Project Risk Management

Project Skills

Team FME

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Preface

Every project involves risks and every project needs to have a management strategy for dealing with the threats and opportunities represented by each risk.

This eBook explains the key issues and concepts involved in effective risk management in a clear and accessible way, providing a comprehensive approach that is applicable to all sizes of project, whether requiring detailed, quantitative analysis or a rougher approach using only qualitative analysis.

You will learn:

- Why a proactive approach to risk management is necessary
- How to develop a risk management plan that will protect the project
- How to identify and document risks
- How to prioritize risks by assessing their probability and impact
- How to assess risks using both qualitative and quantitative approaches

The Free Management eBooks 'Project Skills' series are structured around the ten key knowledge areas of project management detailed in the 'Project Management Institute, A Guide to the Project Management Body of Knowledge, (PMBOK® Guide)—Fifth Edition, Project Management Institute Inc., 2013'. ISBN-13: 978-1935589679.

The eBooks in this series follow the structure of the PMBOK® Guide because it represents a tried and tested framework. We have tried to ensure full alignment of our eBooks with the Guide by using the numbering convention as well as the naming convention.

If you need more detailed explanation of a particular subject then you can simply refer to the related chapter and paragraph number in the PMBOK® Guide. Remember, many of the generic project management methodologies available refer to the PMBOK® Guide as a basic framework.

A knowledge of the PMBOK® processes will go a long way towards giving you an understanding of almost any project management methodology that your organization may use.

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About this Knowledge Area

The PMBOK® defines project risk management as:

> ***'The processes concerned with conducting risk management planning, identification, analysis, responses and monitoring and control a project. The objective is to:***
>
> - ***Increase the probability and impact of positive events, and to***
> - ***Decrease the probability and impact of events adverse to the project objectives'.***

A risk is a future event that may or may not happen, but if it does occur it will have an effect on project scope, schedule, cost, or quality. It may have one or more causes and, if it occurs, it may have one or more impacts. The PMBOK® Guide advises that risks include both threats and opportunities.

All project activities carry some element of risk, which are uncertainties about them that could affect the project for better or worse. It is important to understand the difference between business risks and project risks. The Project Risk Management knowledge area has six processes include the following:

Process	Project Phase	Key Deliverables
11.1 Plan Risk Management	Planning	Risk Management Plan
11.2 Identify Risks		Risk Register
11.3 Perform Qualitative Risk Analysis		Risk Register Updates
11.4 Perform Quantitative Risk Analysis		Risk Register Updates
11.5 Plan Risk Responses		Risk Related Contract Decisions
11.6 Monitor and Control Risks	Monitoring & Controlling	Risk Register Updates

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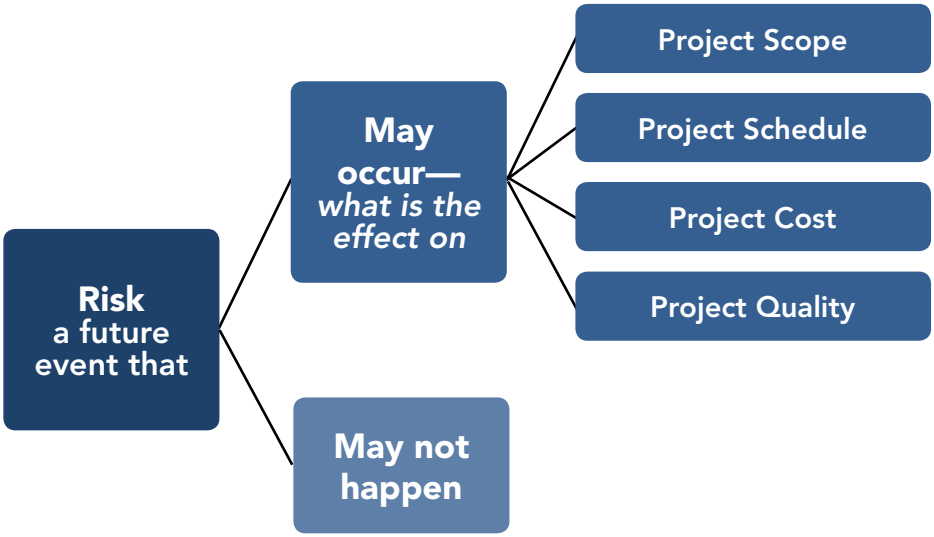
Introduction

What a project manager needs to know is what is the likelihood a risk will occur and if it does what will it impact as this affects the project plan.



What is certain is that if the risk happens in the future it will have an effect on project scope, schedule, cost, or quality. It may have one or more causes and, if it occurs, it may have one or more impacts. All project activities carry some element of risk, which are uncertainties about them that could affect the project for better or worse.

The important distinction that must be understood is the difference between business risks and project risks. Business risks are more general and relate to the organization, whereas project risks relate specifically to the project objectives.

- **Business risk** implies uncertainty in profits or danger of loss and the events that could pose a risk due to some unforeseen events in future, which causes business to fail. (Wikipedia)
- **Project risk** is an uncertain event or condition that, if it occurs, has a positive or negative effect on a project's objectives. (PMI)

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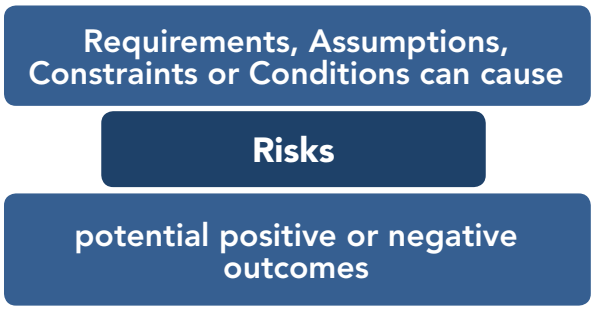
For example,

- ***Project scope—to build the stadium to the agreed specification within an agreed timescale and budget.***
- ***Project Risk—that the building costs may be higher than expected because of an increase in materials or labor costs.***
- ***Business Risk—even if the stadium is constructed on time and within budget that it will not make money for the business. This could be because of lower than expected ticket sales or higher than expected maintenance costs. These risks exist outside of the scope of the project.***

Risks are caused by a requirement, assumption, constraint, or condition that creates the possibility of negative or positive outcomes.



Continuing the example above:

- *Risk Cause—change in health and safety legislation during the build phase.*
- *Risk Outcome—increased costs to modify the parts of the stadium in accordance with the new legislation before it can be used.*
- *Project Impact on cost, schedule and performance needs to assessed:*
  - *Shortage of skilled personnel due to demand by other building projects*
  - *Unexpected cost of inspection & license*
  - *The build of the affected parts of the stadium can be brought forward to finish project on time.*

The PMBOK® Guide advises that risks include both threats and opportunities that project managers must assess.

> Opportunities have uncertainty associated with them, but they should be grasped, and action taken to ensure that they are realized.
>
> Threats have potentially negative impacts that the project management team should strive to mitigate.

Organizations and stakeholders are willing to accept varying degrees of risk. This is called risk tolerance. Risks that are threats to the project may be accepted if they are in balance with the rewards that may be gained from taking them. For example,

> ***Using unproven productivity-boosting software is a risk taken in the expectation that the work will be completed more quickly and with fewer resources.***

The risk of the software not performing as advertised would need to be considered as part of the risk assessment.

All organizations have a 'risk tolerance' that is affected by their legal status and their culture. For instance, a pension fund is likely to be more risk averse than a small start up company. In all cases, attitudes to risk are driven by perception, tolerances, and other biases, which should be made explicit wherever possible.

To be successful, the organization should be committed to address risk management proactively and consistently throughout the project. A conscious choice must be made

at all levels to actively identify and pursue effective risk management during the life of the project. Communication about risk and its handling should be open and honest.

Risk exists the moment a project is conceived. Moving forward on a project without a proactive focus on risk management increases the impact that a realized risk can have on the project and can potentially lead to project failure. The remainder of this eBook focuses on explaining the processes of project risk management knowledge area.

The PMBOK® Project Risk Management Processes

There are six PMBOK® Project Procurement Management processes in this knowledge area:

11.1 Plan Risk Management—the process of defining how to conduct risk management activities for a project.

11.2 Identify Risks—the process of determining which risks may affect the project and documenting their characteristics.

11.3 Perform Qualitative Risk Analysis—the process of prioritizing risks for further analysis or action by assessing and combining their probability of occurrence and impact.

11.4 Perform Quantitative Risk Analysis—the process of numerically analyzing the effect of identified risks on overall project objectives.

11.5 Plan Risk Responses—the process of developing options and actions to enhance opportunities and to reduce threats to project objectives.

11.6 Monitor and Control Risks—the process of implementing risk response plans, tracking identified risks, monitoring residual risks, identifying new risks, and evaluating risk process effectiveness throughout the project.

These processes interact with each other and with the processes in the other Knowledge Areas. Each process is presented here as a discrete element with well-defined interfaces, although in practice they will overlap and interact.

These are dealt with in detail in the following chapters of this eBook.

11.1 Plan Risk Management

This is the process of creating the risk management plan. This plan details how the project management team will perform risk management for this project. It does not involve actually identifying project risk.

> ***Aim of Risk Management Plan—is to ensure that the risk management protocol that is used on the project is commensurate with both the risks and the importance of the project to the organization.***

Establishing this protocol early on in the project ensures that all members of the project management team are using the same methods to evaluate risks and that the risk management tasks are budgeted for in the project plans.

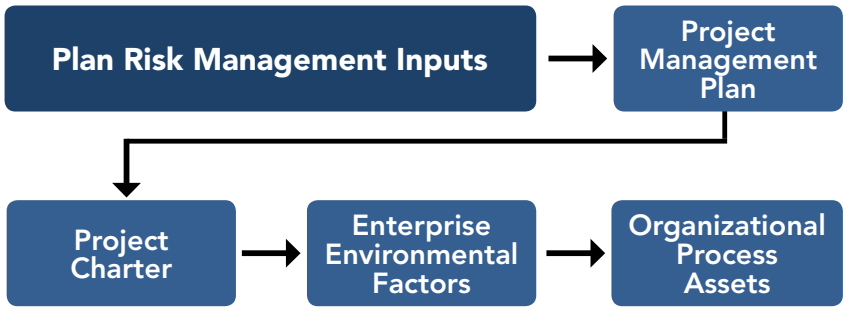
The level of detail in the risk management plan will depend upon the level of risk within the project and the level of risk that the performing organization is prepared to take.

The inputs, tools and techniques, and outputs of this process are summarized in the table below.

Inputs	Tools & Techniques	Outputs
Project Management Plan	Analytical Techniques	Risk Management Plan
Project Charter	Expert Judgment	
Stakeholder Register	Meetings	
Enterprise Environmental Factors		
Organizational Process Assets		

11.1.1 Plan Risk Management: Inputs

This process requires the following inputs:



11.1.1.1 Project Management Plan

All approved subsidiary management plans and baselines should be taken into consideration in order to make the risk management plan consistent with them. For example,

- *Scope Statement* defines the scope of the project, which will have a direct bearing on the type and amount of risk that is likely to be encountered. It provides a clear definition of such risk areas.
- The *Cost Management Plan* defines how risk in terms of budgets, contingencies, and management reserves will be reported and accessed.
- The *Schedule Management Plan* includes information about activities and their timing including aspects such as internal and external constraints that will help identify risk areas.
- The *Communications Management Plan* includes information on all key stakeholders and in particular their concerns for specific risks, and hence, how such communications should be handled.

11.1.1.2 Project Charter

This can provide various inputs such as high-level risks, high-level project descriptions, and high-level requirements.

11.1.1.3 Enterprise Environmental Factors

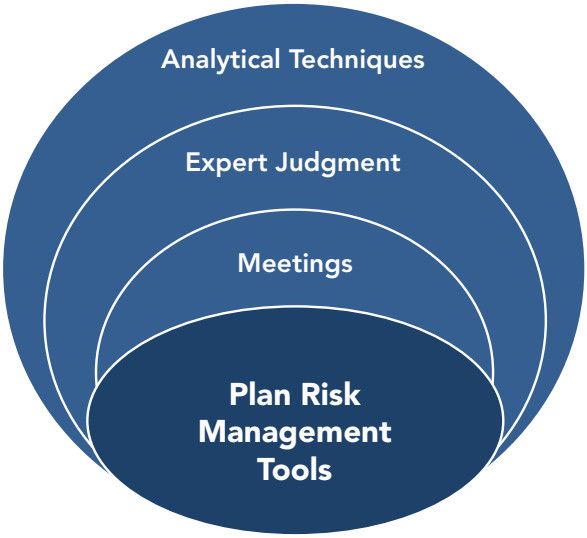
These include any legal obligations and regulatory frameworks that the organization may be subjected to as well as processes and procedures to be followed, the industry and its norms towards risk and the organizations appetite towards risk.

11.1.1.4 Organizational Process Assets

These include risk categories, common definitions of concepts and terms, risk statement formats, standard templates, roles and responsibilities, authority levels for decision-making, lessons learned, and stakeholder registers, which are also critical assets to be reviewed as components of establishing effective risk management plans.

11.1.2 Plan Risk Management: Tools and Techniques

There are three tools and techniques that can be used.



11.1.2.1 Analytical Techniques

These are used to understand and define the overall risk management context of the project, which is based on a combination of stakeholder risk attitudes and the strategic risk exposure of the current project.

11.1.2.2 Expert Judgment

This usually takes the form of expertise collated from:

- Subject matter experts
- Project stakeholders
- Senior management
- Lessons learned from previous projects.

11.1.2.3 Meetings

These involve people who are responsible for risk management including the project manager, the project sponsor, selected project team members, selected stakeholders, anyone with responsibility for any of the risk management processes, and others as needed.

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Collective decision-making is very important area of project management that the PMBOK® does not go into any detail about but which can make or break this part of the project. Almost all of the processes that form part of project risk management will involve meetings between the project manager, the team and other stakeholders in order to make decisions about the activity definitions and associated estimates.

How well these meetings are conducted will have a major impact on how smoothly the project runs. To learn more about making your meetings effective and efficient download the free resources on http://www.free-management-ebooks.com/skills-meeting.htm. These free eBooks, checklists and templates cover all aspects of meetings including how to set an agenda that will ensure that the meeting achieves it's aims and how to chair a meeting so that it is as productive as possible.

11.1.3 Plan Risk Management: Outputs

This process will create only one output, the risk management plan.

11.1.3.1 Risk Management Plan

This plan forms part of the project management plan and describes how risk management will be structured and performed on the project. It contains the following elements:

- Methodology
- Roles & Responsibility
- Budgeting
- Timing
- Risk categories
- Definitions of Risk Probability & Impact
- Probability & Impact Matrix
- Revised Stakeholder Risk Tolerances
- Reporting Formats
- Tracking

Methodology

Defines the approaches, tools, and data sources that may be used to perform risk management on the project.

Roles and Responsibilities

This part of the plan needs to make clear who is responsible for each type of activity in the risk management plan, and clarifies their responsibilities.

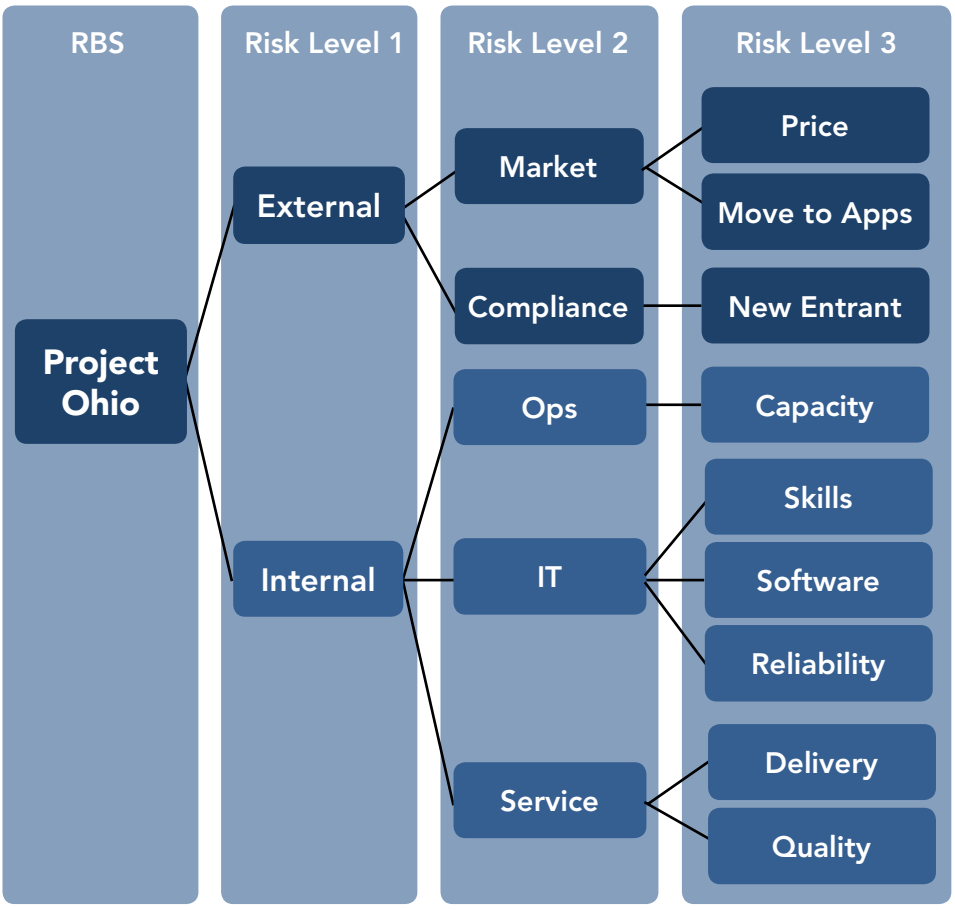
Budgeting

This part of the plan assigns resources, estimates funds needed for risk management for inclusion in the cost performance baseline, and establishes how any extra funding required (if risks are realized) will be raised.

Timing

This part of the plan defines when and how often the risk management process will be performed throughout the project life cycle.

Risk categories



This provides a structure that ensures a comprehensive process of systematically identifying risks to a consistent level of detail. An organization can use a previously prepared categorization framework, which might take the form of a simple list of categories or might be structured into a Risk Breakdown Structure (RBS) as shown in the diagram above.

This is a hierarchically organized depiction of the identified project risks arranged by risk category and subcategory that identifies the various areas and causes of potential risks.

Definitions of Risk Probability and Impact

This ensures that all stakeholders have a common understanding of these definitions. For example,

> ***If the probability of a risk can be described as low, medium or high, what do these categories actually mean?***

Similarly, what effect would a high impact event have on the project in practical terms? How much would it add to the costs? Could anything be done to mitigate it?

Risk Impact Scales for Project Ohio—Major Objectives						
Major Objective	**<5%**	**10%**	**20%**	**40%**	**60%**	**85%**
Scope	Minimal	Minor areas	Major areas	Unacceptable to Sponsor	Project abandoned	
Quality	Very Minor	Minimal	Specific	Need OK of Sponsor	Sponsor Reject	Project ended
Time	None	Trivial	<8% rise	15% rise	25% rise	>30%
Cost	<1%	< 8%	15-20%	40-50%	55-65%	>70%

The table above is an example of definitions that could be used in evaluating risk impacts related to scope, quality, time and cost. By using pre-defined definitions in this way, the project management team ensures that everyone involved is talking the same language when it comes to risk.

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Probability and Impact Matrix

Risks are prioritized according to their potential implications for having an effect on the project's objectives by using a matrix like the one shown.

Impact Probability	Negligible-1	Minor-2	Moderate-3	Significant-4	Severe-5
>81%	Low Risk	Moderate Risk	High Risk	Extreme Risk	Extreme Risk
61-80%	Minimal Risk	Low Risk	Moderate Risk	High Risk	Extreme Risk
41-60%	Minimal Risk	Low Risk	Moderate Risk	High Risk	High Risk
21-40%	Minimal Risk	Low Risk	Low Risk	Moderate Risk	High Risk
<20%	Minimal Risk	Minimal Risk	Low Risk	Moderate Risk	High Risk

The specific combinations of probability and impact that lead to a risk being rated as 'extreme', 'high,' 'moderate,' 'low' or 'minimal' importance, with the corresponding importance for planning responses to the risk, are usually set by the organization.

Revised Stakeholder Risk Tolerances

If there is a need to revise stakeholder risk tolerances then these should be documented here.

Reporting Formats

This part of the plan describes how the outcomes of the risk management processes will be documented, analyzed, and communicated. It describes the content and format of the risk register as well as any other risk reports required.

Tracking

This part of the plan describes how risk activities will be recorded for the benefit of the current project, as well as for future needs and lessons learned, as well as whether and how risk management processes will be audited.

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11.2 Identify Risks

This is the process of determining risks that may affect the project and assessing the impact of the risk should it occur. This information is documented in the risk register, a list of all of the identified risks, their root causes, categories and responses. Because the assessment of risk is an ongoing activity, the risk register will be updated continuously throughout the life of the project.

All project team members should be encouraged to identify risks and this is an iterative process because new risks may become known as the project progresses. The process should involve the project team so they can develop and maintain a sense of ownership and responsibility for the risks and associated risk response actions.

The inputs, tools and techniques, and outputs of this process are summarized in the table below.

Inputs	Tools & Techniques	Outputs
Risk Management Plan	Documentation Reviews	Risk Register
Cost Management Plan	Information Gathering Techniques	
Schedule Management Plan	Checklist Analysis	
Quality Management Plan	Assumptions Analysis	
Human Resource Management Plan	Diagramming Techniques	
Scope Baseline	SWOT Analysis	
Activity Cost Estimates	Expert Judgment	
Activity Duration Estimates		
Stakeholder Register		
Project Documents		
Procurement Documents		
Enterprise Environmental Factors		
Organizational Process Assets		

11.2.1 Identify Risks: Inputs

This process requires the following inputs:

11.2.1.1 Risk Management Plan

This is the sole output from the previous process. It defines the level of risk that is considered tolerable for the project, how all this will be managed, who will be responsible for them, what time and cost is needed for each, and how risk will be communicated.

11.2.1.2—11.2.1.4 Cost, Schedule and Quality Management Plans

These plans describe how cost, schedule and quality are to be managed and implemented, and as such, the information contained within them will have a bearing on project risk.

11.2.1.5 Human Resource (HR) Management Plan

This plan provides guidance on how project human resources should be defined, staffed, managed, and eventually released. It can also contain roles and responsibilities, project

organization charts, and the staffing management plan, which form a key input to identify risk process.

11.2.1.6 Scope Baseline

The scope of the project in terms of the products to be created and the activities required will be a source of risks to the project.

11.2.1.7 Activity Cost Estimates

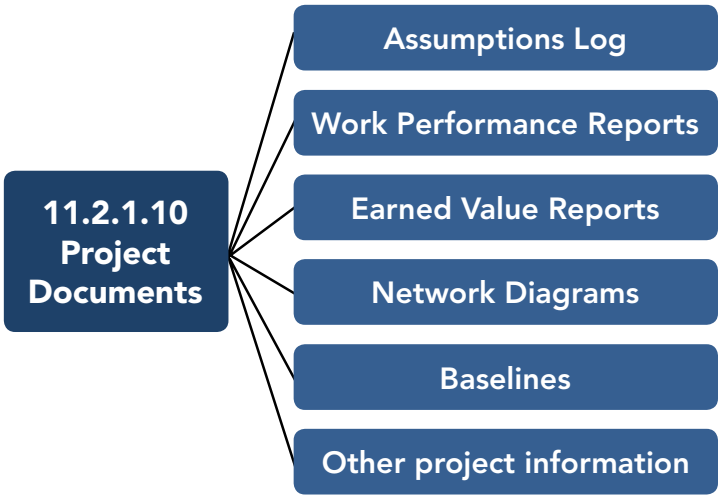
These are useful in identifying risk as they provide a quantitative assessment of the likely cost to complete scheduled activities. Reviewing these may indicate that the estimate is insufficient to complete the activity and hence poses a risk to the project.

11.2.1.8 Activity Duration Estimates

These provide a quantitative assessment of the likely time to complete scheduled activities. Reviewing these may indicate that the estimate is insufficient to complete the activity and hence poses a risk to the project.

11.2.1.9 Stakeholder Register

This lists all of the project stakeholders as well as describing and classifying them. This information will be useful in soliciting inputs for identifying risk, as it will ensure that key stakeholders participate in the process



11.2.1.10 Project Documents

These include, assumptions log, work performance reports, earned value reports, network diagrams, baselines, and other project information proven to be valuable in identifying risks.

11.2.1.11 Procurement Documents

If the project requires external procurement of resources, procurement documents become a key input to this process. The complexity and the level of detail of the procurement documents should be consistent with the value of, and risks associated with, planned procurement.

11.2.1.12 Enterprise Environmental Factors

These will have a major bearing on risks and will include laws and regulations governing the creation or use of the projects products. Also important is the operational environment within which the project is taking place. The views of the project stakeholders and their willingness to accept risk must also be taken into consideration.

11.2.1.13 Organizational Process Assets

These include project files, including actual data, organizational and project process controls, risk statement templates, and lessons learned.

11.2.2 Identify Risks: Tools and Techniques

There are seven tools and techniques that can be used.

11.2.2.1 Documentation Reviews

These are structured reviews of all project documentation up to this point in time including plans, assumptions, previous project files, contracts, and other information.

The quality of the plans, as well as consistency between those plans and the project requirements and assumptions, can be indicators of risk in the project. Missing, inaccurate or incomplete information may hinder the identification of risks and may itself be a source of risk.

11.2.2.2 Information Gathering Techniques

There are many ways in which information on the project risk situation can be gathered, and these include:

- Expert Interviews
- Root cause identification
- Brainstorming workshops
- The Delphi technique.

11.2.2.3 Checklist Analysis

This technique uses the risk breakdown structure (RBS) developed either from this project or from a previous project to help ensure that all significant risks or categories have been identified.

11.2.2.4 Assumptions Analysis

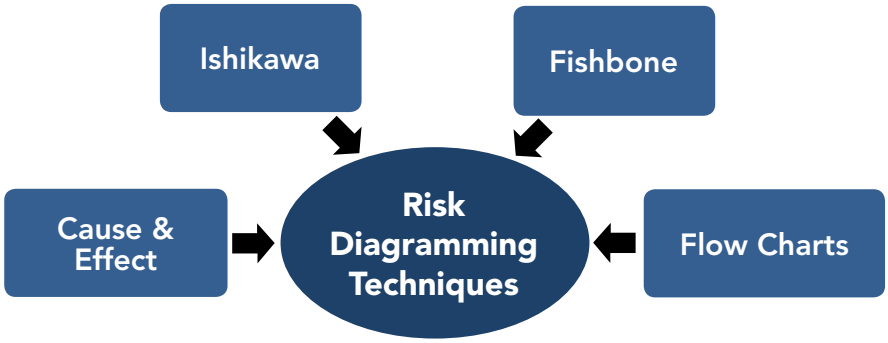
Every identified project risk is based on a set of hypotheses, scenarios, or assumptions. Assumptions analysis explores the validity of assumptions as they apply to the project. It identifies risks to the project from:

- Inaccuracy
- Instability
- Inconsistency OR
- Incompleteness of assumptions.

The purpose of this tool is to challenge such assumptions and determine what risks may arise from them.

11.2.2.5 Diagramming Techniques

Risk diagramming techniques may include cause and effect diagrams. These are also known as Ishikawa or fishbone diagrams, and are useful for identifying causes of risks.



Flow charts can also be used to show how various elements of a system interrelate, and the mechanism of causation, as can influence diagrams, which show causal influences, time ordering of events, and other relationships among variables and outcomes.

11.2.2.6 SWOT Analysis

This technique looks at the project from the perspective of its internal strengths and weaknesses as well as external opportunities, and threats. SWOT analysis is a useful approach to risk assessment and you can learn more about this technique from our free online library http://www.free-management-ebooks.com/dldebk/dlst-swot.htm.

11.2.2.7 Expert Judgment

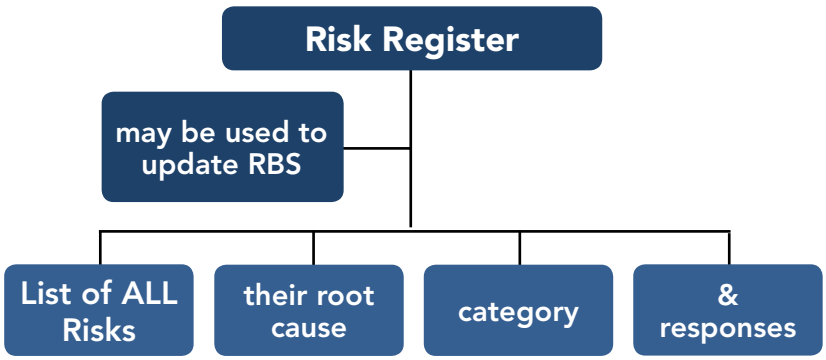
Risks can be identified directly by experts with relevant experience of similar projects or business areas. Such experts should be identified by the project manager and invited to consider all aspects of the project and suggest possible risks based on their previous experience and areas of expertise.

11.2.3 Identify Risks: Outputs

This process will create the following output:

11.2.3.1 Risk Register

This is the only output from this process and consists of the list of all the identified risks, their root causes, categories and responses. The information contained within the risk register may be used to update the risk breakdown structure.



Because of risk is an ongoing activity, the risk register will be updated continuously throughout the life of the project and it is a key tool to aid in the management of risks within a project. The risk register ultimately contains the outcomes of the other risk management processes as they are conducted, resulting in an increase in the level and type of information contained in the risk register over time.

11.3 Perform Qualitative Risk Analysis

This process analyses each risk from the risk register in terms of its probability and impact on the project if it were to occur. It should be performed as soon as possible after risks have been identified so that appropriate time and resources can be allocated to the more serious risks. It uses the probability and impact matrix (PIM) to rank and prioritize risks, and this information is placed back on the risk register.

Like all the processes within risk management, this one should be performed regularly because new risks will be identified and the characteristics of existing risks may change as the project progresses.

The inputs, tools and techniques, and outputs of this process are summarized in the table below.

Inputs	Tools & Techniques	Outputs
Risk Management Plan	Risk Probability & Impact Assessment	Project Documents Updates
Scope Baseline	Probability & Impact Matrix	
Risk Register	Risk Data Quality Assessment	
Enterprise Environmental Factors	Risk Categorization	
Organizational Process Assets	Risk Urgency Assessment	
	Expert Judgment	

11.3.1 Perform Qualitative Risk Analysis: Inputs

This process requires the following inputs:

11.3.1.1 Risk Management Plan

This is developed during process '11.1 Plan Risk Management' and will explain the overall approach that needs to be taken to risk management on this particular project. It will detail how much risk is acceptable and who should be involved in carrying out the qualitative analysis of the known risks.

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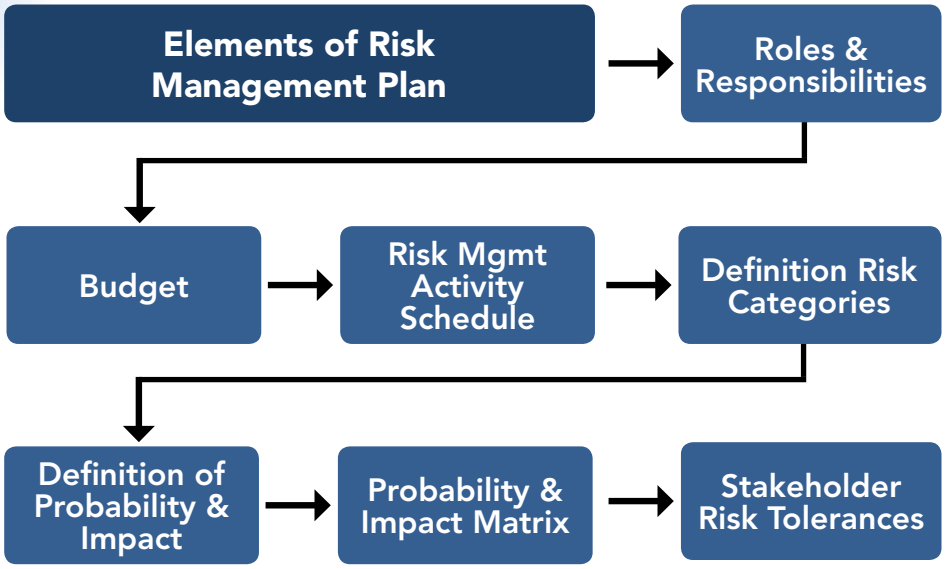


The key elements of this plan used in this process are roles and responsibilities for conducting risk management, budget, schedule for risk management activities, definition of risk categories, definition of risk probability and impact, probability and impact matrix, and stakeholder's risk tolerances.

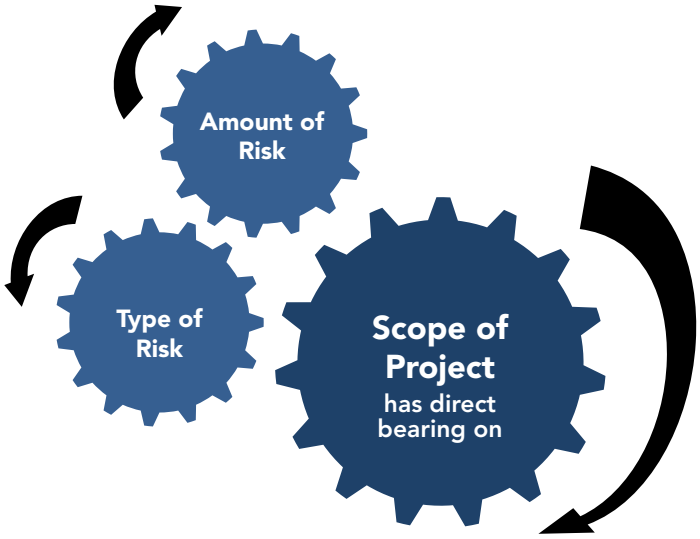
11.3.1.2 Scope Baseline

The scope of the project will have a direct bearing on the type and amount of risk that is likely to be encountered. In general terms, certain types of project are associated with certain types of risk.

For example,

- ***Construction projects** the risks would include such things like, planning permissions, weather, health and safety legislation, and labor union issues.*
- ***IT project** risks tend to be concerned with whether development software will perform as advertised and with compatibility issues.*

Projects of a common or recurrent type tend to have well understood risks, whereas those breaking new ground tend to have more uncertainty.



11.3.1.3 Risk Register

This is the central repository of all of the known risks that are to be analyzed.

11.3.1.4 Enterprise Environmental Factors

These include industry studies of similar projects by risk specialists and risk databases from industry or proprietary sources.

11.3.1.5 Organizational Process Assets

These will include the tools needed to carry out qualitative risk analysis, policies, procedures and guidelines for risk management, and historical information including lessons learned from previous projects.

11.3.2 Perform Qualitative Risk Analysis: Tools and Techniques

There are six tools and techniques that can be used.

Perform Quality Risk Analysis Techniques

- Risk Probability & Impact Assessment
- Probability & Impact Matrix
- Risk Data Quality Assessment
- Risk Categorization
- Risk Urgency Assessment
- Expert Judgment

11.3.2.1 Risk Probability and Impact Assessment

Risk probability assessment investigates the likelihood that each specific risk will occur, whereas risk impact assessment investigates the potential effect on a project objective such as schedule, cost, quality, or performance.

Both the likelihood and impact are given a score according to the definitions given in the risk management plan and these can be considered together to provide a risk score. Risks with a high score will be given high priority while those with a low score will be included on a watch list for future monitoring.

11.3.2.2 Probability and Impact Matrix

Evaluation of each risk's importance and, hence, priority for attention can be done using a probability and impact matrix as shown.

Probability & Impact Matrix								
Probability	**Threats**				**Opportunities**			
0.90	0.05	0.18	0.54	0.72	0.72	0.54	0.18	0.05
0.75	0.04	0.15	0.45	0.60	0.60	0.45	0.15	0.04
0.50	0.03	0.10	0.30	0.40	0.40	0.30	0.10	0.03
0.25	0.01	0.05	0.15	0.20	0.20	0.15	0.05	0.01
0.10	0.01	0.02	0.06	0.08	0.08	0.06	0.02	0.01
Impact	0.05	0.20	0.60	0.80	0.80	0.60	0.20	0.05

This specifies combinations of probability and impact that lead to rating the risks as low, moderate, or high priority. The type of management response should be:

- Threats
  - High-risk (shown in dark gray boxes) are priority and need a hard line response.
  - Low-risk (mid-gray boxes) need to have a contingency made for them & monitored

- Opportunities
  - Dark gray boxes show ones to pursue first as they offer the most benefit & are more easily achieved.
  - Mid-gray boxes indicate the ones to be monitored.

It is possible to rate a risk separately for cost, time, scope and quality. In addition, it can develop ways to determine one overall rating for each risk. An overall rating scheme can be developed to reflect the organization's preference for one objective over another and using those preferences to develop a weighting of the risks that are assessed by objective.

11.3.2.3 Risk Data Quality Assessment

This involves examining how well the risk is understood and the accuracy, quality, reliability, and integrity of the data regarding it. If data quality is unacceptable, it may be necessary to gather higher-quality data.

11.3.2.4 Risk Categorization

The risk breakdown structure (RBS) is the normal way to help structure and organize all identified risks into appropriate categories, and these will assist in determining which aspects of the project have the highest degree of uncertainty.

11.3.2.5 Risk Urgency Assessment

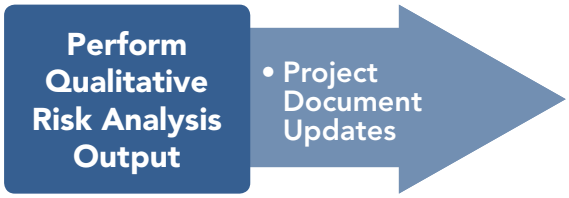
Risks that are likely to occur in the immediate future require more urgent attention than those that may occur later on in the project. Indicators of priority should include the time required to affect a risk response. In some qualitative analyses the assessment of risk urgency can be combined with the risk ranking determined from the probability and impact matrix to give a final risk severity rating.

11.3.2.6 Expert Judgment

This would relate to experience of the probability and impact of typical risks for projects of this type and could come from anyone with relevant experience.

11.3.3 Perform Qualitative Risk Analysis: Outputs

This process will create the following output:



11.3.3.1 Project Documents Updates

The risk register can be updated with the following information.

- *Relative ranking or priority list of project risks*—the probability and impact matrix can be used to classify risks according to their individual significance. Risks may be listed by priority separately for schedule, cost, and performance since organizations may value one objective over another. The project manager can then use the prioritized list of risks to focus attention on those items of high significance to the most important objectives.
- *Risks grouped by categories*—this can point to common underlying causes of risk, which may in turn suggest a holistic approach to dealing with them. Discovering concentrations of risk may also improve the effectiveness of risk responses.
- *List of risks requiring response in the near-term*—includes those risks that require an urgent response and those that can be handled at a later date may be put into different groups.
- *List of risks for additional analysis and response*—some risks might warrant more analysis, including Quantitative Risk Analysis, as well as response action.
- *Watch lists of low-priority risks*—those that are not assessed as important in this process can be placed on a watch list for continued monitoring.
- *Trends in the analysis results*—as this process is iterative, trends for particular types of risk may become apparent. This information can be fed back into the risk management process.
- *Assumptions Log*—the project scope statement may contain assumptions about the project, which may be updated as a result of the qualitative risk analysis done in this process.

11.4 Perform Quantitative Risk Analysis

This is the process of analyzing the effect of those risks identified in the previous process as having the potential to substantially impact the project. It may be used to assign a numerical rating to those risks individually or to evaluate their aggregate effect.

In some projects it may be possible to develop effective risk responses without this process. The availability of time and budget, and the need for qualitative or quantitative statements about risk and impacts, will determine which method(s) to use.

The inputs, tools and techniques, and outputs of this process are summarized in the table below.

Inputs	Tools & Techniques	Outputs
Risk Management Plan	Data Gathering & Representation Techniques	Project Documents Updates
Cost Management Plan	Quantitative Risk Analysis & Modeling Techniques	
Schedule Management Plan	Expert Judgment	
Risk Register		
Enterprise Environmental Factors		
Organizational Process Assets		

11.4.1 Perform Quantitative Risk Analysis: Inputs

This process requires the following inputs:

11.4.1.1 Risk Management Plan

This is developed during process '11.1 Plan Risk Management' and defines the level of risk which is seen as acceptable, how risks will be managed, who will be responsible for carrying out risk related activities, the time and cost of each risk activity and how the communication of risk is to occur.

11.4.1.2 Cost Management Plan

Costs are also quantifiable and can be used as an input for this process.

11.4.1.3 Schedule Management Plan

Schedule timings are presented in a quantifiable manner, which means that risks that will impact time scales can easily be quantified within this process.

11.4.1.4 Risk Register

This is the central repository of all of the known risks that are to be analyzed. It was updated in the previous process to include information on relative ranking, categorization and urgency of responses.

11.4.1.5 Enterprise Environmental Factors

These include industry studies of similar projects by risk specialists and risk databases from industry or proprietary sources.

11.4.1.6 Organizational Process Assets

These will include the tools needed to carry out qualitative risk analysis, policies, procedures and guidelines for risk management, and historical information including lessons learned from previous projects.

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11.4.2 Perform Quantitative Risk Analysis: Tools and Techniques

There are three tools and techniques that can be used.

11.4.2.1 Data Gathering and Representation Techniques

Structured interviews can be used to determine be probability and impact of risks from subject matter experts. This information can then be used in the following modeling techniques.

11.4.2.2 Quantitative Risk Analysis and Modeling Techniques

Several techniques can be used including:

- *Sensitivity Analysis*—this involves analyzing the project to determine how sensitive is to particular risks by analyzing the impact and severity of each risk.
- *Expected Monetary Value (EMV) Analysis*—determining the expected monetary value is to multiply the likelihood by the cost impact to obtain an expected value for each risk, these are then added up to obtain the expected monetary value for the project. A typical way of calculating EMV is using decision trees:
    - *Decision Tree Analysis*—these are in the form of a flow diagram where each node, represented by a rectangle, contains a description of the risk aspect and its cost. These rectangles are linked together via arrows each arrow leading to another box representing the percentage probability.

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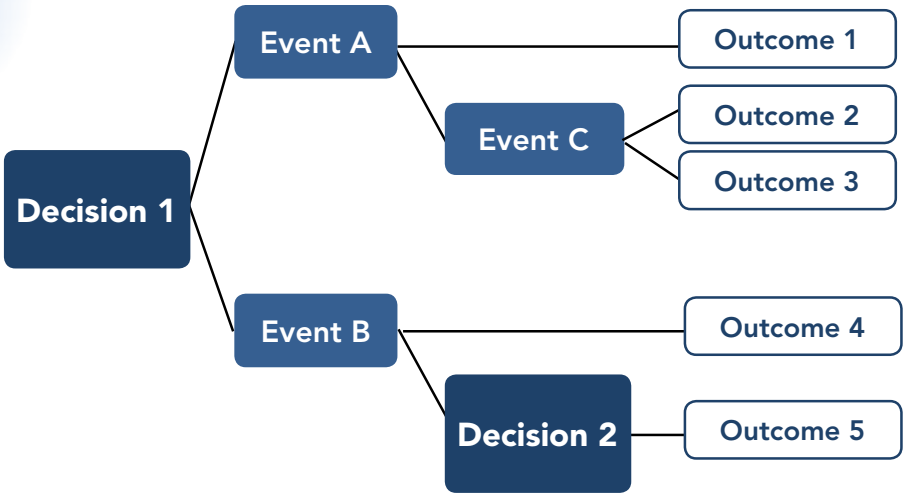
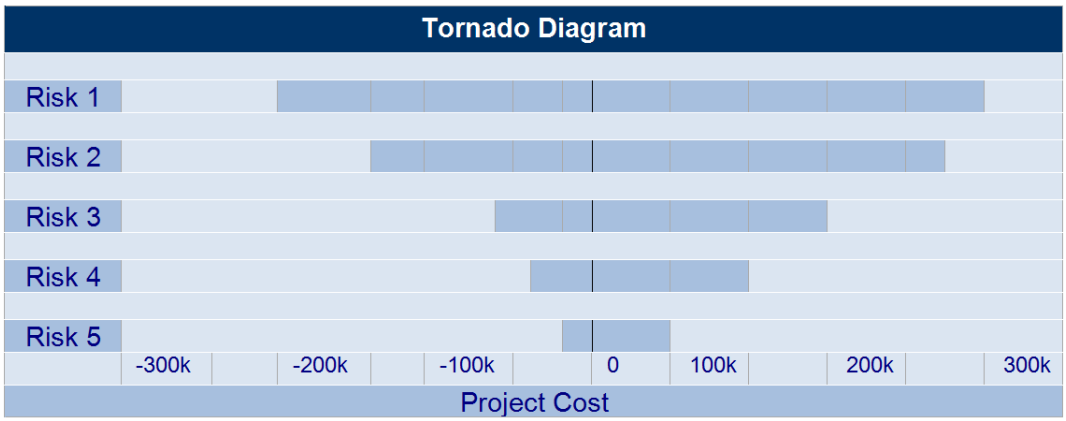


- *Tornado Diagrams*—these are named because of their funnel shaped and portray graphically the project sensitivity to cost or other factors. Each tornado diagram will represent the impact of risks in terms of particular aspects. These aspects may be the stages of phases of all project, and are ranked vertically and represented by a horizontal bar showing plus or minus cost impacts.



- *Monte Carlo Analysis*—is normally calculated by computer by analyzing many scenarios for the project schedule and calculating the impact of particular the risk events. It is helpful in identifying risks and the effect they have on the project schedule.

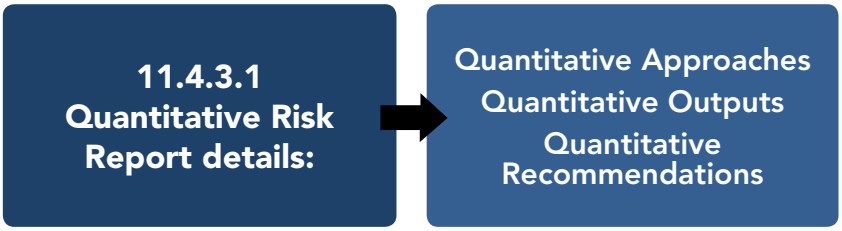
11.4.2.3 Expert Judgment

Rather than ask each expert for a single value for each, the project manager would normally encourage each experts to provide an optimistic, pessimistic and realistic probability and impact value for each risk.

11.4.3 Perform Quantitative Risk Analysis: Outputs

This process will create the following output:

11.4.3.1 Project Documents Updates



The risk register is further updated to include a quantitative risk report detailing quantitative approaches, outputs, and recommendations. Updates include the following:

- *Probabilistic analysis of the project.* Estimates are made of potential project schedule and cost outcomes listing the possible completion dates and costs with their associated confidence levels. This output, often expressed as a cumulative distribution, can be used with stakeholder risk tolerances to permit quantification of the cost and time contingency reserves.

- *Probability of achieving cost and time objectives.* With the risks facing the project, the probability of achieving project objectives under the current plan can be estimated using quantitative risk analysis results.
- *Prioritized list of quantified risks.* This list of risks includes those that pose the greatest threat or present the greatest opportunity to the project. These include the risks that may have the greatest effect on cost contingency and those that are most likely to influence the critical path. These risks may be identified, in some cases, through a tornado diagram generated as a result of the simulation analyses.
- *Trends in the analysis results.* As this process is iterative, trends for particular types of risk may become apparent. This information can be fed back into the risk management process.

11.5 Plan Risk Response

This is the process of developing options and actions to enhance opportunities and to reduce threats to the project. It is important that planned responses are appropriate to the significance of the risk, cost effective in meeting the challenge, realistic within the project context, agreed upon by all parties involved, and owned by a responsible person.

The inputs, tools and techniques, and outputs of this process are summarized in the table below.

Inputs	Tools & Techniques	Outputs
Risk Management Plan	Strategies for Negative Risks or Threats	Project Management Plan Updates
Risk Register	Strategies for Positive Risks or Opportunities	Project Document Updates
	Contingent Response Strategies	
	Expert Judgment	

11.5.1 Plan Risk Responses: Inputs

This process requires the following inputs:

11.5.1.1 Risk Management Plan

This document defines the level of risk which is seen as acceptable, how risks will be managed, who will be responsible for carrying out risk related activities, the time and cost of each risk activity and how the communication of risk is to occur.

11.5.1.2 Risk Register

This is the central repository of all of the known risks that are to be analyzed. It was updated in the previous processes to include information on relative ranking, categorization and urgency of responses and may include quantitative data if appropriate.

11.5.2 Plan Risk Responses: Tools and Techniques

There are three tools and techniques that can be used.

11.5.2.1 Strategies for Negative Risks or Threats

There are four possible strategies for dealing with threats or risks that may have negative impacts on project objectives if they occur.

1. *Avoid*—This involves taking action to either reduce the probability of the risk and/or its impact to zero. In either case this response enables the risk to be circumvented entirely.

   For example, using a certain supplier might carry the risk of them going out of business during the course of the project. This risk could be avoided by using a supplier who was bigger, better established and more financially secure.

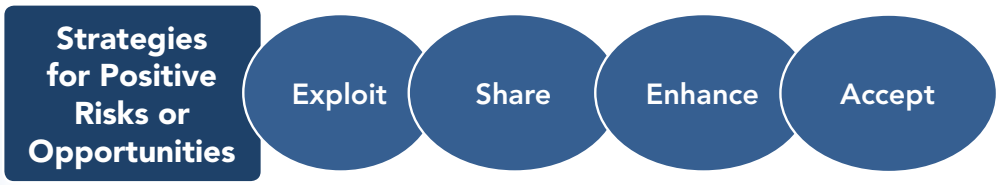
2. *Transfer*—This involves transferring the risk to a third party so that they are responsible for its management and impact. It does not eliminate the risk it simply transfers the liability to someone else. This can be done by:
   - Taking out insurance (the insurance company is now liable) or
   - Having the work done under a fixed-price contract (the contractor is now liable).

   Risk transference nearly always involves payment of a risk premium to the party taking on the risk and may introduce new risks. For example, an insurance company may contest the claim or a contractor might dispute the terms and conditions of the contract if they are having problems delivering.

3. *Mitigate*—Taking early action to reduce the probability and/or impact of a risk occurring is often more effective than trying to repair the damage after it has occurred. Adopting less complex processes, conducting more tests, or choosing a more stable supplier are examples of mitigation actions.
4. *Accept*—The most common acceptance strategy is to establish a contingency reserve, including amounts of time, money, or resources to handle the risks. It is usually chosen either because:
   - Risk is low in terms of impact or probability, or
   - Cost and effort of taking a different action is out of proportion to the risk itself.

11.5.2.2 Strategies for Positive Risks or Opportunities

There are four possible strategies for dealing with opportunities if they occur.



1. *Exploit*—examples of directly exploiting responses include assigning an organization's most talented resources to the project to reduce the time to completion or to provide lower cost than originally planned.
2. *Share*—sharing a positive risk involves allocating some or all of the ownership of the opportunity to a third party who is best able to capture the opportunity for the benefit of the project. Examples of sharing actions include forming risk-sharing :
   - Partnerships,
   - Teams,
   - Special-purpose companies, or
   - Joint ventures (JVs).

   These can be established with the express purpose of taking advantage of the opportunity so that all parties gain from their actions.
3. *Enhance*—examples of enhancing opportunities include adding more resources to an activity to finish early.
4. *Accept*—accepting an opportunity is being willing to take advantage of it if it comes along, but not actively pursuing it.

11.5.2.3 Contingent Response Strategies

These are strategies designed to manage the outcome either to reduce a threat or maximize an opportunity. For example, if there were a risk of the project falling behind schedule then a contingent response strategy would be to assign extra resources to it.

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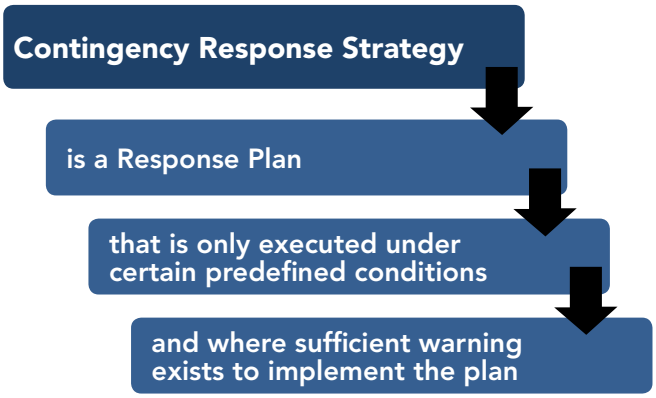

This could be planned for but would not need to be done unless the risk materialized. In other words, it is a response plan that will only be executed under certain predefined conditions if there is sufficient warning to implement it.

11.5.2.4 Expert Judgment

Any group or person with specialized education, knowledge, skill, experience, or training in establishing risk responses may provide expertise.

11.5.3 Plan Risk Responses: Outputs

This process will create the following outputs:

11.5.3.1 Project Management Plan Updates

The risk management plan may need to be modified as a result of identifying risk responses.

11.5.3.2 Project Document Updates

This covers any other documentation that includes or reflects the management of risk such as logs or registers.

11.6 Control Risks

This is the process of implementing risk response plans, tracking identified risks, monitoring residual risks, identifying new risks, and evaluating risk process effectiveness throughout the project.

Planned risk responses that are included in the project management plan are executed during the life cycle of the project, but the project work should be continuously monitored for new, changing, and outdated risks.

The inputs, tools and techniques, and outputs of this process are summarized in the table below.

Inputs	Tools & Techniques	Outputs
Project Management Plan	Risk Reassessment	Work Performance Information
Risk Register	Risk Audits	Change Requests
Work Performance Data	Variance and Trend Analysis	Project Management Plan Updates
Work Performance Reports	Technical Performance Measurement	Project Documents Updates
	Reserve Analysis	Organizational Process Assets Updates
	Meetings	

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11.6.1 Control Risks: Inputs

This process requires the following inputs:

11.6.1.1 Project Management Plan

This contains the risk management plan, which includes risk tolerances, protocols and the assignment of people, time, and other resources to project risk management.

11.6.1.2 Risk Register

This is the central repository of all of the known risks. Key inputs include risk owners, agreed-upon risk responses, specific implementation actions, symptoms and warning signs of risk, residual and secondary risks, a watch list of low-priority risks, and the time and cost contingency reserves.

11.6.1.3 Work Performance Data

This includes the status of deliverables, schedule progress, and costs incurred.

11.6.1.4 Work Performance Reports

These include variance analysis, earned value data, and forecasting data.

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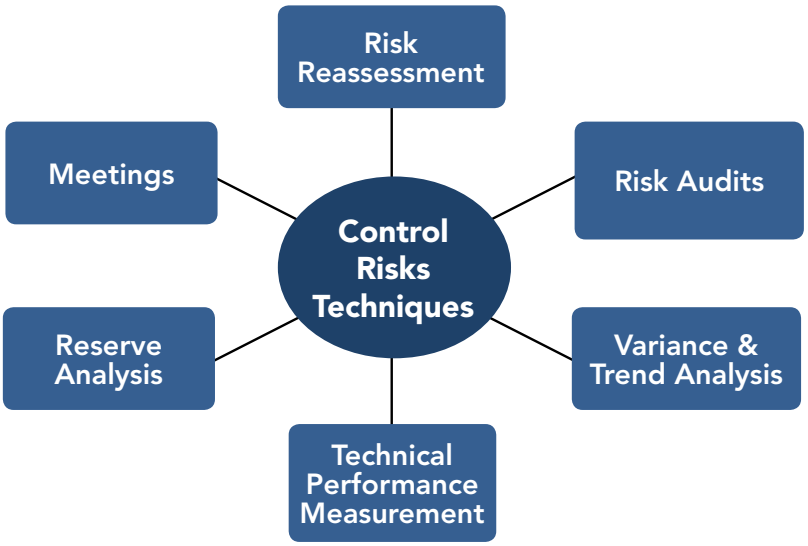
11.6.2 Control Risks: Tools and Techniques

There are six tools and techniques that can be used.



11.6.2.1 Risk Reassessment

Project risk reassessments should be regularly scheduled to keep the risk register updated. The amount and detail of repetition that is appropriate depends on how the project progresses relative to its objectives, as well as, which risks (if any) actually manifest themselves.

11.6.2.2 Risk Audits

These should be scheduled in the risk management plan and examine the effectiveness of risk responses in dealing with identified risks and their root causes. The objectives should be clearly defined in advance and the audit may form part of the routine project review meetings, or may be run separately.

11.6.2.3 Variance and Trend Analysis

Earned value analysis and other methods of project variance and trend analysis may be used for monitoring overall project performance. Outcomes from these analyses may forecast potential deviation of the project at completion from cost and schedule targets. Deviation from the baseline plan may indicate the potential impact of threats or opportunities.

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11.6.2.4 Technical Performance Measurement

This is designed to indicate the degree of technical risk faced by the project. Where deliverables can be measured against the plans in a quantitative way e.g.:

- Response times,
- Number of defects,
- etc.

This can predict the degree of success in achieving the technical aims of the project.

11.6.2.5 Reserve Analysis

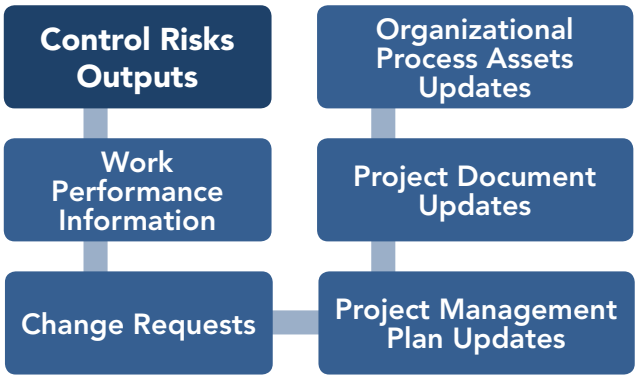
This compares the contingency reserves remaining to the amount of risk remaining at any time in the project in order to determine if the remaining reserve is adequate.

11.6.2.6 Meetings

Project risk should be openly discussed at periodic status meetings so that project staff can contribute to risk identification and management.

11.6.3 Control Risks: Outputs

This process will create the following outputs:



11.6.3.1 Work Performance Information

This provides a mechanism to communicate and support project decision-making.

11.6.3.2 Change Requests

Implementing contingency plans or workarounds sometimes results in a change request.

- *Recommended preventive actions* are documented directions to perform on activity that can reduce the probability of negative consequences associated with project risks.
- *Recommended corrective actions* include contingency plans and workarounds.

The latter are responses that were not initially planned, but are required to deal with emerging risks that were previously unidentified or accepted passively.

11.6.3.3 Project Management Plan Updates

If the approved change requests have an effect on the risk management processes, the corresponding component documents of the project management plan are revised and reissued to reflect the approved changes.

11.6.3.4 Project Document Updates

This covers any other documentation that includes or reflects the management of risk such as logs or registers. The risk register will be updated to take account of any risk reassessments, risk audits, and periodic risk reviews. These outcomes may include identification of new risk events, updates to probability, impact, priority, or ownership. If certain risks are no longer applicable then any associated reserves can be released.

11.6.3.5 Organizational Process Assets Updates

These include templates for the:

- Risk management plan
- Risk breakdown structure (RBS) &
- Lessons learned from the risk management activities.

Summary

Risk plays a significant part in the planning of any project that requires a commitment of time and resources. A project manager should have a clear understanding of the risk tolerance of the project and organization from the outset.

Risk management's sole purpose is to increase the probability and impact of positive events, whilst decreasing the impact and probability of threats or adverse. This is achieved by thoroughly researching and defining any assumptions, conditions or constraints associated with the project requirements and objective. It is not concerned with general business risks those are the responsibility of the organization's executive.

The six processes of this knowledge area are:

- Plan Risk Management—define how to conduct risk management activities for the project.
- Identify Risks—determine and document the risks along with their characteristics that may affect the project.
- Perform Qualitative Risk Analysis—prioritize the risks so further analysis or action can be done to assess and combine their impact and probability of occurrence.
- Perform Quantitative Risk Analysis—analyze the effect of identified risks on overall project objectives numerically.
- Plan Risk Responses—develop options and actions that will enhance opportunities and reduce threats to project objectives.
- Monitor and Control Risks—is the process that implements the risk response plans responsible for tracking identified risks, monitoring residual risks, identifying new risks, and evaluating risk process effectiveness throughout the lifecycle of the project.

The depth of understanding a project manager has of his or her stakeholders' degree risk tolerance is essential to the smooth management of the project. Their perceptions, culture and environment play a significant part if forming their attitude towards risk.

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This knowledge will enable the project manager to reassure and inform each stakeholder appropriately through project communications. Success depends on all levels involved with the project actively identifying and pursuing effective risk management throughout the project lifecycle.

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