

Examining the Relationship between Perceived Project Risk and the Use of Collaborative Environments

Dennis P. Groth
School of Informatics
Indiana University
Bloomington, IN 47408 USA
dgroth@indiana.edu

Abstract

*One view of project management is that it is the portion of a project that is involved with managing tasks, resources, assignments and deadlines. Certainly, many of the daily activities for a project manager might be categorized in such a way; however, these activities merely serve as surrogates for the principal responsibility of the project manager: **risk management**. Risk management includes identification, analysis, and mitigation of risks that, should the risks materialize, have the potential for negatively impacting the completion of a project. Risks may be categorized in many ways, but few methods exist for quantifying risks. We approach the problem of risk management for information technology projects from the perspective of the developers, or principal resources responsible for completing tasks. We pursue an understanding of how the developers perceive project risks using an extension to Tiwana and Keil's "One-Minute Risk Assessment Tool". In this paper we present the results of a study of perceived project risk for 26 different information technology projects completed by more than 50 senior undergraduate students during the 2005/2006 academic year.*

1. Introduction

Risk for information technology projects may occur in many forms. Some risks may be human related, such as the risk that an employee might become ill, and therefore unable to complete assigned tasks. Other risks might be technology related, such as the risk that a system will not perform according to specification. Some risks might be considered easily managed; for example, the project schedule may incorporate a factor on productivity to deal with unforeseen employee illness or absence. Other risks might be considered more challenging to manage, such as in cases of a natural disaster, or other type of catastrophic event.

A successful project manager must certainly be adept at managing crises, but the best managers avoid crises by effectively managing risk. Current thinking identifies risk management as the principal activity for a project manager.[3, 6, 20] Risk management can be divided into the following different activities: risk identification, risk analysis, and risk mitigation. Note that the objective is not to eliminate risk, but rather to minimize either the possibility that a risk materializes, or the cost of dealing with the risk should it materialize.

A common method for organizing and reporting risk information is to identify the probability that a risk may occur, as well as the impact of the risk. For a project manager, risk management activities typically occur after the initial project plan has been completed. The main reason for this timing is that the impact of potential risks manifests itself in the form of project delays, and without some form of initial plan, delays are essentially

meaningless. Luckily, for experienced information technology project managers, many project risks are well understood.[2,7,10] Table 1 identifies some of the frequently occurring information technology project risks.[6, 16]

Table 1: Frequent project risks.

Poor requirements definition	Insufficient or incorrect staff
Inadequate customer involvement	Technology failure
Lack of standards	Poor employee morale
Poor or inappropriate methodology	Quality problems
Inaccurate estimations	Unstable or shifting requirements

In this project, we focus on a technique for quantifying risk that was introduced by Tiwana and Keil [17] called “The One-Minute Risk Assessment Tool”. The tool uses the answers to six questions answered on a 10-point Likert scale. Through the use of this quantitative measure, we were interested in tracking how participants in a project perceived the risk of their project over time, while at the same time measuring their use of collaborative environments. The hypotheses for our study are shown in Table 2.

Table 2: Hypotheses for the study.

H1: Perceived risk decreases as a project matures.
H2: Perceived risk correlates with the use of collaborative tools.
H3: Projects with superior outcomes have low variance in perceived project risk.

The motivation for these hypotheses is straightforward. First, for the first hypothesis, we expect that the most uncertainty for projects occurs at the beginning stages. This is especially the case for student projects, due to a lack of professional experience that will tend to amplify uncertainty. For the second hypothesis we note that many risks materialize because of poor communications. Facilitating and managing communications is a primary feature of collaborative environments.[14] The third hypothesis is based on group dynamics, and that teams that have different team members that generally agree on risk perform better than teams in which the members disagree on risk.

The remainder of this paper is structured as follows. In Section 2 we provide details of the data measurement tool. We describe the context for our study in Section 3. Section 4 describes the quantitative results of our study, and discusses the results, and also some of the trends we observed over the course of the study. In Section 5 we describe the relationship between a group’s members’ ratings of risk. Lastly, we summarize our findings and describe future directions for research in Section 6.

2. Measuring Risk

The assessment tool [17] uses the answers to six questions to create a single quantitative risk score. Tiwana and Keil base their technique on a review of 720 IT projects. Based on their analysis, the authors are 95% confident that the results are not due to chance. The questions are shown in Table 3.

Table 3: Questions in the One-Minute Risk Assessment Tool.[17]

Q1. Fit between chosen methodology and type of project
Q2. Level of customer involvement
Q3. Use of formal project management practices
Q4. Similarity to previous projects
Q5. Project complexity (lack of simplicity)
Q6. Stability of project requirements

The questions are answered using a 10-point Likert scale (10 highest) , and then combined using the following formula:

$$\text{Risk} = Q1*3.0 + Q2*1.9 + Q3*1.7 + Q4*1.5 + Q5*1.1 + Q6*0.8$$

The factors were derived from a regression analysis of the 720 projects. The resulting risk value is a number between 10 and 100, where a higher score indicates a lower risk. In our study we measured this value once a month for 5 consecutive months after the inception of each project.

3. Background Information

For the purposes of this study, our focus is on group projects created by senior undergraduate students. Though the students often lack deep experience with professional practice, they are sufficiently advanced in their technical skills to represent entry-level software development professionals. The projects are completed in the Informatics capstone course [9] and are designed to provide real-world experiences. Students often interact with industry sponsors for their projects, which contribute professional practice experiences and a problem that is perceived as pragmatic.

The design of the course originated with the author's experience in CS capstone courses [8, 9], with earlier origins.[5] With the advent of IT programs, such as informatics, management information systems (MIS), and computer information systems (CIS), the concept of a capstone project course has been carried along.[1, 12, 18, 19, 4] Indeed, computing curriculum guidelines recognize the necessity in capstone project courses.[15]

The course is organized as a two semester sequence. During the first semester we hold two lectures and one lab section per week. Lecture topics (Table 4) are adapted from software engineering practices. The objective for the lectures is to train and instill the students with a "process-oriented" view, rather than an "artifact-oriented" view.

Students are closely managed throughout the course of their projects. Weekly written status reports are required, as well as a weekly meeting with one of the instructors. The status report frames the discussion of the meeting, and provides a vehicle for students to expose issues and challenges in a formal way. We track attendance at meetings, as well as require students to keep a log of their time spend on project tasks. The scheduled meetings consume one full day per week for the instructors. In addition to the scheduled meetings, at least one other day per week is usually spent by the instructors for detailed meetings with teams to solve specific

problems. These meetings may involve programming or development assistance, or issue resolution with clients.

Table 4. Lecture topics

System Components Lifecycles	Project Basics	Development Models
Personnel Issues	Team Organization	Team Dynamics
Requirements Elicitation	Project Proposals	Requirements Analysis
Qualitative Requirements	Process Analysis	Functional Requirements
Project Management	Quality Requirements	Data Requirements
Project Risks	Project Estimation	Project Planning
Functional Design	Risk Mitigation	Change Management
User Interface Design	Data Design	Tool Selection
	Prototyping	Validation Techniques

4. Evaluation

Students filled out the risk assessment tool five different times over the course of the project. Participation in the study was voluntary. In total 80 students participated in the study, with 26 different projects represented. For the purposes of our analysis, however, we include only the results from the 56 students that filled out all of the surveys.

Table 5. Survey Results (n=281).

Mean risk score: 62.1 (sd 14.7)
Lowest risk score: 10
Highest risk score: 95.6

Students reported on their use of collaborative tools at the same time they reported the risk data. Tools available to the students included: email, instant messaging, regular meetings, telephone, and an open source course management project tool [14] called OncourseCL. Students just reported on the frequency of use for the collaborative tools. Figure 1 shows the raw comparison by month for the use of these tools and the associated project risk.

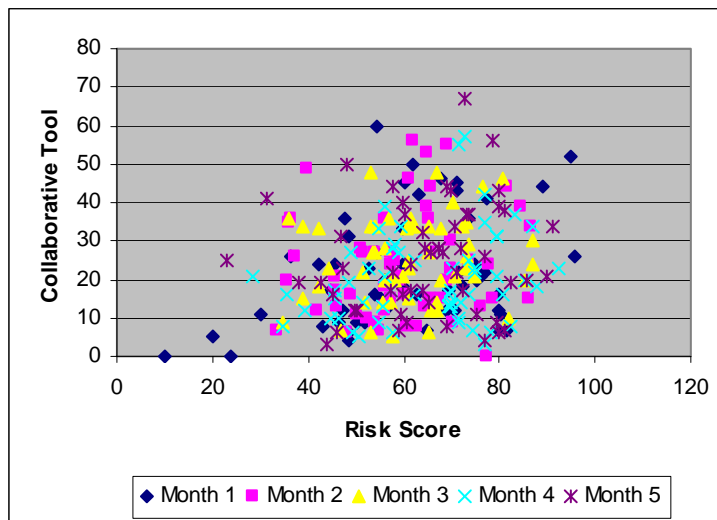


Figure 1. Risk score compared with total use of collaborative tools.

Figures 2-4 show the risk scores in comparison with reported usage of the open source collaboration tool (OncourseCL), E-Mail, and traditional meetings. The collaboration tool provides multiple capabilities to the students, including the features listed in Table 6.

Table 6: Features of OncourseCL.

Announcements	Disk storage
Message board	Calendar
Chat room	Email archive

We have omitted month 2 and 4 from the charts to eliminate some of the clutter, resulting in a view at the beginning, midpoint, and completion of a project.

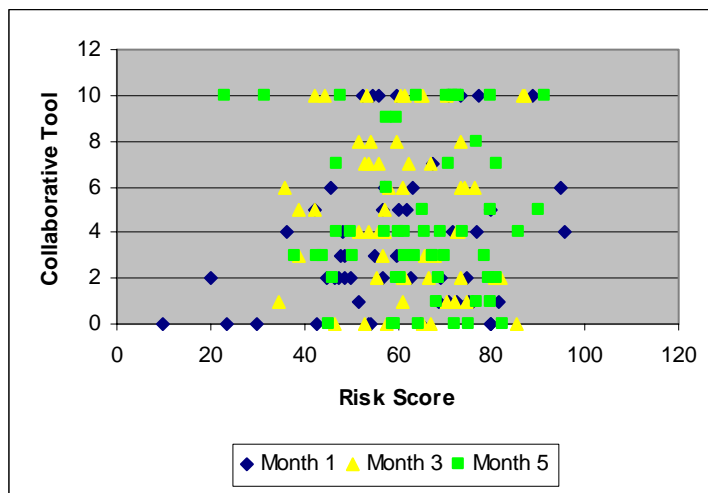


Figure 2. Risk score compared with use of open source OncourseCL.

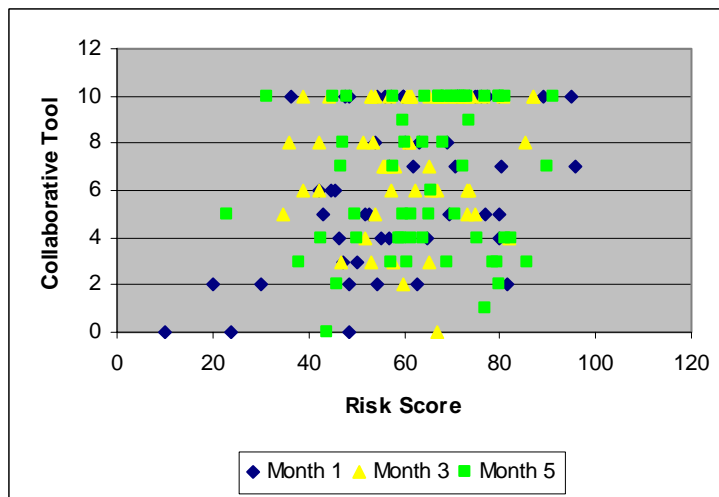


Figure 3. Risk score compared with use of E-Mail.

The charts illustrate that students reported usage of collaborative tools generally increased as the project matured. No single tool was forced upon the students. Rather, all tools were discussed, and the students gravitated to the tools that best fit their perceived needs.

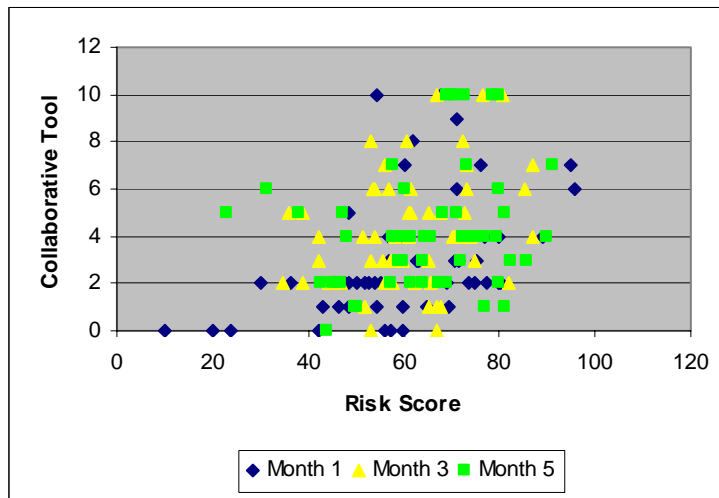


Figure 4. Risk score compared with use of traditional meetings.

Table 7 shows the mean and standard deviation of the risk scores by month for the project. A directional T-Test comparing the first risk score to the last shows a significant ($p < 0.05$) difference between perceived risks, which supports our first hypotheses.

Table 7: Mean and standard deviation risk scores by month.

Month	Mean	Std Dev
1	60.2	17.6
2	59.5	13.2
3	61.8	12.6
4	64.1	14.9
5	64.7	14.5

Generally speaking, students experienced highs and lows over the course of their projects. Table 8 shows the mean differences between the final risk score, and the first, lowest, and highest measurement. 24 out of the 56 students reported an increase in risk when comparing initial assessment with the final assessment. Only 7 out of 56 students reported an increase in risk when comparing the last assessment to the lowest assessment over the 56 month reporting period.

Table 9 shows the correlation between perceived risk and the use of each of the tools reported by the students. The results indicate a slight positive correlation between the total use of tools and perceived project risk. There appears to be a stronger correlation between traditional methods of communication (i.e. meetings, telephone, and email) than others. Relative to our second hypothesis, the hypothesis is supported for E-Mail, meetings, and telephone, but is not supported for the other forms of collaborative tools.

Table 8. Risk score difference results – positive numbers means decreased risk.

Mean difference last to first: +4.5 (sd 19.7)
Largest increase last to first: +58.9
Largest decrease last to first: -37.1
Mean difference last to lowest: +14.6 (sd 14.9)
Largest increase last to lowest: +58.9
Largest decrease last to lowest: -22.6
Mean difference last to highest: -6.7 (sd 12.4)
Largest increase last to highest: +12.4
Largest decrease last to highest: -43.0

Table 9: Correlation of risk with tool usage (* significant p<0.05).

	Correlation (r)
All tools	+0.20 *
OncourseCL	+0.02
E-Mail	+0.27 *
Instant Messaging	+0.08
Meeting	+0.29 *
Telephone	+0.13 *
Whiteboard	+0.04

The data does not support our third hypothesis, which was that higher performing teams experienced less variance on risk assessment than the lowest performing teams. Table 10 shows the risk scores according to the instructor’s assessment of the project outcome.

Table 10: Project risk by outcome.

Project	Mean Risk
Best	65.2
Medium	60.0
Worst	64.4

5. Comparing Risk between Group Members

An interesting outcome of the project is the insight that the risk measurement tool provides to group performance. In particular, since each group member independently answers the risk questions, the tool provides data that is useful for helping groups mitigate their risks. Over the course of the measurement period we observed different trends in the data that correlated with problems identified in status reports, or in some cases, in meetings between a worried student and the course instructor.

Figure 5-7 show the range of scores that were typical for groups participating in the study. Figure 5 illustrates the common thinking shared by groups that are high performing. Namely, their risk assessment tends to track closely with each other. Note that the trend for these groups is also relatively flat, which illustrates a more managed view of their project.

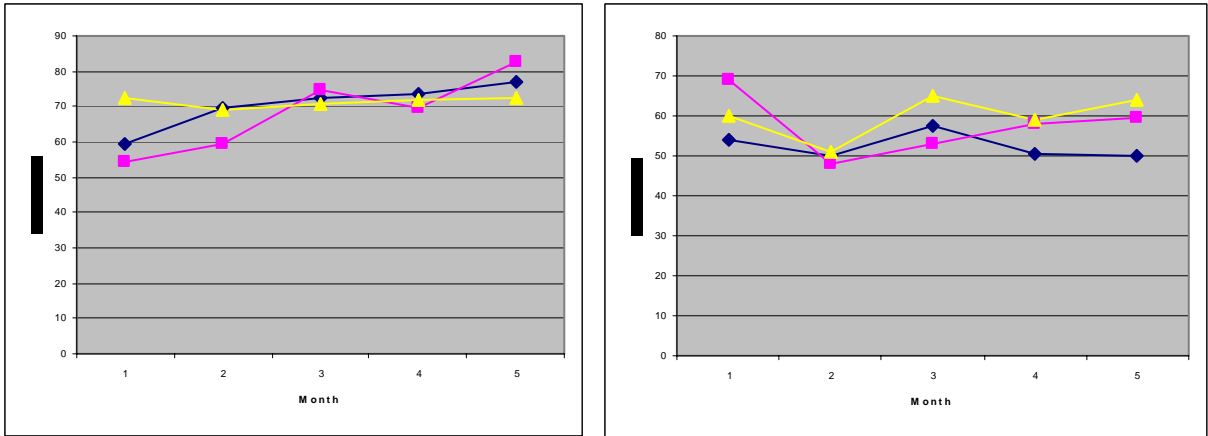


Figure 5. Risk scores by month for two different high performing groups.

Figure 6 shows two different groups that had at least one team member that was seriously worried about their project outcome. For the group on the left, a lengthy meeting was held between the first two measurements where specific tasks were identified. One individual felt they were seriously under-skilled in a particular technology the group was using. After some hands-on training from the instructors, they became the technical lead for the project, and their risk scores completely reversed themselves.

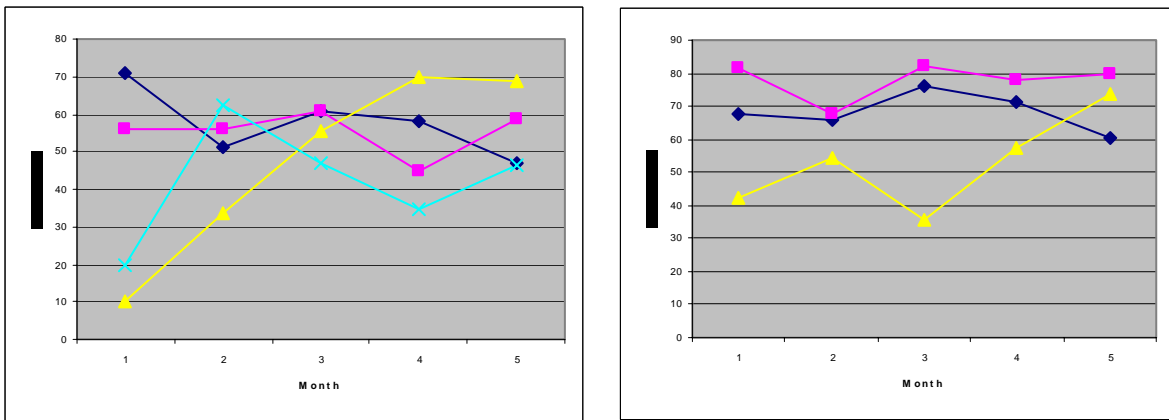


Figure 6. Risk scores by month for two different groups that exhibit individual growth and improvement.

Figure 7 shows risk scores for a group that was experiencing serious problems. Note that two individuals were closely matched in their assessment, while the third continued having a sense that their project was not at risk. Recall that the higher the score the lower the risk. In this case, the majority opinion was most accurate. The main problem the group experienced was a loss of customer contact, which cascaded into multiple problems – all identified by the risk assessment tool.

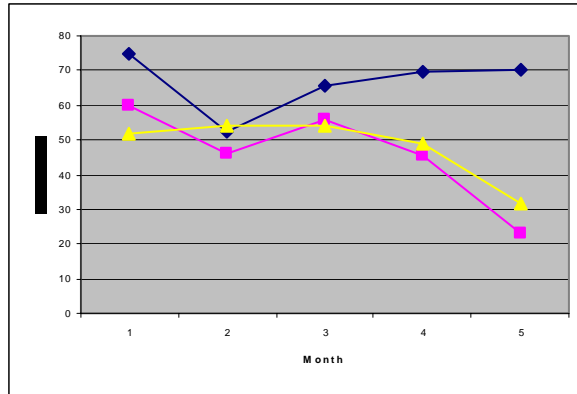


Figure 7. Risk scores by month for a group that exhibits risk of failure.

As a management tool, the risk assessment score provides a quick snapshot of the health of a project. Such information should not replace issue reporting, and other formal management techniques. To the extent that the technique does provide a window into the group dynamics we believe the technique is very useful.

6. Conclusion and Future Work

We have presented the results from a 5 month study of risk assessment for group information technology projects. The main result points to the trends of risk over time. In particular, risk was perceived to be lower at the end of a project than in the beginning. The primary reason for this is, of course, the lessening of uncertainty as a project concludes. Another result points to a linkage between communication and collaborative tools to deal with project issues. Although the most effective form of collaboration for such activities is the traditional meeting, other forms (email, phone, etc.) are useful as well. New collaborative tools did not have the same effect, but with perhaps additional years of use they might also be shown to have an impact.

We have planned to extend our study in the coming year to determine how measuring risk effects the reporting of risk assessments. For this study, students did not have access to the calculated risk scores, or to their team members' scores. One question we would like to answer is whether teams that have a risk score visible to them mitigate risk different than teams that do not. We will experiment with both passive and active methods for reporting risk. The active method will provide views of the data similar to those shown in Section 5. The passive method will involve ambient technology for reporting an abstract notion of risk, similar to a weather report.

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