Crosswind Learning

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Project Management Professional (PMP)® Exam

Crosswind Success Series:
PMP® Exam Bootcamp Manual

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Version 6.1 aligned with the Project Management Institute, *A Guide to the Project Management Body of Knowledge, (PMBOK® Guide)* - Sixth Edition, Project Management Institute Inc., 2017

14.5. Perform Quantitative Risk Analysis (Planning Process Group)

Know the Inputs, Tools & Techniques, and Outputs for Perform Quantitative Risk Analysis.

The Perform Quantitative Risk Analysis process is evolved as a result of the Identify Risks and Perform Qualitative Risk Analysis processes. Perform Quantitative Risk Analysis breaks down risks from a high, medium, and low ranking based on actual numerical values and probabilities of occurrence. **Risks that are higher in probability and impact are more likely to be evaluated during the Perform Quantitative Risk Analysis process. Techniques used include decision tree analysis and Monte Carlo simulation**, which yield realistic schedule and cost targets for the project in accordance with the documented risk.

Perform Quantitative Risk Analysis provides the details necessary to recognize such impacts, whereas Perform Qualitative Risk Analysis often does not.

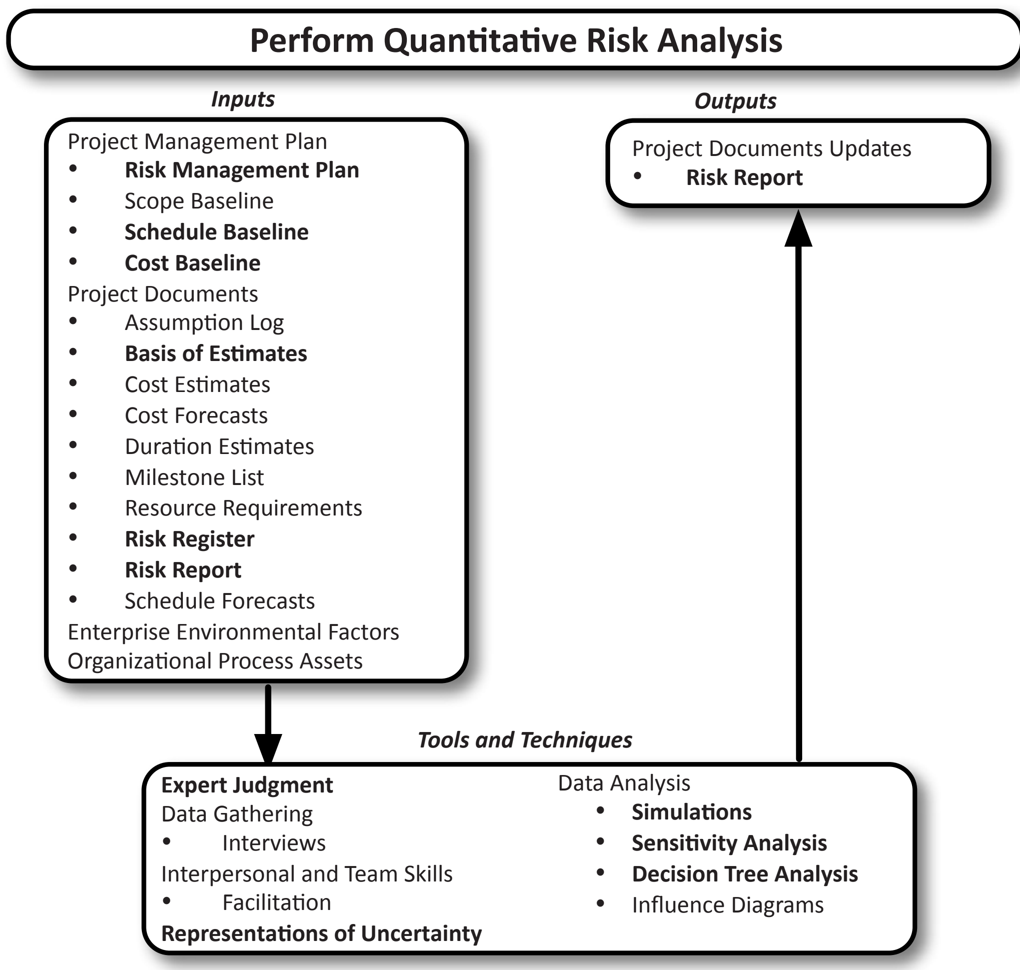


Figure 14-9: Perform Quantitative Risk Analysis Data Flow Diagram

The source for the above figure is the Project Management Institute, *A Guide to the Project Management Body of Knowledge*, (*PMBOK® Guide*) – Sixth Edition, Project Management Institute Inc., 2017, Figure 11-11, Page 428

Perform Quantitative Risk Analysis (Planning)		
Key Inputs	Risk Management Plan	The risk management plan is a component of the project management plan that details the manner in which risk management activities are configured and implemented. Typically it addresses risk strategy, risk methodology, roles and responsibilities, financing (the budget for risk-related activities, contingent reserves, and management reserves), timing of risk processes, risk classification for grouping individual risks (typically, this is accomplished by using a risk breakdown structure), the probability and impact of individual risks (often supported by a probability and impact matrix), reporting formats, and tracking. It also indicates if qualitative risk analysis is required, the frequency at which the analysis will be performed, and the resources available to conduct the analysis.
	Schedule Baseline	The schedule baseline is the authorized version of the schedule model. It contains baseline start and baseline finish dates, is subject to change control, and is used as the basis of comparison to actual results. In addition, it delineates the point in time at which individual project risks and other sources of unpredictability can be assessed.
	Cost Baseline	The cost baseline is the authorized version of the time-phased budget for the project, excluding management reserves, and subject to change control. It is evolved from a summation of approved budgets for specific schedule activities. Cost estimates are aggregated by work packages, then into higher components (typically control accounts) of the work breakdown structure (WBS), and then for the entire project. In addition, it delineates the point in time at which individual project risks and other sources of unpredictability can be assessed.
	Basis of Estimates	The basis of estimates includes documentation that delineates the manner in which the estimates are determined, lists all assumptions and constraints, identifies the resources used to evolve the estimates, the range of estimates, and the degree of certainty in the estimates, and details the risks that impact the estimates. It may be reflected in the variability modeled during a quantitative risk analysis. This may include consideration of the category, accuracy, intention, genesis, and strategy.

Perform Quantitative Risk Analysis (Continued)		
Key Inputs (Cont.)	Risk Register	Each identified risk is recorded in the risk register records. It typically includes the potential owner of and potential response(s) to each identified risk and may include a title, category, status, cause(s), trigger(s), impacted activity(ies), date(s) of identification, date range for probable occurrence, and response deadline(s). It is used to reference details about individual risks that are inputs for quantitative analysis.
	Risk Report	The risk report details the origins of overall project risk and recaps key data about unique project risks (typically the number of threats and opportunities and other summary metrics). It is updated with information related to risks with the highest risk scores. The risk report also includes a prioritized catalogue of all identified risks and their sources as well as the degree of overall project risk.
Key Tools & Techniques	Expert Judgment	Expert judgment is judgment based on expertise acquired in a specific area. It is often more significant and accurate than the best modeling tools available and can be provided by stakeholders, company personnel external to the project, professional organizations or groups, and consultants. It is important to consider expertise related to knowledge or experience in assigning numeric values to individual and overall project risk for use as inputs to quantitative risk analysis, determining the most consequential representation of uncertainty, selecting the most appropriate tools for modeling, and decoding quantitative risk analysis outputs.
	Representations of Uncertainty	Quantitative risk analysis requires the entry of inputs that represent individual risks and other sources of uncertainty into the quantitative risk analysis model. In instances where the duration, resource, or cost requirement is not clear, a range of values in the form of a probability distribution can be used. If a risk is not related to a specific activity, a probabilistic branch can be used instead. If risks are related through a dependency or by a common cause, correlation is used in the model.
	Simulations	The quantitative risk analysis model is used to simulate the likely affect of risk on the project. A common approach to the simulation is the Monte Carlo method. Note that for a quantitative cost risk analysis model, cost estimates are used and for a quantitative schedule risk analysis model, duration estimates are used.

Perform Quantitative Risk Analysis (Continued)

Key Tools & Techniques (Cont.)	Sensitivity Analysis	Sensitivity analysis is a comparison of the relative importance of variables. When applied to risks, a tornado diagram (a type of bar chart) is typically used. The diagram displays individual risks ordered by impact on project outcomes (highest to lowest).
	Decision Tree Analysis	A decision tree analysis is a method employed to choose between possible decisions. The decision tree consists of branches and nodes. Each branch depicts a discreet decision with costs and risks delineated. For each branch, there is a node containing the expected value of the decision.
Key Outputs	Risk Report	The risk report details the origins of overall project risk and recaps key data about unique project risks (typically the number of threats and opportunities and other summary metrics). It is updated with information related to risks with the highest risk scores. The risk report also includes a prioritized catalogue of all identified risks and recommended responses, as well as a brief overview of project risk.

Situational Question and Real World Application

Failure to effectively address the Perform Quantitative Risk Analysis process may lead to an inability to maximize opportunities and minimize threats. It could also result in not knowing the overall risk exposure of the project.

14.5.1. Probability

Probability is the likelihood that an event will occur. It is usually measured in percentages (0 to 100%) or real numbers (0.0 to 1.0). The **sum of all probabilities is equal to 100% or 1.0**, which denotes that all possible outcomes (100%) have been considered. Probability can also be measured as low, medium, and high (or another non-numerical method can be used).

Understand probability as it relates to risk management.

14.5.2. Impact

Impact is the consequence to the project if the risk event occurs. The impact can be positive or negative. An example of impact is a large number of sales resulting from the launch of a website for a start-up company. If the company can fulfill the orders, the impact is positive; if not, the impact is typically negative.

Understand impact as it relates to risk management.

14.5.3. Probability Distributions

Continuous probability distributions graphically represent uncertainty in schedule and cost values and are used extensively in modeling and simulation.

The three most common types of probability distribution functions are normal distribution, beta distribution, and triangular distribution.

Normal distribution is typically used for statistical or scientific computing.

Beta distribution is used to model events that must take place within an interval that has a minimum and maximum value. Beta distribution, along with triangular distribution, is commonly used with PERT and CPM.

Triangular distribution is the most common distribution used in business modeling because its parameters (minimum, most likely, and maximum) are understood even by those unfamiliar with risk analysis.

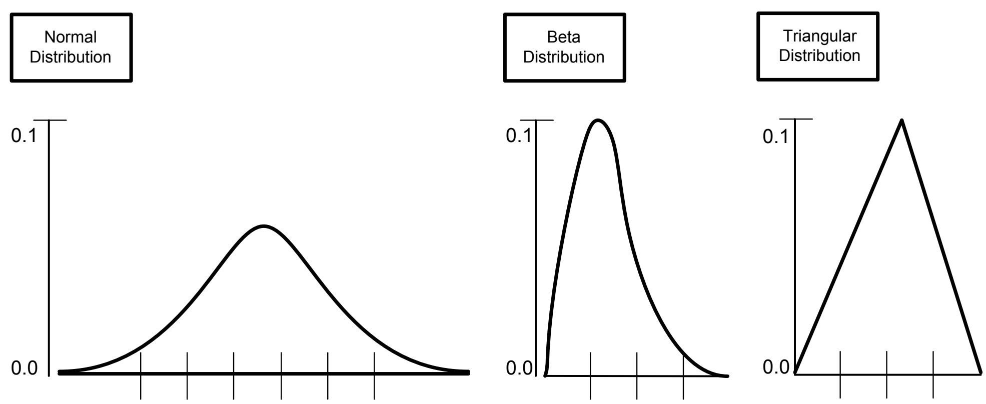


Figure 14-10: Probability Distributions

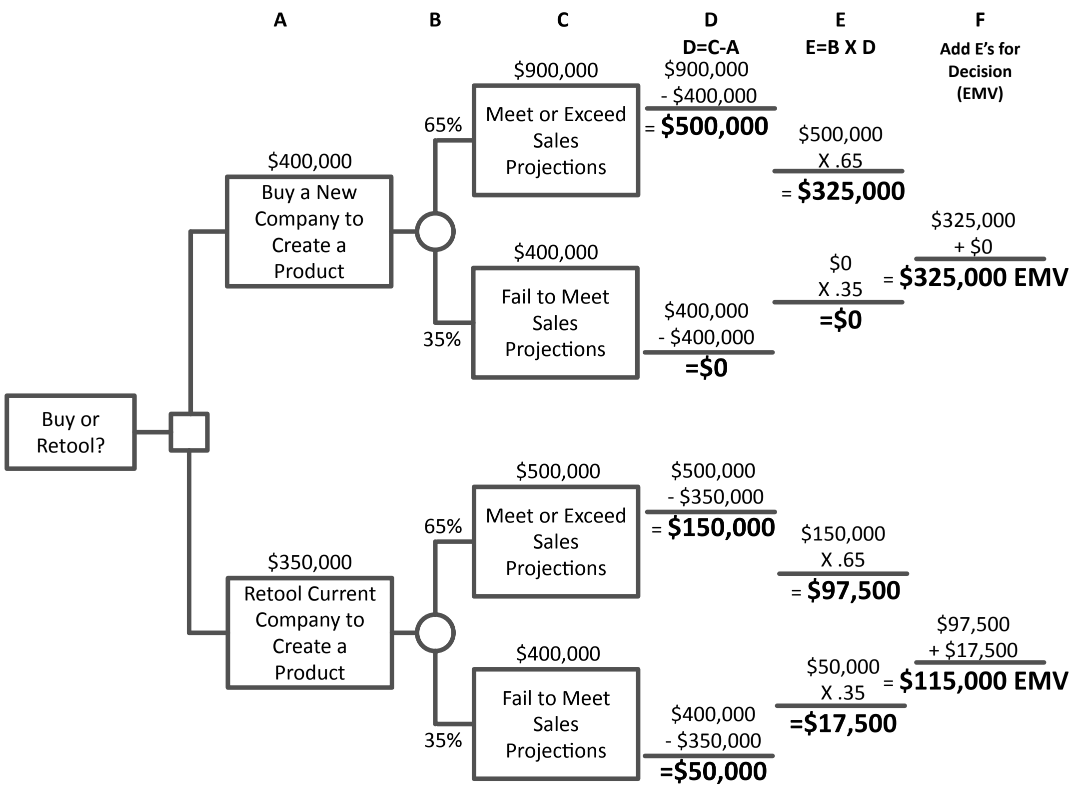
14.5.4. Decision Trees and Expected Monetary Value (EMV)

Know how to calculate expected monetary value (EMV) and make a project selection decision based on the outcome.

Decision tree analysis is based on an analysis of the probability and impact of all potential decisions to determine the potential expected monetary value (EMV), or expected risk value, of the opportunity as a whole.

This is accomplished by multiplying the probabilities and the impact (minus any costs) , then totaling the results for each project or opportunity. Note that the sum of all probabilities must equal 1.0 (or 100%).

For example, an organization wishes to create a specific product and currently does not have the capacity to do so. The organization must decide if it will purchase a new company that currently has the capability of creating the product or if it will retool a current company so that it will have the capacity to create the product. The organization uses a decision tree to compare the EMV of purchasing against the EMV of retooling. Reference Figure 14-11: Decision Tree.



	A	B	C	D D=C-A	E E=B X D	F Add E's for Decision
Decision Definition	Decision Node	Chance	Chance Node	Net Path Value	EMV of Each Path	EMV
Decision to be made	Cost of individual decisions	% Chance of each outcome	$ Revenue amount of each possible outcome	Potential reward minus costs	Path worth	Decision worth (Choose the Biggest $)

Figure 14-11: Decision Tree

The source for the above figure is the Project Management Institute, *A Guide to the Project Management Body of Knowledge*, (*PMBOK® Guide*) – Sixth Edition, Project Management Institute Inc., 2017, Figure 11-15, Page 435

Figure 14-11: Decision Tree shows that purchasing a new company makes more sense than retooling, since the EMV for retooling is $115,000 compared to the EMV of $325,000 for purchasing a new company.

Note that in the exam, if only one percentage value is referenced in a question, the other value can be determined by subtracting the referenced value from 100%. For example: if a value of 70% is the only value referenced in the question, the other value is 30% (100% - 70%).

14.5.5. Monte Carlo

Monte Carlo is a mock-up technique that uses software to simulate project characteristics in order to determine the possible outcome. While the simulation is typically applied to scheduling in order to determine the necessary schedule reserve, it can be used in other areas of the project.

Know what a Monte Carlo simulation does.

14.5.6. Probabilities Tables

The following tables display the probabilities associated with a project's cost and schedule parameters.

Tables like this can be helpful. If management wanted to know if a project could be completed for no more than $41,000, the budget table prepared by the Monte Carlo software indicates an 80% confidence level that the project will be completed for that cost. The confidence level (as a percentage) typically increases as costs and durations increase because the likelihood of realizing those targets becomes more realistic.

The Monte Carlo software considers many project variables to generate the data.

Quantitative Analysis For Total Budget Table

Confidence Level	Total Cost		Confidence Level	Total Cost
100%	$43,564		60%	$30,000
95%	$42,500		55%	$27,500
90%	$42,000		50%	$25,000
85%	$41,500		45%	$22,500
80%	$41,000		40%	$20,000
75%	$40,500		35%	$17,500
70%	$40,000		30%	$15,000
65%	$35,000		25%	$14,500

Quantitative Analysis For Completion Date Table

Confidence Level	Date Complete		Confidence Level	Date Complete
100%	12/15/xx		60%	08/15/xx
95%	12/01/xx		55%	08/01/xx
90%	11/15/xx		50%	07/15/xx
85%	11/01/xx		45%	07/01/xx
80%	10/15/xx		40%	06/15/xx
75%	10/01/xx		35%	06/01/xx
70%	09/15/xx		30%	05/15/xx
65%	09/01/xx		25%	05/01/xx

14.5.7. Tornado Diagram

The tornado diagram is a graphical representation of project risks and their potential impact as determined by a sensitivity analysis. The risk with the highest potential impact is represented by the top bar in the diagram, the risk with the next highest potential impact is represented by the bar directly underneath the top bar, etc. When completed, the chart typically resembles a funnel or tornado.

Project Value (Baseline $0K is on Track)

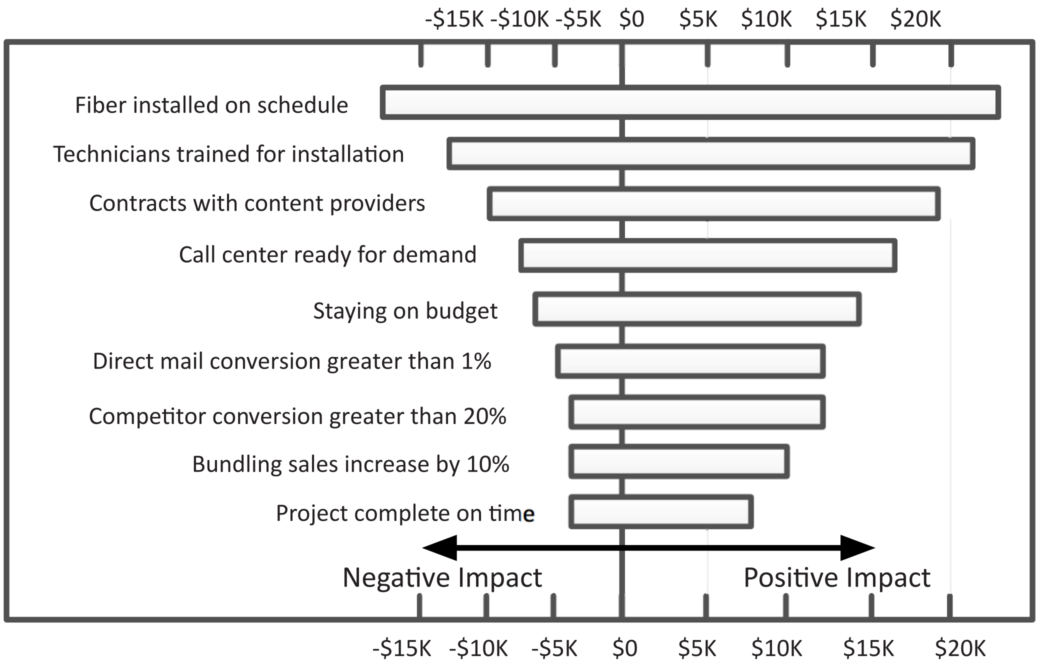


Figure 14-12: Tornado Diagram

The source for the above figure is the Project Management Institute, *A Guide to the Project Management Body of Knowledge*, (*PMBOK® Guide*) – Sixth Edition, Project Management Institute Inc., 2017, Figure 11-14, Page 434

Sensitivity analysis determines risk impact by considering how much the uncertainty of each project element impacts a particular project objective when the other elements remain at their baseline values.

The source for the above text is the Project Management Institute, *A Guide to the Project Management Body of Knowledge*, (*PMBOK® Guide*) – Sixth Edition, Project Management Institute Inc., 2017, Pages 428-436

14.6. Plan Risk Responses (Planning Process Group)

During the Plan Risk Responses process, responses for risks are developed, strategies for addressing risks are determined, and actions for addressing risk exposure are decided for both individual risks and overall project risk.

Know the Key Inputs, Tools & Techniques, and Outputs for Plan Risk Responses.

Chapter 14
Risk