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Factors of Successful Management of Information Systems Development Projects

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ABSTRACT

The tradition on IS research has established the so called "iron triangle", the three dimensions that characterize the project management success (PMS) if it is delivered on time, within the budget and according to specifications. However, less attention has been given to the continuum characterized by deviations from the baseline from each of these three dimensions. This paper draws on the definition of the PMS continuum and analyzes four potential factors that may influence PMS: team, project manager, project, and portfolio. We develop hypotheses and test them in a hierarchical linear regression using a sample of 899 IS projects of a leading bank, collected between January, 2014 and December, 2015. Besides proposing and discussing a new continuous PMS indicator, we identify factors that influence IS PMS positively (project size, duration, postponement, and project manager formal power) and negatively (team size and team allocation dispersion). The results suggest guidance of team members' allocation.

Keywords

ISD success, Information Systems Project Management, Project Management Sucess.

INTRODUCTION

The success of Information Systems (IS) largely depends on the system quality and functionality perceived by customers and users (Agarwal and Rathod 2006; Procaccino and Verner 2006). However, aside the interest in qualifying the resulting IS artifact, from the developer standpoint it is important to assess the success of project management, as usually ISD is configured in a repetitive set of activities. In this vein, developers are usually interested in improving their competence in allocate resources efficiently. Accordingly, the project management research tradition has established the importance of the "iron triangle", three evaluative dimensions by which a project is considered successful. These dimensions characterize success based on a project being delivered on time, within the budget and according to specifications (Lim and Klein 2006; Westerveld 2003). It is to note that these three conventional dimensions are in fact related to project management activities, not to the project artifact itself (Baccarini 1999; de Wit 1988; Turner 2016). For example, the Standish Group has been monitoring IS projects worldwide since 1985 and since then uses the triple constraint as a measure of project management success (PMS) (Standish 2013). In IS research, even though these dimensions are important constraints to the project management activities, they are still commonly used to measure the PS of IS projects (de Bakker et al. 2010; Ramasubbu et al. 2015).

Despite the widely acceptance of this conventional measure of PMS, the same cannot be asserted about its operationalization. The vast majority of the literature usually consider PMS as a dichotomous attribute by which either there is success or not. Because developers usually deal with recursive activities, the competence in precisely allocate resources is crucial for future projects. Therefore, one may consider inadequate to either over or under estimate time or budget because both situations lead suboptimum resources allocations. The remaining dimension, the project scope – the required set of client specifications – has become managerially dealt with proximity and communication between development teams and business areas. Considering a multiple projects scenario where the development provider is accessed recursively, there are strong incentives for these relational governance mechanisms that minimize initial project misspecifications, but also foster dynamic scope adjustments. Accordingly, in recursive project management settings – those where the development team is reinforced to repeatedly interact with business/client areas, it is expected that scope is usually achieved, while time and budget vary as consequence.

Also of interest are the factors that may influence PMS. In an effort to clarify this aspect, extant IS literature has analyzed a myriad of factors that can affect PMS. For example, technological environment has been presented as having an effect of interaction with IS development teams abilities often leading to irrelevant and ineffective systems (Lee and Xia 2005); the intrinsic motivation of the IS project manager has been found relevant to project success (Procaccino and Verner 2006) and the IS project manager's ambidexterity can affect team effectiveness (Tiwana 2010); the collective belief of self-effectiveness of a team can influence IS project success (Akgün et al. 2007); the face-to-face contact between remote counterparts of a IS development team might result in difficulties within the project (Oshri et al. 2007); the agile IS development team diversity was found to improve software functionality (Lee and Xia 2010); the social networks of team members are found important in procedures alignment that can lead to IS development team productivity (Sarker et al. 2011; von Krogh et al. 2012); project duration are related to project success likelihood (Gefen et al. 2016); the balance of team member allocation has an effect on project success (Doherty et al. 2012); as well as the ability to assess the individual risks of projects and consolidate them into an analysis on portfolio level can affect the project's success (Flyvbjerg and Budzier 2011).

These few examples illustrate how multiple effects are expected on PMS originating from a number of levels of analysis. It is easily recognizable, at least, four levels: (1) team level (skills, motivation, social network, and communication); (2) project manager level (ambidexterity and motivation); (3) project level (duration); and (4) portfolio level (team allocation, risks and interdependencies).

In this paper, we proceeded as follows. First, we formulate the hypotheses based on IS and project management literature by means of a research related the main aspects that affects project success in *IS senior basket*, project management and innovation relevant journals. Subsequently, we partnered with a leading bank that develops internally and outsources software projects. From a sample of 899 IS projects initiated in 2014 and concluded in the period between January, 2014 and December, 2015. We tested our hypotheses by means of a hierarchical linear regression technique and, finally, based on the results of the analysis, we developed a set of conclusions about the main factors accounted for successful management of ISD projects.

LITERATURE REVIEW

Success, in project management perspective, can be understood as being composed of three major dimensions (Lim and Klein 2006; Westerveld 2003). It may be delivered on time (Time Success), within the budget (Cost Success) and according to specifications (Scope Success) and combinations of these three dimensions. Nevertheless, one might expect these dimensions as correlated, since delivery delays usually have implications in cost and possibly on the fulfillment of the specifications. On the other hand, cost overruns may implicate reductions of scope to maintain the delivery time on target, or maintaining the specifications can implicate in time delays. Since the three dimensions are interconnected, for the purpose of this paper, we aggregate the three dimensions into one, and define Cost and Time Project Management Success (CTPMS), defined as the deviations on budget combined with delivery time that a scope successful project may have incurred. Following, we present the research model in Figure 1 and review the IS and PM literature and elaborate the rationale behind each hypothesis regarding the potential effect of each factor on CTPMS. In doing so, we believe we can better analyze the effects of each level of factors in a more comprehensive way.

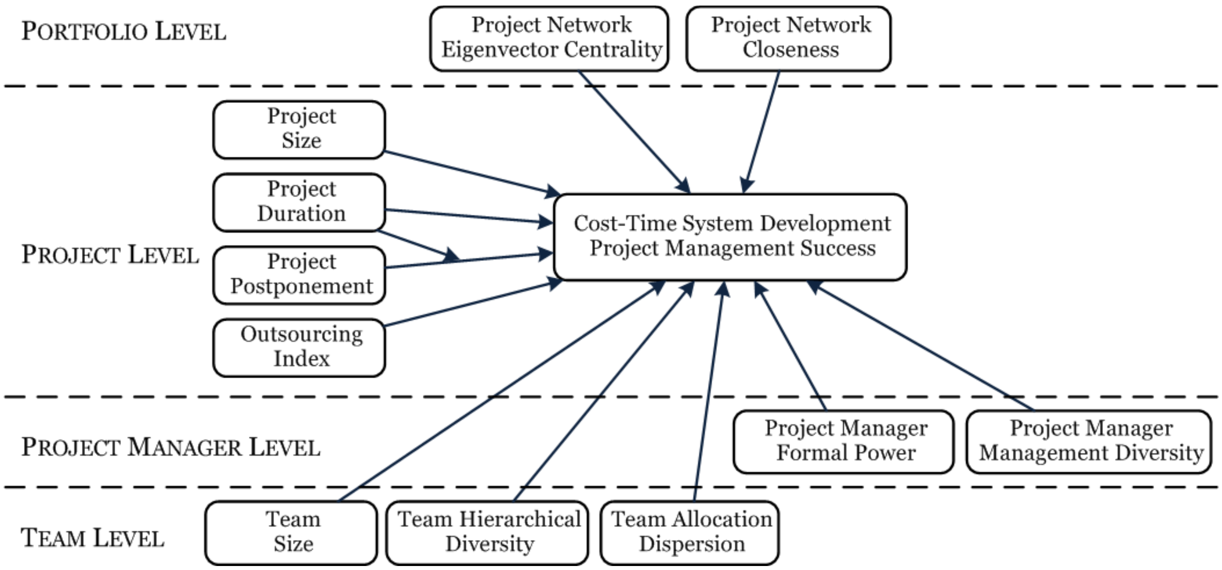

Figure 1 - Research Model

Project Level Effects

Literature presents many specific characteristics that projects can assume and should be under consideration when analyzing CTPMS. We considered as project factors the project duration, size, postponement and outsourcing.

Project Size and Duration

Literature presents different postulates regarding the impact of project duration on project management success. According to Martin et al. (2007) project duration is negatively correlated with project performance. In the same direction, Taylor et al. (2012) posit that large projects tend to be more complex, requiring larger teams with greater communication, leading to higher organizational complexity and decreasing the likelihood of success. Accordingly, risks increase as duration increases Martin et al. (2007). In another direction, Cho et al. (2009) has found that short time projects are associated with higher cost overruns, while Zwikael and Unger-Aviram (2010) argue that longer projects have a positive impact in the team skills development, showing a subsequent positive influence on project management success. Adding to this view, Gefen et al. (2016) argue that larger projects are more likely to be successful, due to the fact that they are supposed to be minutely described and estimated more precisely. In line with the positive influences argumentation we therefore state that:

Hypothesis 1: *Increased project size enhances Cost and Time Project Management Success (CTPMS) of IS development projects*

Hypothesis 2: *Increased projects duration enhances Cost and Time Project Management Success (CTPMS) of IS development projects*

Project Postponement

The Project Postponement refers to the flexibility of postponing the start of a project execution and part of resources commitment. This decision may be based on the necessity of learning about the nature of uncertain payoffs and can result in prioritization changes (Benaroch et al. 2007). Project postponement is one of the project portfolio management decisions comprised by decisions to start, stop or accelerate projects (Cooper and Edgett 1997). In the face of risk of potential losses on IT projects, organizations can adopt a defensive posture relate their project portfolios (Fichman et al. 2005). As a way to facilitate decision makers with project portfolio optimization companies often use the real option framework to decide on defer, invest, grow or abandon a project investment (Benaroch et al. 2007; Trigeorgis 1996). Although the postponement option should contemplate the cost of not making a decision (Lewis et al. 2004), a project start delay can be worthwhile if future information is expected to decrease the execution risks (Benaroch et al. 2007). Based on these elements we propose the following:

Hypothesis 3: The longer the Project Postponement is, the higher is Cost and Time Project Management Success (CTPMS) of IS development projects

As postponement option allows decision makers to collect additional information to cope with potential risks of the project. As the project presents longer duration, however, it is expected that part of the initial perceived risks are relieved given the raise of opportunities to consider solutions for them in the future. Also, some risks in longer projects tend to be less emphasized, as less complete information is available ex-ante (Benaroch et al. 2007). Therefore, we complement the afore stated hypothesis as follows:

Hypothesis 4: Project Duration moderates and reduces the direct effect of Project Postponement on Cost and Time Project Management Success (CTPMS) of IS development projects.

Outsourcing

The outsourcing of IT functions has been widely discussed in the literature over the past years (Lacity et al. 2010) and cost reduction emerges as one of the major factors that lead a corporation to consider outsourcing (Schwarz 2014). Specifically from ISD project perspective, outsourcing is considered a crucial decision due to its impacts on projects cost, time (Gorla and Somers 2014) and risk management (Gefen et al. 2016). Nevertheless, there are several studies that point to a positive relationship between IS projects outsourcing and PMS. For example, Srivastava and Teo (2012) posits that there is a moderating influence of outsourcing governance on ISD quality and cost performance. Also, client governance can be better performed when activities are performed by a vendor then conducting tasks internally, reducing coordination costs. In this direction, Han et al. (2013) found that complementary client and vendor IT capabilities are significant factors of IS projects success. Summing up, we propose the following:

Hypothesis 5: The higher level of project outsourcing is, the higher is the Cost and Time Project Management Success (CTPMS) of IS development projects.

Team Level Effects

A team, by definition, consists of two or more individuals who socially interact aiming to perform organizational relevant tasks, and are characterized by: (1) common goals; (2) interdependencies related to activities, workflow, goals, and outcomes; (3) different roles and responsibilities; and (4) are embedded in an organizational system. Team work may be characterized by recurring cycles of mutually dependent interaction. Currently, many organizations use some form of team-oriented work with the purpose of obtaining greater efficiency (Kozlowski and Bell 2003). However, staffing projects is challenging (Walter and Zimmermann 2016), due to project teams are comprised of members from different skills and disciplines and whom are difficult to bring together (Zwikael and Unger-Aviram 2010).

Team Size

Considering the specific context of the development of Open Source Systems (OSS), increasing the number of developers is necessarily a problem, as individuals accept to work based on voluntary affiliation. Studies of OSS dynamics and team productivity have shown that larger team size positively effect on project outcomes due to developers' engagement (Chengalur-Smith et al. 2010). Between other motivations, OSS developers can find in larger projects an opportunity for learning, know people and to improve their reputation, if they can be associated with a good performance (Chengalur-Smith et al. 2010). However, outside the particular field of OSS development, general literature supports that large project team size has setbacks as negative effects on budget (Martin et al. 2007), productivity losses due to the need for increased coordination effort, loafing, and decreasing motivation of the team members (Ingham et al. 1974; Walter and Zimmermann 2016). In the same vein, there is empirical evidence that as team size increases, productivity per person decreases due to the effect of social loafing, wherein team members achieve less than their potential (Chidambaram and Tung 2005). Taylor et al. (2012 have also posited that larger teams require higher levels of communication and leads to organizational complexity, while Balliet (2010 argues that a small team eases communication both within the team and to project stakeholders improving cohesion and cooperation. Based in these statements we propose the following hypothesis:

Hypothesis 6: The larger projects team size is, the lower is the Cost and Time Project Management Success (CTPMS) of IS development projects

Team Allocation Dispersion

Team allocation in ISD projects is a combination of the project technical requirements and the specialties and abilities of the developer. Currently, the required specialties have been increasingly defined by a fast technological evolution scenario where knowledge on multiple technologies is an imperative (Ramasubbu et al. 2015). While team members allocation ideally requires individuals with multiples skills (Walter and Zimmermann 2016), finding developers with multiple specialties is costly. In consequence, teams can be elaborated in a manner that gathers individuals with strategically defined complimentary abilities and knowledge. In order to this elaboration work, collaboration is also needed and putting together team member's congruent values is a key to foster the required connections and communication (Narayanaswamy et al. 2013). However, deploying the team member collaboration strategy is also complex. In many cases, the alternative approach is to share the costly resource between multiple projects attempting to productively use it. Considering this resource as a skilled team member, which will be allocated few hours in multiple projects with diverse teams, it is reasonable to infer that there will be unlikely that this individual can develop common interests and affinities with any particular project team. Therefore, we posit:

Hypothesis 7: The higher Team Allocation Dispersion is, the lower the Cost and Time Project Management Success (CTPMS) of IS development projects

Team Hierarchical Diversity

The issue of the effects of hierarchical diversity on team effectiveness and productivity is still open (Keller 2001; Lim and Klein 2006). However, extant literature on team diversity provides some hints about the possible negative effect, since functional diversity is associated with teamwork more difficult (Ancona and Caldwell 1992). Accordingly, (Mannix and Neale 2005) claim that homogeneous teams are better for profiteering of existing knowledge. Considering other types of diversity, though, is has been argued that groups with different expertise, experience, and education background benefits creativity, and problem solving in complex systems (Page 2010). In line with the previous view, we propose:

Hypothesis 8: Higher levels of project Team Hierarchical Diversity are associated with lower levels of Cost and Time Project Management Success (CTPMS) of IS development projects

Portfolio Network Level Effects

The project portfolio management has gained the attention of executives as a way to enable organizations to align projects with organizational strategy and ensure the adequate human resources for projects at the right time (Killen and Hunt 2013). The cost of human resources is usually the largest one in an IS project (Acuna et al. 2006) and allocating the right people determine the quality and productivity of a project (Chan et al. 2008). Therefore, the process of allocating team members considering the best composition of cost and skills is crucial to project management success (Walter and Zimmermann 2016).

Project Network Closeness and Project Network Eigenvector

Two of the indices most commonly used in the social network analyses are closeness centrality (Beauchamp 1965) and eigenvector centrality (Bonacich 1972). While closeness centrality measures how close a node is to all other nodes in the network, eigenvector centrality measures how close a node is to well-connected (popular) nodes in the network. In other words, it is important to connect to nodes, but it matters which node to connect to. As IS projects are comprised of multiple team members, and each team member can participate in multiple projects, a team member can exchange ideas (Zika-Viktorsson et al. 2006) and share knowledge on software development techniques between projects' teams (Ozer and Vogel 2015), acting as a conduit for knowledge and expertise flow across the connected IS projects (Xu et al. 2006). These relationships in which members and projects are embedded can lead to improved outcome and performance (Burt 2009), influencing the success of projects (Peng et al. 2013) due to the decreased cost coordination among members. However, not any relationship matters. In fact, for a specific skilled team member, being allocated in a myriad of projects can reduce his/her own productivity while not allowing the spread of his/her knowledge properly. In fact, a variety of team memberships increase the information complexity with which a skilled team member must. Additionally, too many connections may slow down the speed of project development (Colazo 2010), because building and maintaining relationships with others takes time and effort and consumes resources (Adler and Kwon 2002). So, an increased number of generic ties may improperly create information overload and enhance the managing cost; consequently, reducing outcome and performance (O'leary et al. 2011). Therefore, we posit:

Hypothesis 9: Higher project network closeness has a negative impact Cost and Time Project Management Success (CTPMS) of IS development projects

In the opposite direction, having the opportunity to establish connections from where an individual can exchange useful information is a key to performance since it allows individuals to reach others with the same level of skills that can improve the performance of an IS project (Ozer and Vogel 2015). It is especially important when software requirements volatility, design and technological novelty, as well as higher levels of customer involvement increase the simultaneous use of multiple software development process frameworks within a single project, which requires focused and specialized information (Ramasubbu et al. 2015). Having good quality ties grants quick access to specialists and similar projects. The perspective of performing collaborative but equitable tasks between team members nurtures the social capital formation by which knowledge, trust, and mutual respect are fostered, which contributes to grant to individuals improved productivity (Wagner et al. 2014). We, therefore, propose:

Hypothesis 10: Higher project network eigenvector has a positive impact on Cost and Time Project Management Success (CTPMS) of IS development projects

Project Manager Level Effects

The project manager is the main responsible for overseeing the project and project team (DuBois et al. 2015). To be able to inspire people, project leaders need to be able to influence others to act to achieve project goals. However, in leadership, it is important not only achieve good business results, but also create a culture where people are empowered and inspired by a common purpose (DuBois et al. 2015). However, in order to the project management success, the project manager not only needs the soft skills to motivate the team member's contribution, but also to access the hard skills (tools and techniques) necessary to monitor and control the project activities (Singh and Tan 2010). Additionally, must have the authority to delegate, control and monitor the team members' activities (PMI 2013) and should be formal empowered to conduct with flexibly the unforeseen circumstances (Jugdev and Müller 2005).

Hypothesis 11: The higher the PM Formal Power is, the higher the Cost and Time Project Management Success (CTPMS) of IS development projects

PM Management Diversity

The management of projects of different sizes requires diverse approaches, leadership styles and skills (Müller and Turner 2010). At one end, the management of small to medium sized projects requires focus on the prioritization of resource allocation across several projects, while in large projects the emphasis is on the coordination a complex sequence of activities, balancing resources across the activities, but focusing on the enablement of the critical activities (Payne and Turner 1999). In general, project manager knowledge and skills are seem as key to the effectiveness in solving project crisis and maximize the likelihoods of the project success (El-Sabaa 2001). For example, expertise in problem-solving, skills in communication and leadership, ability to correctly identify the context condition, and expertise in planning and monitoring scope, timelines, and budgets are deemed of fundamental importance (Müller and Turner 2010). One way to obtain the knowledge and develop the experience and skills needed is to be engaged in projects of diverse sizes, where the PM can be exposed to multiple conditions that require the exert of multiple abilities. For example, being assigned to manage small projects can serve as training ground for managers of later large projects (Payne and Turner 1999). Based on the above, we formulate:

Hypothesis 12: Higher levels of PM Management Diversity are associated with higher levels of Cost and Time Project Management Success (CTPMS) of IS development projects

METHODS

Sample and Data Collection

The organization is a Brazilian company in the Financial Service Industry that is present in 15 countries and one of the largest in the world in its field, with more than US$ 400 million in assets, more than 80,000 employees and ranked as the top 50 worldwide most valuable banking brands in 2015 (Finance 2015). The IT department counts around 5,000 employees, the IT Project Management Office has 50 employees, and the capacity of external collaborators is flexible, depending on demand. The portfolio reaches more than 3,000 annually initiated IS projects. An initial dataset of 3,778 IS projects were extracted from the Corporate Project Management Software on February 2016, containing IS projects initiated in the period from December, 2013 to December, 2014 and concluded within the period of January 2014 to December 2015.

Variable	Mean	s.d.	*1*	*2*	*3*	*4*	*5*	*6*	*7*	*8*	*9*	*10*	*11*
1- Cost and Time PM Success	0.987	0.287											
2- Project Size (Hs)	2931	7674	-0.005										
3- Team size (members)	9.71	10.00	0.006	0.643**									
4- PM Formal Power	0.055	0.229	-0.009	0.028	0.015								
5- Project Duration (Days)	261.7	143.8	0.320**	0.223**	0.275**	0.026							
6- Outsourcing Index (% Hs)	0.272	0.287	-0.132**	0.112**	-0.096**	0.021	-0.134**						
7- Project Postponement (Days)	3.5	15.1	0.146**	-0.008	0.004	0.003	0.051	0.098**					
8- Team Time Allocation Dispersion	384.0	648.4	-0.051	0.808**	0.334**	0.070*	0.229**	0.342**	0.037				
9- Team Hierarchical Diversity	1.199	0.642	-0.105**	-0.033	-0.174**	0.074*	-0.106**	0.602**	0.035	0.079*			
10 -Project Network Closeness	0.318	0.088	-0.038	0.133**	0.283**	-0.035	0.120**	-0.054	0.028	0.057	-0.047		
11- Network Eigen. Centrality	0.094	0.211	0.025	0.157**	0.457**	-0.024	0.053	-0.042	0.045	0.041	-0.196**	0.238**	
12- PM Managmt Diversity	0.171	0.267	0.096**	0.030	0.086**	-0.019	0.096**	-0.007	0.011	0.029	-0.041	0.058	0.000

Table 1 – Descriptive Statistics and Correlations

Note: n= 899 ; * $p<0.05$ ** $p<0.01$ *** $p<0.001$

We excluded 2,636 IS projects with less than 501 hours of development, reducing the data set to 1,142 projects. This reduction was necessary because these projects are deemed small projects according to the project management methodology (PMM) established by the organization. Small IS projects are conducted by separate team and budget using a simplified PMM, based on FIFO (First-In, First-Out) order. So, given the very diverse nature of the project management processes, we decided that small IS projects should be studied in a separate study. Later, we further deselect cases which presented an unlikely extreme case of success. For example, cases that succeeded in time by using less than 33% of the baseline time, or cases that succeeded in cost by costing less than 33% of the baseline cost were segregated. Those cases were deemed as being supported by a probable faulty initial planning process or carrying any incomplete scope change. In order to apply this criterion, we developed additional indicators for Cost Project Management Success (CPMS) and Time Project Management Success (TPMS) which were respectively calculated based on the percentage of cost deviance incurred from the baseline cost, and percentage of time deviance incurred from the baseline time. Cost or time unsuccessful projects, however, were included at any percentage of deviance. Based on this criterion, 243 projects were isolated from the dataset, resulting in 899 valid IS projects.

Measures

All measures were operationalized by variables available as secondary data, extracted from the ongoing PM control systems. Following, we present how the regression variables were defined.

Dependent variable

We operationalize CTPMS as the proportion of the cost baseline relative to actual cost that a successful scope project incurs, multiplied by the proportion of the time baseline relative to the actual time expend. This perspective allows to measure deviations from planned cost and time, controlling for the scope, which is dynamically adjusted between development and business/client teams. All projects in the sample are considered scope-successful. As per our proposition, deviations either from cost or time (or both) baselines result a score that can depart from the gold maximum of "1". This operationalization also compensates for managerial decisions that may proportionally combine the use of resources. For example, the managerial team may decide to reduce 10% in time by means of an increment of 10% in cost, with the resulting maximum score. If, in the other hand, 10% of time reduction is achieved without any increment in cost, although it may be considered a good result from the organization, it may hide the bad practice of manipulating the planned baseline by deliberately defining more resources than needed intending to achieve artificial success in future. It is considered a fail in planning phase, a crucial project management activity. Below is Cost-Time PMS formula:

$$\boldsymbol{Cost\ and\ Time\ PMS_i} = \left(\frac{\boldsymbol{Baseline\ Cost_i}}{\boldsymbol{Actual\ Cost_i}}\right).\left(\frac{\boldsymbol{Baseline\ Time_i}}{\boldsymbol{Actual\ Time_i}}\right) \quad \text{(Eq. 1)}$$

Independent and control variables

Project Size: We operationalize project size by the total number of labor units required to complete the project (Calisir and Gumussoy 2005; PMI 2013), expressed in hours.

Project Duration: It is the time required to complete the project (Calisir and Gumussoy 2005; PMI 2013), expressed in days, by the difference between the actual finish date and the actual start date of the project.

Outsourcing Index: The Outsourcing Index is the relation between the total number of hours outsourced and the total amount of labor work (hours).

Project Postponement: We operationalize Project Postponement by the difference of days between the planned start date indicated in the project baseline and the actual start date. A positive number means that the project started late, and it may incur additional costs (Olaniran et al. 2015).

Team Size: Defined as a set of individuals who support the project manager in performing the work of the project to achieve its objectives (Calisir and Gumussoy 2005; PMI 2013), and was operationalized by the project headcount. Outsourced resources and employees of the business departments don't register the time sheet on the Corporate Project Management Software, so the variable Team Size consider only the employees that work in the IT department.

Team Allocation Dispersion: Defined as the intensity by which a project combines analysts with hourly allocation which departs from the typical allocations of the majority of the other team members. The best-case is to allocate the developer to complete a task or deliver a feature PMBOK according to its capacity (PMI 2013). We operationalize Team Allocation Dispersion by the Standard Deviation of the hourly allocation of the team member within each team.

Team Hierarchical Diversity: We operationalize Team Hierarchical Diversity as a measure of the spread of the Hierarchical position (H) of team member (m) within each project (i), according to their position in the organization. The formula calculates the variance of a binomial distribution, as follows:

$$\boldsymbol{Team\ Hierarchical\ Diversity_i} = \sum_{\mathbf{1}}^{\boldsymbol{m}} [(\boldsymbol{H_m} - \boldsymbol{\overline{H}})^{\mathbf{2}}.\boldsymbol{P(Hm)}] \quad \text{(Eq. 2)}$$

Project Network Closeness: We operationalize Project Network Closeness with network analysis using the team membership as measures of the edges. In consequence, the nodes were set as the projects, and in this case network closeness is a measure on how much central a project is considering all other projects in portfolio network, as a result of multiple allocations of developers (Beauchamp 1965). The use of the Social Network Theory is new in the project management research field and it has been recently used in studies of open source projects (Peng et al. 2013).

Project Network Eigenvector Centrality: We operationalize Project Network Eigenvector Centrality with network analysis using the team membership as measures of the edges. In consequence, the nodes were set as the projects, and in this case Network Eigenvector Centrality is a measure of how much the project is central to other central projects in the portfolio network, as a result of multiple allocations of developers (Bonacich 1972).

Project Manager Formal Power: It is defined as a measure of the formal authority given to the project manager to apply organizational resources to project activities (Lee et al. 2000; PMI 2013). The variable was operationalized based on the project manager role (1=System Analyst Junior, 2=System Analyst Medium, 3=System Analyst Senior, 4=Coordinator, 5=Manager) by means of a dummy variable set to zero if manager role is 1 to 3 and assume value=1 if manager role is 4 to 5 (Sandhu et al. 1996).

PM Management Diversity: A project manager that coordinates projects of different sizes (Müller and Turner 2010). We operationalize PM Management Diversity as a measure of the spread of size of the managed project (Ps) of project manager (pm) within each managed project (i). The formula calculates the incremental project variance of a binomial distribution, as follows:

$$\boldsymbol{PM\ Management\ Diversity_i} = \sum\nolimits_{1}^{pm} \left[\left(Ps_{pm} - \overline{Ps}\right)^2 . P(Ps_m)\right] \Big/ \sum i \qquad \text{(Eq. 2)}$$

RESULTS

Table 1 provides descriptive statistics and Pearson and Kendall's tau correlations of our variables. The descriptive statistics indicate that the sampled Project Size met an average of 2931 hours, with a wide standard deviation. On average, a team size counts on 9.71 members, and a project duration averaged 261.7 days. Outsourcing happens on average of 27.2% of the size of the projects, while Program Managers, are responsible for managing projects that differ on average 17,1% in size. Our measure of Cost and Time Project Management Success is positively and significantly correlated with the project duration, project Postponement and PM management diversity, but negatively and significantly correlated with outsourcing and team hierarchical diversity. Variance inflation factors (VIFs) and a linear dependency test was used to test for collinearity. We found some significant correlations among predictors, but none of the multicollinearity statistics estimated in conjunction with our regression models reached the point at which multicollinearity is a concern. All VIF coefficients were individually estimated at any regression stage and resulted less than 5, well below the threshold of 10, indicating that multicollinearity was not a likely threat to the parameter estimation (Cohen et al. 2003). Also, we analyzed the maximum Condition Index (CI) for each block of predictors and the result shows the maximum value of 5.2, less than the threat value of 15 (Belsley et al. 2004). These results suggested that multicollinearity was not a concern for our model.

ANALYTICAL TECHNIQUE AND HYPOTHESES TESTS

We tested the hypotheses by using hierarchical regression analysis (Cohen et al. 2003), with all main effects added first and later on adding the interaction terms. We mean-centered all variables to avoid any potential of multicollinearity and examined the threat of multicollinearity by calculating the variance inflation factor (VIF) for each predictor (Cohen et al. 2003). Model 1 in Table 2 reports the effects of the model with control variables which we preliminarily were interested in. Successive models include variables with diverse levels of analysis to analyze the effects above and beyond each previous block of variables. Model 2 includes project level variables, while model 3 includes team allocation variables. Similarly, model 4 includes portfolio team allocation variables, and model 5 adds project manager variables. Finally, model 6 helps to check for interactions.

All the following effects of predictors on Cost and Time Project Management Success (CTPMS) are shown in Model 5, Table 2. H1 posited that project size increments increase CTPMS of IS development projects. The results reveal that project size had a strong positive impact on CTPMS [B = 0.261, t (261) = 3.48, p<0.001]. As a result, H1 is supported. H2 suggested that increasing project duration increases CTPMS of IS development projects. The results reveal that project duration had a strong positive impact on CTPMS [B = 0.362, t (886) = 10.791, p<0.001].

Therefore, H2 is supported. H3 indicated that longer project postponements have a strong positive impact on CTPMS of IS development projects. The results reveal that project postponement had a strong positive impact on CTPMS [B = 0.142, t (886) = 5.08, p<0.001]. As a result, H3 is supported. H4 posited that Project Duration moderates and reduces the direct effect of Project Postponement on CTPMS of IS development projects. The results reveal that this interaction is significant, showing a negative, small effect [B = -0.074, t (886) = -2.160, p<0.05], thus supporting H4. H5 posited that the higher level of project outsourcing is, the higher is the CTPMS of IS development projects. The results reveal that project outsourcing had a marginal negative non-significant impact on CTPMS [B = -0.024, t (886) = -0.683, ns]. As a result, H5 is not supported. H6 suggested that the larger projects team size is, the lower is the CTPMS of IS development projects. The results reveal that projects team size had a strong negative impact on CTPMS [B = -0.198, t (886) = -3.729, p<0.001]. As a result, H6 is supported. H7 indicated that the higher Team Allocation Dispersion is, the lower the CTPMS of IS development projects. The results reveal that Team Allocation Dispersion had a strong negative impact on CTPMS [B = -0.274, t (886) = -4.188, p<0.001]. As a result, H7 is supported. H8 posited that higher levels of project Team Hierarchical Diversity are associated with lower levels of CTPMS of IS development projects. The results reveal that Team Hierarchical Diversity had a non-significant negative impact on CTPMS [B = -0.049, t (886) = -1.17, ns]. As a result, H8 is not supported. H9 suggested that higher project network closeness has a negative impact CTPMS of IS development projects. The results reveal that project network closeness had a negative, small effect on CTPMS [B = -0.074, t (886) = -2. 160, p<0.05]. As a result, H9 is supported. H10 indicated that higher project network eigenvector has a positive impact on CTPMS of IS development projects. The results reveal that project network eigenvector had a small positive impact on CTPMS [B = 0.066, t (886) = 1.83, p<0.10]. As a result, H10 is supported. H11 posited that the higher the PM Formal Power is, the higher the CTPMS of IS development projects. The results reveal that PM Formal Power had no significant effect on CTPMS [B = 0.001, t (886) = -0.032, ns]. As a result, H11 is not supported. Finally, H12 suggested that higher levels of PM Management Diversity is associated with higher levels of Cost and Time Project Management Success (CTPMS) of IS development projects. The results reveal that PM Management Diversity had small, positive effect on CTPMS [B = 0.080, t (886) = 2.581, p<0.05]. As a result, H12 is supported.

	Controls: model 1	**Project Factors: model 2**	**Team Factors: model 3**	**Portfolio Factors: model 4**	**PM Factors: model 5**	**Interaction: model 6**
Project Size (Hs)	-0.015	-0.006	0.242**	0.251***	0.261***	0.257***
Team size (members)	0.016	-0.091*	-0.172***	-0.187***	-0.198***	-0.193***
PM Formal Power	-0.009	-0.014	0.001	-0.001	0.001	-0.001
Project Duration (Days)		0.326***	0.360***	0.368***	0.362***	0.362***
Outsourcing Index (% Hs)		-0.111***	-0.009	-0.020	-0.024	-0.031
Project Postponement (Days)		0.140***	0.143***	0.142***	0.142***	0.171***
Team Time Allocation Dispersion			-0.270***	-0.269***	-0.274***	-0.272***
Team Hierarchical Diversity			-0.067 +	-0.053	-0.049	-0.047
Project Network Closeness				-0.071*	-0.074*	-0.076*
Project Network Eigenvector Centrality				0.061 +	0.066 +	0.066 +
PM Management Diversity					0.080*	0.080*
Project Duration_x_ Project Postponement						-0.074*
Constant	-0.003	-0.004	-0.002	-0.002	-0.002	0.002
R^2	0.0%	13.9%	15.6%	16.2%	16.8%	17.2%
R^2 Change	0.0%	13.8%	1.7%	0.6%	0.6%	0.4%
Adjusted R^2	0.0%	13.3%	14.8%	15.2%	15.8%	16.1%
F Change	0.074	47.735***	9.003***	3.300*	6.583*	4.667*
Model F	0.074	23.910***	20.505***	17.149***	16.286***	15.380***

Table 2 – Results of Fixed-Effects Regression Analysis Predicting Cost-Time Project Management Success

Note: n=899; + p<0.10 * p<0.05 ** p<0.01 ***p<0.001

We also analyzed the data robustness against the possibility of omitted variables bias. In our study, Team Time Allocation and Outsourcing Index are likely to be proxies for some unmeasured organizational factors such software development methodologies or Project Management Office policies, or even organization policies regarding the development of sensitive codes as in financial sector, information systems are of strategic value. We applied Ramsey RESET test for omitted variables a series of robustness measures to obtain our estimates. The results support the null hypothesis that the omitted variables bias is not a major concern in the study [F (3,883) = 2.017, ns].

DISCUSSION AND CONCLUSIONS

Expanding upon past research that emphasized the role of only some levels to consider the antecedent's factors on project management success, we recognized factors spread out four different levels of analysis - project level, portfolio level, team level, program manager level. We drew on projects of ISD literature to study how related multilevel factors affect project management success. Besides assembling multiple levels into one piece of research we added the network analysis approach to convey factors that are intensely present in organizations that deal with heavy software portfolios, and where multiple teams are shared between multiple projects. Our empirical study showed that ISD project size can indeed increase the cost-time project management success and project duration is a key factor to positively influence the project management performance, that happens because in a bank, larger projects are usually strategic and prioritized by the top management, corroborating (Gefen et al. 2016). Moreover, the results show that team allocation is a very important PM issue, as team size, team time allocation dispersion, and project network closeness; all of them reduce cost-time project management success. In consequence, smaller, focused and less disperse teams can present better results than multiple, bigger and sparse teams, dealing with a multiplicity of projects, contributing to the recent literature about agile IS development which indicates that this model of management improves the PMS (Lee and Xia 2005). Expanding upon past ISD research, we analyzed the team allocation into the portfolio that emerges two types of resulting networks that leads to opposite effects. Having individuals originally allocated in central projects sharing hours with multiple projects reduces project management success while having individuals sharing hours with other central increases project management success. In addition, our study shows that while specialization is an important economic concept, in the case of project managers, it is important to mix projects with diverse sizes, since it contributes to PMS, corroborating the previous literature in which project managers that are exposed to projects of different sizes are more prepared to deal with unexpected situations that could impact the PMS (El-Sabaa 2001; Müller and Turner 2010; Payne and Turner 1999).

PRACTICAL IMPLICATIONS

The findings of this study bring several managerial contributions for a better understanding of the antecedent factors of ISD success in respect to multiple levels, as project, portfolio, team and program manager dimensions above all. From project and portfolio perspective, the results can help project and portfolio decision makers to strategically allocate their resources pursuing a better balance among team members and across projects. Furthermore, the model presents important advises for team staffing related to team size and hierarchical diversity that may improve projects' success. The study also gives some guidance on how spread team members along multiple projects, looking for a positive effect on overall portfolio success. Additionally, it helps to understand the benefits of allowing program managers diverseness by experiencing the interaction with a multiplicity of project sizes.

LIMITATIONS

This study is not free of limitations. First, although we were able to gather data from a highly relevant in the financial services industry, some organizational policies and cultural aspects may heavily influence the results. Second, despite the extensive research literature concerning the factors that may contribute to project management success, not all factors could be included in our research model. Third, this study has focused on project management success, whereas the quality of the ultimate software artifact is to be analyzed to evaluate the overall project success. Forth, we didn't have access to the scope failed projects. Fifth, as we measured project management success with an indicator aggregating scope, cost and time dimensions, relative success in one dimension may alleviate relative failure in others. As a consequence, further research can analyze what factors may influence the success of management from each dimension perspective. Also, PMS can be analyzed in each dimension with respect of PS. Additionally, there is a field open to study the influence of methodologies, e.g. agile, on PMS and PS from the governance perspective.

REFERENCES

Acuna, S. T., Juristo, N., and Moreno, A. M. 2006. "Emphasizing Human Capabilities in Software Development," *IEEE Software* (23:2), pp. 94-101.

Adler, P. S., and Kwon, S.-W. 2002. "Social Capital: Prospects for a New Concept," *Academy of Management Review* (27), pp. 17-40.

Agarwal, N., and Rathod, U. 2006. "Defining 'Success' for Software Projects: An Exploratory Revelation," *International Journal of Project Management* (24:4), pp. 358-370.

Akgün, A. E., Keskin, H., Byrne, J., and Imamoglu, S. Z. 2007. "Antecedents and Consequences of Team Potency in Software Development Projects," *Information & Management* (44:7), pp. 646-656.

Ancona, D. G., and Caldwell, D. F. 1992. "Demography and Design: Predictors of New Product Team Performance," *Organization science* (3), pp. 321–341.

Baccarini, D. 1999. "The Logical Framework Method for Defining Project Success," *Project management journal* (30:4), pp. 25-32.

Balliet, D. 2010. "Communication and Cooperation in Social Dilemmas: A Meta-Analytic Review," *Journal of Conflict Resolution* (54), pp. 39-57.

Beauchamp, M. A. 1965. "An Improved Index of Centrality," *Behavioral Science* (10), pp. 161-163.

Belsley, D. A., Kuh, E., and Welsch, R. E. 2004. *Regression Diagnostics: Identifying Influential Data and Sources of Collinearity*. John Wiley & Sons.

Benaroch, M., Jeffery, M., Kauffman, R. J., and Shah, S. 2007. "Option-Based Risk Management: A Field Study of Sequential Information Technology Investment Decisions," *Journal of Management Information Systems* (24:2), pp. 103-140.

Bonacich, P. 1972. "Factoring and Weighting Approaches to Status Scores and Clique Identification," *The Journal of Mathematical Sociology* (2), pp. 113-120.

Burt, R. S. 2009. *Structural Holes: The Social Structure of Competition*. Harvard University Press.

Calisir, F., and Gumussoy, C. A. 2005. "Determinants of Budget Overruns on It Projects," *Technovation* (25:6), pp. 631-636.

Chan, C. L., Jiang, J. J., and Klein, G. 2008. "Team Task Skills as a Facilitator for Application and Development Skills," *IEEE Transactions on Engineering Management* (55:3), pp. 434-441.

Chengalur-Smith, I., Sidorova, A., and Daniel, S. 2010. "Sustainability of Free/Libre Open Source Projects: A Longitudinal Study," *Journal of the Association for Information Systems* (11), p. 657.

Chidambaram, L., and Tung, L. L. 2005. "Is out of Sight, out of Mind? An Empirical Study of Social Loafing in Technology-Supported Groups," *Information Systems Research* (16), pp. 149-168.

Cho, K., Hong, T., and Hyun, C. 2009. "Effect of Project Characteristics on Project Performance in Construction Projects Based on Structural Equation Model," *Expert Systems with Applications* (36:7), pp. 10461-10470.

Cohen, J., Cohen, P., West, S. G., and Aiken, L. S. 2003. *Applied Multiple Regression/Correlation Analysis for the Behavioral Sciences*. Routledge.

Colazo, J. A. 2010. "Collaboration Structure and Performance in New Software Development: Findings from the Study of Open Source Projects," *International Journal of Innovation Management* (14), pp. 735-758.

Cooper, R. G., and Edgett, S. J. 1997. "Portfolio Management in New Product Development: Lessons from the Leaders--I.," *Research Technology Management* (40), p. 16.

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), pp. 493-503.

de Wit, A. 1988. "Measurement of Project Success," *International Journal of Project Management* (6:3), pp. 164-170.

Doherty, N. F., Ashurst, C., and Peppard, J. 2012. "Factors Affecting the Successful Realisation of Benefits from Systems Development Projects: Findings from Three Case Studies," *Journal of Information Technology* (27:1), pp. 1-16.

DuBois, M., Koch, J., Hanlon, J., Nyatuga, B., and Kerr, N. 2015. "Leadership Styles of Effective Project Managers: Techniques and Traits to Lead High Performance Teams," *Journal of Economic Development, Management, IT, Finance & Marketing* (7), pp. 30-46.

El-Sabaa, S. 2001. "The Skills and Career Path of an Effective Project Manager," *International Journal of Project Management* (19), pp. 1-7.

Fichman, R. G., Keil, M., and Tiwana, A. 2005. "Beyond Valuation:" Options Thinking" in It Project Management," *California Management Review* (47), pp. 74–96.

Finance. 2015. "Brand Finance Banking," Brand Finance.

Flyvbjerg, B., and Budzier, A. 2011. "Why Your It Project May Be Riskier Than You Think," *Harvard Business Review* (89:9), pp. 601-603.

Gefen, D., Gefen, G., and Carmel, E. 2016. "How Project Description Length and Expected Duration Affect Bidding and Project Success in Crowdsourcing Software Development," *Journal of Systems and Software* (116), pp. 75-84.

Gorla, N., and Somers, T. M. 2014. "The Impact of It Outsourcing on Information Systems Success," *Information & Management* (51), pp. 320-335.

Han, H.-S., Lee, J.-N., Chun, J. U., and Seo, Y.-W. 2013. "Complementarity between Client and Vendor It Capabilities: An Empirical Investigation in It Outsourcing Projects," *Decision Support Systems* (55), pp. 777-791.

Ingham, A. G., Levinger, G., Graves, J., and Peckham, V. 1974. "The Ringelmann Effect: Studies of Group Size and Group Performance," *Journal of Experimental Social Psychology* (10), pp. 371-384.

Jugdev, K., and Müller, R. 2005. "A Retrospective Look at Our Evolving Understanding of Project Success," Project Management Institute.

Keller, R. T. 2001. "Cross-Functional Project Groups in Research and New Product Development: Diversity, Communications, Job Stress, and Outcomes.," *Academy of Management Journal* (44), pp. 547-555.

Killen, C. P., and Hunt, R. A. 2013. "Robust Project Portfolio Management: Capability Evolution and Maturity," *International Journal of Managing Projects in Business* (6:1), pp. 131-151.

Kozlowski, S. W. J., and Bell, B. S. 2003. "Work Groups and Teams in Organizations," in *Handbook of Psychology*. John Wiley & Sons, Inc.

Lacity, M. C., Khan, S., Yan, A., and Willcocks, L. P. 2010. "A Review of the It Outsourcing Empirical Literature and Future Research Directions," *Journal of Information Technology* (25), pp. 395-433.

Lee, G., and Xia, W. 2005. "The Ability of Information Systems Development Project Teams to Respond to Business and Technology Changes: A Study of Flexibility Measures," *European Journal of Information Systems* (14:1), pp. 75-92.

Lee, G., and Xia, W. 2010. "Toward Agile: An Integrated Analysis of Quantitative and Qualitative Field Data on Software Development Agility," *MIS Quarterly* (34:1), pp. 87-114.

Lee, J., Lee, J., and Souder, W. E. 2000. "Differences of Organizational Characteristics in New Product Development: Cross-Cultural Comparison of Korea and the Us," *Technovation* (20:9), pp. 497-508.

Lewis, N., Enke, D., and Spurlock, D. 2004. "Valuation for the Strategic Management of Research and Development Projects: The Deferral Option," *Engineering Management Journal* (16), pp. 36-48.

Lim, B.-C., and Klein, K. J. 2006. "Team Mental Models and Team Performance: A Field Study of the Effects of Team Mental Model Similarity and Accuracy," *Journal of Organizational Behavior* (27:4), pp. 403-418.

Mannix, E., and Neale, M. A. 2005. "What Differences Make a Difference? The Promise and Reality of Diverse Teams in Organizations," *Psychological science in the public interest* (6), pp. 31–55.

Martin, N. L., Pearson, J. M., and Furumo, K. 2007. "Is Project Management: Size, Practices and the Project Management Office," *Journal of Computer Information Systems* (47), pp. 52-60.

Müller, R., and Turner, R. 2010. "Leadership Competency Profiles of Successful Project Managers," *International Journal of Project Management* (28), pp. 437-448.

Narayanaswamy, R., Grover, V., and Henry, R. M. 2013. "The Impact of Influence Tactics in Information System Development Projects: A Control-Loss Perspective," *Journal of Management Information Systems* (30:1), pp. 191-226.

O'leary, M. B., Mortensen, M., and Woolley, A. W. 2011. "Multiple Team Membership: A Theoretical Model of Its Effects on Productivity and Learning for Individuals and Teams," *Academy of Management Review* (36), pp. 461-478.

Olaniran, O. J., Love, P. E. D., Edwards, D., Olatunji, O. A., and Matthews, J. 2015. "Cost Overruns in Hydrocarbon Megaprojects: A Critical Review and Implications for Research," *Project Management Journal* (46:6), pp. 126-138.

Oshri, I., Kotlarsky, J., and Willcocks, L. P. 2007. "Global Software Development: Exploring Socialization and Face-to-Face Meetings in Distributed Strategic Projects," *The Journal of Strategic Information Systems* (16:1), pp. 25-49.

Ozer, M., and Vogel, D. 2015. "Contextualized Relationship between Knowledge Sharing and Performance in Software Development," *Journal of Management Information Systems* (32:2), pp. 134-161.

Page, S. E. 2010. *Diversity and Complexity*. Princeton University Press.

Payne, J. H., and Turner, J. R. 1999. "Company-Wide Project Management: The Planning and Control of Programmes of Projects of Different Type," *International Journal of Project Management* (17), pp. 55-59.

Peng, G., Wan, Y., and Woodlock, P. 2013. "Network Ties and the Success of Open Source Software Development," *The Journal of Strategic Information Systems* (22), pp. 269-281.

PMI. 2013. *A Guide to the Project Management Body of Knowledge: (Pmbok® Guide)*. Newtown Square, PA: PMI.

Procaccino, J. D., and Verner, J. M. 2006. "Software Project Managers and Project Success: An Exploratory Study," *Journal of Systems and Software* (79:11), pp. 1541-1551.

Ramasubbu, N., Bharadwaj, A., and Kumar Tayi, G. 2015. "Software Process Diversity: Conceptualization, Measurement, and Analysis of Impact on Project Performance," *MIS Quarterly* (39:4), pp. 787-807.

Sandhu, R. S., Coynek, E. J., Feinsteink, H. L., and Youmank, C. E. 1996. "Role-Based Access Control Models Yz," *IEEE computer* (29:2), pp. 38-47.

Sarker, S., Sarker, S., Kirkeby, S., and Chakraborty, S. 2011. "Path to "Stardom" in Globally Distributed Hybrid Teams: An Examination of a Knowledge-Centered Perspective Using Social Network Analysis," *Decision Sciences* (42:2), pp. 339-370.

Schwarz, C. 2014. "Toward an Understanding of the Nature and Conceptualization of Outsourcing Success," *Information & Management* (51), pp. 152-164.

Singh, P. V., and Tan, Y. 2010. "Developer Heterogeneity and Formation of Communication Networks in Open Source Software Projects," *Journal of Management Information Systems* (27), pp. 179-210.

Srivastava, S. C., and Teo, T. S. H. 2012. "Contract Performance in Offshore Systems Development: Role of Control Mechanisms," *Journal of Management Information Systems* (29), pp. 115-158.

Standish. 2013. "Chaos Manifesto," The Standish Group International, Boston, p. 52.

Taylor, H., Artman, E., and Woelfer, J. P. 2012. "Information Technology Project Risk Management: Bridging the Gap between Research and Practice," *Journal of Information Technology* (27), pp. 17-34.

Tiwana, A. 2010. "Systems Development Ambidexterity: Explaining the Complementary and Substitutive Roles of Formal and Informal Controls," *Journal of Management Information Systems* (27:2), pp. 87-126.

Trigeorgis, L. 1996. *Real Options: Managerial Flexibility and Strategy in Resource Allocation*. MIT Press.

Turner, R. 2016. *Gower Handbook of Project Management*. Routledge.

von Krogh, G., Haefliger, S., Spaeth, S., and Wallin, M. W. 2012. "Carrots and Rainbows: Motivation and Social Practice in Open Source Software Development," *Mis Quarterly* (36:2), pp. 649-676.

Wagner, H.-T., Beimborn, D., and Weitzel, T. 2014. "How Social Capital among Information Technology and Business Units Drives Operational Alignment and It Business Value," *Journal of Management Information Systems* (31:1), pp. 241-272.

Walter, M., and Zimmermann, J. 2016. "Minimizing Average Project Team Size Given Multi-Skilled Workers with Heterogeneous Skill Levels," *Computers & Operations Research* (70), pp. 163-179.

Westerveld, E. 2003. "The Project Excellence Model®: Linking Success Criteria and Critical Success Factors," *International Journal of Project Management* (21:6), pp. 411-418.

Xu, J., Christley, S., and Madey, G. 2006. *Application of Social Network Analysis to the Study of Open Source Software*. Elsevier Press.

Zika-Viktorsson, A., Sundström, P., and Engwall, M. 2006. "Project Overload: An Exploratory Study of Work and Management in Multi-Project Settings," *International Journal of Project Management* (24), pp. 385-394.

Zwikael, O., and Unger-Aviram, E. 2010. "Hrm in Project Groups: The Effect of Project Duration on Team Development Effectiveness," *International Journal of Project Management* (28:5), pp. 413-421.