THE MODERATING INFLUENCE OF INHERENT PROJECT RISK ON THE RELATIONSHIP BETWEEN PROJECT PLANNING AND PERCEIVED PROJECT SUCCESS

ABSTRACT

Project planning is considered to be a critical success factor for project success. However, recent literature questions whether planning has similar importance in various project contexts. This research investigates the effectiveness of project planning on project success in various project risk contexts of software development projects. A survey based research design was used to collect data to test the proposed model. The results reveal that various inherent project risks can moderate the effects of project planning on project success and in different ways for various success measures. More specifically, the results indicate that project planning makes a greater contribution to project success when there is a low level of inherent project risk and its positive impact on project success diminishes when there is a high level of inherent project risk. The results of this study contribute to a more acute understanding of the contingency approach to software project risk management. Practical implications of these results suggest that project managers should put more emphasis on less detailed formal planning in high risk project situations in order to meet project success.

1. INTRODUCTION

General management strongly indicates planning is a core element of management. Similarly, in project management, planning is considered one of the major contributors to project success (Pinto & Slevin, 1987), and as a result discussed in project management methodologies as the first step under the responsibility of project managers (e.g., OGC, 2007; PMI, 2013). However, recent literature suggests the importance of planning is overplayed. For example, in strategy, Mintzberg (1994) discusses the "rise and fall of strategic planning". In project management, Andersen (1996) and Ahimbisibwe, Cavana and Daellenbach (2015) raised doubts regarding the importance of formal project planning, while Dvir and Lechler (2004) underplayed the importance of planning in their paper entitled "Plans are nothing, changing plans is everything".

These conflicting findings in the literature regarding the importance of project planning can be better understood if the source of data is analyzed. For example, low effectiveness of planning was found in studies with samples heavily biased towards high risk projects, such as software development projects and product development (Dvir & Lechler, 2004) and R&D projects (Bart, 1993). On the other hand, Zwikael and Globerson (2006a) found that in construction projects, planning had a positive effect on success. As a result, one may claim that project risk influences the level of planning effectiveness (Ahimbisibwe et al., 2015). Recent literature provides some support for this line of thought (Zwikael & Sadeh, 2007). For example, De Meyer et al. (2002) claim that decisions about the best way of planning are influenced by the level of risk. In order to understand the inconsistent results in the literature, this paper examines the circumstances under which planning is more effective as a tool to be used by project managers and organizations. In particular, this study analyzes the moderating role of inherent project risk on the relationship between project planning and perceived project success for software development projects.

The rest of this article is organised as follows: the next section reviews the literature to develop hypotheses and a conceptual framework. In section 3, methodology is described and in section 4, contributions and conclusion are discussed.

2. LITERATURE AND HYPOTHESIS DEVELOPMENT

2.1. Planning in general management

Planning is a core element of management of various management areas, such as strategy, operations management, and human resources management. For example, in marketing and procurement, the marketing or procurement plan is a central instrument for directing and coordinating the marketing and procurement effort, which operates at two levels: strategic and operational (Kotler & Keller, 2006). In strategy, strategic planning is one of two dimensions of the strategic management process (Boseman & Phatak, 1989). The human resource planning requires forecasting personal needs for an organization and deciding on the steps necessary to meet these needs (Schuler, 1994).

2.2. Planning in project management

Project planning specifies a set of decisions concerning its execution in order to deliver a desired new product, service or result (PMI, 2013; Zwikael & Sadeh, 2007). Kerzner (2009) finds uncertainty reduction to be a core reason for planning a project. Russell and Taylor (2003) identify seven planning processes—defining project objectives, identifying activities, establishing precedence relationships, making time estimates, determining project completion time, comparing project schedule objectives, and determining resource requirements. Planning was found to be a critical process in project management (Pinto & Slevin, 1987; Turner, 2008). For example, based on an analysis of prior studies, Lechler (1997) concluded that planning has positive effect on project success. Narayanan et al. (2011) explain the positive effect of planning on success by highlighting the regular exchange of information with the customer, which occurs during planning. According to Jugdev and Muller (2005) project success is an integrative concept that includes short- and long-term implications, such as project efficiency, customers, business success, and preparing for the future.

Although there is an "almost unanimous agreement in the project management literature" regarding the great effectiveness of project planning (Dvir & Lechler, 2004), some underplay its role in projects. For example, Bart (1993) indicated that the traditional approach to planning of R&D projects tends to fail because of excessively restrictive formal control, which curtails creativity as a factor contributing to project success. Consequently, Dvir and Lechler (2004) proposed to reduce formal planning to a minimum required level. Dvir et al. (2003) suggest that project success is insensitive to the level of implementation of management processes and procedures. It has also been claimed that "the positive total effect of the quality of planning is almost completely overridden by the negative effect of goal changes" (Dvir & Lechler, 2004:10).

Consistently, in a comparative contingency study for traditional plan-based software development (low risk projects) and agile software development (high risk projects), Ahimbisibwe et al. (2015) indicate that project planning and controlling are likely to make a greater contribution to process or product success of traditional plan driven projects which are characterized with low levels of inherent project risk than for agile projects with high levels of inherent risks. Because of the different findings on project planning effectiveness in the literature two competing hypotheses are formulated: H1 assumes a positive main effect of project planning on success, whereas the null hypothesis assumes no significant cause and effect relationship exists.

H0: Project planning does not improve (i) process and (ii) product success.
H1: Project planning improves (i) process and (ii) product success.

According to Jun et al. (2011) inherent project risks can be regarded as project-specific characteristics that initially exist in a project rather than emerge during the course of its implementation. Thus, there is no or little change in the perceived nature of these characteristics as the project is being completed. For instance, Jun et al. (2011) emphasize that the project doesn't become more or less complex overtime, nor does it become smaller or larger in size. The level of inherent project risk is made up of technological uncertainty (Nidumolu, 1995); technical complexity (Jun et al., 2011); relative project size (Jun et al., 2011) and specification changes (Nidumolu, 1995).

Project risk factors, such as technical complexity, technological uncertainty, project size and specification changes negatively affect project success. For instance, technical complexity adversely and negatively affected software project performance in terms of both process and product performance (Jun et al, 2011). The use of unfamiliar technologies can also lead to software problems that reduce the performance of the software product or delay the project. Similarly, large project size can also negatively affect project performance. According to Nidumolu (1995) requirements instability (changes) have a negative effect on project performance.Thus, generally, the level of project inherent risk associated with the project is negatively associated with project success.

H2: Inherent project risk is negatively associated with perceived project success.
H2a: Technical complexity is negatively associated with (i) process and (ii) product success.
H2b: Technological uncertainty is negatively associated with (i) process and (ii) product success
H2c: Relative project size is negatively associated with (i) process and (ii) product success.
H2d: Specification change is negatively associated with (i) process and (ii) product success.

2.3. The moderating effect of inherent project risk

Both PMI (2013) and APM (2006) define the concept of risk as "an uncertain event which might have positive events (opportunities) or negative effects (threats)". According to (PMI, 2013), risk itself is traditionally described as an uncertain event (p. 310), however, it is not specified what ''uncertainty'' is moreover, uncertainty is not a self-explanatory term. According to the description of risk presented by PMI (2013) one can make a conclusion that risk is uncertainty (p.310). However, these two phenomena are not synonymous (Perminova et al., 2007).

Project risk can be defined as a "scenario in which a project suffers a damaging impact." (Zwikael & Smyrk, 2011: 311). High level of project risk is perceived to become a problem (PMI, 2013) and an obstacle to success (Kerzner, 2009). Although risk cannot be fully eliminated, Chapman and Ward (2004) found that organizations spend significant funds and resources in risk management. Because risk is considered to be an important moderator for the success of projects (Zwikael & Ahn, 2011), this paper aims at understanding the conflicting findings on planning effectiveness through an analysis of project risk. The literature offers support for this line of investigation. For example, low effectiveness of project planning was found in studies with samples heavily biased towards high risk projects, such as software and product development (Dvir & Lechler, 2004) and R&D projects (Bart, 1993).

Furthermore, Zwikael (2009b) found that development of project plans has more impact on success in construction projects (characterized with relatively low level of risk), compared with services and information technology projects (perceived as having higher levels of risk). On the other hand, Zwikael and Sadeh (2007) suggested planning to be more effective in high risk projects than in low risk ones. Hence, although the direction of the interaction is not clear from the literature, the next hypothesis suggests risk has a moderating effect on the relationship between planning and project success:

H2: Inherent project risk moderates the relationship between project planning and perceived project success.

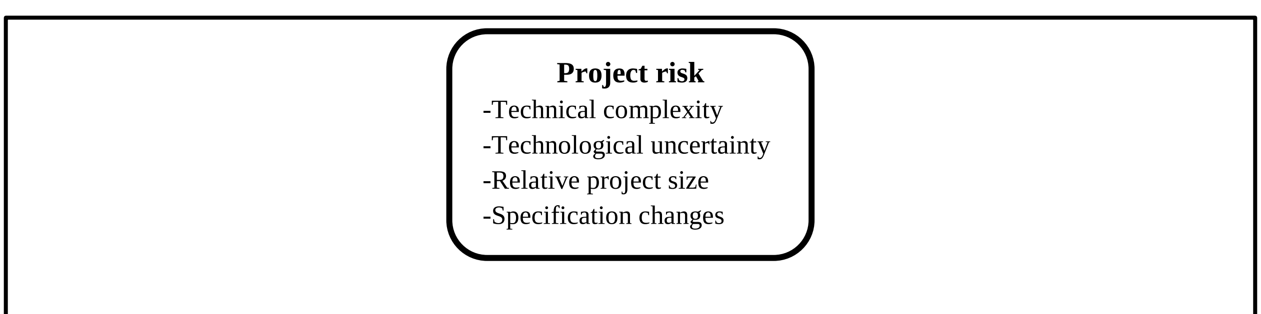
H3a: technical complexity moderates the relationship between project planning and (i) process and (ii) product success.

H3b: technological uncertainty moderates the relationship between project planning and (i) process and (ii) product success.

H3c: relative project size moderates the relationship between project planning and (i) process and (ii) product success.

H3d: specification changes moderates the relationship between project planning and (i) process and (ii) product success.

Based on the literature review, Figure 1 illustrates the theorized moderating influence of project risk on the relationship between project planning and perceived project success. As shown in the model, project planning is hypothesized to fundamentally have a direct positive influence on project success. In contrast, project risk is hypothesized to have a moderating effect on the relationship between project planning and perceived project success. Project risk factors can also negatively affect project success.



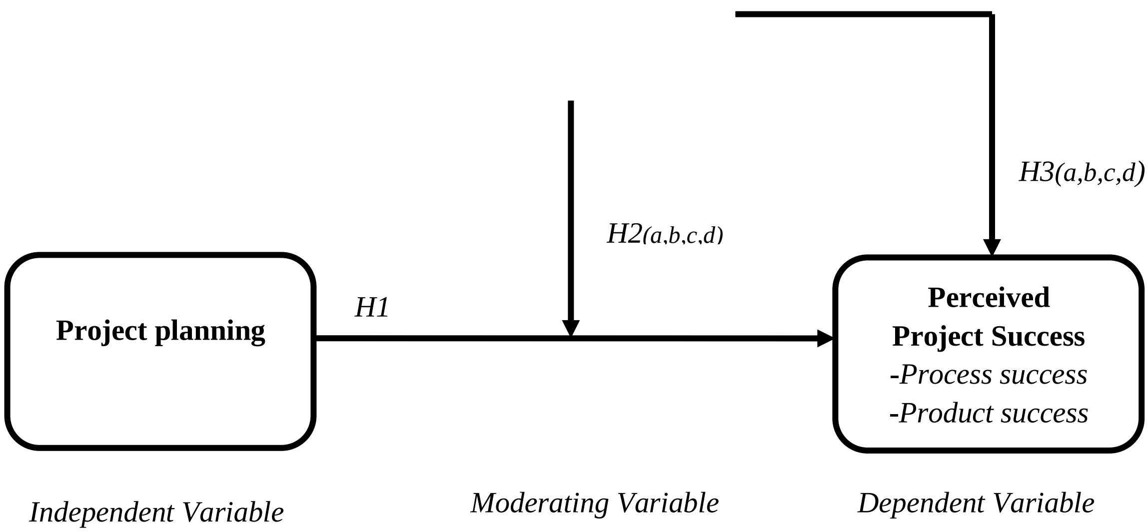


Figure 1: The research model

3. RESEARCH METHODS

3.1. Data collection and sample

A survey design was selected for testing the research model. The questionnaire developed for the study was subject to a pretest and a pilot test prior to usage. The questionnaire was administered to a large sample of software project managers who are involved in international software development projects by email. The respondents were requested to provide information with respect to a recently completed outsourced software development project. Of the 1880 questionnaires administered, 984 usable responses were obtained from the survey, a response rate of approximately 34.2%, which compares well with most other IS surveys response rates of about 20% (e.g., Wallace et al., 2004; Jun et al, 2011).

3.4. Measures

Although all measurement scales used in the questionnaires have been validated and used in previous studies, they were tested again to ensure they conform to the current research context. Sources for research and tested instruments used to operationalize constructs were as follows: project planning (Jun et al., 2011); technological uncertainty (Nidumolu, 1995); technical complexity (Jun et al., 2011); relative project size (Jun et al., 2011); specification changes (Nidumolu, 1995); project success (Jun et al., 2011). All measures were anchored on a seven point scale, ranging from 1-strongly disagree to 7-Strongly agree.

The majority of employees had worked on software development projects for many years with over 86% of the respondents having an experience of more than 5 years. Typically, about 95% of these respondents occupied senior positions and carried out senior roles on their previous project, hence are very conversant with the operations, risks and management of software development projects. Most of the projects were found to have been conducted in large organizations with employees of more than 5,000; this is possibly because most of the respondents were from America, Europe and Australia where there are large firms. More than 80% of the projects had a budget of more than $750,000, whereas more than 80% of the projects lasted for more than 6 months to complete. A summary of the demographic characteristics of the respondents and the profile of the projects investigated is presented in Table 1.

Self-evaluation of performance was adopted in this study. As it is possible for self-reported project performance measures to be biased, an additional small sample from 40 corresponding projects, which included performance assessments by project leaders from the client organizations were used to conduct a paired-sample *t*-test. No significant differences were found indicating that common methods bias was not a problem in this study.

Table 1: Respondents demographics

Characteristics	Scale	n=984		Characteristics	Scale	n=984
Experience of the vendors	Less than 1 year	21(2.1%)		**Positions**	Project Manager	830(84.3%)
	1 to less than 2 years	22(2.2%)			Team Leader	100(10.2%)
	2 to less than 5 years	79(8.0 %)			Developer	23(2.3%)
	5 to less than 10 years	214 (21.7%)			Tester	23(2.3%)
	More than 10 years	648(65.9 %)			Others	8(0.8%)
Size of the client firm	1-10	39(4.0%)		**Budget (USD)**	Less than $100,000	209(21.2%)
	11-50	66(6.7%)			$100,000 to less than $1M	419(42.6%)
	51-100	90(9.1%)			$1M to less than $10M	252(25.6%)
	101-500	140(14.2%)			$10M to less than $100M	70(7.1%)
	501-1000	133(13.5%)			More than $100M	34(3.5%)
	1001-5000	190(19.3%)				
	More than 5000	326(33.1%)				
Project duration in months	Less than 6 months	187(19.0%)		**Team size**	2-5	112(11.4%)
	6- less than 12 months	391(39.7%)			6-100	750(76.2%)
	12-to less than 24 months	238(24.2%)			101-500	90(9.1%)
	24-to less than 36 months	70(7.1%)			501-1000	8(0.8%)
	More than 36 months	98(10.0%)			1001-5000	4(0.4%)
					Above 5000	20(2.0%)
Industry of the clients	Finance/Insurance	243(24.7%)		**Sector of the project**	Public sector	302(30.7%)
	Manufacturing	109(11.1%)			Private sector	643(65.3%)
	Marketing/retail	67(6.8%)			Others	39(4.0)
	Health	107(10.9%)				
	Consulting	61(6.2%)				
	Software	182(18.5%)				
	Transportation	42(4.3%)				
	Utility	38(3.9%)				
	Aerospace	27(2.7%)				
	Education	68(6.9%)				
	Others	40(4.1%)				

4. RESULTS

4.1. Structural Equation Modelling (SEM)

SEM was used for data analysis. SEM was chosen because (i) it tests an overall model rather than individual coefficients (ii) is a confirmatory approach that provides explicit test statistics for establishing convergent and discriminant validity important to management research (iii) allows for error terms and (iv) reduces measurement error through the use of multiple indicators and is a robust technique for testing moderating effects (Byrn, 2001; Kearns & Sabherwal, 2007; Hair et al, 2009). Following the two-step approach to structural equations proposed by Anderson and Gerbing (1988), the measurement models for the constructs were validated before the structural model was examined to test the hypothesized relationships between constructs.

The measurement model in the SEM procedure can be defined as either a reflective or a formative mode. The reflective mode is used for constructs that are viewed as underlying factors that give rise to observable variables, such as attitude and personality. In contrast, the formative mode is used for constructs that are modeled as explanatory combinations of their indicators (Fornell and Booktein, 1982). In this study, all of the constructs are modeled in a reflective mode. This is consistent with other studies since all measures have been adopted and were previously modeled as reflective. Confirmatory factor analysis (CFA) was conducted to refine the reflective measurement models. The results are presented in Table 2.

Table 2: Latent variable, measurement items, CSR, Cronbach alpha and AVE

	Factor	Composite	Cronbach	Average

Construct and indicator	Loadings	Scale Reliability	alpha	Variance Extracted
Planning and controlling		0.853	0.805	0.59
Special attention was paid to project planning.	0.86***			
Project milestones were clearly defined.	0.85***			
Progress was monitored closely e.g. using PERT or CPM tools.	0.78***			
There were reviews at each milestone.	0.65***			
Technical complexity		0.866	0.866	0.69
Operating system, procedures and programming were complex.	0.89 ***			
Computers, databases and networks were highly complex.	0.84***			
Project had high level of technical complexity.	0.78***			
Specification changes		0.855	0.832	0.61
Requirements may fluctuate quite a bit in the future.	0.77***			
Requirements identified at beginning were quite different.	0.86***			
Requirements fluctuated quite a bit in later phases.	0.81***			
Technological uncertainty		0.921	0.921	074
Lack of a clearly known way to develop software.	0.82***			
No available knowledge was of great help in developing software.	0.84***			
No established procedures and practices could be relied upon.	0.89***			
Lack of an understandable sequence of steps that could be followed.	0.90***			
Relative project size		0.936	0.936	0.74
The overall project size was much larger.	0.87***			
The number of people on team was much larger.	0.86***			
The dollar budget allocated to this project was much higher.	0.91***			
Months for completing this project were much higher.	0.87***			
Person-days for completing this project were much higher.	0.87***			
Process project success		0.846	0.839	0.65
The project was completed within budget.	0.86***			
The project was completed within schedule.	0.85***			
The project scope was met.	0.73***			
Product project success		0.943	0.941	0.67
The software developed is reliable.	0.78***			
The application developed is easy to use.	0.78***			
Flexibility of the system is good.	0.75***			
The system meets users' intended functional requirements.	0.87***			
Users were satisfied with the system delivered.	0.87***			
The project team was satisfied.	0.85***			
Top level management was satisfied.	0.83***			
The overall quality of the delivered application is high.	0.88***			

<u>Note:</u> **** Significant at $p<0.001$. All regression factor loadings are standardised and greater than 0.6 for convergent validity (Straub, 1989; Bagozzi & Yi, 1988).*

The following formulae were used to calculate AVE and CSR: Composite Scale Reliability = [SUM (A)] ^{2} / [(SUM (A)] ^{2} + SUM (B). Where [SUM (A)] ^{2}= sum of standardised factor loadings squared and SUM (B) = sum of indicator measurement errors (sum of the variance due to random measurement error for each loading=1-the square of each loading) (Fornell & Larcker, 1981). AVE= [(SUM (A^2)]/ [(SUM (A^2)] + SUM (B).Where [(SUM (A^2)] =sum of squared standardized loadings and SUM (B) =sum of indicator measurement error) (Fornell & Larcker, 1981). Cronbach alpha was computed using SPSS V.19 as AMOS does not compute it.

All the measurement items loaded well on their respective factors with strong statistical significance (p>0.01), indicating good convergent validity. The Cronbach alpha for each construct is higher than the recommended level of 0.70. The Composite Scale Reliability of all the latent variables is higher than the recommended level of 0.60 (Bagozzi and Yi, 1988). The average variance-extracted (AVE) value for each construct is higher than the recommended level of 0.50 (Bagozzi and Yi, 1988). All of these results indicate good reliability. In addition, the Average Variance-Extracted test was used to establish discriminant and convergent validity. Validity is demonstrated if the AVE of each construct is higher than the squared multiple correlations of the constructs. The results (shown in Table 3) indicate good convergent and discriminant validity. In short, all constructs were measured by reflective indicators and the results of the CFA indicate that all the constructs have good convergent and discriminant validity and reliability.

Table 3: Correlation matrix and squared correlations

Construct	1	2	3	4	5	6	7
Planning (1)	**0.59**	0.08	0.13	0.00	0.11	0.23	0.23
Technical complexity(2)	0.28**	**0.69**	0.01	0.04	0.01	0.01	0.06
Technology uncertainty(3)	-0.60***	0.08	**0.74**	0.10	0.29	0.07	0.12
Relative project size(4)	0.03	0.21***	0.32***	**0.74**	0.13	0.05	0.03
Specification changes(5)	-0.32***	0.10*	0.54***	0.36**	**0.61**	0.14	0.09
Process project success(6)	0.48***	0.10*	-0.27***	-0.2*	-0.4**	**0.65**	0.57
Product project success(7)	0.48***	0.24**	-0.35**	-0.2*	-0.3**	0.78***	**0.67**

*Note: Zero order (Pearson) correlations appear below the diagonal. Squared correlations are placed above the diagonal. Average Variances Extracted (AVE) values are indicated on the diagonal in bold. *,**,*** significant at 0.05, 0.01, 0.001 respectively.*

4.2. Hypothesis testing

To test the hypotheses, the main effects model was run separately without interactions and then with the interactions.

Main effects

Figure 2 shows the results of the main effects model without interactions. All hypotheses were supported. The only insignificant path (p<05) was between planning and product success, partly failing for provide full support for *H1*. The percentages of variance explained by the model in relation to process success and product success were 53.8% and 61.4%, respectively. The results suggest that proper project planning is likely to be associated with efficiencies in development and, thus, prevent budget and time variances. This is consistent with previous research which has demonstrated a positive relationship between planning and project success. Pinto and Slevin (1987) found a positive impact between planning and project success. Jun et al. (2011) found that project planning and controlling are positively correlated with process performance. Similarly, Yetton et al. (2000) found that project planning and controlling was negatively related to budget variances.

The results further indicate that inherent project risks negatively affect project success. This is consistent with literature. For instance, Jun et al. (2011) reported that technical complexity adversely and negatively affects software project performance in terms of both process and product performance. Technological uncertainty can influence decisions to abandon, redefine or complete a project. The use of unfamiliar technologies also can lead to software problems that reduce the performance of the software product and delay the project. Equally, technological uncertainty could have significant influence on budget (time-cost) overruns, because of the unproven availability, performance, timeliness and functionality of new products and services. Likewise, Jun et al. (2011) found that the project size was negatively and significantly associated with project performance in terms of both process and product performance. Similarly, Nidumolu (1995) found that requirements instability or changes had a negative effect on project performance. Too much user specification changes may have a negative effect on project success and in particular, variations in delivery time, scope and budget. The results indicate that clients/users who continually change their requirements, can lead to conflict and the product being delivered late and over budget. Therefore, managers need to be aware of the potential trade-offs between too much, and extremely limited user participation.

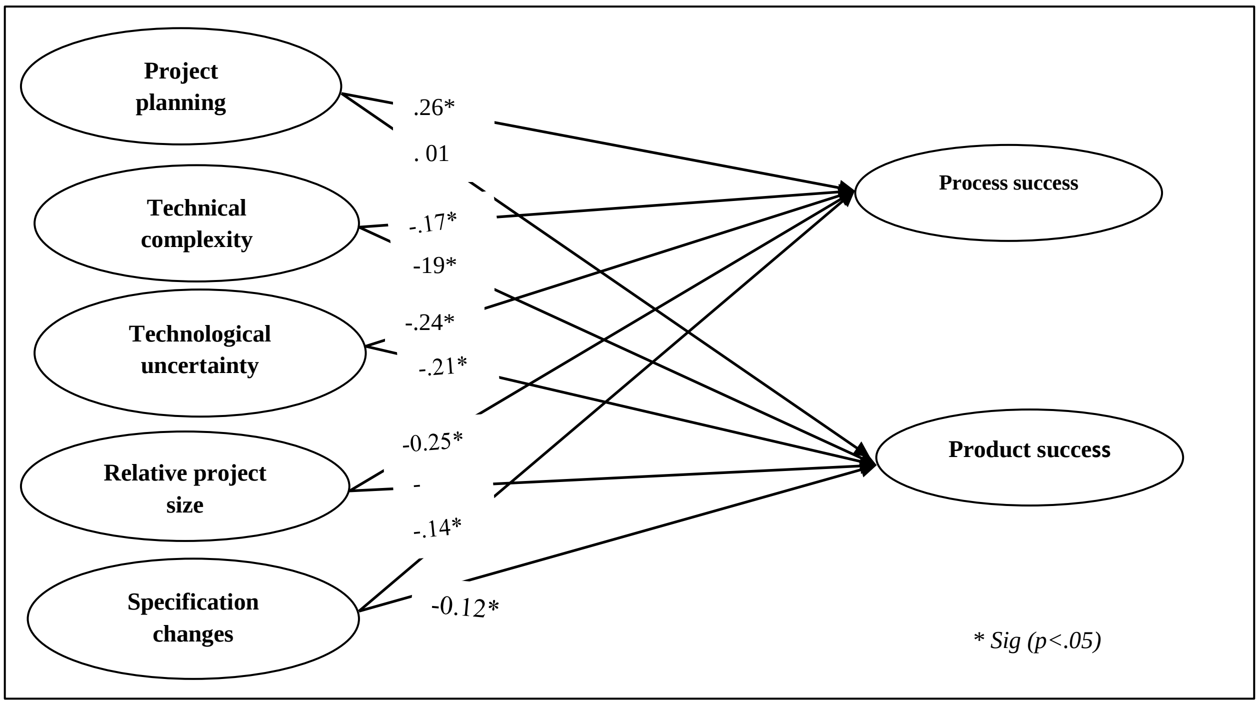


Figure 2: Analysis results from main effects model

Interaction effects

This section presents the application of the SEM technique to detect the moderating effects of inherent project risk on the relationship between project planning and project success. To test the moderating effects, the product terms were added based on the main effects model to create an interaction model. All moderating effects of different types of inherent project risks on project planning–project success relationship (i.e. hypothesis H1-H3) were all tested simultaneously in one single SEM model. The summary of the path coefficients and the corresponding levels of significance for each hypothesized path in the full model with interactions is presented in Table 4.

Table 4: Standardized path coefficients and significant levels of all hypothesized paths

Hypothesis and path	Process success	Support	Product success	Support
H1: Project planning	0.22*	Yes	0.02	No
H2a: Technical complexity	-0.18	Yes	-0.13*	Yes
H2b: Technological uncertainty	-0.31**	Yes	-0.18*	Yes
H2c: Relative project size	-0.23*	Yes	-0.26*	Yes
H2d: Specification change	-0.15*	Yes	-0.17*	Yes
H3a: Interaction term between technical complexity and planning	-0.03	No	0.17*	Yes
H3b: Interaction term between technological uncertainty and planning	-0.01	No	-0.31*	Yes
H3c: Interaction term between relative project size and planning	-0.02	No	-0.01	No
H3d: Interaction term between specification change and planning	-0.05	No	-0.12*	Yes

Results show that inherent project risk level moderates the influence of planning on process success. In addition, project risk level moderates the influence of planning on product success. Hypothesis 3 was thus largely supported. The percentages of variance explained by the interactions model in relation to process performance and product performance were 48.2% and 54.6%, respectively.

Following the widely used procedure outlined by Aiken and West (1991), moderation graphs were generated using Stats tool software programme for two way interactions (Dawson, 2014), to show how project planning significantly interacts with some project risks to influence project success. Specifically, the SEM equations were calculated for the relationship between planning and the two project success measures at high and low levels of risk.

Fig. 3 shows that technical complexity diminishes the positive relationship between project planning and product success. Fig. 4 shows that technological uncertainty diminishes the positive relationship between project planning and product success. Fig. 5 shows that a specification change diminishes the positive relationship between project planning and product success. Generally, the level of project risk appears to diminish project success.

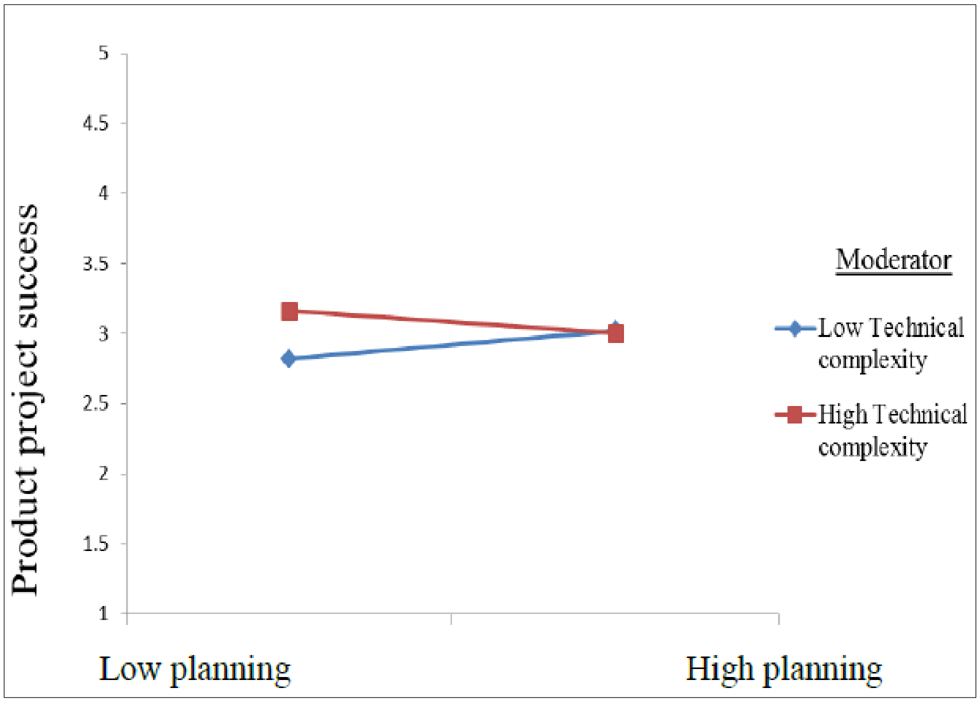


Figure 3: The moderating effect of technical complexity between project planning and product success

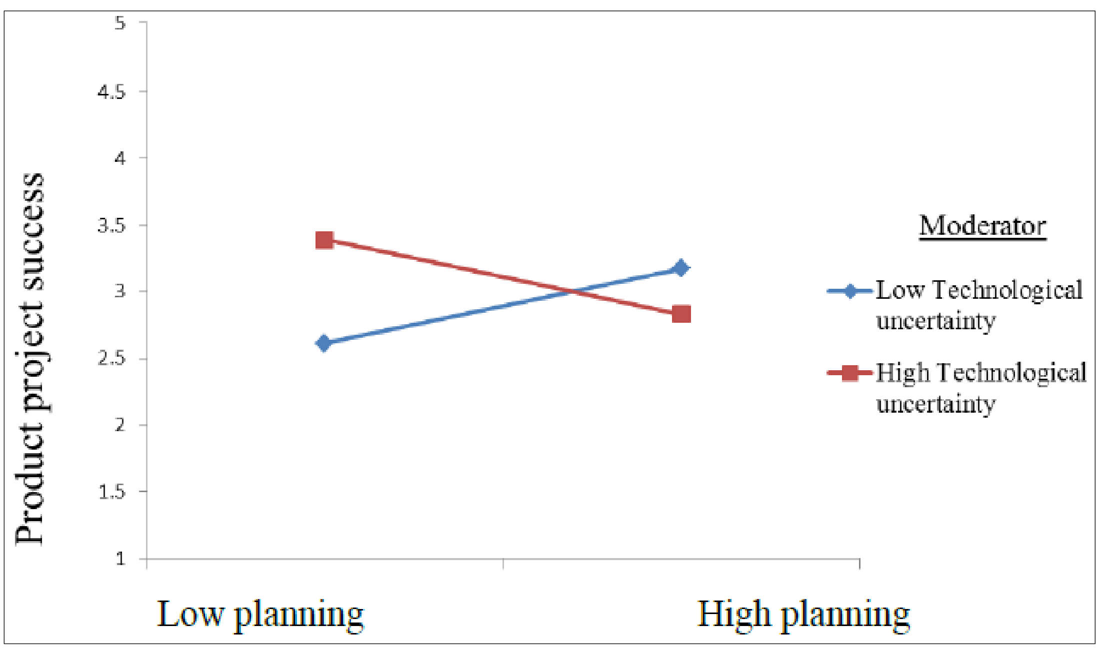


Figure 4: The moderating effect of technological uncertainty between project planning and product success

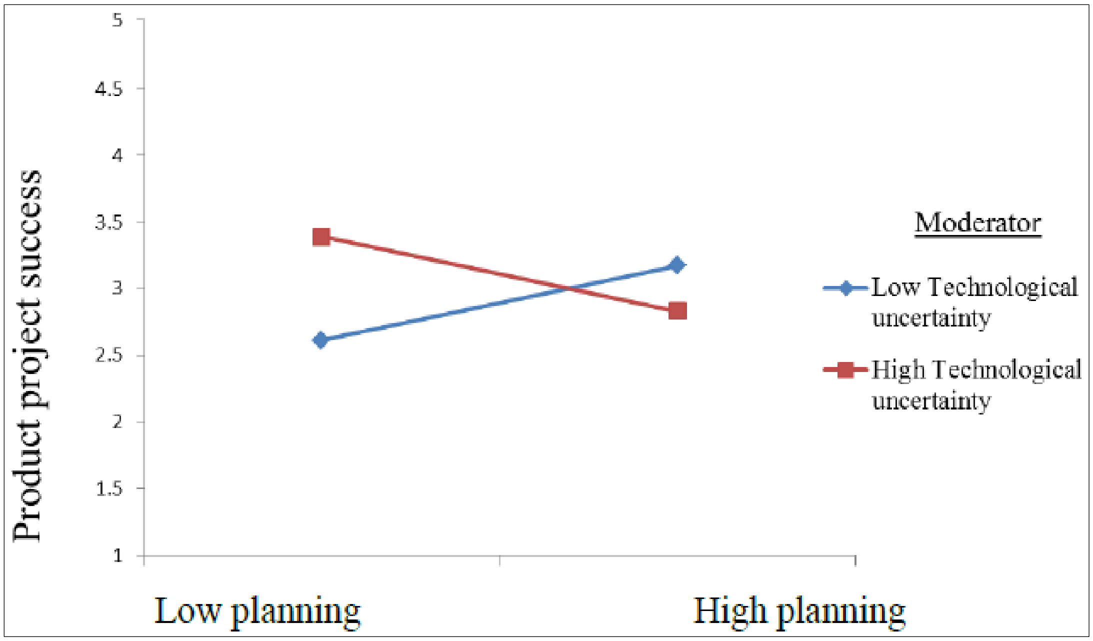


Figure 5: **The moderating effect of specification change between project planning and product success**

5. DISCUSSION

The purpose of the study is to examine the moderating influence of inherent project risk on the relationship between project planning and perceived project success. Although professional bodies of knowledge (e.g. PRINCE2, 2009; OGC, 2007; PMI, 2013) advocate planning as a core process for all projects, literature is inconsistent regarding the importance of planning for success. While some studies have found a positive contribution of planning (Pinto & Slevin, 1987), others have suggested weak relationship between planning and success (Bart, 1993; Dvir & Lechler, 2004). Conflicting evidence in the literature and no evidence for main effect in this study suggest that planning may not have similar importance in all project scenarios, and that more robust and advanced analysis is required. This potentially provides more clarity and sheds more light to the current conflicting evidence.

This research analyzes the impact of planning on two common success measures separately—process success (efficiency) and product success (effectiveness) (Pinto & Prescott, 1990, Jugdev & Muller, 2005; Jun et al., 2011; Ahimbisibwe et al., 2015). Efficiency measures the extent to which time and cost targets mentioned in the project plan have been met (Dvir & Lechler, 2004), whereas effectiveness focuses on the realization of target benefits included in the business case (Pinto & Prescott, 1990; Zwikael & Smyrk, 2012). Following recommendations in recent literature (De Meyer et al., 2002; Zwikael & Sadeh, 2007; Ahimbisibwe et al., 2015), this research also proposes the moderating effect of project risk. Results suggest that project management factors impact distinctly different success measures. This is consistent with previous studies. For example, Pinto and Prescott (1990) found that planning factors have stronger impact on ‘external’ success measures (perceived value of the project and client satisfaction) than on efficiency.

The results of this study strongly suggest that project risk moderates the relationship between project planning and various success measures. In particular, intensifying detailed formal planning does not improve product success when there is high technical complexity, whereas in the presence of low technical complexity increased formal planning appears to improve the likelihood of project success.

Equally, the results suggest that detailed formal planning should not be used when there is high technological uncertainty. This is possibly because plans and controls easily become obsolete when there is high uncertainty since change usually occurs faster than plans can be updated. Technological uncertainty can influence decisions to abandon, redefine or complete a project. Equally, high technological uncertainty has significant negative influence on budget (time-cost) overruns, because of the unproven availability, performance, timeliness and functionality of new products and services. These findings are consistent with Jun et al. (2011). The results also suggest formalised plans should not be relied on when user requirements (specifications) are changing very fast. This is possibly because if specifications changes are low future features are prepared in the design and all the pieces are designed to fit well together.

6. CONTRIBUTION AND CONCLUSION

This research aims at shedding light on the inconsistent literature on the importance of project planning to project success. Bridging conflicting views ranging from "recognized importance" (Zwikael & Globerson, 2004) to "plans are nothing" (Dvir & Lechler, 2004), this paper suggests that the importance of planning is contingent upon the type of success measures employed and the level of project risk. In other words, the importance of planning depends on the level of project risk and the success measure being targeted. This paper contributes to theory by proposing a robust theoretical framework for the moderating impact of project risk on the relationship between project planning and project success.

Practical contribution of this study targets both project managers and senior executives. While project managers tend to use planning tools regardless of risk levels, they may benefit from using more advanced planning tools in high risk projects and for short term predictable periods. In particular, this behavior will contribute to enhanced project efficiency, which is a common measure to evaluate project managers' work. Organizations, on the other hand, may become more actively involved in low risk projects. This approach may specifically support project effectiveness, e.g., by focusing on planning the realization of target benefits. Senior executives can provide additional resources and specialized teams for project planning, as well as ensure project benefit realization plans are properly discussed and approved by project steering committees.

Thus, this study contributes towards understanding the effectiveness of project planning on project success in various project risk contexts of software development projects. The results of this study contribute to a more acute understanding of the contingency approach to software project risk management. Practical implications of these results suggest that project managers should put more emphasis on less detailed formal planning in high risk project situations in order to meet project success.

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