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Abstract:
This research aims to investigate the circumstances and possible reasons for a very high and rather unexpected success rate of Information Technology (IT) projects implemented in the Federation of Bosnia and Herzegovina (F BiH). For that purpose, the existing literature was reviewed thoroughly, and appropriate research design was formulated. In order to answer the research questions posed, a questionnaire was developed and sent to 400 companies in the F BiH that meet the defined business profile, yielding 62 valid responses. For the purpose of data analysis, a multivariate analysis of variance (MANOVA) was employed. The obtained results show that keeping the project size small significantly increases the odds for achieving IT project success, regardless of the organizational maturity level in project management. In addition, the higher the organizational maturity level in project management, the higher IT projects success ratio. Results also revealed that the differences between IT projects' success ratio of different groups of organizations are primarily induced by the time and costs project constraints, but not with the project scope.

Keywords:
project management; IT projects; PM success rate; PM success factors; The Federation of Bosnia and Herzegovina.

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1. Introduction

Managers and academics alike agree that the company's efficiency and growth stem from its successful implementation of IT projects, which provide various IT solutions that are critical for businesses success. Apart from the common project's challenges, IT projects are further tangled by specifics and constant changes of a business and its needs, as well as by unprecedented technology evolvement. All of this makes IT project management a distinct and very complex branch of the discipline of project management. Even though there has been a significant improvement in IT project management, the problem of the high failure rate of IT projects still stands.

The Standish Group International report of 2015 [1], although representing the best results over the last eight years, still shows 19% of all IT projects as failed, while the astonishing 45% are "challenged" – projects that are late, over budget, and/or under the scope, and 36% were successful. Results that are more desirable are shown in the 2018 IT Success Rate Survey of Ambler [2], presenting in total a failure rate of 8%, with 38% of challenged projects, and 49% successfully completed. These numbers include significant improvements that occurred over the last years in both the general project management and IT project management [3], [4], but despite the progress achieved, there is still a fairly high failure rate of IT projects [5].

The results of a recent survey conducted among companies from the Federation of Bosnia and Herzegovina differ significantly from those presented in the literature related to this topic. These results show a very high and rather unexpected success rate of the implemented IT projects [6]. More specifically, only 20% of closed IT projects were reported as failed and/or challenged, measured by the three main project constraints – time, cost and scope. Such an unusual finding may indicate surprisingly good managerial performance, some specific projects' characteristics, or a combination of these two elements.

In order to explore such findings in more detail, this study aims to analyze the circumstances and possible reasons for the rather high and unexpected IT projects' success rate. Thus, the main research question of the study is as follows:

RQ: Which IT projects' characteristics and characteristics of the organizations that implement those projects influence the unexpectedly high level of IT projects success in the Federation of Bosnia and Herzegovina.

To further investigate this issue, relevant research was designed, and appropriate research model was proposed. The research model was subsequently tested using the data gathered through the above-mentioned survey.

The next section of this study presents a thorough literature review of the theoretical background relevant to the research. The section that follows provides a description of the research methodology, the data analysis methods used, and the research results obtained. Interpretation and discussion of the results, followed by research limitations, concludes this section. The final section of this study contains concluding remarks about the research and the list of main research findings.

2. Literature review

The ever-increasing competition and fast-changing business environments create challenges for organizations to continuously adapt to new conditions. In order to stay competitive, as laid out by PricewaterhouseCoopers [7], organizations have to move from doing business as usual to pursuing project management as part of their competitive strategy. However, numerous research results point out that IT project failures and projects running over budget and time amount to almost half in numbers, sometimes even higher [1], [2], whereas the project failures often jeopardize the very existence of the companies that have implemented them [8]. The missing awareness of the financial impacts of failed projects is illustrated by a survey conducted by Ernst&Young [9], stating that 56% of the responding companies consider the opportunity costs of failed projects as simply being the direct costs of the failed projects, totalling not more than 5% of the annual sales. Although this is considered as underestimated, the alarming figure is that the opportunity losses are unknown for 34% of respondents. At the same time, this survey shows that IT-related projects are, with more than 30%, by far the most frequent of all projects that were implemented.

2.1 Project success – The definition and influential factors

There is no commonly accepted definition of project success. Stare [10] lists numerous reasons for a project to succeed or fail, such as project schedule definition, the number of changes during the project implementation, or adequacy of project control, just to name a few. Since differing in value, size, or complexity, projects do have different attributes which affect their performance and outcomes [11]. The study of Alqahtani and associates [11] identifies three major streams of performance criteria that accords with other research outcomes: the project manager´s characteristics (skills, competencies, etc.), organizational factors (structure, strategy, culture types, etc.), and the project management culture (project management methodology, project review and learning, etc.). In addition, some researches show a positive relationship between project management culture and project success [11], [12].

In terms of having a deeper understanding of project success, recent developments in the respective literature indicate that project success is a multi-dimensional and networked construct [13]. It is influenced by project cost, time, and scope, but also by interactions of personal competences and quality of teamwork. The perception of project success differs by individual type of person, by nationality, or by project type. Therefore, the project success continues to be to a great extent "in the eyes of the beholder" [13]. Also, the *PMBOK® Guide* [14] recognizes stakeholder satisfaction as an additional measure of project success.

The measurement of project success creates challenges to efficiency and effectiveness at different levels within an organization – at the entity level, team level, and individual level. The degree of a project´s success is influenced by numerous factors, and the literature shows that two components of project success are frequently referred to: project success factors and project success criteria [11], [13]. The first are the elements of a project that increase the likelihood of success, so-called independent variables, while the latter are measures to assess the success of a project, called the dependent variables [13]. Project performance and the outcome can be evaluated by using various performance indicators, such as project cost, quality, business satisfaction, or customer satisfaction [15]. However, time, cost and quality are the three major dimensions of a project to evaluate [16]. Similar ranking of main project success criteria is also suggested by the study of Pankratz and Basten [17]. To gain even deeper insight in meeting quality requirements, Pankratz and Basten further separated the quality criterion into two parts - conformance and the actual realization between: a) specified functional requirements, and b) specified non-functional requirements.

An interesting view of the variety of project success measures and their correlation is taken by Serrador and Turner [18] by clearly differentiating between project efficiency and the overall project success as such. Whereas the first is related to meeting the traditional triangle of cost, time and scope goals, the latter refers to meeting broader business and enterprise goals, which are defined by key stakeholders. The results of the analysis performed by Serrador and Turner [18] show a positive correlation between the iron triangle of project efficiency and the overall project success. Since scope is sometimes considered as closer related to project success than to project efficiency, an additional, modified, analysis was completed by removing scope. Even in this case there is still a clear correlation between conformity of time and budget constraints and overall project success [18]. These two factors, time and budget, are also correlated, while time overruns seem to be bigger than budget overruns [19].

Finally, a very important issue of choosing between the two approaches to project management in regard to the projects' success should be addressed. Even though there exist certain differences in the projects' success perception between the two approaches to project management, the project success criteria in projects using agile-based approaches do not significantly differ from projects following a waterfall model [20].

2.2 Project size and complexity

One of the first tasks in any formal project management methodology is to determine the size of the project, because, in general, project size corresponds to the extent of the application of formal project management methodology. Usually, the project size is designated by three typical terms – small, medium, and large, but the parameters that identify the size designation vary a lot. However, most commonly, project size is determined by the number of project team members, the components of the final product, or the project costs

To distinguish between project complexity and size is rather difficult, because project complexity is sometimes the result of project size [21]. Project complexity is widely discussed in literature and can be impacted by a variety of factors. There is not a single obvious definition of project complexity anymore, but rather choices of many. When linking complexity to project budget, Ernst&Young [9] illustrate that the average project budgets (and costs) of Western-European countries are considerably higher than those of CEE countries. At the same time, the projects are on average significantly more complex in bigger Western-European countries, which points to the direct and positive correlation between projects' costs and complexity.

Jørgensen [22] presents a study based on a data set that is dominated by small-scale software projects. According to this study, larger projects are identified to be on average more complex than smaller ones, and the failure rate increases with the increase in the size of a project. Even though the project size measurement based on the bid price may not be an accurate proxy of the actual project size, especially where a very low bid price was offered in order to get reference clients, the overall bid price gives sufficiently accurate indication of the project size [22].

Both project size and complexity are negatively related to the overall project success. Hurskainen [19] emphasizes the relationship between project size and duration and project success. Namely, numerous research studies indicate that, when project size or duration increase, the probability of project failure also rises [1]. This indicates a strong negative correlation between size and duration and project success. In addition, the reason of increased project failure is often tied to different project risks. The project risk level depends on the systems' size, scope, components and level of complexity [23]. Numerous research results show that the bigger the project size the higher risk of project failure [19], [24]-[27]. Thus, increasing the project size and complexity introduces greater risks to the project, which negatively impacts project schedules and budgets, and, consequently the overall project success [21].

2.3 Project management maturity

Project management maturity is considered as a means to assess an organization´s project management competences, whereas the basic assumption suggests that the higher the organization´s maturity level, the higher the chances of successfully completing its projects [28]. Since any effort to increase an organization´s project management maturity level is connected with costs, that begs the question of an ideal maturity level. Whilst the Lukač [29] study shows a positive correlation between organization size and project management maturity, in their study Albrecht and Spang [28] examine the maturity level which suits the organization´s needs and, at the same time, represents an optimal cost-benefit ratio. It is not necessary for every organization to operate at the highest maturity level. Rather, the ideal level is determined by the magnitude of an organization´s project business, the complexity of projects, and the project´s stakeholders and their interaction with each other [28].

A research performed by PricewaterhouseCoopers [7] shows the positive correlation between the project management maturity level and project performance. The survey results indicate three main areas where mature organizations favor highly formalized project management processes: scope management, quality management, and cost management. Using established project management methodologies increases the chance to meet project objectives in the key performance indicators of budget, schedule, scope, quality, and business benefits [7].

The project organizational culture and top management´s attitude also show a strong impact on project performance [10]. Even though some studies show that simply having a specific project management certification does not make a difference in overall project success [30], organizations investing in proven project management practices achieve better financial performance due to successfully completed projects [4]. The strong influence of project success on the business success of an organization is particularly evident in case of information system projects [31]. The PMI's report states that for the first time in five years more projects are meeting their original goals and are completed within budget, which indicates that the higher an organization´s project management maturity the more likely it is to achieve its goals [4]. PwC [7] also noted a significant rise in project management maturity over the last years, which goes along with more practitioners becoming certified in project management. Another key finding that PwC [7] reports is that maturity level is directly correlated with organizational success.

Yazici [32] illustrates in his research the relationship between project management maturity and organizational competitiveness, showing that a higher project management maturity is perceived to contribute to an organization´s savings, improvement of competitiveness and increase of market share. The results of various studies indicate the need for improvement of the PM skills of the project managers [33].

According to a 2014 Wrike study [34], only 56% of IT project managers hold an official certificate, which indicates that project managers may be lacking formal education in the project management area [33]. According to a 2014 PM Solutions study [35], only 49% of the organizations surveyed have a project management training in place [33]. It is especially important for organizations to put more attention to their ability for effectively pursuing IT projects [36]. This can be done either by recruiting professional project managers or strengthening the knowledge of current staff by way of formalized trainings and certification such as Project Manager Professional (PMP)®.

The recent efforts of the U.S. government in incentivizing the PMP are very important for the global project management community. In December 2016, former US President Barack Obama signed the "Program Management Improvement and Accountability Act" (PMIAA) into law, which creates an increased awareness of the need for experienced and certified project management professionals across America [37]. This bill impacts all areas of the US federal government except the Department of Defense [38]. Any government agency that is required to have a CFO are mandated to appoint a Program Management Improvement Officer. According to Alexander [38], this amplifies and elevates the project management profession as a whole, and shines a spotlight on the imperative role which project management professionals play in both the government and private sector.

2.4 Status of project management capacity and IT sector in Bosnia and Herzegovina

Bosnia and Herzegovina (BiH), a Southeast Europe country, is a small, transitional economy, which with its GDP per capita of 5,149 US$ and population of 3.5 million belongs to the group of developing countries. BiH is considered as the least competitive economy in the region for its lack of a single economic space, poor institutional support for business, and slow technological infrastructure development [39]. The country and its economy was severely devastated during the war from 1992 to 1995, but in the first decade after the war, BiH recorded substantial economic recovery with an average GDP growth rate of 16.76% [40]. Unfortunately, fast postwar economy growth was decelerated by the complex and inefficient public administration and very unstable political climate.

Besides the agriculture and energy sectors, the most promising industry sectors in BiH are IT and telecommunications sectors [41]. Even though BiH lags behind other countries from the wider region in ICT adoption [39], the IT sector, with a 201% income growth and 1419% employment growth during the five years period, from the year 2012 to the year 2016, is one the fastest growing industry sectors in BiH [42]. The largest user of IT solutions and services is the public sector, followed by the financial and telecommunications sectors.

The main method of providing IT solutions is through project-based endeavors, which points to the critical importance of project management competences for both the users and solution providers. A study on the project management capacity of Western Balkan countries has shown that the project management capacity in Bosnia and Herzegovina is rather limited, but still above the regional average. Furthermore, there was a pronounced interest for improving project management capacity in both industry and academia [43]. This is corroborated with the fact that the PMI Bosnia and Herzegovina Chapter was established in 2017, since when the number of certified project management practitioners was increased by more than twofold.

So far, the research work on project management and its success factors in Bosnia and Herzegovina is quite rare. Although the situation in many transition economies has dramatically changed since 1989, the development process in transition economies has shown much heterogeneity [44]. Yanwen [45] suggests that implementing project management into developing countries must be seen in connection with the general political, economic, social and technological conditions. In addition, the strategy for introducing project management in developing countries must be aligned with the culture, the characteristics of the society and the set-up of the economic, political and administrative system of the particular country [46]. Such strategic approach is optimal for developing countries, since these country specific factors still hamper the advance of software project management [47]. Despite all differences, Moohebat and associates [48]

highlight in their research on implementing ERP software that comparing the critical success factors in the two groups of developing and developed countries almost have similar patterns.

This similarity is supported by a recent research pursued in the former Yugoslav Republic of Macedonia, which suggests a positive correlation between project management approach and IT project success [49]. According to a research on IT project planning practices, also conducted with Macedonian SMEs, 86.7% firms have confirmed having planning practices in place [50]. Some other research work from the wider region also points to positive correlation between IT project implementation success and use of sound project management practices [51], [52]. Therefore, and despite all differences between developed and developing countries, there is a strong need and increasing importance of having adequate project management processes in place.

2.5 IT projects success – Study hypotheses

Although there is an uptick in the reported success rates of IT projects of 36%, research findings still point to IT project failures of 19%, and IT projects running over budget and time amounting to 45% [1]. A number of other studies point to the similar, rather low success rate of IT projects [8], [53], [54]. However, some research findings point to quite different outcomes. Namely, companies that are very experienced in managing IT projects have had around two thirds of all IT projects implemented almost on time, on budget and within the scope [25].

In spite of the wide variety of project success factors, one of the most important project management practices is project costs control. A research by Gładysz and associates [55] suggests that larger organizations are more likely to complete IT projects within the budget than smaller organizations. Another finding of this study shows that organizations running several IT projects in parallel are more likely to stay within the budget than organizations which always concentrate on one single project [55]. On the other hand, it is very interesting that cost control, as a success factor, ranks fifth in construction industry, while in IT industry it is ranked only eleventh [56].

This study aims to better understand the overall project success under the conditions of a still underdeveloped market such as that of the Federation of Bosnia and Herzegovina. Special attention is given to the project budget, as a proxy for project size and complexity, as well as to the companies' project management maturity level. The results of a recent study show that great majority of the closed projects (more than 80%) were on budget and time, and with no or only minor changes in scope (almost 80%). This study also reveals that one third of the implemented IT projects had rather small budgets [6], which indicates both a smaller project size on average and lower project complexity. This finding leads to the first hypothesis of the study:

H1: Organizations that implement small-size projects, measured by the average project budget, have a higher IT projects success ratio, regardless of the achieved project management maturity level.

The remaining two thirds of the closed IT projects had medium-to-large size budgets. To successfully manage such projects, companies are assumed to have a fairly high overall level of project management maturity. These facts intuitively point to the implication that both the project characteristics and sound managerial practices influence the project implementation success. The second hypothesis of this research study is therefore:

H2: Organizations that have achieved a high level of project management maturity have a higher IT projects success ratio for medium-to-large size IT projects, measured by the average project budget.

These two hypotheses define the research design and the corresponding research model, which are described in the following section.

3. Data and methodology

To test the hypothesized research model, a survey questionnaire was developed and sent to 400 organizations in the Federation of Bosnia and Herzegovina, which were randomly chosen from within the whole population. All selected organizations comply with the following profile:

- employing 10 or more people (in any year during the period from 2012 to 2016),
- established in 2010 or earlier,
- capable of implementing at least small-scale IT projects.

A total of 84 responses (21.0%) to the survey were received, out of which 62 belonged to the organizations that have implemented at least one IT project within the observed time-period, so they were considered as valid (15.5%). The total number of projects implemented by the organizations surveyed, which includes successful, unsuccessful and cancelled projects, over the last 5 years, is 846.

About one third (33.87%) of all organizations surveyed have had more than 10 years of experience in project management, while only one fifth (19.35%) of them have less than two years of experience. Regarding the average budget of closed IT projects, which can be considered as a project complexity indicator, all closed projects are equally distributed between small-size (budget less than 50K BAM – 33.9%), mid-size (budget between 50K BAM and 100K BAM – 33.9%), and large-size projects (budget greater than 100K BAM – 32.3%).

3.1 Research design and measures

The main concern of this study is the success rate of IT projects implementation, and comparison of the success rate between different groups of organizations. More specifically, the accompanying research examines whether the differences in the project success rate between different groups of organizations as a whole are statistically significant. In accordance with the two research hypotheses posed, the groups of organizations were formed based on the implemented projects size and organizations' project management maturity level. These groups differentiate between three types of organizations: a) those that have implemented only small-size IT projects, b) those that have implemented larger IT projects and are immature in project management, and c) those that have implemented larger IT projects and are mature in project management. Since the first research hypothesis relates only to those organizations that have implemented small-sized IT projects, regardless of the organizations' maturity level, there was no need to differentiate them based on the achieved project management maturity level. In order to conduct an appropriate testing, the MANOVA was employed, where the differences in IT projects success ratio between three groups of organizations were examined.

The corresponding research design is presented in Figure 1. The dependent latent variable, *"Project Success Rate"* (*PSR*), is measured by two indicators – "*Time and Cost Conformity*" (Y_1) and "*Scope Conformity*" (Y_2), which are listed and described in the next section. As it can be seen from Figure 1, there are three sets of project success rate measures, which are designated with PSR_{Gi} ($i = 1, 2, 3$). Each measure-set (PSR_{Gi}) relates to the single data-cell of the research design vector, where the vector dimension is defined by the independent variable *"PM Maturity & Project Size"* (*G*). The independent variable *G* designates different groups of organizations (described in details later in the text), formed on the basis of *project size–project management maturity* criterion. Both dependent (*PSR*) and independent (*G*) variables were measured using data from the survey, while the measurement spans a five-year period from the year 2012 to the year 2016.

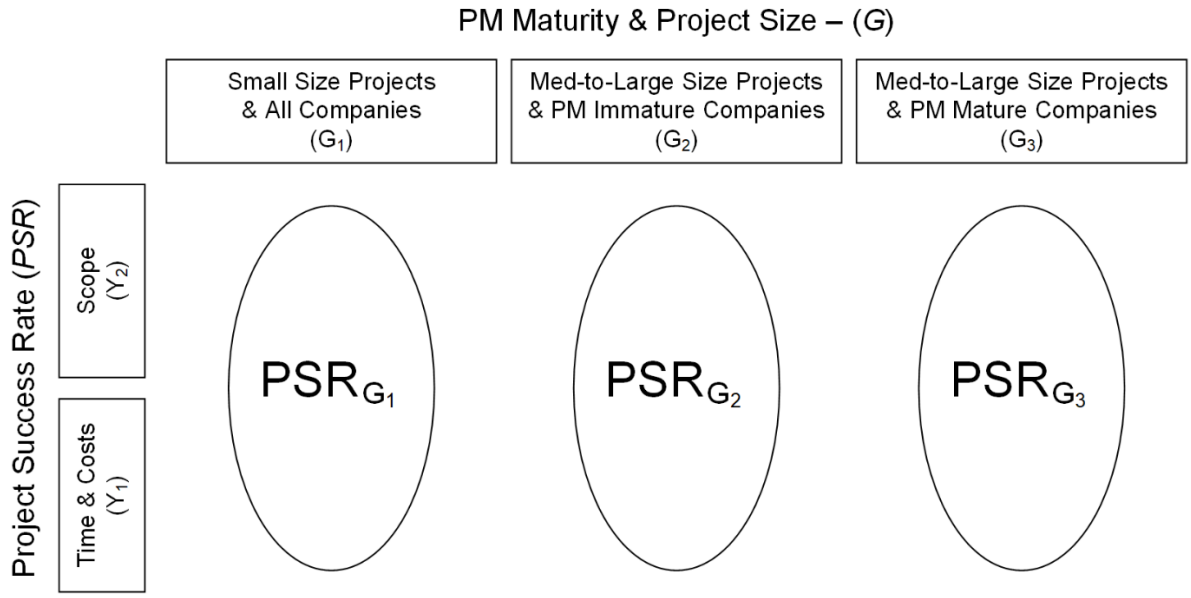

Figure 1. Layout of the research design

Dependent variables

Traditionally, project success is measured by the main project constraints – time, cost and scope. For that purpose, two five-degree rating scales were defined. The first scale corresponds to the project success level in regard to time and costs, and the second scale in regard to project scope conformity (Table 1).

Table 1. Project success level rating scales

Level	Value (SV)	Criterion for time (*T*) and costs (*C*)	Criterion for scope (*S*)
L1	*10.0*	Both time (*T*) and costs (*C*) are within the plan	No changes in planned scope
L2	*5.0*	Both time and costs are up to 10% over the plan ($0\% \leq T \leq 10\%$ and $0\% \leq C \leq 10\%$)	Minor changes in planned scope ($0\% \leq S \leq 10\%$)
L3	*2.0*	Either time or costs are above 10% over the plan, but each of them is below or equal to 50% over the plan ($T > 10\%$ or $C > 10\%$) and ($T \leq 50\%$ and $C \leq 50\%$)	Moderate changes in planned scope ($10\% < S \leq 50\%$)
L4	*0.5*	Either time or costs are above 50% over the plan, but each of them is below or equal to 150% over the plan ($T > 50\%$ or $C > 50\%$) and ($T \leq 150\%$ and $C \leq 150\%$)	Significant changes in planned scope ($50\% < S \leq 75\%$)
L5	*0.0*	Either time or costs are above 150% over the plan ($T > 150\%$ or $C > 150\%$)	Complete changes in planned scope ($S > 75\%$)

In order to quantify the overall project success level, an arbitrary threshold and scoring value is assigned to each level of the proposed scales (columns "*Value*" and "*Criterion*" from Table 1). These values are chosen experientially and in accordance with some empirical findings from the existing literature (e.g. [54]). In addition, scoring values approximate the exponential function, since it best estimates the perceived value of the project's success level.

For each IT project closed during the measurement period (from the year 2012 to the year 2016) survey responders have assessed the corresponding success level (*L1* to *L5*), both for the scope and time and costs constraints. Based on this assessment and the chosen scoring values, a very simple two-indicator measure for the dependent latent variable – *Project Success Rate* (*PSR*), was adopted. Those two indicators are as follows:

- "*Time & Costs Conformity*" (Y_1) – measuring conformity with planned project schedule and costs:

$$Y_1 = \frac{1}{N_p}\sum_{i=1}^{N_p} SV_i^{T\&C} \quad (1)$$

Where:

N_p – number of closed projects in period from the year 2012 to the year 2016.

$SV_i^{T\&C}$ – scoring value for *i*-th closed project in regard to time and costs ($i = 1 \ldots N_p$).

- "*Scope Conformity*" (Y_2) – measuring conformity with planned project scope:

$$Y_2 = \frac{1}{N_p}\sum_{i=1}^{N_p} SV_i^{S} \quad (2)$$

Where:

N_p – number of closed projects in period from the year 2012 to the year 2016.

SV_i^{S} – scoring value for *i*-th closed project in regard to scope ($i = 1 \ldots N_p$).

Independent variables

As it can be seen from Figure 1, the research design must ensure comparison between three groups of organizations:

- Group 1 – organizations that declared that all their IT projects, closed during the measurement period, had a small project budget on average (budget less than 50K BAM),
- Group 2 – organizations that are immature in project management, and that declared that all their IT projects, closed during the measurement period, had a medium to large project budget on average (budget greater than 50K BAM),
- Group 3 – organizations that are mature in project management, and that declared that all their IT projects, closed during the measurement period, had a medium to large project budget on average (budget greater than 50K BAM).

Obviously, this is a simple case of a single three-level independent variable – *"PM Maturity & Project Size"* (*G*), which differentiates these three types of organizations. The organizations which declared that their closed IT projects, during the measurement period (from the year 2012 to the year 2016), had, on average, budgets less than 50K BAM, were allocated to the *Group 1* (G_1). All other organizations were further allocated to the remaining two groups based on their

maturity level in project management – organizations that are mature in project management were allocated to the *Group 3* (G_3), and those that are not, were allocated to the *Group 2* (G_2).

A number of different indicators were used to determine the maturity level in project management – number of implemented projects during the measurement period (separating threshold was set at five projects), formal certifications in project management, corresponding organizational structure (*P*roject *M*anagement *O*ffice), and number of years applying the project management techniques. Combining these indicators, organizations are allocated to *Group 2* (immature in project management) or *Group 3* (mature in project management).

3.2 Results

Table 2 contains the means and standard deviations of all model dependent variables for all three groups of independent variable *G*. Same data are graphically presented in Figure 2. To test the differences between the defined groups of organizations, MANOVA was employed in order to examine a set of two indicators, which represents the organizations' IT projects implementation success rate.

Table 2. Descriptive statistics of indicator variables for groups of *G*

Indicator	Group of *G*	N	Mean	Std. Deviation
Y_1	Group 1	21	8.02	2.42
Time & Cost Conformity	Group 2	18	5.68	2.87
	Group 3	23	7.74	2.17
	Total	*62*	*7.24*	*2.63*
Y_2	Group 1	21	8.04	2.33
Scope Conformity	Group 2	18	6.99	2.46
	Group 3	23	7.05	2.84
	Total	*62*	*7.37*	*2.57*

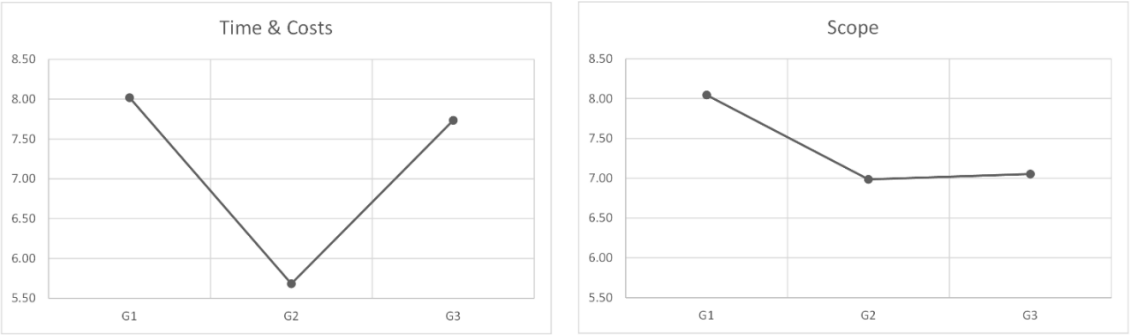

Figure 2. Graphical display of indicator variables for groups of *G*

Assumptions

The most important assumptions for MANOVA – independence, multivariate normality and homogeneity of covariance matrices, were evaluated through the IBM® SPSS Statistics®. Independence of observations is provided as much as possible by a random selection of the responding organizations.

There were no missing data and no outliers in the sample, so in relation to this assumption no action of any type was taken. However, both indicator variables showed modest deviation from normal distribution (skew < 1, kurtosis < 1).

Since the MANOVA analysis is robust to modest violations of normality [57], it can be considered that the findings may not be severely affected by the normality deviation. This violation can be further compensated by decreasing the *p-value* while testing the significance of MANOVA statistics [58].

The assumption of the homogeneity of variance-covariance matrices among all groups was checked using Box's test. The assumption of homogeneity of variance-covariance matrices was met, since Box's test results [M = 6.934, $F(6, 66436) = 1.098$, $p = 0.361$] were not statistically significant at $p < 0.001$, meaning that there was no difference between the two groups on all variables collectively.

The assumption of univariate homogeneity was assessed by the Levene's test. As can be seen from the test results (Table 3), this assumption was met for both indicator variables ($p > 0.05$).

Table 3. Levene's test of equality of error variances

Dependent Variable	F	df_1	df_2	Sig.
Y_1 – *Time & Cost Conformity*	0.829	2	59	0.442
Y_2 – *Scope Conformity*	0.998	2	59	0.375

Finally, the correlation between two indicator variables is below the threshold value of 0.9 ($r = 0.498$, $p < 0.001$), which means that multicollinearity does not exist, so this assumption was also met.

The MANOVA model estimation

After all of the assumptions were checked, the next step in MANOVA procedure was to assess whether there exist significant differences for all IT projects success rate variables (indicators) across the three groups of organizations, first all variables together and then each of them individually [59].

In order to compensate for the normality deviation, the family-wise error rate was taken as $\alpha = 0.025$, both for the MANOVA test and the follow-up ANOVA tests for main effects. All four most commonly used multivariate tests are statistically significant at $p < 0.025$, indicating that the set of IT projects success rate variables has a significant difference between three types of organizations (Table 4).

Table 4. Multivariate tests for group differences in IT projects success rate

Test	Value	F	df_1	df_2	Sig.	Power[1]
Pillai's Trace	0.185	3.000	4	118	0.021	0.691
Wilks' Lambda	0.820	3.029	4	116	0.020	0.696
Hotelling's T^2	0.214	3.055	4	114	0.020	0.700
Roy's Largest Root	0.185	5.463	2	59	0.007	0.745

[1] – *Computed using $\alpha = 0.025$*

Univariate ANOVA tests for both indicator variables show that only indicator Y_1 (*Time & Costs Conformity*) has a significant main effect ($p < 0.025$), while indicator Y_2 (*Scope Conformity*) has a non-significant main effect (Table 5).

Table 5. Univariate tests for group differences in IT projects success rate

Source	Variable	Σ of sq.	*df*	Mean sq.	*F*	Sig.	η^2	Power
Model	Y_1 – *Time & Cost Conformity*	62.075	2	31.038	5.077	0.009	0.147	0.801
	Y_2 – *Scope Conformity*	14.519	2	7.260	1.100	0.339	0.036	0.234
Error	Y_1 – *Time & Cost Conformity*	360.673	59	6.113				
	Y_2 – *Scope Conformity*	389.219	59	6.597				

Since there exists a significant main effect, a further analysis of post hoc comparisons for each indicator was conducted. For that purpose, two post hoc comparison methods, LSD and Bonferroni, were applied to both indicators across three groups of organizations (Table 6).

Table 6. Post hoc comparison for individual indicators of IT projects success rate

Indicator Variable	Group (A)	Group (B)	Mean Diff. (A – B)	*Std. Err.*	Sig.*	Sig.**
Y_1 – *Time & Cost Conformity*	G_1	G_2	2.338	0.794	**0.005**	**0.014**
		G_3	0.285	0.746	0.704	1.000
	G_2	G_1	-2.338	0.794	**0.005**	**0.014**
		G_3	-2.052	0.778	**0.011**	**0.032**
	G_3	G_1	-0.285	0.746	0.704	1.000
		G_2	2.052	0.778	**0.011**	**0.032**
Y_2 – *Scope Conformity*	G_1	G_2	1.059	0.825	0.204	0.613
		G_3	0.991	0.775	0.206	0.618
	G_2	G_1	-1.059	0.825	0.204	0.613
		G_3	-0.068	0.808	0.934	1.000
	G_3	G_1	-0.991	0.775	0.206	0.618
		G_2	0.068	0.808	0.934	1.000

* - LSD adjustments for multiple comparisons; ** - Bonferroni adjustments for multiple comparisons

The LSD and Bonferroni tests shows the same pattern of results (Table 6). The post hoc comparison results show that the difference between groups of organizations is statistically significant for indicator Y_1 (*Time & Costs Conformity*), while being non-significant for indicator Y_2 (*Scope Conformity*).

Interpretation of the results

Since all assumptions for MANOVA have been met or there are appropriate corrections for their violation, the results obtained by the analysis can be considered as reliable. Thus, some deeper understanding of the relationship between IT projects success ratio and organizational and project characteristics may be inferred. Of course, all of that under the market conditions of the Federation of Bosnia and Herzegovina.

The multivariate effect of the between-subject factor (*PM Maturity & Project Size*) on the IT projects success ratio, which is measured with two indicators, was statistically significant [Wilks' $\lambda = 0.820$, $F(4, 116) = 3.029$, $p = 0.02$]. This finding means that there exists a difference in combined IT projects success ratio indicators between the three groups of organizations. The follow up ANOVA analysis showed that there was a significant main effect for indicator Y_1 [$F(2, 59) = 5.077$, $p = 0.009$], and non-significant for indicator Y_2 [$F(2, 59) = 1.1$, $p = 0.339$].

Results from multivariate and univariate tests show that the difference in IT projects success rate between the three groups of organizations is primarily induced by the difference in indicator Y_1 (*Time & Costs Conformity*), and some underlying combination of the two indicators. A further post hoc comparison for each indicator was conducted to break down this interaction.

The post hoc comparison results (Table 6 and Figure 2) revealed that the difference between *Group 1* and *Group 3* is non-significant for both indicators. On the other hand, the difference between *Group 1* and *Group 2* is positive and statistically significant for indicator Y_1 (*Time & Costs Conformity*), while being non-significant for indicator Y_2 (*Scope Conformity*). This finding, along with the significant multivariate interaction effect, fully supports the first hypothesis of this study. The same stands for difference between *Group 3* and *Group 2*, which, along with the significant multivariate interaction effect, fully supports the second hypothesis of this study.

3.3 Discussion

The results of data analysis indicate that organizations in BiH that either keep their IT projects small and simple, or are very experienced in managing IT projects, both achieve a higher project success ratio. This goes along with the general economic conditions in BiH as a transitional and developing country [39], where the average project budgets are considerably lower than in developed countries [9], while the IT sector is one of the fastest growing industry sectors [42]. The results are therefore interpreted as supportive of both research hypotheses, which goes in favor of the main study assertion about the factors that significantly impact IT projects' success ratio. Therefore, given the importance of projects in modern business, investing the necessary organizational resources in improving the project management processes, tools and skills is a matter of carefully building and maintaining the organizational competitive advantage. In other words, project management excellence has become an ultimate competitive weapon in today's highly competitive business environment [60].

Two particularly interesting findings regarding the project size and complexity are revealed by the data analysis. First, keeping the project size small significantly increases the odds for the IT project success, irrespective of the organizational maturity level in project management. On the other side, the higher the organizational maturity level in project management the higher its IT projects success ratio. These two findings combined provide a very practical insight into the process of achieving project management excellence. Namely, organizations that are not experienced in project management should strictly control the size and complexity of the IT projects launched, while simultaneously investing in improving formal project management skills and gathering the necessary experience through a number of small-size IT projects. Once they achieve an appropriate maturity level in project management, they can pursue bigger and more complex IT projects. This line of reasoning is highly aligned to the fact that a strong interest for improving project management capacity exists in BiH in both industry and academia [43].

All these findings and insights are in concordance with the existing theory and practice of project management (e.g. [1], [7], [21], [22], [25], [31], [32] and [61]), which is of particular importance given the fact that the most significant research work on project management has been done by scholars and professionals from the most developed countries. Namely, the study findings provide a further support for the validity and applicability of such theoretical and practical propositions under the economic and market circumstances of the developing countries. Furthermore, the small size of the overall IT market in Bosnia and Herzegovina [62] indicates that the most common IT projects are of a small or, possibly, medium size. That fact, combined with the study findings, provide a further explanation of high success rate of the implemented IT projects in the F BiH.

Finally, the study results showed that the differences between IT projects' success ratio of the three groups of organizations are primarily indicated by the time and costs project constraints. The difference regarding the project

scope was not found to be statistically significant (Table 6). Such a finding can be interpreted in two ways. First, project scope can be treated as a distinguishing trait of the project and not as an indicator of project management efficiency [18]. Furthermore, scope is quite often considered as a project constraint that is functionally dependent on the other three constraints – time, costs, and quality [63]. Therefore, project scope should not or could not be treated as a project success indicator along with time and costs.

On the other hand, this finding may point to a shortcoming in research design. More specifically, it is possible that the measurement of project scope constraint was not defined properly, which prevented the necessary distinguishing between different projects' efficiency levels. However, it must be noted that such outcome could also be caused by inadequate data sample (see "Limitations of the Research" sub-section). Whatever the case may be, these results point toward the necessity of further research of the link between the IT projects' success ratio and project scope. For example, one way to improve the research design for future studies is to separate the criterion scope (or quality) between functional and non-functional requirements, as suggested by Pankratz and Basten [17]. That would also be the main recommendation for the future research on the topic. Results of that research along with the results of this study will be useful for both academia and management practitioners – the former to get a deeper insight into the ever-interesting issue of IT projects' success, and the latter to better manage their IT projects.

Limitations of the research

There are several limitations that apply to this research, both design and technical. In order to keep the research design simple, the IT projects' success was only measured by the projects' time and costs constraints, and by the projects' scope constraint. Hence, one recommendation for the future research would be to seek out new indicators which would improve the measurement of the dependent latent variable (*Project Success Rate*). In addition, the study focuses on project efficiency measures only, so the measurement of the dependent latent variable should be expanded by the indicators of business and enterprise goals [18].

Regarding the technical limitations, the data analysis was conducted on a single sample whose size is just adequate for this research design. Consequently, no confirmation of the findings was done. Besides, the data were collected from a single country, so the obtained results could be generalized only for the population from which the sample was drawn. Future studies may remedy the above noted limitations by applying this (or similar) research design to different datasets.

Finally, it must be noted that MANOVA is primarily intended for experimental research. Nevertheless, this quasi-experimental approach (survey research) is quite common in empirical research. The main problem here is that an unambiguous cause and effect relationship cannot be established, since the researcher does not have full control over the research environment. For this research, this issue comes down to whether the increase in project management maturity is a cause or effect of the increase in IT projects' success ratio. However, strong support in theory that a higher project management maturity is positively related to a favorable project outcome (see the Literature Review section) justifies the assumed causal order.

4. Conclusion

Running counter to the literature found on the topic of IT projects success, a great majority of closed IT projects in the F BiH were on budget and time, and with no or very small changes in the project scope. Consequently, this study aims to get a deeper understanding of the relationship between organizational and project characteristics and success ratio of implemented IT projects, under the conditions of an underdeveloped market, such as the market of the F BiH.

In order to get a deeper insight into the phenomena, a comparison of the success rate between different groups of surveyed organizations was made. These groups are formed based on the implemented projects size and organizations' project management maturity level. To conduct an appropriate data analysis, the MANOVA was used.

The research results showed that organizations which implement small-size projects, measured by the average project budget, have a higher IT projects success ratio, regardless of their project management maturity level. Furthermore, the results also showed that organizations which have achieved a high level of project management maturity have a higher IT projects success ratio for medium-to-large size IT projects, measured by the average project budget. These two research findings combined explain such (unexpectedly) high success ratio of implemented IT projects in the F BiH. Finally, the research results unveil that the differences between IT projects' success ratio of the three groups of organizations was primarily induced by the time and costs project constraints.

A practical insight into the process of achieving project management excellence, which arises from the main research findings, is that organizations inexperienced in project management should focus on controlling the size and complexity of their IT projects, while simultaneously improving formal project management skills and gathering the necessary experience by implementing a number of small-size IT projects. Upon reaching an adequate project management maturity level, they should pursue larger and more complex IT projects.

The main implication of this research is a deeper insight into the possible reasons for a very high and rather unexpected success rate of IT projects implemented in F BiH, as well as a better understanding of the importance of organizational and project characteristics for the IT projects' success. In addition, as a more distant research outcome, the study showed that the existing theoretical propositions and sound practices of modern project management are fully applicable to the economic and technological conditions of Bosnia and Herzegovina as a developing country.

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