Face-to-Face versus Virtual: NZ Software Project Managers' perceptions of risk

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Abstract

Risk management is important in achieving successful project outcomes. This research explores Software Project Managers perceptions of risk in face-to-face and virtual settings in order to draw conclusions on whether or not project setting has an impact on software project risk profile. A list of risk factors is compiled from risk management literature for use in asking SPMs to indicate how they would perceive the given risks in face-to-face and virtual settings. Specific information is sought regarding most likely risks, risk probability of occurrence, risk impact and difficulty and complexity of project management processes in either setting. Risk impact-probability metrics are used to show the differences and similarities in risk importance between the two settings.

The results suggest that even though most of what can go wrong in face-to face settings can also go wrong in virtual settings there are important differences in likely risk events between the two settings. Of major importance is the result that there are significant differences in risk probability and risk impact between the two settings. Another finding is that risk management processes are perceived to be different between face–to-face settings and virtual settings. The comparative differences in risk components and management process strongly suggest that project setting has an impact on software project risk.

Keywords: Software risk management, Software Project Manager, Face-to-face, Virtual.

1 Introduction

Globalisation of the firm, markets and human resources invariably mean that more and more projects are being carried out in virtual settings in order to overcome the constraints of time, scarce resources and geography. Compressed time windows to deliver projects, dwindling margins and budgets are increasingly making it difficult for a team to meet face-to-face (F2F).

The situation is likely to be much more difficult for software development which is a complex undertaking even when efforts are concentrated in one location. Software projects are the riskiest endeavour of the modern firm (Cooper & Kleinschmidt, 1987). They are notorious for extremely high failure rates (Meyer, 1998). Dispersing the team members adds far greater complexity (Mayer, 1998). Guss (1998) describes the virtual projects as inherently risky, uncertain and complex. The practical problem is that Software Project Managers (SPM) are increasingly being asked to manage projects in a virtual mode despite the higher level of difficulty and complexity alluded to here.

There are a number of reasons why software development projects are particularly suited for the virtual setting. Global networking make it possible to set up teams intelligently and swiftly on a project basis from a global pool of resource (Mayer, 1998). Mayer notes that such teams can be equipped with development environments, tools, and methodologies that are logical extensions of their extensions of their current environments and practices. Mayer also notes that the Inter*net al*ready provides an ubiquitous client server platform for software applications and a global programming infrastructure for software development.

Given the need to manage projects in virtual settings (Lipnack & Stamps, 1997), it is fair to suggest that software project management processes may need to adapt in order to help improve chances of project success in the virtual setting. The adaptation alluded to here can succeed if the impact of project setting on the risk profile is known. There is no specific study identified at the time of writing this paper that provides an analysis of the how a project setting affects the risk profile of a software project. This study is a step in that direction.

In order to get a comparative perspective of differences between the F2F and Virtual settings, a self selected sample of SPMs in New Zealand were presented with an online structured questionnaire in order to collect data on their perception of software project risks in the two settings. SPMs were asked to provide answers to the following three key questions with respect to risk in F2F settings and Virtual settings.

- ✓ What are the most likely risks that can occur?

- ✓ What is the probability of each risk factor occurring?

- ✓ What is the likely impact of each risk factor if it occurred?

The quest for achieving project success is universal and central to software project risk management research (Pitkanen, 1999; Ropponen, 2000). While project success is elusive and difficult to define, it is not random. SPMs endeavour to maximise opportunities and minimise risks from the most likely outcome (Lauer, 1996; Pitkanen, 1999). Risks, represented by negative deviations in the estimates, must be purposefully managed. In this study, and consistent with Wallace, Keil, and Rai (2004), and PMI (2000), software project risk factors are defined as conditions that that are likely to prevent the project from reaching a successful outcome.

2   Design of the study and research method

The purpose of this research was to gain insight into SPMs in New Zealand perceptions of whether or not software project risk and its management changes from a F2F setting to a Virtual setting or vice versa. The research is exploratory in nature. The key research question that guided this work is:

"To what degree do SPMs perceive differences between the risk profiles of F2F software projects and the risk profiles of Virtual software projects?"

The findings reported in this paper draw on data obtained from an online survey. In this study, the population is defined as SPMs within New Zealand and working on IT projects in which software enhancement, development and or implementation is a deliverable of the project. The SPMs population is estimated to be 300 based on Project Management Institute of New Zealand (PMINZ) total membership as at March 2005 of 1076 project managers.

Two strategies were employed to administer the questionnaires. Firstly, the questionnaire was sent to the entire PMINZ membership. Secondly, the questionnaire was sent to non-PMINZ members through a targeted referral strategy. Each respondent who received the questionnaire was asked to complete the questionnaire and forward an invitation to take part in the survey to other SPMs known to them.

3   Questionnaire Design

3.1   In view of the data required and the time and budget constrains of the researcher, structured questions were used. A list of risk factors, Table 1, drawn from literature is used.

3.2   The questions are logically organized to follow each other. First, the respondents were asked to select the 10 most likely risk factors for each setting.

Second the respondents were asked to provide information on risk probability and risk impact for the risk factors they selected as the most likely. Last, some information is sought regarding risk management processes in the two settings

3.3   Survey respondents analysis

3.4   Of the 192 survey views, a total of 76 completed responses were received. This was 25%- above the target-of 60 completed questionnaires. On average, each respondent took 15 minutes to complete the survey. This is consistent with the estimated completion time obtained at the pilot stage of the survey.

Of the responses received, 57% have experience in managing projects in F2F setting and 44% have experience in managing projects in Virtual settings.

This near even split suggests a balanced view of the SPMs feedback on perception.

4   Data Analysis

The four dimensions on which the analysis is done to answer the research question are shown in Figure 1.
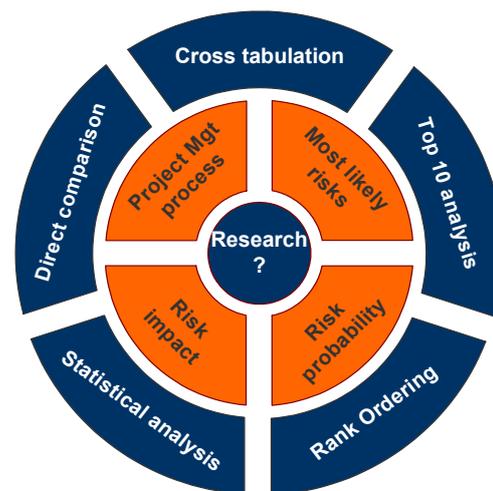

Figure 1 - Data Analysis to address the research question

Rank ordering is the main data analysis method used in gaining insight into the likely risk events in either setting. The criterion for ranking the data is primarily the frequency of selection of the particular risk by the SPMs. The rank orders are then compared against each other for purposes of establishing differences and similarities between them.

It is important to keep in mind that the risk rank-orders do not necessarily represent the priority order of the risk factor since the SPMs were not asked to select the risk factors in any order. The rank-orders simply reflect the order based on frequency of selection by the SPMs. As such, these outcomes can only be used to gain insight into the differences between the two settings. They are

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Planning and Control Risk	Lack of effective project management methodology(Schmidt *et al.*, 2001; Wallace *et al.*, 2004)
	Poor progress monitoring(Schmidt *et al.*, 2001; Wallace *et al.*, 2004)
	Ineffective communication(Wallace *et al.*, 2004)
	Confusion during meetings(Olaniran, 2004)
	Poor change control(Schmidt *et al.*, 2001)
Team Risk	Inexperienced team members(Barki *et al.*, 2001; Boehm, 1991; Wallace *et al.*, 2004)
	Lack of specialised skills required by the project(Wallace *et al.*, 2004)
	Misunderstanding between team members
	Lack of trust between members(Lipnack & Stamps, 2000; Mayer, 1998)
	Difficulty maintaining relational ties with team members
	Key members being left off distribution lists
Requirements Risk	Frequent to requirements(Boehm, 1991; Schmidt *et al.*, 2001; Wallace *et al.*, 2004)
	Unclear systems requirements(Schmidt *et al.*, 2001; Wallace *et al.*, 2004)
	Incorrect systems requirements(Wallace *et al.*, 2004)
Project Complexity Risk	High level of technical complexity(Barki *et al.*, 1993; Wallace *et al.*, 2004)
	High level of non-technical complexity(Barki *et al.*, 1993, 2001; Mayer, 1998)
	Unfamiliar technology(Wallace *et al.*, 2004)
Organisational risk	Lack of top management support(Schmidt *et al.*, 2001)(Thamhain, 2004)
User risk	Conflict between users(Wallace *et al.*, 2004)
	Lack of Cooperation from users(Wallace *et al.*, 2004)

Table 1: Selected risk factors for use in research

not indicative of the relative priorities of the individual risk factors. The findings are therefore not meant to be prescriptive about what SPMs must do regarding the individual risks. They only provide SPMs with suggestions on areas of focus when they move from F2F setting to Virtual setting or vice versa.

There are three groups of risk factors in the top 10 comparative analysis. Firstly, the '**F2F only**' risks, are the risks which are in the F2F setting top 10 risks factors but not in the Virtual setting top 10 risk factors. Secondly, the 'Virtual only' risks, which are risks in the Virtual setting top 10 risk factors but not in the F2F setting top 10 risk factors. Thirdly, the 'Common**'** risks which are risks common to both the F2F and Virtual settings Top 10 risk factors.

In this research, two methods are used to analyse SPMs perception on risk probability and risk impact. Firstly, the unweighted method is used. This takes SPMs majority view in one setting and compares it with the majority view of SPMs in the other setting. The unweighted method discussed here has a number of weaknesses. Firstly, it ignores the view of other SPMs who did not select the risk factor being evaluated.

Secondly, it fails to take into account the differences in selection of risk scales by the SPMs on the same risk factor. To address these weakness the weighted method, is also used.

Spearman rank-order correlation coefficient (r_{sj} is used to measure the degree of agreement between rank-orders of the two settings.

5   Findings

5.1   Likely risks – F2F versus Virtual settings

The comparative rank-orders of the twenty risk factors are shown in Table 2 below. The rank-order position of each risk factor in the two overall ranks is different. For example**,** Unclear system requirements is ranked first in F2F setting and yet it is ranked third in the Virtual setting.

5.1.1   Most likely risk factors - top 10 analysis

The top ten risks from the two settings have seven common risk factors. This is shown in **Error! Reference source not found.**.

Figure 2: Top 10 likely risks analysis

Ineffective communication and **Poor Change control** are dimensions of **Planning and control** risks. **Misunderstanding between team members** is a dimension of Team risk. **Frequent changes to requirements**, **Unclear systems requirements** and **Incorrect systems requirements** are dimensions of Requirements risk. Finally, **Lack of top management support** is a dimension of Organisation risk.

The F2F only risks have **Lack of effective project management methodology** which is a dimension of **Planning and control risk**. **Inexperienced team members** and **Lack of required specialized resources** are dimensions of Team risks. The Virtual only risks have **Poor progress monitoring** which is a planning and control risk. The other two, **Lack of trust between members** and **Difficulty maintaining relational ties with team members** are dimensions of Team risk.

What the finding suggests is that SPMs are advised to give additional focus on project management risk when they move from F2F setting to a Virtual setting or vice versa. In addition, the focus in project management risks must be on team risk given that for both F2F only risks and Virtual risks, two of the three risks are elements of team risk.

Some caution is required when reading this conclusion because of the limited number of risk factors used in this research. In the final analysis, risk events do not in themselves indicate conclusively whether or not project setting has an impact on project risk profile. A statistical analysis gave $r_s = +.43$ and rs^2 is $+.18$. The positive sign of $r_s = +.43$ suggest that the agreement in rank-orders between the two settings is in the same direction. The $r_s = +.43$ shows that there is reasonably strong evidence of association between the two rank orders but since this falls short of the critical value of .45 for r_s for rank size 20, the relationship is statistically not significant at 95% confidence level.

5.2 Risk probability - F2F versus Virtual settings

Tables 2 and 3 show the summary of the results of the analysis of risk probability using the weighted and unweighted analysis

Of note in the unweighted results is the trend that the risk probability is higher in the Virtual setting than in the F2F setting. This is an important insight for SPMs because it strongly suggests that things are more likely to go wrong in a virtual setting. The higher chances of risks occurring suggest a requirement for a more stringent risk management regime in a Virtual setting than in a F2F setting. This finding is consistent with Guss (1998) who describes virtual settings as inherently risky operate to in

Lack of specialised resources and lack of top management support have a higher level of probability in a F2F setting than in a Virtual setting. These are expected for a number of reasons. First, Virtual teams are usually a network of specialised resources which are in a position to access the global pool of resources. They are formed usually in order to exploit the specialist resources available in different places. Secondly, Top management support problems are not likely to arise in a Virtual setting. (Guss, 1998; Mayer 1998). In addition the Virtual teams focus on the work to be done and are less likely to exist without Top management support in the first place. Lipnack and Stamps (1997) assert that Virtual teams are not plagued by corporate politics and power plays prevalent in F2F teams.

5.3 Risk impact - F2F versus Virtual settings

Tables 5 and 6 show the summary of the results of the analysis of likely risk impact using the weighted and unweighted analysis

Table 5 indicates that risks have a higher likely impact in the Virtual setting than in a F2F setting. **Ineffective communication** has a higher likely impact in a Virtual setting than in a F2F setting. This is expected and consistent with literature. Guss (1998) and Mayer (1998), assert that while both the F2F teams and Virtual team communicate to get things done Virtual teams depend on effective communication to function and continue to exist. **Inexperienced team members** risk is unlikely to have a high impact in a Virtual setting

Risk factor	% of respondents	F2F Rank	% of respondents	Virtual Rank
Unclear systems requirements	8.40%	1	7.11%	3
Ineffective communication	8.00%	2	8.82%	1
Frequent changes to requirements	7.87%	3	6.05%	6
Poor Change control	7.33%	4	6.71%	5
Lack of top management support	7.20%	5	5.39%	10
Lack of required specialized resources	6.00%	6	3.42%	15
Incorrect systems requirements	5.47%	7	5.66%	7
Inexperienced team members	5.33%	8	3.55%	14
Misunderstanding between team members	4.93%	9	8.03%	2
Lack of effective project management methodology	4.93%	9	4.08%	13
Poor progress monitoring	4.67%	11	5.53%	9
Unfamiliar technology	4.40%	12	2.37%	19
High level of technical complexity	4.27%	13	2.89%	17
Conflict between Users	4.27%	13	2.76%	18
Lack of cooperation from users	3.73%	15	3.29%	16
Lack of trust between members	3.20%	16	5.66%	7
High level of non-technical complexity	3.20%	16	2.37%	19
Confusion during meetings	2.53%	18	5.00%	11
Key members being left of distribution lists	2.40%	19	4.47%	12
Difficulty maintaining relational ties with team members	1.87%	20	6.84%	4

Table 2: Likely risk rank orders - F2F versus Virtual

mainly because the Virtual team is itself made up of experienced team members and above all, they are in the best position to mitigate the risk should it occur. Mayer (1998) asserts that Virtual teams are flexible with respect to decision-making and their ability to correct those decisions gone wrong. In contrast, F2F teams usually do not have such a predisposition to make decision swiftly and flexibly.

The implication of these findings suggests that when risks occur in a Virtual setting they can cause a lot more problems than if they occurred in a F2F setting. Most importantly, the differences span the whole spectrum of software project risk. Risk impact alone is insufficient to conclusively determine the implication of this difference in risk impact between the two settings.

Lack of specialised resources has a higher level of impact in a F2F setting than in a Virtual setting. This is expected because the Virtual setting has a wider base of specialised resources. They are set up to exploit the global resource pools and can therefore not be expected to be plagued by specialised resources shortages. Similarly, **Unclear systems requirements** and **Frequent changes to requirements** have potential to cause more problems in a F2F setting than in Virtual setting maybe because at set up time, the team members are chosen for their expertise and professional experience and this impacts on the technical aspects of the project. The requirements are expected to be of a sufficiently high quality to avoid problems in this area.

An important aspect to emphasise here about the results depicted in Table 5 is that all the differences in risk impact are in the area of Project management risk. This could be because project success is essentially driven by how effectively the team is organised and managed to achieve the set objective. In summary, the risk impact differences suggest that project setting has an impact on project risk profile given the following observations:

		F2F	Virtual
x	Poor Change control	Medium	High
	Lack of top management support	High	High
	Unclear systems requirements	High	High
	Incorrect systems requirements	High	High
x	Poor progress monitoring	Medium	High
	Lack of effective project management methodology	High	High
x	Ineffective communication	High	Very High
x	Inexperienced team members	Medium	High
	Lack of required specialized resources	High	High
	High level of non-technical complexity	High	High
	High level of technical complexity	High	High
x	Unfamiliar technology	Medium	High
x	Frequent changes to requirements	High	Very High
	Conflict between Users	High	High
x	Misunderstanding between team members	Medium	High
x	Difficulty maintaining relational ties with team members	Medium	High
x	Confusion during meetings	Medium	High
x	Key members being left off distribution lists	Medium	High
x	Lack of trust between members	Medium	High
x	Lack of cooperation from users	Medium	High

	Risk factors with similar probabilities
	8 risk factors are perceived to have the same level of probability

x	Risk factors with different probabilities
	12 risk factors are perceived to have different level of probability. All the 12 risk factors are perceived to have higher levels of probability in a Virtual setting than in a F2F setting

Table 3: Unweighted Probability scales: F2F versus Virtual

✓ At least thirty percent of risk factors have different risk impact between the two settings.

✓ Some of the Common risk events exhibit different risk impacts. This suggests that while risks events may be common they are not the same which seems to suggest that project setting has an impact on project risk profile.

✓ The existence of differences in all the three sources of risk, a high degree of the influence of project setting on risk profile.

5.4 Probability and Impact matrix (Unweighted)

The risk exposures for all the risks based on the unweighted analysis method are shown in **7.** Fourteen risks have a higher exposure in Virtual setting than in a F2F setting. One risk, Lack of effective project management methodology has a higher risk exposure in a F2F setting than in a Virtual setting

Two risks, **Ineffective communication** and **Frequent changes to requirements** are the only risks in the Very High-Very High box. The most important observation is that these two are for the Virtual setting. They show as having lower risk exposure in a F2F setting. In the Very High impact – High probability box, three of the five risks have the same risk exposure. The other two, **Poor change control** and

Frequent changes to requirements have higher risk exposure in the Virtual setting than in a F2F setting.

The results show that the same risks are perceived to have a higher risk exposure in Virtual setting that in a F2F setting. Virtual setting has a number of risks falling in the Very High probability –Very High impact box. This is consistent with literature (Lipnack & Stamps, 1997; Barki *et al*., 1993; 2001; McFarlan,

1981; Schmidt *et al*., 2001). The risk exposure of the risks is somewhat perceived to be higher in a Virtual setting than in a F2F setting. This suggest that leading Virtual teams is far more demanding than leading a F2F team which, is consistent with some of the conclusions made by Mayer (1998).

Probability assessment (Weighted)		F2F	Virtual
	Poor Change control	Medium	Medium
x	Lack of top management support	Medium	low
x	Unclear systems requirements	High	Medium
	Incorrect systems requirements	low	low
	Poor progress monitoring	low	low
	Lack of effective project management methodology	low	low
x	Ineffective communication	low	High
	Inexperienced team members	low	low
x	Lack of required specialized resources	Medium	low
	High level of non-technical complexity	Low	low
	High level of technical complexity	Low	low
	Unfamiliar technology	Low	low
x	Frequent changes to requirements	low	Medium
	Conflict between Users	low	low
x	Misunderstanding between team members	low	High
x	Difficulty maintaining relational ties with team members	low	Medium
	Confusion during meetings	low	low
	Key members being left off distribution lists	low	low
	Lack of trust between members	low	low
	Lack of cooperation from users	low	low

Table 4: Weighted Probability scales: F2F versus Virtual

	Risk factors with similar probability
	13 risk factors are perceived to have the same level of probability

x	**Risk factors with different probability**
	7 risks are perceived to have different levels of probability.
	Of these 5 are perceived to have higher level of probability in Virtual than in F2F. The other two are perceived to be of higher probability in F2F setting than in Virtual setting

5.5 Probability and Impact matrix (Weighted)

Table 8 which depicts the risk impact and risk probability metric is based on the weighted data analysis method. It shows that 11 of the risks factors have the same risk exposure. Of particular interest is the indication that 15 of the risks are in low risk exposure box.

The four risks in the top box are project management risks. What is somewhat surprising is the result that "Unclear system requirements" has a higher exposure in a F2F setting than in Virtual setting. This may be because of the use of highly specialised resources in

	Risk Impact assessment	F2F	Virtual
	Poor Change control	Very High	Very High
	Lack of top management support	Very High	Very High
	Unclear systems requirements	Very High	Very High
	Incorrect systems requirements	Very High	Very High
	Poor progress monitoring	High	High
	Lack of effective project management methodology	High	High
x	Ineffective communication	High	Very High
x	Inexperienced team members	High	Medium
x	Lack of required specialized resources	High	Medium
x	High level of non-technical complexity	High	Medium
	High level of technical complexity	High	High
	Unfamiliar technology	High	High
	Frequent changes to requirements	Very High	Very High
	Conflict between Users	High	High
	Misunderstanding between team members	High	High
	Difficulty maintaining relational ties with team members	High	High
	Confusion during meetings	High	High
x	Key members being left off distribution lists	Medium	High
	Lack of trust between members	High	High
x	Lack of cooperation from users	Medium	High

Table 5: Unweighted Risk Impact scales - F2F versus Virtual

	Risk factors with similar likely impact 14 risk factors are perceived to have the same level of impact

x	**Risk factors with different likely impact** 6 risks are perceived to have different levels of probability. Of these 3 are perceived to have higher level of impact in Virtual than in F2F. The other 3 are perceived to be of higher impact in F2F setting than in Virtual setting

Virtual settings to define the specifications in the first place. This is not the situation with F2F settings where there may be a tendency to make do with the available resources who may not be subject matter experts and hence the project runs the risk of having unclear system requirements. This is a plausible explanation but there could be other reasons for this to be the case.

In summary risk exposure differences suggest that project setting has an impact on project risk profile given the following observations:

✓ A number of risk factors have different risk exposure in the two settings.

✓ The findings here are consistent on with findings on the risk components that define risk exposure

Risk Impact assessment (Weighted)	F2F	Virtual
Poor Change control	Medium	Medium
Lack of top management support	Medium	Medium
x Unclear systems requirements	High	Medium
x Incorrect systems requirements	Low	Medium
Poor progress monitoring	Low	Low
Lack of effective project management methodology	Low	Low
Ineffective communication	High	High
Inexperienced team members	Low	Low
x Lack of required specialized resources	Medium	Low
High level of non-technical complexity	Low	Low
High level of technical complexity	Low	Low
Unfamiliar technology	Low	Low
x Frequent changes to requirements	High	Medium
Conflict between Users	Low	Low
x Misunderstanding between team members	Low	High
x Difficulty maintaining relational ties with team members	Low	Medium
Confusion during meetings	Low	Low
Key members being left off distribution lists	Low	Low
x Lack of trust between members	Low	Medium
Lack of cooperation from users	Low	Low

Table 6: Weighted Risk Impact scales - F2F versus Virtual

	Risk factors with similar likely impact
	13 risk factors are perceived to have the same level of impact

x	**Risk factors with different likely impact**
	7 risks are perceived to have different levels of probability. Of these 4 are perceived to have higher level of impact in Virtual than in F2F. The other 3 are perceived to be of higher impact in F2F setting than in Virtual setting.

Table 4: Source of risk and risk type differences in risk impact – weighted

5.6 Conclusions

The results suggest that although there is a high degree on commonality in risk events that can occur in F2F and virtual settings, project setting appears to have a significant impact on software project risk profile. Four results areas support this conclusion. First, the comparative analysis of the most likely risks shows that there are differences in risk events that can occur between the two settings. In addition, the analysis of the Common risk in terms of risk probability and risk impact show that even though the risk events may be common to both settings there are differences in some of the risk events in terms of probability and likely impact.

Impact (Scale)	Risk	Low F2F	Low Virt	Medium F2F	Medium Virt	High F2F	High Virt	Very High F2F	Very High Virt
Very High	Poor Change control			VHM			VHH		
Very High	Lack of top management support					VHH	VHH		
Very High	Unclear systems requirements					VHH	VHH		
Very High	Incorrect systems requirements					VHH	VHH		
Very High	Ineffective communication								VHVH
Very High	Frequent changes to requirements					VHH			VHVH
High	Poor progress monitoring			HM			HH		
High	Lack of effective project management methodology				HM	HH			
High	Ineffective communication					HH			
High	Inexperienced team members			HM					
High	Lack of required specialized resources				HM	HH			
High	High level of non-technical complexity					HH			
High	High level of technical complexity					HH	HH		
High	Unfamiliar technology			HM			HH		
High	Conflict between Users					HH	HH		
High	Misunderstanding between team members			HM			HH		
High	Difficulty maintaining relational ties with team members			HM			HH		
High	Confusion during meetings			HM			HH		
High	Key members being left of distribution lists						HH		
High	Lack of trust between members			HM			HH		
High	Lack of cooperation from users						HH		
Medium	Inexperienced team members						MH		
Medium	Lack of required specialized resources						MH		
Medium	High level of non-technical complexity						MH		
Medium	Key members being left of distribution lists			MM					
Medium	Lack of cooperation from users			MM					

Table 7: Unweighted Risk Impact and Probability matrix

Second, the results show differences in risk probability and risk impact on a number of risk factors. The risk probability differences strongly suggest that the likelihood of risk occurring changes from one setting to another. Similarly, the risk impacts are different for some of the risks between the two settings. These differences in risk probabilities between F2F and Virtual projects are the Project management type risks, particularly team risks. The F2F only risks and the Virtual only risks are each made up of two team risks and one planning and control risk.

Third, a large number of risk events turn out to have a different risk exposure. This finding does not only suggest that project setting has an impact project risk profile but provides SPMs with insights on areas of focus when they move from one setting to another. There are simply too many risks to be managed in any software project and SPMs need to focus on the risks that have the most exposure individually or a logical group (Turner, 1999). What this study has done is to provide a starting point in the identification of the most problematic areas in software project management in different settings.

Fourth, the risk management processes appear to be much more difficult and complex in a Virtual setting than in F2F setting.

The assessment of the importance of risk management process supports the underlying theme that project setting affects project risk profile. The results obtained suggest that project setting does indeed have an impact of project risk profile.

5.7 Implication for practice

The similarities and differences in project risks between the two settings highlighted in this study can be used to provide a heads-up of potential problem areas for SPMs and other stakeholders when they move from F2F setting to a Virtual setting or vice versa. The implications of such knowledge go beyond aiding project risk management process. This will among other things help in decision making at project budgeting and planning. SPMs will be in a position to rationally justify the need for additional resources including alternative risk management frameworks when the same type of software projects previously done in one setting are started or continued in a different setting.

Scale (Impact)	Risk	Probability							
		Low F2F	Low Virt	Medium F2F	Medium Virt	High F2F	High Virt	Very High F2F	Very High Virt
High	Unclear systems requirements					HH			
High	Ineffective communication	HL					HH		
High	Frequent changes to requirements	HL							
High	Misunderstanding between team members						HH		
Medium	Poor Change control			MM	MM				
Medium	Lack of top management support		ML	MM					
Medium	Unclear systems requirements				MM				
Medium	Incorrect systems requirements		ML						
Medium	Lack of required specialized resources			MM					
Medium	Frequent changes to requirements				MM	MH			
Medium	Difficulty maintaining relational ties with team members				MM	MH			
Medium	Lack of trust between members		ML						
Low	Incorrect systems requirements	LL							
Low	Poor progress monitoring	LL	LL						
Low	Lack of effective project management methodology	LL	LL						
Low	Inexperienced team members	LL	LL						
Low	Lack of required specialized resources		LL						
Low	High level of non-technical complexity	LL	LL						
Low	High level of technical complexity	LL	LL						
Low	Unfamiliar technology	LL	LL						
Low	Conflict between Users	LL	LL						
Low	Misunderstanding between team members	LL							
Low	Difficulty maintaining relational ties with team members	LL							
Low	Confusion during meetings	LL	LL						
Low	Key members being left of distribution lists	LL	LL						
Low	Lack of trust between members	LL							
Low	Lack of cooperation from users	LL	LL						

Table 8: Weighted Risk Impact and Probability matrix

The research is also important because it adds to the knowledge on the impact of project setting on risk profile. This knowledge will increasingly become more important as more and more projects are managed in

Fourth, the risk management processes appear to be much more difficult and complex in a Virtual setting than in F2F setting.

The assessment of the importance of risk management process supports the underlying theme that project setting affects project risk profile. The results obtained suggest that project setting does indeed have an impact of project risk profile.

5.8 Implication for practice

The similarities and differences in project risks between the two settings highlighted in this study can be used to provide a heads-up of potential problem areas for SPMs and other stakeholders when they move from F2F setting to a Virtual setting or vice versa. The implications of such knowledge go beyond aiding project risk management process. This will among other

Virtual settings. The scanty empirical evidence on how risk changes from one setting to another is partly addressed by the results given in this research.

things help in decision making at project budgeting and planning. SPMs will be in a position to rationally justify the need for additional resources including alternative risk management frameworks when the same type of software projects previously done in one setting are started or continued in a different setting.

5.8.1 Limitations and areas of future research

There are three limitations of this study. First, risk is a complex construct and this research does not cover software project risks comprehensively. Second, the list of risk factors used in the study is limited in terms of the types of risks included and above does not distinguish between different types of software projects. Third, the study is restricted SPMs in New Zealand. The external validity and generalisability of finding in this study is therefore limited. Further research addressing these limitations is required.

One potential area of research would be carrying out an expanded international study not only to increase the size of sample but also to have feedback from other project stakeholders such as testers, project sponsors, developer and System Users. Involving other stakeholders in assessing their perception of risk between the two settings should be an important consideration for future research. This is because it is reasonable to believe that project participants would view risk differently (Wallace *et al*., 2004) and that such differences may be useful in identifying the specific areas of differences in risks between F2F and Virtual settings.

Another avenue for future research would be to take the data obtained from this research for purposes of gaining insight into the differences in perceptions of SPMs by personal attributes such as age, project management experience and the SPMs gender profile. Information from these suggested studies would provide critical knowledge and empirical evidence to better understand the differences between the risk-profiles of projects managed in F2F setting versus those managed in Virtual settings.

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