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An extension of the technology acceptance model for business intelligence systems: project management maturity perspective

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Abstract:
Business intelligence systems (BISs) refer to a wide range of technologies and applications useful for retrieving and analyzing a large amount of information with the goal to generate knowledge useful for making effective business decision. In order to investigate adoption of BISs in companies, we propose a model based on the technology acceptance model (TAM) that is expanded by variables representing the concept of a project management maturity (PMM). The survey on the sample of USA companies has been conducted with the chief information officer (CIO) as the main informant. A structural equation model has been developed in order to test the research model. Results indicate that TAM expanded with the notion of PMM is useful in increasing understanding of BISs adoption in companies.

Keywords:
business intelligence systems; technology acceptance model; project management maturity, chief information office.

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1. Introduction

Business intelligence systems (BISs) are used to analyze information with the goal to acquire valuable data, information and knowledge which could improve the quality of management decision making across different business processes [1]. BISs include different software solutions for collecting, analyzing, and reporting information to managers [2]. Importance of BISs is related to the generation of timely, relevant and easy to use information which will have positive impact on making better and faster decisions at different management levels. Their growing strategic importance lies in tactical and operational process improvements, supply chain, production and customer service [3], which enable companies to gain competitive advantage [4].

Current research on the BISs adoption is scarce, and one of the rare examples is a study conducted by Hou [5], which focuses on the adoption of BIS at the employee level. Other examples focus on parts of the BISs, such as data mining, and the online-analytical processing (OLAP) [6, 7, 8]. However, the research on the BISs adoption, as perceived by the chief information officer (CIO) has not been conducted, although CIO plays one of the most important roles in the decision making on the information system (IS) adoption [9, 10]. Therefore, the goal of this paper is to present and empirically test a framework for investigating the determinants of the BISs implementation in companies, by expanding the TAM with the PM, using the CIO as the main informant. The original TAM is based on the theory of reasoned action, and explores the relationship between perceived usefulness, perceived ease of implementation, intentions to implement and the actual system implementation. Our goal is to propose a normative model that expands the basic TAM model by incorporating variables representing the concept of a project management maturity in companies. This paper extends the research framework presented at the PROJMAN 2016 conference [11].

After the introductory part, the paper presents the review of relevant literature on the BIS and the TAM. The third part of the paper focuses on the conceptual framework, investigating the TAM related research propositions, and project management maturity related research propositions. The fourth part of the paper overviews the used methodology, and the fifth part presents the research results. Finally, conclusion remarks are presented in the sixth part of the paper.

2. Literature review

2.1 Business Intelligence Systems

Modern organizations generate a huge amount of information, which has become a major competitive factor in today's business world [12]. Providing the right persons with the information which is complete, correct, relevant and in-time is important to support strategic, operative and tactical decision making [13]. Therefore, transformation of useful information into knowledge leads to a higher competitive advantage. Business intelligence (BI) refers to the set of methods for knowledge discovery from data using a set of analytical techniques, e.g. data mining [5]. Analyzing performance of an organization, the BI enables organizations to increase revenue and competitiveness, to formulate new strategies and to make effective decisions [14]. The concept "business intelligence systems" (BIS) refers to the data-driven decision support system that combines information technology (IT) used for data collecting, data storage and data analysis, and the main goal of the BIS is to provide information that is business-driven and results-oriented [15]. BIS comprises a set of tools to transform data into information to support decision-making [16].

2.2 Project Management Maturity

Project management presents a complex activity with many factors and participants which often lead to unpredictable obstacles and uncertainty. According to Varajão [17] project management refers to planning and organizing available resources to accomplish predetermined goals. In other words, project management plays a critical role in planning and managing execution of project dealing with available resources, time and budget and at the same time satisfying requirements of company [18]. In addition, clear mission, vision and strategy should be defined in order to complete project.

In project management, there are several interrelated goals that should be satisfied and achieved in order to have successfully completed project: scope management, time management, cost management, quality management, human resources management, communications management, risk management, procurement management, integration and success management [17]. However, it is important to highlight three main goals which should be met, and which are the most often used in project evaluation: scope, time and cost [18]. When aforementioned goals have not been achieved and are not aligned, project failure is likely to occur. In order to prevent this to happen, project manager must be aware of all possible problems and constraints in the organization related to the project. In a case, where pre-defined time is very tight and goal of the project is demanding in terms of the workload, it become challenging to complete project successfully. Hence, primary function of project management refers to successfully balancing time, cost and performance in all projects, large and small, IT or non-IT [19].

The importance of project management is recognized in different sectors. Construction projects are mostly criticized for ineffective trade-offs between time, cost and scope, mainly due to the impact of several different stakeholders with the opposite goals [9]. Another example of critical role of project management can be found in IT projects, specifically in managing software development. The most of software development projects are not completely developed or are cancelled during the planned period of time, besides the fact that the project has not achieved its goal [9]. According to research conducted, only 16% of US IT projects are completed on time and on budget [20]. Besides three main goals which have to be align (scope, time and cost), human factor is of critical concern in software development projects, taking into account that technology related and soft-skills, as well as senior management support are also important [21, 22]. In addition, communication plays an important role in successful IT project management [23]. There are two significant issues regarding communication. First, open communication enables project managers to be effective. Second, open communication among all project actors prevents conflicts. In other words, lack of information exchange among project actors lead towards many problems, e. g. strategic goals are at risk, resources are not used optimally and clients' expectations are unfulfilled [9].

Project maturity refers to integration and improvement of project management activities. In other words, project maturity improves project management ability to execute projects successfully [20]. Project management maturity can be defined as a process which enable codification, measurement and control of project management activities which at the same time estimate integration of project and organizational processes in companies [24]. Research results of the study conducted by Price Waterhouse Consulting showed that companies with greater project management maturity have in the same time overall better project performance [20]. Another significant issue regarding project management maturity is its role in strategic planning and approach to measurement and benchmarking. Growing importance in project maturity management lies in the following benefits: strategic planning of project management structures, improvements in time, cost and quality of project management, improvements in customer relationship management, minimization of project risk and increase in profit [25].

2.3 Technology Acceptance Model

Adoption of IS has been studied using different theoretical approaches. The theory of reasoned action, proposed by Fishbein and Ajzen [26], and the theory of planned behavior proposed by Ajzen [27] have roots in cognitive psychology [28]. Even though other models have been used in IS research, the TAM has captured the most attention of the IS community [29]. TAM has evolved from the theory of reasoned action and it has been updated several times.

TAM proposes three major factors as a motivation for a potential adopter to actually use a system: perceived ease of use (PEU), perceived usefulness (PU) and attention to use. Davis [30] used the first refined version of TAM and found that both the PEU and the PU have a direct influence on intention to use which eliminated the previous attention to use factor. PU is defined by Davis [20] as "the degree to which an individual believes that using a particular system would enhance his or her productivity", while PEU is defined as "the degree to which an individual believes that using a particular system would be free of effort". Another refined version of the TAM known as the TAM2 came out in 1996 [31] and 2000 [32].

The adoption of enterprise resources planning systems is often investigated using the TAM approach via numerous studies. Pasaoglu [33] performed the research in Turkey using demographics, knowledge about the enterprise resources planning (ERP), organizational culture, PEU and actual use of the ERP system. Main findings indicated that the ERP is also a social system in addition to being a technical one and that Turkish company in general wants to implement the ERP. Kwak et al. [34] used TAM in the project-based sector and found out that the consultant support during the implementation of the IS had negative impact of the PU. They extended the TAM in terms of implementation projects, internal and external support and functionality selection. Money and Turner [35] have used the TAM approach to study adoption of knowledge management systems and found that relationships between PEU, PU and system usage were consistent with earlier findings. Despite the vast support for the TAM, researchers also explores whether there are other factors relevant for the adoption and usage of the technology, and often explore whether the external variables are mediators of the TAM belief variables [36], and if so, which external variables are important, such as project management maturity.

2.4 Technology Acceptance Model for Business Intelligence Systems

Several studies have investigated the adoption of BISs in companies using the TAM approach. The first group of authors is focused on the adoption of the OLAP. Hart et al. [37] have researched acceptance and perceptions of the OLAP software among college students. Hart et al. [8] have also investigated the role of cognitive and other factors in the PU of the OLAP. Sharoupim [39] has also focused on the perception of OLAP usefulness, taking into account the impact of culture and human elements. The second group of authors is focused on the adoption of data mining. Huang et al. [6] have investigated factors that influence the adoption of data mining tools. Huang et al. [7] are further focusing on the use continuance of data mining tools. Wook et al. [39] have researched the acceptance of educational data mining technology among students in public institutions.

Research on the BISs adoption is scarce. One of the examples is the study conducted by Hou [5], which examines the user satisfaction with the BISs usage and individual performance related to the BISs. However, this research is focused on the determinants of the BISs usage among individual employees in Taiwan's electronics industry. The main limitation of the previous research is the emphasis on adoption of individual technologies, such as data mining and the OLAP, while the BIS adoption research is scarce. To our knowledge there is no research that would investigate the BISs usage from the CIO perspective, although CIO plays a critical role in the IS adoption [9, 10], and that would also take into account the impact of project management maturity, as one of the most important factors for the successful IT adoption [20].

3. Research prepositions

In this part of the paper, is presented the conceptual framework. The main constructs of the model as well as the hypothetical relationship between the main constructs are elaborated, based on the previous research. The conceptual framework investigates the TAM related research propositions and project management related research propositions. The research model is presented in Fig. 1.

3.1 Technology adoption model related research propositions

The two most important determinants of system usage and intention of usage are PU and PEU [40]. Previous research has indicated that both the PU and the PEOU have a direct impact on the adoption of IS in general, such as ERP [33], as well as on the modules of the BIS, such as the OLAP [37] and data mining [39]. Our research focuses to the CIO perspective of the BIS adoption, and we are investigating the organizations with different levels of BISs implementation. Therefore, we do not take into account the intention to use BISs, but we focus directly to the BIS implementation. In addition, instead of using the perceived ease of usage, we focus to the perceived ease of implementation, since we investigate the adoption from the CIO perspective, who is the person most involved in the IS

implementation. That approach is taken in other similar research [41]. Since we measure different levels of BIS adoption, we use the notion of BIS implementation in the model. Based on this approach, the following research propositions are refined from the original TAM model:

- RP1: Perceived usefulness of the BIS positively influences the BIS implementation;
- RP2: Perceived ease of implementation of the BIS positively influences the BIS implementation;
- RP3: Perceived ease of implementation of the BIS positively influences Perceived usefulness of the BIS.

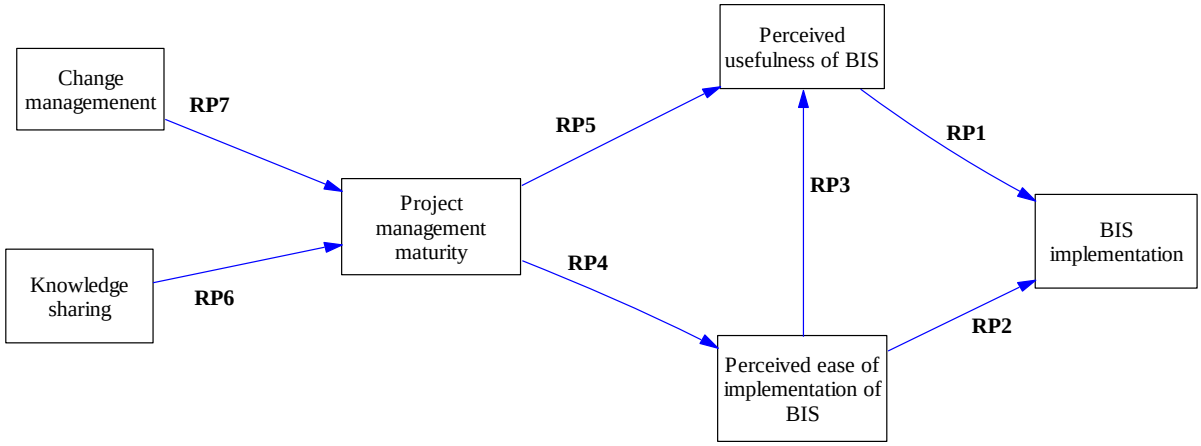

Fig. 1. Proposed Research model

3.2 Project Management Maturity related research propositions

Gyampah and Salam [42] have extended the TAM in the areas of project communications and training and shared beliefs. Their findings suggest that training and communication in the aspect of project communication could be used for extending the TAM, since effective project management is likely to positively impact the PU and PEU. This leads us to the following research proposition that emerges from the impact of project management maturity on the PEU and PU:

- RP4: Project management maturity positively influences Perceived ease of implementation of the BIS;
- RP5: Project management maturity positively influences Perceived usefulness of the BIS.

Project management is also influenced in organizations by different factors. Law and Ngai [43] suggest a successful business process change, user support and involvement, and expertise of vendors as critical success factors in the ERP projects. Markus [44] and Gu [45] suggest that managing organizational change is critical for a successful IT project implementation. Al-Zayyat et al. [46] concluded that knowledge sharing enables a project team to reduce doing rework and compresses the time that it takes to plan projects. They also stated that providing the "right knowledge" to the "right person(s)" at the "right time" allows for greater control over the project throughout the project's lifecycle by reducing uncertainty. Therefore, in our work we presume that project management is driven by the change management and knowledge sharing in companies. Research propositions that emerge from these relationships are:

- RP6: Change management positively influences Project management maturity;
- RP7: Knowledge sharing positively influences Project management maturity.

4. Research Methodology

4.1 Sample description

In order to test the research propositions, a questionnaire survey method was used. Questionnaires were sent to companies with more than 50 employees in June and July 2015. Purposive sampling was used in order to target companies that implemented BIS at least to some extent. The initial list of the 500 companies was developed by collecting the contacts of the companies at various business intelligence social media groups, such as "Big Data, Analytics, Business Intelligence & Visualization Experts Community" at LinkedIn.

An invitation to fulfill the questionnaire was sent to the CIOs who are supposed to be the business experts that are the most familiar and involved in BIS implementation in the companies. The invitation was sent to 500 USA large and medium sized manufacturing and service companies. Final data sample consists of 87 completed questionnaires, which represents a response rate of 17.4%. Dilman [47] propose that response rate attained in our survey is comparable with similar research which were using mail surveys.

Most of the companies from the sample are from banking, insurance, and financial services (18.4%), telecommunications (19.5%) and tourism and leisure (12.6%). Around 8% of companies are involved in manufacturing, mining and energy sector following. IT companies comprise 6.9% of the sample, while 4.6% companies are providing consulting services. Only 3.4% are public institutions, and 1.1% of companies are focused on media and communication services. Most of the companies have more than 500 employees (71.26%), while 28.74% companies have less than 500 employees.

CIO of the company was selected as the informant in the study, since IS implementation is one of the major focuses of their work. Almost all respondents are full time employees (90.8%), while 9.2% of respondents are part time employees. There is approximately the same percentage of respondents who are working in the company for 10 and more years (26.4%), from three to five years (23%) and from five to ten years (25.3%). Only 5.7% of respondents are working for more than twenty years in the same company. Around fifth of the respondents (19.5%) are employed from one to three years in the company. Regarding education level, most of the respondents have master (43.7%) or university degree (39.1%), followed by those who have doctoral degree (10.3%). Only 1.1% of respondents finished college or high school while 4.6% respondents finished 2 years college degree (junior college).

4.2 Research instrument

Table 1 presents the research instrument, which consists on the following constructs: perceived usefulness of the BIS, perceived ease of implementation of BIS (PEU), BIS implementation (BISI), project management maturity, change management, and knowledge sharing. The constructs were selected based on the presented conceptual model and research propositions. Survey questions were prepared as closed questions. Likert scale was used for measuring the respondents' level of agreement with specific statements from 1 to 7 (1-do not agree at all, 7-completely agree).

Perceived usefulness of BIS and *perceived ease of implementation of BIS* constructs were developed using the original constructs used in Davies [11]. The construct measuring *BIS implementation* was developed based on the notions of the data integration [15], decision making using information [16], and the usage of BIS across the organization [14].

Project management maturity was measured using the PMM model developed by PM Solutions [48]: project integration management, project scope management, project time management, project cost management, project quality management, project human resource management, project communications management, project risk management, and project procurement management. However, the project procurement management was not taken into account since BIS implementation was examined in privately owned companies in which procurement management does not take the crucial role, as is the case in public companies. Statements that describe different aspects of the project management were used as the items in the construct. For example, IT project managers have an influence over project costs during the total project time, taking into account the project budget was used in order to measure the project cost management.

Table 1. Research instrument

Construct	Code	Indicators
Perceived usefulness of BIS (PU) Source:[30]	PU1	Using the BIS improves company performance.
	PU2	Using the BIS increases company work productivity.
	PU3	I would find the BIS useful in my company.
Perceived ease of implementation of BIS (PEU) Source:[30]	PEU1	Implementation process of BIS is understandable.
	PEU2	Company has adequate financial resources for BIS implementation.
	PEU3	IT department has adequate knowledge for BIS implementation.
	PEU4	It is easy to integrate BIS with the existing solutions.
	PEU5	I find BIS in my company easy to use.
BIS implementation (BISI) Sources:[14, 15, 16]	BISI1	BIS is used in all organizational units, and hierarchical levels.
	BISI2	Internal (both structured and unstructured) and external data are integrated, and requirements (e.g. data quality) are met in BIS.
	BISI3	BIS is a base for all decisions, and has a critical impact on organizational performance.
Project management maturity (PMM) Source: [48]	PMM1	IT projects are strongly connected with the enterprise strategy (project integration management).
	PMM2	Implementation goals for the IT projects are clearly defined (project scope management).
	PMM3	Schedules for IT projects in the company are detailed and understandable (project time management).
	PMM4	IT project managers have an influence over project costs during the total project time, taking into account the project budget (project cost management).
	PMM5	IT project manager has influence over project team member (project human resource management).
	PMM6	If I have to use new features (modules) of the IS my progress is monitored by IT project managers and I am asked for feedback (project quality management).
	PMM7	IT project manager can easily communicate the risk issues with the top-level manager that is the "sponsor" of the project in order to minimize the risk of the project (project risk management).
	PMM8	If I am not satisfied with a new feature (module) of the IS I have procedure on how to communicate to IT Project Manager (project communications management).
Change management (CM) Sources: [44,45]	CM1	If new features of the IS are introduced, written procedures on how to do it are available.
	CM2	Coaching or trainings are available when new features of the IS are introduced.
	CM3	When new features (modules) of the IS are introduced, change managers are available.
	CM4	When new features (modules) of the IS are introduced, all necessary documentation is available.
	CM5	When I need to use new features (modules) of the IS I have support from other employees.
	CM6	When I need to use new features (modules) of the IS I receive all necessary documentation on time.
	CM7	When I need to use new features (modules) of the IS I know exactly where to find all necessary documentation or who will provide these documents to me.
Knowledge sharing (KS) Source: [46]	KS1	Employees are able to communicate and share knowledge with other employees.
	KS2	Top management encourage employees to meet and share knowledge about job activities.
	KS3	Company has an incentive and rewards system to encourage employees to share knowledge.
	KS4	Company has written (stored) policies, procedures or guidelines to support knowledge sharing.
	KS5	Employees are able to use knowledge or information from the IS related to their activities.
	KS6	Collaborative tools or knowledge portals are available to learn or to share knowledge.

Change management construct was developed using the approach of Markus [44] and Gu [45], while *knowledge sharing* construct was developed using the approach of Al-Zayyat et al. [46].

4.3 Statistical methods

Data were collected by the questionnaire survey method and were analyzed in five steps using the following statistical methods: (i) content validity analysis, (ii) reliability analysis, (iii) descriptive data analysis, (iv) path model fit and (v) path model analysis:

- First, content validity has been confirmed by using the items adapted from the literature in conjunction with the pilot study.
- Second, Cronbach's alpha coefficients that indicate internal consistency of the items used for calculating scales were used to conduct reliability analysis [49].
- Third, descriptive data analysis and non-parametric correlation analysis were conducted in order to check for negative or low correlations which could indicate some data validity problems [50].
- Fourth, in order to test the path model fit, following indices were used: Chi-square index, goodness of fit statistics (GFI), adjusted goodness-of-fit statistics (AGFI), normed-fit index (NFI), non-normed-fit index (NNFI), comparative-fit index (CFI) and root-mean-square-error (RMSEA) [51].
- In the last step, the path model was used for statistical testing of the research propositions paying attention on the signs and statistical significance of the parameters, as well as on the amount of variance of endogenous constructs accounted by independent constructs variation. The significance level of 5% was used as a threshold for the research proposition testing.

5. Results

5.1 Content validity and reliability analysis

Since the research instrument in Table 1 was developed based on the previous research, the pilot research was conducted, in order to assess the internal validity. The pilot research was conducted using in-depth interviews with 5 CIOs, and based on their positive comments it was concluded that questions are understandable and relevant. Reliability analysis was conducted using Cronbach's alpha coefficients. According to Feldt and Kim [49] internal consistency coefficients of 0.70 or higher are considered to indicate adequate reliability. In our research, all Cronbach's alpha coefficients were above the cut-off value (0.70), which propossed that the item scales were internally consistent (Table 2). Therefore, the average values of items in the construct were calculated: PU, PEU, BISI, PMM, CM, and KS, and are presented in Table 3.

5.2 Primary data analysis

In order to understand better given results, we have conducted descriptive data analysis and correlation analysis. Spearman's correlation coefficients have not revealed negative neither very low (near-zero) correlations between examined items, and all of them were statistically significant, mostly at level 0.01 (Table 3). Most correlation coefficients show strong correlation especially among following independent variables: BIS and PU (ρ=0.917, $p<0.01$), and PEOU and PU (ρ=0.700, $p<0.01$), BIS and PEOU (ρ=0744, p<001), CM and PMC (ρ=0.782, $p<0.01$). There is positive linkage between two constructs which is confirmed by determined correlation values. The medium positive correlations were found in the following cases: PMC and PU (ρ=0.437, $p<0.01$), KS and PU (ρ=0.409, $p<0.01$), PMC and PEU (ρ=0.537, $p<0.01$), KS and PEOU (ρ=0.450, $p<0.01$), PMC and BIS (ρ=0.500, $p<0.01$), KS and BIS (ρ=0.402, $p<0.01$), KS and PMC (ρ=0.628, $p<0.01$), and KS and CM (ρ=0.666, $p<0.01$). The results clearly emphasized that elements of TAM were positively related and had an significant influence on the adoption of BIS. Additionally, project management commitment they have also led towards the adoption of BIS. The lower positive correlations were found in

the following cases: CM and PU (ρ=0.259, p<0.05), CM and PEOU (ρ=0.372, p<0.01), and CM and BIS (ρ=0.284, p<0.01). However, these correlations were still statistically significant.

Table 2. Descriptive statistics and Cronbach's alpha

	N	Minimum	Maximum	Mean	Std. Deviation	Cronabch's alpha
PU1	87	3	7	5.966	0.994	0.971
PU2	87	3	7	6.011	1.029	
PU3	87	3	7	6.011	1.017	
PEU1	87	3	7	5.690	0.968	0.951
PEU2	87	2	7	5.471	1.109	
PEU3	87	2	7	5.540	1.139	
PEU4	87	2	7	5.494	1.109	
PEU5	87	2	7	5.506	1.033	
BISI1	87	3	7	5.966	1.005	0.991
BISI2	87	3	7	5.977	1.011	
BISI3	87	3	7	5.989	1.029	
PMM1	87	1	7	5.586	1.106	0.936
PMM2	87	2	7	5.253	1.081	
PMM3	87	2	7	5.126	1.149	
PMM4	87	1	7	5.345	1.150	
PMM5	87	1	7	5.161	1.328	
PMM6	87	1	7	4.851	1.498	
PMM7	87	2	7	5.218	1.125	
PMM8	87	1	7	5.115	1.233	
CM1	87	2	7	4.897	1.230	0.889
CM2	87	2	7	5.080	1.133	
CM3	87	2	7	5.034	1.280	
CM4	87	1	7	4.931	1.388	
CM5	87	1	7	5.172	1.153	
CM6	87	1	7	4.920	1.269	
CM7	87	1	7	4.931	1.179	
KS1	87	3	7	5.701	0.823	0.821
KS2	87	1	7	5.517	1.066	
KS3	87	1	7	4.586	1.808	
KS4	87	1	7	4.517	1.791	
KS5	87	1	7	5.460	1.054	
KS6	87	1	7	5.287	1.275	

Table 3. Descriptive statistics and correlation coefficients

	Mean	**σ**	PU	PEOU	BIS	PMC	CM	KS
PU	5.992	0.984	1					
PEOU	5.540	0.981	0.700**	1				
BIS	5.977	1.006	0.917**	0.744**	1			
PMC	5.207	1.011	0.437**	0.537**	0.500**	1		
CM	4.995	0.957	0.259*	0.372**	0.284*	0.782**	1	
KS	5.178	0.985	0.409**	0.450**	0.402**	0.628**	0.666**	1

*Note: ** p-value <0 .01, * < 0.05*

5.3 Assessment of model fit

In our study we used fit indices proposed by Hooper *et al.* [51] and Bentler and Bonnet [52]. The proposed conceptual model was tested using Lisrel software and it yielded a Chi-square of 13.938 with 7 degrees of freedom. The ratio of Chi-square and degrees of freedom was lower than 2, which is considered as a very good result, according to Hooper et al. [51]. In order to confirm given results and while Chi-square is usually sensitive to sample size, some other indices were also used to assess the overall model fit (Table 4):

- The value of Goodness-of-fit (GFI) was 0.951 indicating a very good result. Adjusted goodness-of-fit statistic (AGFI) was 0.853 indicating a good result [51, 52].
- The values of Normed-fit index (NFI) and Non-Normed-fit index (NNFI) were higher than 0.90 which is also very good result [51, 52].
- Value of comparative-fit index (CFI) was higher than 0.95, also considered as good result [51, 52].
- The Root-mean-square-error (RMSEA) is 0.107, which is slightly higher than 0.10 recommended threshold [51, 52]. However, number of other studies reports similar values as an acceptable result [42].

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Table 4 summarizes the fit indices for the hypothesized model, and regarding given results, we may conclude that our conceptual model correspond with explained requirements.

Table 4. Fit indices for the hypothesized model

Fitness indicator	Model estimated	Explanations
Chi-square (χ^2)	13.938	χ^2 is not significant
Degrees of freedom (df)	7	
p-value	0.053	
χ^2/df	1.991	Very good, close to 2
GFI	0.951	Very good result
AGFI	0.853	Good
NFI	0.966	Very good result
NNFI	0.963	Very good result
CFI	0.983	Very good result
RMSEA	0.107	close to 0.100, fairly good result
90% confidence interval of RMSEA	(0.005 ; 0.189)	Upper limit <.20, fairly good result

5.4 Research proposition testing

Conceptual model showed a good fit, which lead us to examine the structural part of the model (Fig. 2). Therefore, we want to investigate whether proposed theoretical relationships are supported in specific research context. In the path analysis, we pay attention on the following: (i) the signs of the parameters, (ii) statistical significance of parameters (measured by t-value) and the amount of variance of endogenous constructs (measured by the squared multiple correlation coefficient – R^2).

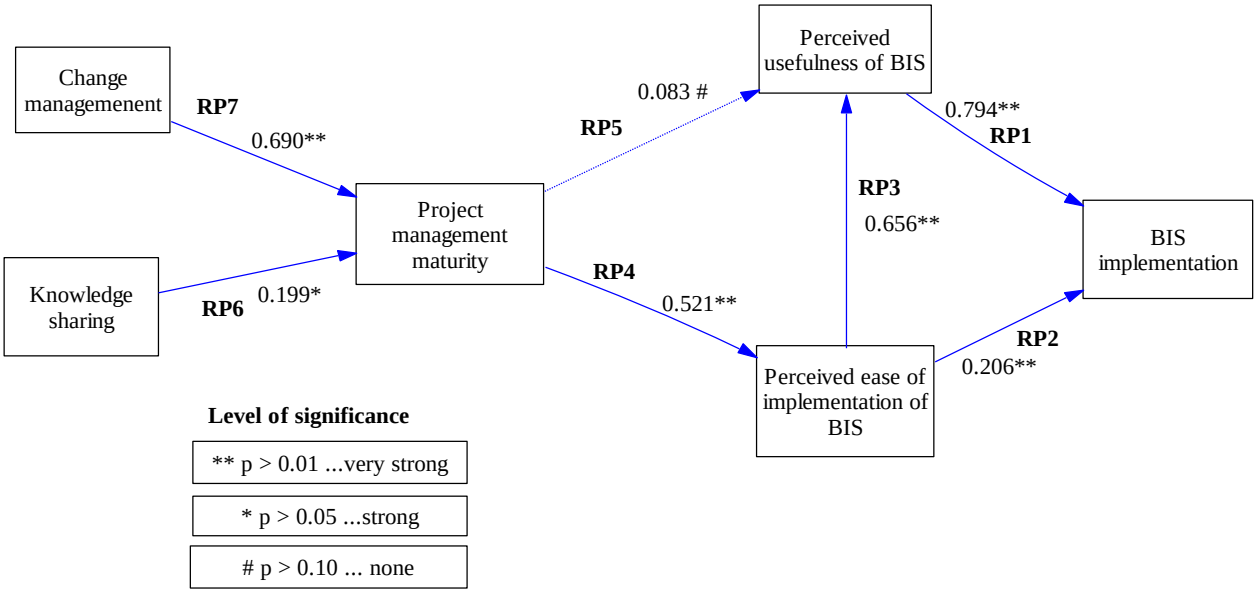

Fig. 2. Path diagram

In Fig. 2 path diagram is shown. The path coefficient for the RP5 had a low statistical significance (lower than the cut-off value of 0.5) which mean that the research proposition RP5 is rejected. Other research propositions were supported with the path coefficients higher than cut-off value and with statistical significance present at the 1% level (RP1, RP2, RP3, RP4 and RP7) while RP6 was supported with statistical significance present at the 5% level, which mean that these research propositions should be accepted.

The first research proposition (RQ1), proposing that *Perceived usefulness of BIS* is positively related to *BIS implementation*, was accepted. The standard solution of path coefficient estimate was 0.794 with the t-value of 13.728. The second research proposition (RQ2), indicating that *Perceived ease of use of BIS* is positively related to *BIS implemenation*, was also accpted, with the standard solution of path coefficient estimate of 0.206 with the t-value of 3.552. R^2 value for both RQ1 and RQ2 was 0.861 indicating that the 86.1% of variations in BIS implementation could be explained by the variations in PU and PEU.

	BISI =	0.794*PU +	0.206*PEOU,	Errorvar.= 0.140;	R = 0.861	(1)
Stand.err		(0.0578)	(0.0580)	(0.0215)		
Z-values		13.728	3.552	6.519		
P-values		0.000	0.000	0.000		

The third research proposition (RQ3), proposing that PEU is positively related to PU, was accepted, with the standard solution of path coefficient estimate of 0.656 with the t-value of 7.152. The fourth research proposition (RQ4), indicating that PMM is positively related to PEU, was not accepted, with the standard solution of path coefficient estimate of 0.083 with the t-value of 0.936. R^2 value for both RQ3 and RQ4 was .495 indicating that the 49.5% of variations in PU could be explained by the variations in PEU.

	PU =	0.656*PEOU +	0.0832*PPM,	Errorvar.= 0.490	R = 0.495 (2)
Stand.err		(0.0917)	(0.0890)	(0.0751)	
t-values		7.152	0.936	6.519	
P-values		0.000	0.350	0.000	

The fifth research proposition (RQ5), proposing that PPM is positively related to PEU, was accepted, with the standard solution of path coefficient estimate of 0.521 with the t-value of 5.872. However, R^2 value for RQ5 was 0.289 indicating that the 28.9% of variations in PEU could be explained by the variations in PPM.

	PEOU = 0.521*PPM,	Errorvar.= 0.684	R = 0.289	(3)
Stand.err	(0.0887)	(0.105)		
Z-values	5.872	6.519		
P-values	0.000	0.000		

The sixth research proposition (RQ6), proposing that KM is positively related to PPM, was accepted, with the standard solution of path coefficient estimate of 0.199 with the t-value of 2.194. The sevent research proposition (RQ7), indicating that CM is positively related to PPM, was also accepted, with the standard solution of path coefficient estimate of 0.690 with the t-value of 7.403. R^2 value for both RQ6 and RQ7 was 0.632 indicating that the 63.5% of variations in PPM could be explained by the variations in KM and CM.

	ITPM = 0.690*CM	+ 0.199*KSC,	Errorvar.= 0.376	R = 0.632	(4)
Stand.err	(0.0932)	(0.0906)	(0.0577)		
Z-values	7.403	2.194	6.519		
P-values	0.000	0.028	0.000		

To summarize, path model confirmed the hypothetical model with the adequate goodness of fit. Path model was interpreted in order to test the conceptual model. Most of the research propositions were proven, indicating the following relationships: (i) BIS implementation is positively interrelated with the perceived usefulness and perceived ease of use of BIS; (ii) Project management maturity positively impacts the perceived ease of use of BIS, but do not have a statistically significant interrelation with the perceived usefulness of BIS, and (iii) Project management maturity is positively interrelated with the change management and knowledge sharing practices in the companies.

6. Conclusion

From the academic perspective, the contributions are following. First, Factors that influence the acceptance of the BIS in companies were examined in order to enrich scientific literature in the area of BIS adoption, and we confirm the significant impact of the TAM core variables (PU and PEU) to the IS adoption, as indicated in number of previous research studies [40, 33]. Second, TAM model was refined in order to be used for the implementation of the BISs, using the CIO as the informant, thus extending the research of Varajão et al. [9] and Portela et al. [10] who investigate the role of CIO in organizations. Third, we expand the TAM model, thus following the proposed approach of Venkatesh et al. [36], with the construct measuring project management maturity based on the Grant et al. [48]. Fourth, we confirm the significant impact of change management and knowledge management to the project management maturity, as indicated as previous research [44, 45, 46].

Findings and results could have future practical implications for the IT project management teams, management strategies towards future implementations of the BIS and end users' perspective on the usage of the BISs. In the sense of the BISs development, the study could also have practical implications for future planning and design of the BISs solutions, with regard to the major determinants of their adoption in organizations. The practical recommendations are following for the implementation of external BISs. First, the PU and PEU are of the highest importance for the BISs implementation, and software companies selling BISs solutions should focus their effort toward the education of CIO about the ease-of-implementation and usefulness of their applications, possibly in the manner that can be understandably presented to other C-level managers. Second, software companies selling BISs solutions should also take into account the importance of project management maturity in the targeted companies. Third, assessment of the change management and knowledge management practices would be also recommended before the project for the BIS implementation is launched.

Limitations of the paper stem mainly from the sample characteristics. First, although we consider that purposive sampling was useful for targeting companies that have already implemented BISs, the potential readers should take that into account. Second, the research was conducted on the sample of US companies, and the results of the research studies conducted in other countries could be impacted by country-related cultural issues, since the previous research indicated that project management is prone to be different across different country-cultures [53]. Third, our research was of cross-sectional nature, thus allowing us to focus on the state of BISs adoption in the particular period, while not allowing the assessment of dynamic aspect of technology adoption. Further research stems from the abovementioned limitations in two directions. First, the research of the larger scale on different national samples could greatly enhance the knowledge about the impact of project management maturity to technology in general. Second, the longitudinal research would provide insight into the impact of project management in different stages of BISs adoption. Such studies would be of high complexity on large sample, multi-case longitudinal studies would be welcome in the research area of BISs adoption.

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