

# Risk Management



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# Overview of risk



- ❑ Risks affect successful completion of software project.
- ❑ Risks involve potential loss.
- ❑ Risk analysis and mgmt helps s/w team to understand and manage uncertainty.
- ❑ Risk management is a s/w engineering process, methods, and tools for managing risks.
- ❑ Risk is Decision-making activity to what can go wrong.

- A problem that has a greater than 0% but less than 100% probability of occurrence.
- What could go wrong with the task.
- A problem is an event that has a negative value.
- The probability a risk has a 100% of occurrence.
- Examples of risk include: losing a critical resource
- Risk can be listed, categorized, and potentially managed.

# Risk Definition

- A risk is a potential problem: it might happen or might not happen.
- Conceptual definition of risk
  - Risk concerns future happenings.
  - Risk involves change in mind, opinion, actions, places, etc.
  - Risk involves choice and the uncertainty.
- Two characteristics of risk
  - Uncertainty: the risk may or may not happen, that is, there are no 100% risks.
  - Loss: Risk becomes reality and unwanted consequences or losses occurs.

# Risk Management

- A good project manager is a good risk manager.
- Risk management continues until the product is delivered.
- Risk analysis and mitigation continue through the implementation stages.
- Project management includes with identifying, analyzing, and responding to project risk.
- Risk analysis plan should be reviewed regularly and adjusted accordingly.

# Risk Identification

- ❑ Risk identification is the process of understanding what potential events might hurt in a project.
  - ❑ This is an ongoing process throughout the project lifecycle.
  - ❑ You cannot manage risks that you don't identify.
- ❑ Identify potential risk event (checklists, problem decomposition, experience, etc).
- ❑ Risk identification is a systematic pattern to identify threats to project plan.
- ❑ By identifying known and predictable risks, the project manager takes towards avoiding them.

# Risk Analysis

- Risk projection: Impact of risks/likelihood of risk actually happening.
- Risk assessment: What happens if risk becomes reality.
- Risk Event: Precise description of what might happen to the project.
- Risk probability: The degree to which the risk event is likely to occur.

# What happens if **risk** becomes reality

- Risk is the possibility of loss.
- Impacts in financial loss, time, delay.
- The predicted goals cannot be achieved within available resources.
- Risk cannot be eliminated from a software project, but it can be managed.



# Sources of Risk

- Assumptions about the availability of the technology.
- Misunderstanding of the real impact on new methodology.
- Misunderstanding of customer requirements.
- Uncontrolled continuous changes of customer requirements.
- Inexperience project leader.

# Cont...



- ❑ Not having enough technical skills within the group.
- ❑ Project is too complex to understand.
- ❑ Miscalculation of teamwork and group effectiveness.
- ❑ Miscalculation of cost and effort.
- ❑ Unrealistic expectations about the availability of resources.

# General Causes of Risk

- ❑ Lack of Information
- ❑ Lack of Control
- ❑ Lack of Time
- ❑ Quality of the product
- ❑ Increased costs
- ❑ Delayed completion
- ❑ Total program failure

*It is impossible, for complex systems, to know everything before it happens.*

# Classify new risks

- ❑ Classify or group risks statements in to categories with a single risk,
- ❑ A configuration manager might see an aspect that affect configuration management.
- ❑ A software engineer might see an aspect that affects component quality.
- ❑ A project manager might see an aspect that affects the customer.

# Purpose of Risk Management

- ❑ Identify risk.
- ❑ Minimize the impact / damage / loss.
- ❑ Reduce the probability.
- ❑ Monitor risk areas for early detection.
- ❑ Ensure management awareness of risks.

# Hazard, Problem, and Risk

- *Hazard:* Mary's baby may be born early.
- *Problem:* Modules P and Q will have no coder.
- *Risk:* Milestone 7 will be delayed, Extra budget is needed to hire another coder.

# Environment and health Factors

- ❑ Changes in environment such as hardware platforms
- ❑ Changes in government policies
- ❑ Changes in business rules
- ❑ Restructuring of organizations
- ❑ Health and safety of staff and environment
  - Staff sickness, death, pregnancy etc
  - Accident to the employee

# Risk Estimation

- Risk likelihood
  - The probability that a hazard is going to occur
- Risk impact
  - The effect of the problem caused by the hazard
- Risk likelihood
  - Rank from Low, Medium to High
  - Rank from 1 (least likely) to 10 (most likely)



# Risk Estimation cont..

- Risk Impact
  - Rank from 1 to 10
- Establish a scale indicating perceived likelihood of risk occurring
- Determine consequences.
- Estimate impact of consequences on project (for each risk).

# Eventualities



- Unexpected and unimaginable events
- Common unexpected events
  - Hardware cannot be delivered on time
  - Requirements specification needs to be rewritten
  - Staffing problem

# Estimation Errors

- Planning assumptions.
- Estimation errors.
- Estimation can be improved by analyzing historic data for similar tasks and similar projects.
  - Keep historic data of your estimation and the actual performance
  - Compare your estimation and the actual value
  - Classify the tasks that are easy or difficult to give accurate estimation
- Difficult to have accurate size or time estimations
  - Lack of experience of similar tasks
  - Lack of historical data

# How to deal the risk

- Identify the risk
- Analyse its implications
- Determine treatment methods
- Monitor performance of treatment methods

# Risk Process model

- Identify: Search the risks before creating a major problem.
- Analyze: understand the nature and gather information.
- Plan: Convert them into actions and implement them.
- Track: Need to monitor the necessary actions.
- Control: Correct for deviations from planned risk actions.
- Communicate: Discuss about current risks and the plans to be undertaken.

# Predictable and Unpredictable risk

- Known risks: risks which are known well in advance.
- Predictable risks: Those risks that are inherited from past project experience.
- Unpredictable risks: Extremely difficult to identify in advance.
- By identifying known and predictable risks, the project manager takes a first step toward avoiding them.

# Risk Management in Small Project

- Requirements changes
- Unknown technology
- Cost And Schedule uncertainty.
- Identify and Analyze Risks: Identify the risks and understand the nature of risks.
- Prioritize the risks and try to solve the risks.
- Mitigate the risks: Risk acceptance, risk transfer, risk avoidance, risk control.

# How To Manage the Risks



- ❑ Determine risk sources and Categories.
- ❑ Determine Risk Parameters.
- ❑ Establish a Risk Management Strategy.
- ❑ Evaluate and prioritize the risks.
- ❑ Develop and Implement Risk mitigation plans.



# Common Software Risks

- ❑ Changing and uncertain requirements.
- ❑ Unrealistic schedules and budgets.
- ❑ Personnel shortfalls (numbers, experience etc.).
- ❑ Developing the wrong user interface.
- ❑ Problem is too complex to understand.
- ❑ Developer is not an experienced person.
- ❑ Staff suddenly quits the company.

# Common Risk Factors



- ❑ Application factors
- ❑ Staff factors
- ❑ Project factors
- ❑ Hardware and software factors
- ❑ Changeover factors
- ❑ Supplier factors
- ❑ Environment factors
- ❑ Health and safety factors

# Risk Reduction Strategies

Different types in a generic sense

- Hazard prevention
- Likelihood reduction
- Risk avoidance
- Risk transfer
- Contingency planning

# Steps for the risk management

- Identify possible risks: recognize what can go wrong.
- Analyze each risk to estimate the probability that it will occur and the impact.
- Rank the risks by probability and impact:
  - Impact may be negligible, marginal, critical. Develop a contingency plan to manage those risks having high probability and high impact.

# Risk impact

- High: Risks are detected when they have happened.
- **High impact:** Result in the costly loss of major assets or resources
  - Significantly violate, harm, reputation.
  - May result in human death or serious injury.

# Risk impact cont...

- Medium: There is some advance warning, symptoms.
- **Medium impact:** Result in the costly loss of assets or resources.
  - Harm, or effects organization's mission, reputation, or interest, result in human injury.

# Risk impact cont...

- Low: If this risk is going to happen, it can be seen long before.
- **Low impact:** Result in the loss of some assets or resources
  - Effects organization's mission, reputation, or interest.

# Risk Strategies

## □ Reactive strategies

- Very common, also known as fire fighting.
- Project team sets resources aside to deal with problems.
- Team does nothing until a risk becomes a problem.

## □ Proactive strategies

- Risk management begins long before technical work starts,
- Risks are identified and prioritized by importance.
- Team builds a plan to avoid risks if they can.
- Minimize risks if they turn into problems.



# Risk Components

- The project manager identifies the risk drivers that affect the following risk components
- **Performance risk** : the product does not meet its requirements.
- **Cost risk**: the project budget will be gradually increased.
- **Support risk**: the resultant software is difficult to correct, adapt, and enhance.
- **Schedule risk**: The project schedule will not be maintained and delivered on time.
- **Project Risk**: The project delayed or over-budget.

# Risk Categories

- Product size :Overall size of the software to be built.
- Business impact: risks associated with constraints imposed by management or the marketplace.
- Customer characteristics: customer and the developer's ability to communicate in time.
- Development environment: Quality of the tools to be used to build the project.
- Technology to be built :complexity of the system to be built and the "newness".
- Staff size and experience: risks associated with overall technical and project experience of the s/w engineers.

# Risk questionnaires

## ☐ **Market risk :**

Will the new service or product be useful to the organization.

Will the users accept it? Will someone else create a better product?

Building an excellent product or system that no one really wants.

## ☐ **Financial risk :**

Can the organization afford to undertake the project?

## ☐ **Technology risk :**

Is the project technically feasible? Is it leading edge technology?

# Risk questionnaires cont...

- ❑ **People risk:**

Are people with appropriate skills.

- ❑ **Budget risk:**

Losing budgetary or personnel commitment

- ❑ **Strategic risk:**

Building a product that no longer fits into the overall business strategy for the company.

- ❑ **Sales risk:**

Building a product that the sales force doesn't understand how to sell.

# Various types of risks

- Technical risks: Problems with languages, project size, project functionality, platforms, methods, lack of experience, poorly defined parameters.
- Management risks: Lack of planning, lack of mgmt experience and training, communications problems, organizational issues, lack of authority, and control.
- Financial risks: Include cash flow, capital and budgetary issues.

# Various types of risks cont...

- Contractual and legal risks: Changing requirements, schedules, health & safety issues, warranty issues.
- Personnel risks: include staffing, experience and training problems, staff conflicts, and productivity issues.
- Include unavailability or late delivery of equipment & suppliers other resource risks: lies, inadequate tools, inadequate facilities, distributed locations, unavailability of computer resources.

# The questions



- ❑ What can go wrong?
- ❑ What is the likelihood it will go wrong?
- ❑ What are the consequences.
- ❑ What can be done?
- ❑ What are the different options available?

# Questionnaire on Project Risk

- ☐ Have top software developers and customer committed for the project?
- ☐ Are end-users committed to the project and the system to be built?
- ☐ Are requirements fully understood by the software engineering team and its customers?
- ☐ Have customers been involved fully in the definition of requirements?



# Questionnaire on Project Risk cont..

- ☐ Is the project scope stable?
- ☐ Does the software engineering team have the right mix of skills?
- ☐ Are project requirements stable?
- ☐ Does the project team have experience with the technology to be implemented?

# Plan follow up

- Plan regular checking (monitoring),
- Specifically for high surprise risks.
- Some risks are ignored which have no impact.
- Some risks go to external parties (insurance).
- For some risks, the impact is reduced (prevention of occurrence or of loss).
- For some risks, the alternative actions if the risk occurs, are planned.

# Planning Assumptions

- Uncertainties in early stage of the project.
- Common assumption:
  - “Everything will go smoothly”
    - Design will be perfect first time.
    - Coding will be ‘nearly perfect’.
- Guidelines
  - List all the assumptions.
  - Identify the effects of these assumptions

# Risk Management Planning

- Risk management plan: The main output of risk management planning is a risk management plan.
- A plan document having procedures for managing risk throughout a project.
- Project team should review project documents, Lessons-learned reports from past projects.

# Project risks

- Project risks concern various forms of budgetary, schedule, personnel, resource, and customer problems.
- Project risk is schedule slippage.
- For any cars manufacturing project, see that the engine is fitted, doors are fitted, painting is done, etc.
- Can easily assess the progress of the work.
- Many s/w projects suffer from risk of schedule slippage.
- Problem Unclear to every team member and users.

# Technical risks

- Technical risks concern design, implementation, interfacing, testing, and maintenance problems.
- Technical risks also include ambiguous specification, incomplete specification, changing specification.
- Team's insufficient knowledge about the project.
- Team inexperience in a particular domain.

# Transfer

- Transfer risk by shifting responsibility to insurance.
- Insurance protects your company from a loss.
- If a loss occurs, the insurance covers it.
- Financial risks: Your house is at risk if you fail to repay mortgage loan.
- Health risks: the chance that a person will encounter a specified adverse health outcome.

# Why is the software world interested in **risk**?

- ❑ **Project disasters:** Software project indicate that problems have been solved, avoided or strongly reduced. If Risk have been identified in advance.
- ❑ Industry analysis says if risk is well defined in advance then the system can be
  - delivered in time
  - With no extra cost
  - With no extra effort
- ❑ Early indication of risks is identifying & resolving high-risk elements.



# Risk assessment



- Risk identification : list project-specific risk for a project's success.
- Risk analysis: assessing the loss probability & loss magnitude for each identified risk item.
- Risk prioritisation: Ordering & ranking the risk items identified & analysed.

# Risks Due to the Customer

- Have you worked with the customer in the past?
- Does the customer have a solid idea of requirements.
- Has the customer agreed to spend time with you?
- Is the customer willing to participate in reviews?
- Does the customer understand the software engineering process.

# Staff/People Risks

- Are the best people available?
- Does staff have the right skills?
- Are enough people available?
- Are staff committed for entire duration?
- Will some people work part time?
- Have staff received necessary training?
- Experience and skills
- Appropriateness of experience
- Staff satisfaction

# Qualitative Risk Analysis

- After identifying risks, understand which risks are most important.
- Impact and determine their magnitude and priority.
- A **probability/impact matrix** lists the relative probability and impact of a risk occurrence.
- List the risks as high, medium, Low.
- Deal first with those risks in the high probability.

# Project **Risk** Management Processes

- **Risk management planning:** How to plan the risk management activities for the project.
- **Risk identification:** Determining which risks are likely to affect a project.
- **Qualitative risk analysis:** Prioritizing risks based on their probability and impact of occurrence.
- **Risk response planning:** Take steps to enhance opportunities and reduce threats to meeting project objectives.
- **Risk monitoring and control:** Risk monitoring, identifying new risks, carrying out risk response and evaluating the risk strategies.

# Risk Item Tracking

- Risk Item Tracking is a qualitative risk analysis helps to identify risks and maintain awareness in project.
- Establish a periodic review of the project risk.
- List current ranking, previous ranking, number of times the risk appeared over a period of time.
- Look for alternative with customer involvement.
- Summary of progress made in resolving the risk.

# Unexpected Events

- Late delivery of hardware.
- Late completion of building sites.
- On time delivery, cost increases, quality decreases.
- Unexpected and unimaginable events
- Common unexpected events
  - Requirements specification needs to be rewritten.
  - Staffing problem.

# Risk Evaluation

- Ranking the risks
- Determine risk reduction strategies
- Ranking the risks based on their risk exposures
- Ranking shows the order of importance
- In practice, also consider factors like
  - Confidence of the risk assessment
  - The number of risks
  - Cost of action



# Risk Control

- Minimizing and reacting to problems from risks throughout the project.
- It is an ongoing activity throughout the whole project to monitor
  - The likelihood of a hazard; and
  - The impact of the problem caused.

# Risk Directing and Staffing

- These concerns with the day-to-day management of risk.
- Risk problem solving strategies are frequently investigated.
- Use of additional staff must be planned.

# Hazard prevention

- Some hazards cannot be avoided
  - A project can be protected from the risk of overrunning the schedule by increasing duration estimates.
- Prevent a hazard from occurring or reduce its likelihood to an insignificant level.
  - Lack of skilled staff can be prevented by employing staff with appropriate skills.
  - Unclear requirements specification can be prevented by using formal specification techniques.

# Likelihood reduction

- Reduce the likelihood by prior planning
  - Late change to the requirements specification can be reduced by using prototyping.
  - When problem is clearly understood and need to build in less time then choose the RAD model.
  - If problem is too complex then can choose the prototyping model.
  - In some cases customer wins and developer wins then go to win-win process model.

# Contingency planning



- Contingency plans are needed to reduce the impact of those risks cannot be avoided.
  - The impact of any unplanned absence of programming staff can be minimized by using agency programmers.

# Risk Priority

- Risk priority: ordering risks based on some set of criteria.
- Recovery cost: The cost in terms of effort.
- The cost identified may not be exact but rather identified as merely high, medium, and low.

# Negative impact of Risk

- Negative impact of risk can include
  - Effects quality of product
  - Increased cost
  - Delayed completion
  - Project failure
- Risks are analyzed and prioritized on a weekly basis.
- Risk list is presented at each weekly project status meeting.

# Risk Identification Techniques



- Brainstorming
- Questionnaires
- Risk assessment workshops
- Incident investigation



# Example Risk 1

- ❑ Person X is assigned to three tasks on the critical path!
  - ❑ How do we deal the risk of them getting sick?
- ❑ Possible Steps:
  - ❑ Analyze the possible impact of a delay caused by their absence.
  - ❑ Determine cost of training another person to do one or two of those tasks.
  - ❑ What is the extra cost to be incurred in training?

# Example Risk 2

## **The risk of employee turnover?**

- What happens if one of the employee leave?
  - How dependant is our schedule on people with these exact skills?
  - Will information be lost with the person?
- How can we keep them/replace them?
  - How costly would it be to raise salaries?
  - How else could we make them happy?
  - Costs to hire good replacements?

# Example Risk 3

## **The Market for our product may change.**

- What is the likelihood of change? How acceptable would our product be?
- How risky is it to speed production?
  - Effect of speed on quality?
  - Costs of extra personnel or overtime pay?
- What is the risk of making in more general?
  - Cost and time of extra features?

# Example Risk 4

## **Risk to Functionality based on unknown technology?**

- ❑ Not having Enough skills for one of the requirement?
- ❑ How important is this requirement to the project?
- ❑ If someone knows about this, what is the cost?

# Risk Assessment

- Define referent levels for each project risk that can cause project termination
  - Performance degradation
  - Cost overrun
  - Support difficulty
  - Schedule slippage
- Attempt to develop a relationship between each risk (risk, probability, impact) and each levels.
- Try to predict how combinations of risks will affect at a level.

# RMMM

## □ Risk mitigation

- Planning for risk avoidance

## □ Risk monitoring

- Assessing whether predicted risks occurs or not.
- Ensuring risk aversion steps are being properly applied
- Collect information for future risk analysis
- Determining which risks caused which problems

## □ Risk Management

- Contingency planning
- Actions to be taken when mitigation steps have failed and the risk has become a live problem.

# Risk mitigation

- **Risk mitigation:** An activity that may reduce minimize, or totally avoid a risk.
- **Risk item:** Not able to complete a system integration with a tool because only one person possesses the skill.
- Alt. 1: Hire an extra person with the needed skill as a backup helper.
- Alt. 2: Provide extra incentives to the current employer to stay.
- Alt.3: Set alternatives to stay the employee.

# Risk Mitigation Example

Risk: loss of key team members

- ❑ Determine causes.
- ❑ Eliminate causes before project starts.
- ❑ After project starts, assume turnover is going to occur and work to ensure continuity.
- ❑ Make sure teams are organized and distribute information widely.
- ❑ Define documentation standards
- ❑ Be sure documents are produced in a timely manner.
- ❑ Conduct peer review of all work.
- ❑ Define backup staff.



# Risk Information Sheets

- Each risk is documented individually.
- Often risk information sheets (RIS) is maintained.
- RIS components
  - risk id, date, probability, impact, description
  - refinement, mitigation/monitoring
  - status
  - assigned staff member

# Peer reviews




- ❑ Meet with current staff to determine causes for failure (poor working conditions, low pay)
- ❑ Mitigate those causes that are under our control before the project starts.
- ❑ Conduct peer reviews of all work.
- ❑ Assign a backup staff.

# Contents of a Risk Table

- A risk table provides a project manager with a simple technique for risk projection
- It consists of five columns
  - Risk Summary : short description of the risk
  - Risk Category: one of risk categories
  - Probability: estimation of risk occurrence based on group input
  - Impact : (i)critical (ii)marginal (iii)negligible
  - RMMM: Pointer to a paragraph in the Risk Mitigation, Monitoring, and Management Plan

# Risk Table Construction

- List all risks in the first column of the table.
- Classify each risk and enter the category label in column two.
- Determine a probability for each risk and enter it into column three.
- Enter the severity of each risk in column four.
- Sort the table by probability and impact value.
- Determine the criteria for deciding where the sorted table will be divided into the first priority concerns and the second priority concerns.

- 
- List all risks in the first column.
  - Mark the category of each risk.
  - Estimate the probability of each risk occurring.
  - Assess the impact of each risk.
  - Determine an overall impact value.
  - Sort the rows by probability and impact in descending order.

# Cost-base mitigation

- ❑ Which mitigation alternative to chose when choices are available?
- ❑ Which criteria should be used in decision making?
- ❑ One of any several parameters as the basis for decision making.

# Six Principles of Risk Management

## □ **Maintain a global perspective**

- View software risks within the context of a system.

## □ **Take a forward-looking view**

- Think about risks that may arise in the future.

## □ **Encourage open communication**

- Encourage all stakeholders and users to point out risks at any time.

# Six Principles of Risk Management

## □ **Integrate risk management**

- Integrate the consideration of risk into the software process.

## □ **Emphasize a continuous process of risk management**

- Modify identified risks and add new risks.

## □ **Encourage teamwork when managing risk**

- Pool the skills and experience of all stakeholders when conducting risk management activities.



# Conclusion



- Effective risk management focuses on avoiding future problems.
- Effective risk management, people recognize potential problems daily before they occur.
- Produce the finest product within the budget and schedule.