2,646	13,21%	12,34%	23,50%	4,12%
R10	2,826	2,586	2,513	2,751	4,86%	6,14%	15,27%	-2,46%
R11	2,404	2,194	2,132	2,340	16,16%	18,70%	27,62%	7,02%
R12	2,481	2,279	2,203	2,426	17,67%	17,03%	29,22%	6,91%
R13	3,052	2,760	2,695	2,911	16,90%	17,50%	25,56%	9,77%
R14	2,603	2,458	2,370	2,610	17,12%	15,67%	25,38%	6,67%
R15	2,962	2,782	2,730	2,899	9,05%	9,65%	14,75%	4,49%
Difference compared to general risk					10,48%	10,83%	21,94%	0,86%

According to the results, the risks of SAP implementation are perceived higher comparing to the general risk. That is especially significant if the system is substantially customized during implementation. SAP is very standardized software, not very open for changes, so that could be the reason for more than 1/5 higher average risk. The largest increase of almost 1/3 is recorded for risk factors R1. High fluctuation of project team members or lack of people within the project team during the ERP implementation and R12. Inadequate change management during the implementation. On the

other hand, Vanilla approach is the same as average, and some risk factors are even decreased. It is interesting that the largest decrease is recorded for factor R1. High fluctuation of project team members or lack of people within the project team during the ERP implementation which have also the largest increase for substantial customization. The main conclusion is that overall, SAP implementation is perceived riskier, especially when the client requests high system customization to align with its business process. These results showed the validity of the situational approach to the risk management, because the risks are not the same in every situation, and do not come with the same strength.

5. Conclusion

ERP projects implementation management requires a special approach, due to their specifics and characteristics, especially integration. Project management is generally comprised of several management aspects. In this paper, a study on the management of risks in the implementation of ERP systems was conducted. A model of research - risk management according to the situational methodology was set. The risk management approach according to the PMBOK methodology was used as a basis, which was then modified according to situational characteristics of the implementation, the organization where the system was implemented, and other characteristics.

The main aspect of the research was associated with the impact of implementation characteristics on the given risk factors or on the change of risks depending on which implementation approach was used. As the research results have shown, implementation characteristics lead to lesser or greater changes in risks compared to the general risk, in both, the factor values (% increase/decrease), as well as in their mutual ranking. Out of the four analyzed implementation approaches ("big bang", phased approach, "vanilla", substantial system modification) the highest increase of risk was registered with the "big-bang" approach, which was somewhat expected since the whole implementation happens simultaneously and the time for reaction and error revision is very limited. Aside from risk increase in the general sense, this approach had the biggest changes in risk ranking where as much as eight factors changed ranks. On the other hand, phased approach had far lesser differences, the risk was considerably less rated compared to the "big-bang" so it can be concluded that the "big-bang" approach is riskier than the phased one. System modification during implementation, as the second aspect of implementation characteristics research, increases risks depending on the modification level. Therefore, the substantial modification

(customization) of the system approach was rated as a considerably riskier approach to implementation, which is accordant with the ERP system implementers' logic who generally favor the standard system implementation (the closer to the "vanilla" approach the better). Implementers arguments are that the standard system has fewer implementation surprises, is more standardized, easier for implementation, was many times tested in earlier implementations and usage, and that it has fewer problems in the future system upgrade. Surely, only the aspect of risk management in the implementation was viewed here, not the loss of specific organization characteristics, or competitive advantages mentioned in the literature, as a result of the standard system implementation.

The impact of organization where implementation is performed characteristics on general risk factors was analyzed in the paper, along with the risk change dependent on these characteristics. Three types/aspects were analyzed, with six organization characteristics: territorial organization type (one or multiple locations), proprietary organization type (state/public and private organizations) and organization size (small and medium businesses and large enterprises). When considering the territorial organization type, it can be concluded according to the research results that the implementation in organizations on multiple locations is riskier than those in one location. Regarding the proprietary organization type, results showed that the implementation in state/public organizations is riskier than those in private organizations. The last aspect which was researched was the organization size, and the research results showed that the risk was increased with the organization size, or that the projects in large organizations were riskier than those in small and medium ones. Apart from the risk ratings, many risks have changed their ranking - depending on the organization characteristics some were better or worse ranked compared to the general rating. This was mainly expressed in the organization implementation on multiple locations and the implementations in private organizations where the change in ranking was recorded in 6 factors each.

Furthermore, combined characteristics were analyzed, to show the differences inside the main sets of data. Results showed that introducing another characteristic can significantly change the risk amount, which happened after the result for SAP were presented. The participants who implement the SAP system acknowledged the higher risk then average, especially if the substantial customization was used.

Like every other research, this one is limited too, so space was left for future research. Some aspects of further research could be: additional and specific

risk factors, additional research characteristics, and a larger number of participants. Apart from the mentioned risk factors, many other are present in the literature (specific factors) which only matter in certain situations. They could also be analyzed according to the situational approach to get a better image on their impact on the project. Additional research characteristics or the greater elaboration of existing ones could be seen as a space for further research. Example could be an additional elaboration of the implementation strategies, beside the "big-bang" and phased approach, such as the "roll-out", the pilot project implementation and others. Also, there are additional ERP brands and methodologies which could be analyzed, a more detailed classification of organizations where the system is implemented according to the industry. As a result of additional respondents and characteristics, an online tool could be made, which would give the anticipated risks based on the different characteristics and approaches to the ERP implementation.

References

1. A Guide to the Project Management Body of Knowledge (PMBOK Guide). (2013). 5th ed. Project Management Institute.
2. Al-Mashari, M. (2003), Enterprise resource planning: A taxonomy of critical factors, *European Journal of Operational Research*, 146, 352–364.
3. Operational Research. 146. pp. 352–364. Aloini, D., Dulmin, R., Mininno, V. (2012), Risk assessment in ERP projects, *Information Systems* 37 (3), 183-199.
4. Aloini, D., Dulmin, R., and Mininno, V. (2007). Risk Management in ERP Project Introduction: Review of the Literature. *Information & Management*, 44(6), 547-567.
5. Appuswamy, R. (2000), Implementation issues in ERP, 1st International Conference on Systems Thinking in Management, ICSTM2000, Geelong, Australia
6. Bannerman, P. L. (2008). Risk and risk management in software projects: A reassessment. *Journal of Systems and Software*, 81(12), 2118-2133.
7. Camara, M., Kermad, L., and El Mhamedi, A. (2006). Risk prediction in ERP projects: classification of reengineered business processes, *Int. Conf. on Computational Intelligence for Modelling, Control and Automation – CIMCA*
8. Chapman, C. B. and Ward, S. (1997), *Project Risk Management: Processes, Techniques and Insights*, Wiley, New York
9. Chen, C. C., Law, C. C., and Yang, S. C. (2009). Managing ERP implementation failure: a project management perspective. *IEEE transactions on engineering management*, 56(1), 157-170.

10. De Bakker, K., Boonstra, A., and Wortmann, H. (2010). Does risk management contribute to IT project success? A meta-analysis of empirical evidence. *International Journal of Project Management*, 28(5), 493-503.
11. Gargeya, V. B. and Brady, C. (2005). Success and failure factors of adopting SAP in EPR system implementation", *Bus. Process Manage. J.*, vol. 11, no. 5, 501-516
12. Henderson-Sellers, B., Ralyte, J., Agerfalk, and P.J., Rossi, M. (2014). *Situational Method Engineering*, Springer-Verlag Berlin Heidelberg, pp 12.
13. Huang, S. M., Chang, I. C., Li, S. H. and Lin, M. T. (2004). Assessing risk in ERP projects: identify and prioritize the factors, *Industrial Management and Data Systems*, 108 (8), 681-688.
14. Iskanius, P. (2009). Risk management in ERP project in the context of SMEs. *Engineering Letters*, 17(4), 266.
15. Kraljic, A., Kraljic, T., and Delismajlović, D. (2011). ERP implementation's risk factors in state owned company in post-socialist transitioning country. In E. Ariwa & E. El-Qawasmeh (Eds.), "Communications in Computer and Information Science" (CCIS 2011) Series of Springer LNCS, 187-196
16. Markus, M.L., Tanis, C. and van Fenema, P.C. (2000). Enterprise resource planning: multisite ERP implementations, *Commun. ACM* 43, 4, 42-46.
17. O'Leary, D. E. (2000). *Enterprise Resource Planning Systems: Systems, Life Cycle, Electronic Commerce, and Risk*. Cambridge, UK: Cambridge University Press.
18. Ravasan, A.Z. and Mansouri, T. (2014). A FCM-Based Dynamic Modeling of ERP Implementation Critical Failure Factors, *International Journal of Enterprise Information Systems*, 10(1), 32-52
19. Scott, J.E. and Vessey, I. (2002). Managing risks in enterprise systems implementations, *Communication of the ACM*, 45 (4), 74-81.
20. Sumner, M. (2000). Risk factors in enterprise-wide/ERP projects, *Journal of Information Technology (Routledge, Ltd.)*, 15 (4), 317-327
21. Tatsiopoulou, I. P., Panayiotou, N. A., Kirytopoulos, K. and Tsitsiriggos, K. (2003). Risk Management as a Strategic Issue for the Implementation of ERP Systems: A Case Study from the Oil Industry, *International Journal of Risk Assessment and Management*, 4 (1).
22. Umble, E. J., Haft, R. R. and Umble, M. M. (2003). Enterprise resource planning: Implementation procedures and critical success factors", *Eur. J. Oper. Res.*, vol. 146, 241-257
23. Wright, A. M. and Wright, S. (2001). Information system assurance for ERP systems: Unique risk considerations, *Journal of Information Systems*, 16, 5-15.
24. Wu, L. C., Ong, C. S., and Hsu, Y. W. (2008). Active ERP implementation management: A Real Options perspective. *Journal of Systems and Software*, 81(6), 1039-1050.
25. Zafeiropoulos, I., Metaxiotis, K., and Askounis, D. (2005). Dynamic risk management system for the modeling, optimal adaptation and

- implementation of an ERP system, *Information Management & Computer Security*, Vol. 13 Iss: 3, 212 - 234
26. Zeng, Y., (2010). *Risk Management for Enterprise Resource Planning System Implementations in Project-Based Firms*, Doctoral dissertation, University of Maryland, College Park
 27. Zur Muehlen, M., and Ho, D. T. Y. (2005). Risk management in the BPM lifecycle. In *International Conference on Business Process Management* (pp. 454-466). Springer Berlin Heidelberg.