Performing Empirical Risk Management Studies in Industrial Organizations – A Case Study

ESRM - Meeting

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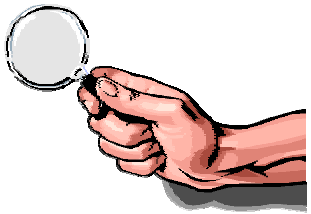
Bernd Freimut

Bernd.Freimut@iese.fhg.de

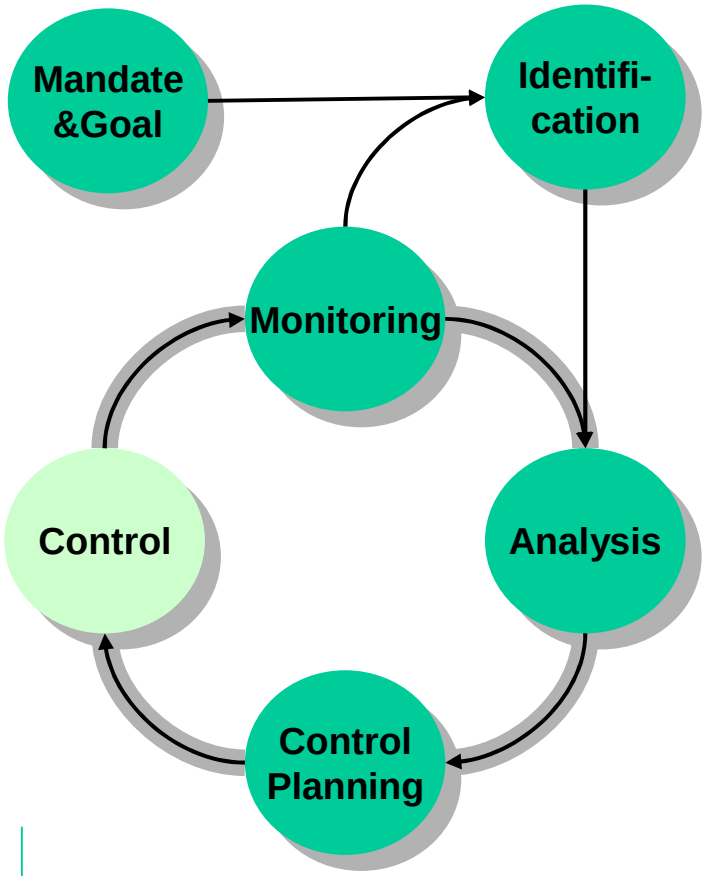
Fraunhofer Institut
Experimentelles
Software Engineering

Introduction

- Empirical Studies on Risk Management are necessary
  - Important to learn about how to transfer and apply RM methods
  - Important to evolve and validate RM methods
- However, although industry uses RM more and more, only few systematic empirical studies with scientific rigor exist
- Present a systematic case study to demonstrate how empirical studies on RM could look like
  - Implementing RM with Riskit in telecommunication company
    - Characterize usefulness/adequacy
    - Characterize cost-benefit



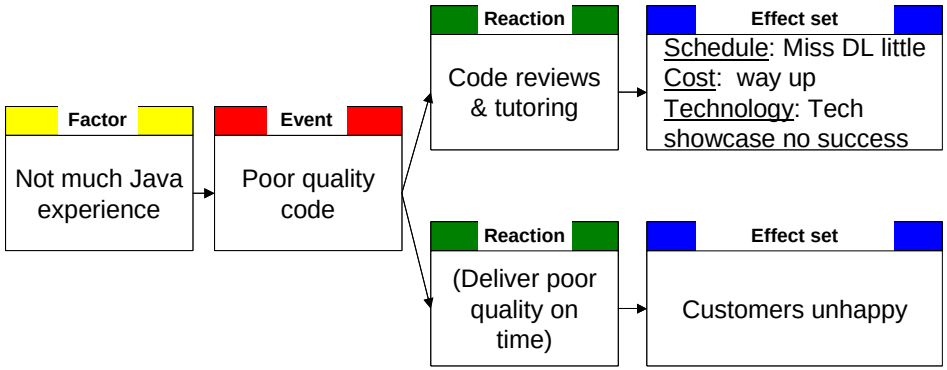
Risk Management

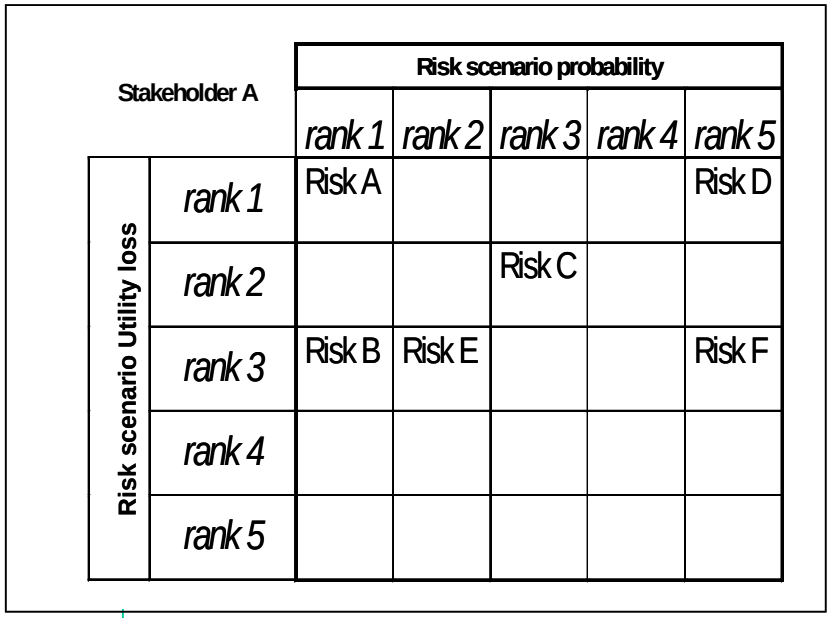


Risk Management:
identify and mitigate threats before they occur

- Mandate and Goal Definition
  - clarify task of RM in project
  - identify project goals
- Risk Identification
  - identify potential threats for project
- Risk Analysis
  - understand and describe risks
  - assess probability and loss
  - select Top N risks
- Risk Control Planning
  - define controlling actions
- Risk Control
  - implement controlling actions
- Risk Monitoring
  - react to changes in the project

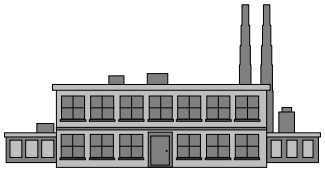
Features of Riskit Method





- Riskit Method
  - Comprehensive, practical RM method based on sound theoretical principles
- Riskit Process
  - Fully defined activities and appropriate techniques
  - Incl. activity to analyze stakeholder interests
- Riskit Techniques
  - Riskit-scenarios to describe risks
    - Graphical representation of risk elements for unambiguous risk definition
  - Pareto ranking technique
    - Allows assessment of probability and loss for several goals with ordinal data
    - Selection of TOP10 risks based on utility loss

Case Study Context

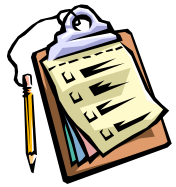


- Company: Tenovis
  - One of Germany's large companies in telecommunication sector
- Project: Tool Harmonization
  - Provide innovative administration of PBX platforms (e.g., combine functionality of several single tools, provide access via web)
- Serve as pilot project for introducing new technology
  - Web-application in client/server context
  - Object-orientation; Java (incl. New OO development process)
  - New project structure (locations in India, France, Germany)
- Systematic risk management is required
  - Project: particularly risky
  - Company: systematic RM is professional project management
    - Market calls for short development cycles, new technologies

  ⇒ Intuitive, adhoc RM no longer appropriate

Transfer of Risk Management

- Initial workshop (2 x 1 day)
  - For department management, project management+senior developers
  - Tutorial to train the basics of RM and the application of Riskit
  - Identify, analyze risks and define controlling actions ⇒ risk baseline



- Set up process in Tenovis context
  - Document process in manual
  - Select techniques
  - Develop forms to document risk information

- RM meetings (analysis, control planning, monitoring)
  - RM team: department head + 2 project managers
  - In addition to project meetings
  - Invited, prepared, facilitated, documented by IESE experts

Project Incidents
- RM = yet another technique
- Project manager left
- Company sold

Selection of Research Method

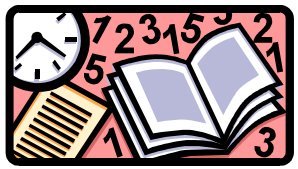
- Which Research Method to choose?
  - Surveys, Controlled Experiment, Case Study ???
- Solution: Case Study
  - Qualitative Aspects
    - RM Method is comprehensive construct = difficult to evaluate in quantitative experiment
    - Constructs used in limited number of cases => quant. analysis less powerful
    - New constructs: qualitative information provide more insight
  - Quantitative Aspects
    - Try to measure what is measurable and interesting for other environments
  - Apply systematic, scientific principles
  - Include cross-case analysis
    - Try to generalize results

Case Study Design

- Define case study goals explicitly at beginning of transfer

Characterize the *usefulness+adequacy* of the *Riskit process* from the viewpoint of the *RM participants*	Characterize the *cost-benefit* of the *Riskit process* from the viewpoint of *management*

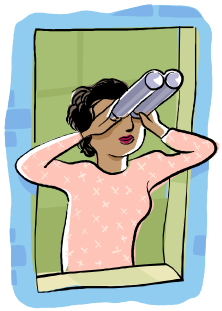
- Use GQM to refine goal into questions and metrics



- Data collection
  - Metrics: effort, number of risks, number of controlling actions, impact of controlling actions
  - Interview: usefulness/adequacy of Riskit techniques+cost-benefit
  - Observation: practicality of techniques as seen by facilitators

- Analyze data to identify strengths and weaknesses of approach
- Validate observations and improvement proposals in feedback session with Tenovis RM team

Case Study Design: Data Collection Example



- Observation
  - Recorded into “logbook” after each RM meeting, if possible with ideas for better performance

Controlling Actions
The architects proposed many controlling actions that could only be initiated once the risk manifested itself as problem.
IDEA: If sufficient time is available: perform a focused brainstorming

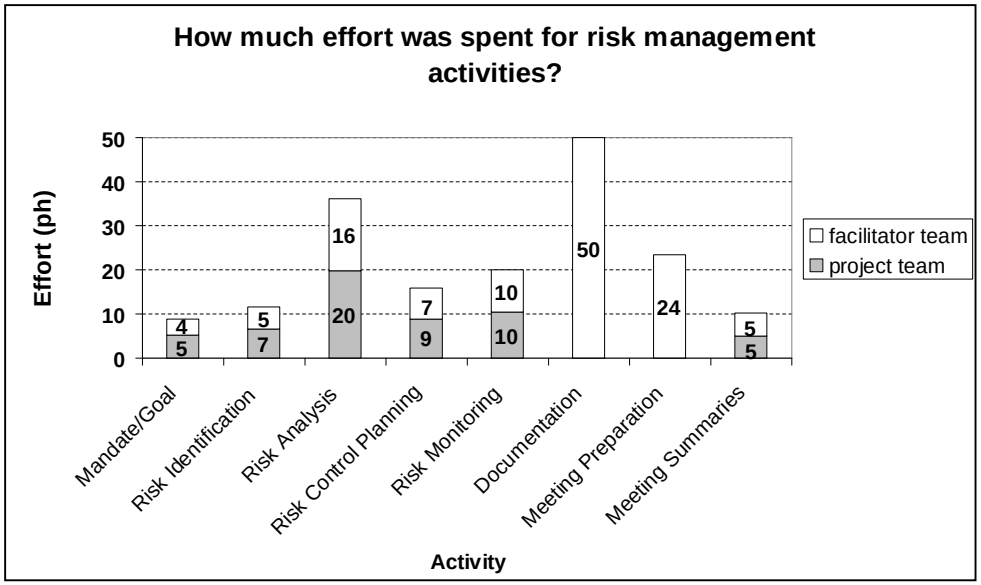
- Interview:
  - Structured interview with all RM team members
  - Topics: problems/ usefulness of techniques, confidence in results, commitment, cost-efficiency

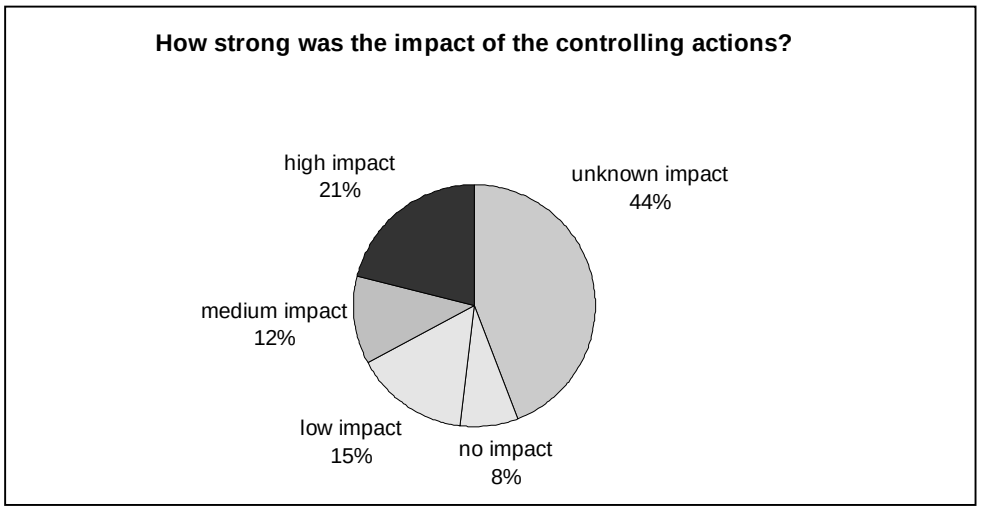
Considering the techniques applied in the process (see figure), which **techniques** were particularly **useful** and which ones should be thought over (why?)?
F Was the selection of TOP10 risks using the **Pareto table** comprehensible or were there problems?(which problems?)

Case Study Design: Validity Threats

- Reliability of data collection
  - Questionnaires and interview procedure for repeatable interviews
  - Pilot-test for understandable interview procedure
  - Concrete documents to help interviewees remember
- Experimenter expectation bias (desire to see positive results)
  - Emphasize Tenovis feedback
  - Record obervations in logbook to remember precisely
- Maturation (subjects react differently over time)
  - Clear learning effect but interviews were performed at end of project in short period of time
- Representativeness (of project and subjects)
  - Project managers as typical RM participants
  - Project with high expectation level
    - Need for RM clearly recognized
    - Aggessive goals reduced available effort but increased expectation

Results: Cost-Benefit





- Collection of data for effort
  - RM effort = 23 pd = 5% of overall project management effort
- Collection of data for benefit
  - Subjective assessment of participants
    - Appreciated: systematic identification and tracking of risks
    - Insight: controlling actions can successfully tackle risks
  - Impact of controlling actions
  - Number of risks, controlling actions
- Subjective assessment of cost-benefit
  - Acceptable effort but impact too low on project-level (can be improved)
  - At management level more professional RM worth the cost

Results: Lessons Learned (1/2)

- Explicit and systematic risk management is perceived as useful
  - Process triggers activities
  - Emphasizes importance of RM
  - Valuable add-on to „intuitive“ RM
- Distinguishing features of Riskit perceived as practical and understandable
  - Riskit scenarios effective for understanding and discussing risks
  - Pareto ranking practical and comprehensible with ordinal metrics
- Monitoring is one of the most important activities
  - Regular performance to react quickly on changes
  - Question sufficiently impact and status of controlling actions
- Aim at seamless integration of RM activities into project work
  - Monitoring in project meetings allows everybody to contribute
  - RM is part of daily work of everybody

Results: Lessons Learned (2/2)

Tenovis Risk Scenario Form

ID 1-1 poor quality code –review/tutoring	**Project:** Tool Harmonization
Owner/Responsible:	**Date reviewed**: 2000-02-01
Timeframe:	**Priority**: Controlled **Probability**: 2
Stakeholder: Tenovis Mgmt	**Loss**: 3
Stakeholder: Dept. Lead	**Loss**: 4
Stakeholder: Project Leader	**Loss**: 4

Event description	"poor qual." The missing experience of the development team with Java leads to poor quality code (i.e., buggy, not efficient)
Factors:	Not much Java experience

Selected scenario				
X	**Reaction:** Code reviews & tutoring	**Effect set**	**Schedule**: Miss deadline a little **Cost**: go way up **Technology** Tech showcase not successful
	Reaction: (Deliver poor quality on time)	**Effect set**	Customers unhappy
	Reaction:	**Effect set**	

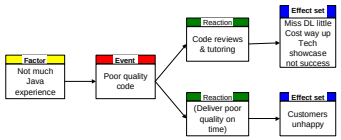
Potential risk controlling actions	Improve review practice, organize tutoring – log results, define metrics and thresholds, reduce time pressure and communicate importance of quality

Selected risk controlling actions

	Action	*Respons.*	*State*	*Finish*	*Check*
1	Introduce review process	Smith	done	end May	ü
6	Perform review process	Miller	ongoing	End Proj.	Oct.
2	Monitor the results of training	Miller	Ongoing	End Proj.	Sept.
3	Develop coding guidelines	Architects	Ongoing	End Proj.	Oct.
4	Evaluate Java code checkers	Doe	done	mid July	ü
5	Communicate importance of quality	Miller	done	end Sep	ü

Closing date:	**Closing Rationale**:

Graphical representation of scenario



Risk History:

31.3.00:	risk probably smaller, because people are aware of the importance of quality as a result of controlling action 5
17.5.00:	risk is still to be considered; there are new people within the project; and there will be new people coming within near future
29.5.00:	risk unchanged; controlling actions sufficient
13.6.00:	Re-ranking changed probability from 3 to 2, new utility loss for project leader assessed
30.6.00:	risk unchanged; controlling actions sufficient
25.8.00:	action 4 was stopped since an evaluation of a Code Checker was completed action 5 was stopped because this is an integral part of the tasks of the project leader and line managers

Controlling Action History

Controlling Action	Impact
1	29.5.00: introduced; impact: see follow-up controlling action 6
2	31.3.00: minor 29.5.00: reveals the effectiveness of training 30.6.00: currently no training 25.08.00 effect positive as people do build up know how; through the monitoring the need for additional training has been detected

- Documentation should be appropriate
  - Have right amount of information for risk monitoring
  - Have descriptions understandable for other people
  - Maintenance effort should be minimal
- Ensure commitment of project manager!
  - Person who drives process, takes rm decisions, monitors actions, and motivates developers

Riskit Results: Comparison to Other Case Studies

IESE

NASA, 1996

= good visual appeal, understandability of Riskit scenarios

≈ higher levels of confidence in RM results than old method

≈ more detailed controlling actions

- Although partly poorly implemented at Tenovis, rated as potentially effective

≠ 20% of project management effort vs. 5% at Tenovis

- Smaller project at NASA, Riskit in early development?

Nokia and DaimlerChrysler, 1998

= systematic RM perceived as beneficial

= project time pressures limit the time available for RM

≠ users had difficulties understanding, using Riskit scenarios

- More detailed training in Tenovis workshop?

DaimlerChrysler, 1999

= emphasized the need for efficiency in risk management

≈ emphasized the importance of stakeholders as defined in Riskit

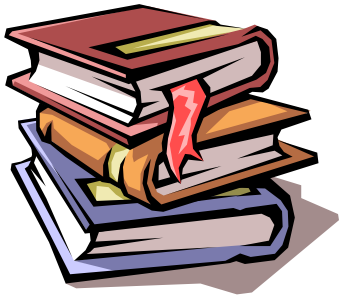
- At Tenovis not specifically evaluated but applied

Findings in all studies fairly consistent
Differences useful to improve application of Riskit

Summary and Future Activities

- Case Study as research method highly applicable for industrial empirical studies
  - Both quantitative and qualitative
- Example of sound, practical case study design in industrial setting
  - Goal definition at beginning, derivation of questions, metrics with GQM
  - Data collection using variety of data collection methods
- Study generated many useful lessons learned
  - Useful for project managers for identfiying do‘s and don‘ts
  - Used to better tailor RM in case study context (-> empirical learning)
- Future IESE Activities
  - On-line survey to characterize RM application in German industry
  - Develop and validate RM method for embedded SW development
  - Develop and validate RM method for small development projects

Literature



– Bernd Freimut, Susanne Hartkopf, Peter Kaiser, Jyrki Kontio, Werner Kobitzsch, An Industrial Case Study of Implementing Software Risk Management, Proceedings of the 8th European Software Engineering Conference, 2001.
  – http://www.iese.fhg.de/pdf-files/iese-016_01.pdf

– Jyrki Kontio: The Riskit Method for Software Risk Management, Version 1.00. University of Maryland, CS-TR-3782, 1997.
  – http://mordor.cs.hut.fi/~jkontio/riskittr.pdf

Backup-Slides

Why is empirical research for RM so difficult?

- Correct phrasing and clustering of risks is subjective and depends on situation and participants. This makes comparison of risk data difficult at best and meaningless at worst.
- Actuals for probability and loss are not known, or even knowable. As situations inevitably change, even historical data on past risks cannot give correct estimates for risks. This makes it difficult to evaluate the impact of risk management methods as we do not have access to “real risk data”. This constraint requires us to use indirect measures to evaluate risk management methods.
- Each set of events occurring in a project is unique and not repeatable. Risks are sensitive to the characteristics of the project and its environment in time. In practice, it is impossible to identify or control all factors that influence the risk portfolio of a project. This makes the comparison of different empirical studies and data difficult as specific characteristics of a situation cannot be factored out. This constraint motivates us to use single case studies in our empirical studies.

Jyrki Kontio, Software Engineering Risk Management: A Method, Improvement Framework, and Empirical Evaluation, PhD Dissertation, Helsinki 2001.

Why is empirical research for RM so difficult?

- Risk management method cannot be separated from the object of study: if a method results in some action, the state of the system irrevocably changes. Only one scenario of risks and events is available from any system. This constraint leads us to measure the results of a risk management method as snapshots of reality, i.e., comparisons over time may decrease the validity of results.
- Risks are probabilistic phenomena. A single occurrence of a risk (predicted or not), cannot be used to draw any conclusions about the accuracy of a method. Large number of data points necessary to counter the probabilistic effect. As this is often unrealistic (C-3, C-4 and C-7), we should utilize the limited number of studies more effectively by using qualitative research and analysis methods.
- Introduction of a risk management method changes the behaviour of participants. This limits results' validity. It is likely that awareness of experimental interest in risks increases the sensitivity to identify risks and, possibly, introduces bias in risk analysis.
- Software projects have relatively long cycle times and are costly => not feasible to set up real projects just to experiment with a management method. This limits the number of data points we will be able to obtain in a given time.

Jyrki Kontio, Software Engineering Risk Management: A Method, Improvement Framework, and Empirical Evaluation, PhD Dissertation, Helsinki 2001.