

Risk and Decision Analytics

Prepared by Dr.

Lecture 2

جامعة الجميع الذكية

تسعى لتكون الكيان الأول الذي يتبنى مبدأ المجتمع التعليمي
التعاوني ويقدم العلم مقابل العمل لتنمية وبناء المجتمعات.

PMG 621

Decision analysis process



جامعة الجميع الذكية
EVERYONE'S SMART UNIVERSITY

In most work, we expect professionals to use consistent, proven processes. A sales consultant friend of mine, Don Aspromonte, uses dentistry as an example. When you go to a dentist for some work, such as filling a tooth, you expect him to know exactly how to do the job. He has successfully filled many cavities with excellent results. As he approaches your tooth, he isn't asking, "What method should I try today?" Rather, he will apply a tried and proven process.

Ten Steps toward Better Decisions

Decision analysis is a process for solving problems. While most decisions are unique, the general process can be the same. Figure 2.1 outlines a ten- step sequence for decision making. The following subsections describe each step in more detail.

1. Proactively Identify
Decision Opportunities

Brainstorming. SWOT analysis. Strategizing.

2. Define the Problem

Frame and scope the problem to be addressed.
Try to deal with root causes, not symptoms.

3. Identify Alternatives

Evaluate the several major approaches first;
can fine-tune later.

4. Develop the
Decision Model

Identify chance events, relationships, and sequence.
Often started by building an influence diagram,
followed by building a decision tree or system-flow
diagram.

5. Quantify Judgments
about Uncertainty

Outcomes and probabilities of chance events.

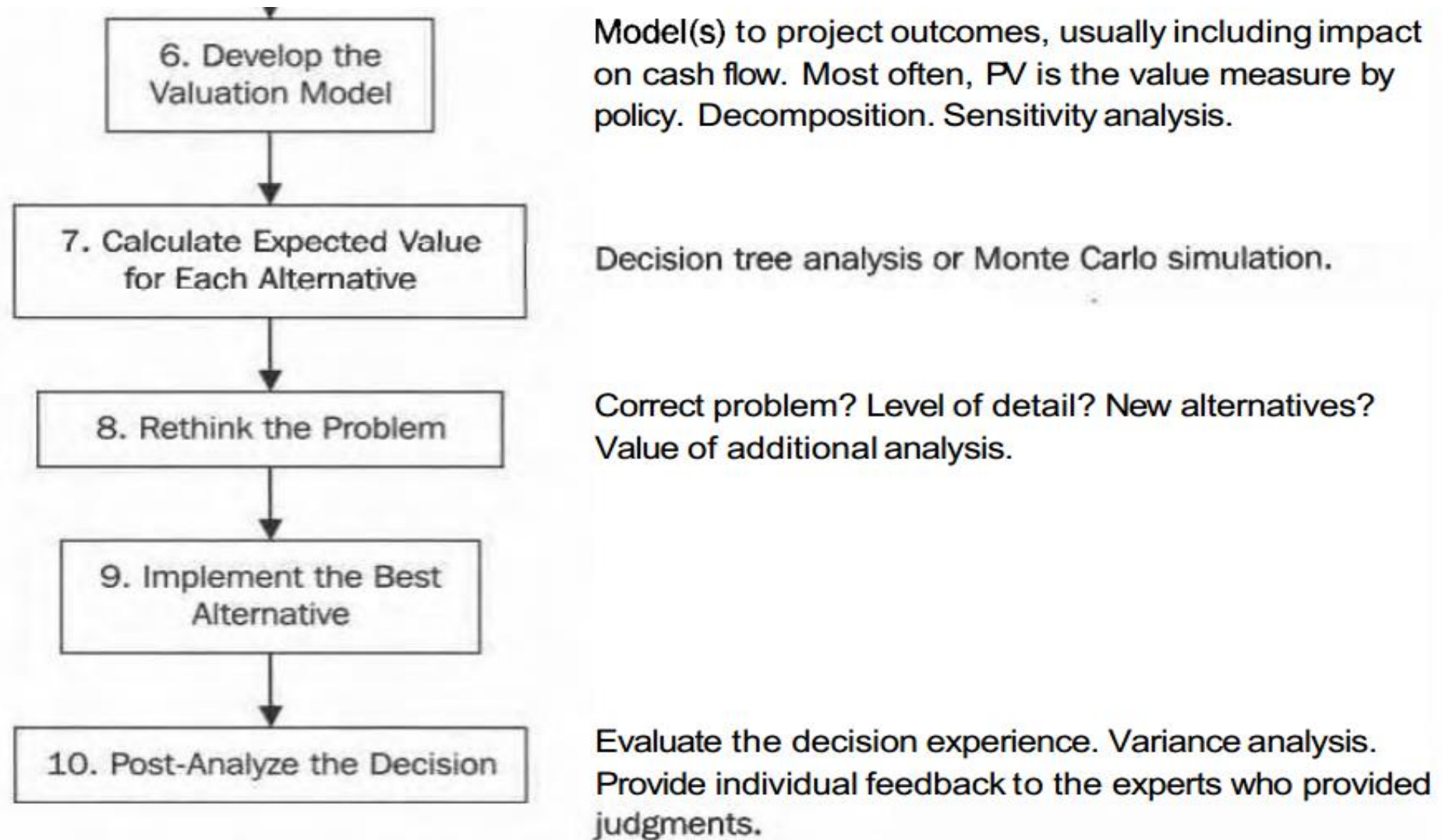


Figure 2.1 Decision Analysis Process

1. Proactively Identify Decision Opportunities

Most of us are so busy that we seldom go looking for problems. However, there may be better opportunities to add value than what we have planned. Be proactive in creating or identifying decision-making opportunities. Brainstorming techniques are helpful.

A SWOT analysis is a good source of ideas: performing a situation analysis; identifying Strengths, Weaknesses, Opportunities, and Threats. Follow this with planning your strategies and tactics.

تحليل نقاط القوة والضعف والفرص والتهديدات "SWOT Analysis" ، التحليل الرباعي

تفحص المشروع من أربع جهات وهن:

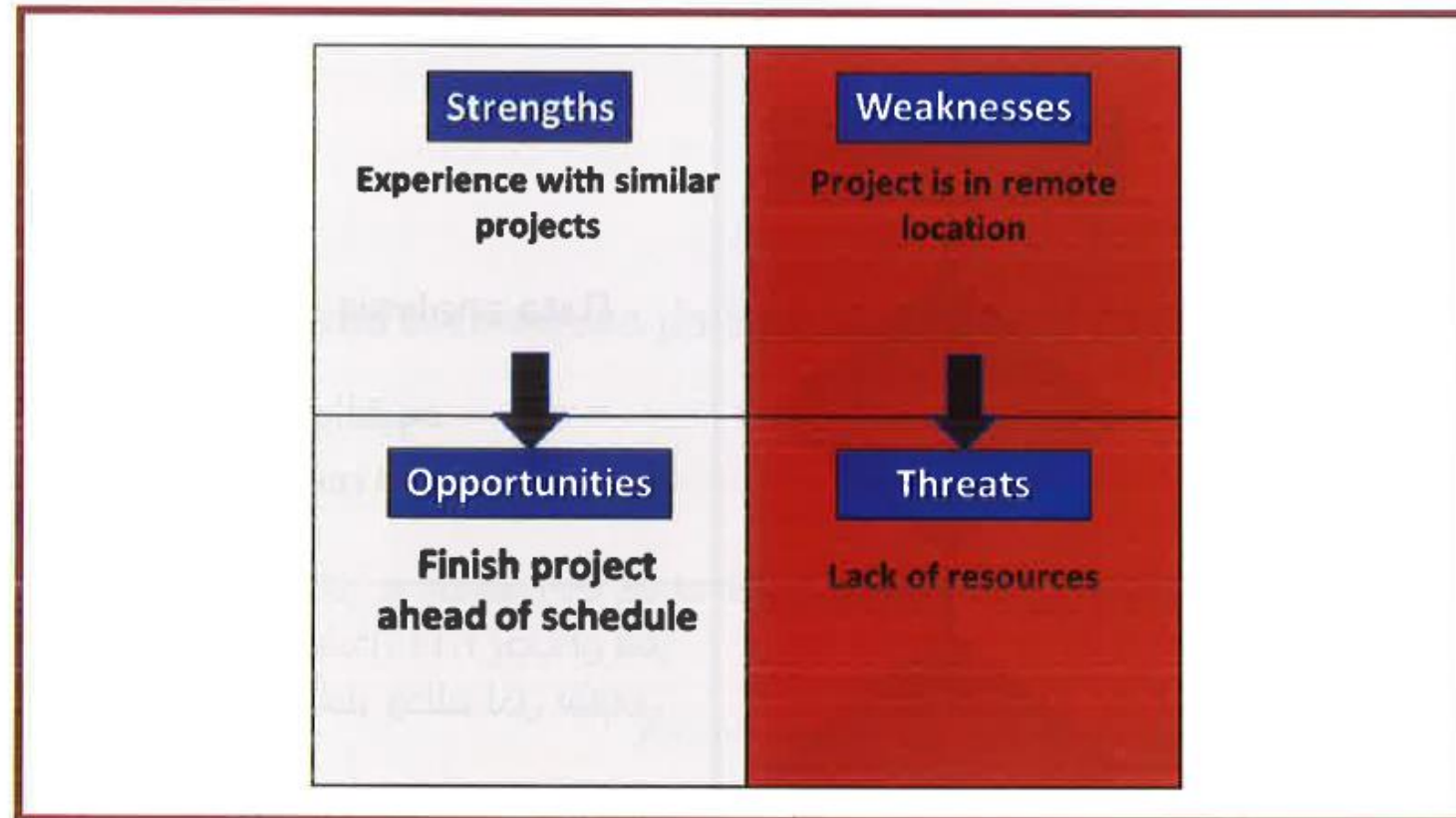
التهديدات

الفرص

الضعف

القوة

تحدد أي فرص للمشروع قد تنشأ من نقاط القوة وأية تهديدات ناتجة عن نقاط الضعف. الشكل 8,11 يعرض مثال على تحليل نقاط القوة والضعف والفرص والتهديدات "SWOT Analysis"

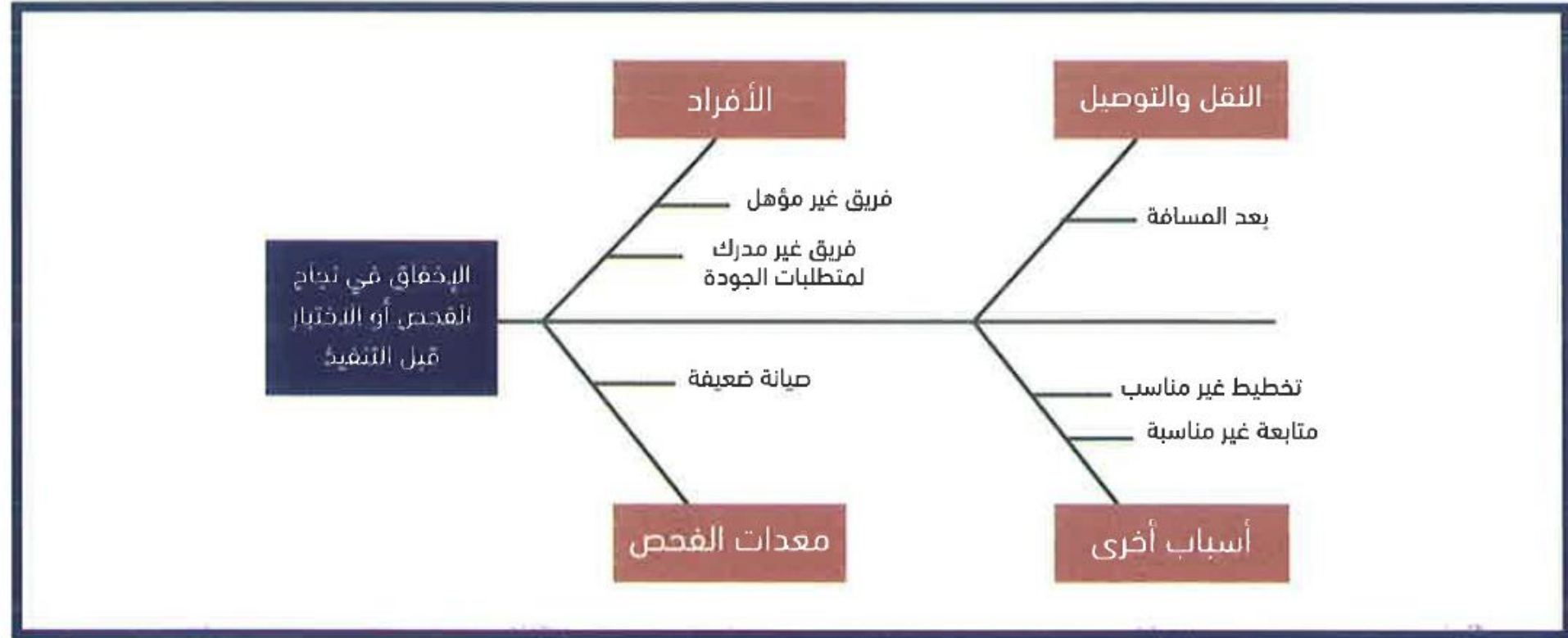


2. Define the Problem

Ask exactly what is the problem we want to solve. Are we addressing a root problem or merely a symptom?

People often talk about framing a problem-that is, defining the boundaries. What is the context of the decision in terms of corporate mission, goals, and strategy? What are the constraints, and how firm or real are they?

Root- Cause analysis



الشكل 15,8: مخطط السبب

Does this decision affect other decisions? Are there any synergies? Some times we need to expand the scope of the evaluation model to encompass effects of this decision on other projects and operations.

Step 2, if not Step 1, is a good time to involve the decision maker(s) and stakeholders. Communication with and the support of these people are important to project success. Further, they may have ideas and important information to contribute.

3. identify Alternatives

Good decision-making opportunities (Step 1) and good alternatives are more important than the actual evaluation methods. Ensure that plenty of time and attention are devoted to this step. Be creative. For a complex problem, such as designing a facility, there are often several stages of design decisions. Perhaps you should determine the best technology and location first; then fine-tune the configuration.

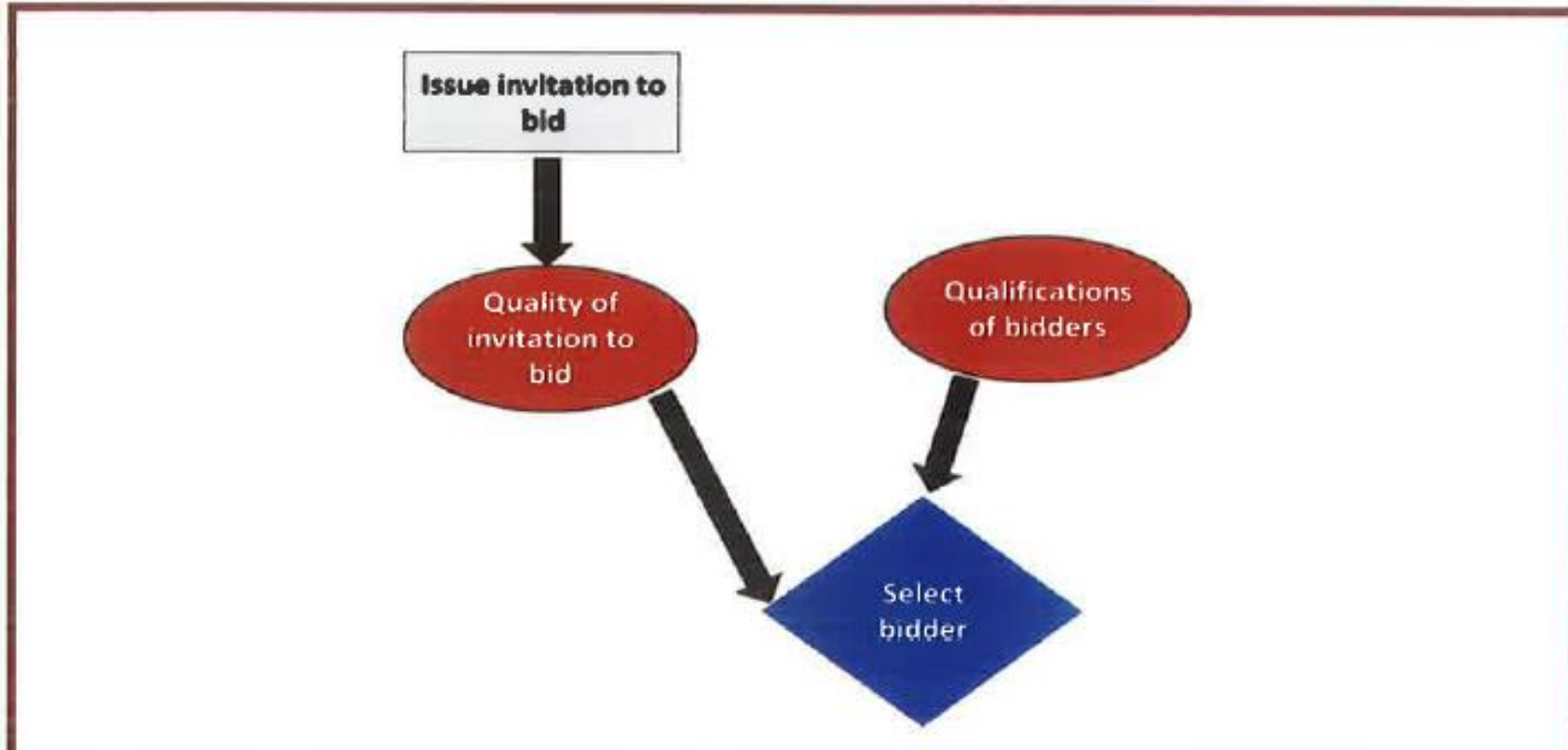
4. Develop the Decision Model

Develop a map, diagram, or outline of the decision problem. This should include the alternatives and possible outcomes of each. Decision trees and influence diagrams are good techniques, because they provide an illustration of the problem. In some cases, flow diagrams or scripting may be more convenient.

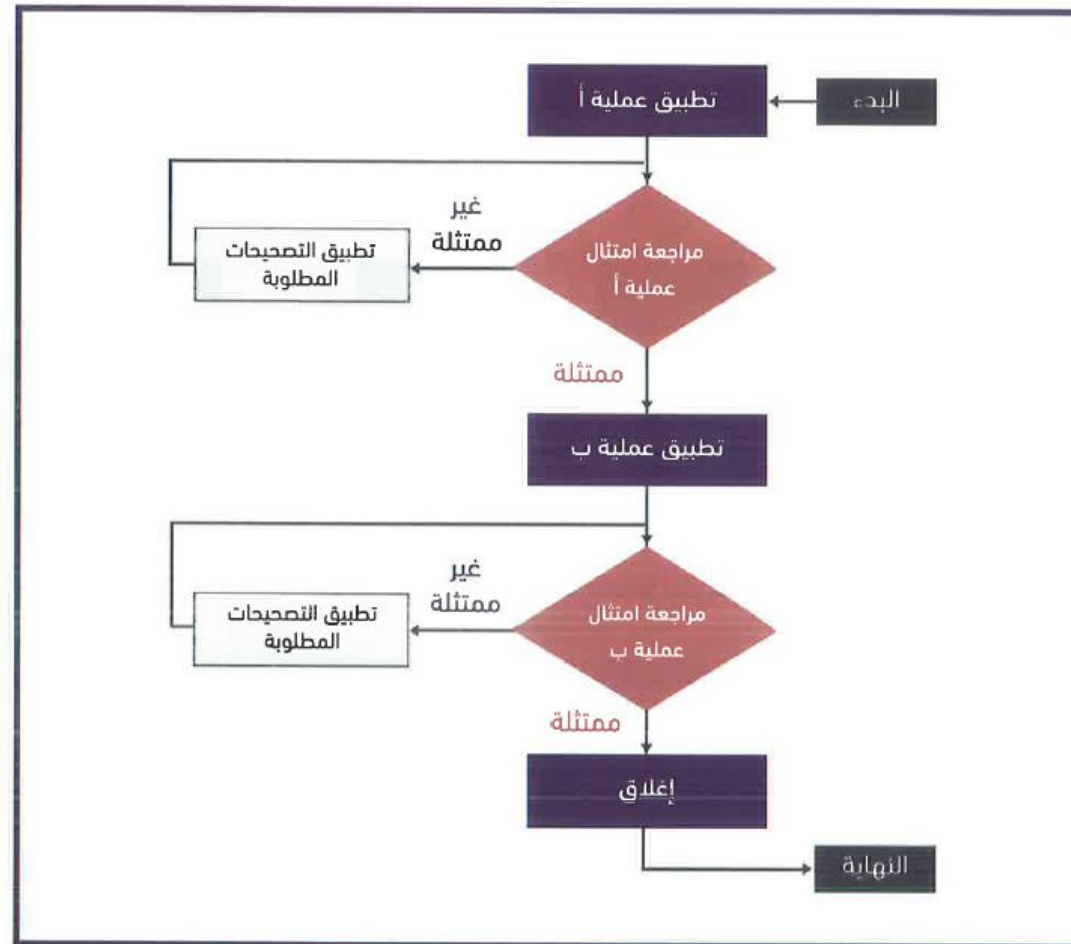
Identify the decision and chance events, their relationships and sequence.

مخططات التأثير Influence diagrams

- هي أدوات رسومية مساعدة لصنع القرار في ظل حالة الشك.
- يمثل حالة المشروع كمجموعة من الكيانات والمخرجات والتأثيرات التي توضح علاقاتها وتأثيراتها كما هو موضح في الشكل 19.11.



مخططات القرار او العمليات Flow diagram



5. Quantify Judgments about Uncertainty

From Step 4, we know what chance events are included in the model. Usually, we enlist the most knowledgeable available person to judge a chance event (as a probability distribution). We also need the expert's judgment about any relationships (correlations) with other variables in the model.

Sometimes a chance event is difficult to judge directly. Decomposing the system further and building a submodel may be a good way to develop a distribution for a variable in the top-level decision model. Sometimes there may be multiple experts, or at least opinions, involved with a chance variable. It is the decision maker's responsibility to designate those to provide the judgments going into the model. This includes any opinion-weighting or tie-breaking rules.

6. Develop the Valuation Model

We need a means to determine a value for every possible outcome, combinations of decision and chance variable outcomes. The core of the model- and the most work if it is a special evaluation-is usually a deterministic operations and cash flow model. Commonly in business, the model projects incremental net cash flow and present value. What scale you use comes from your decision policy.

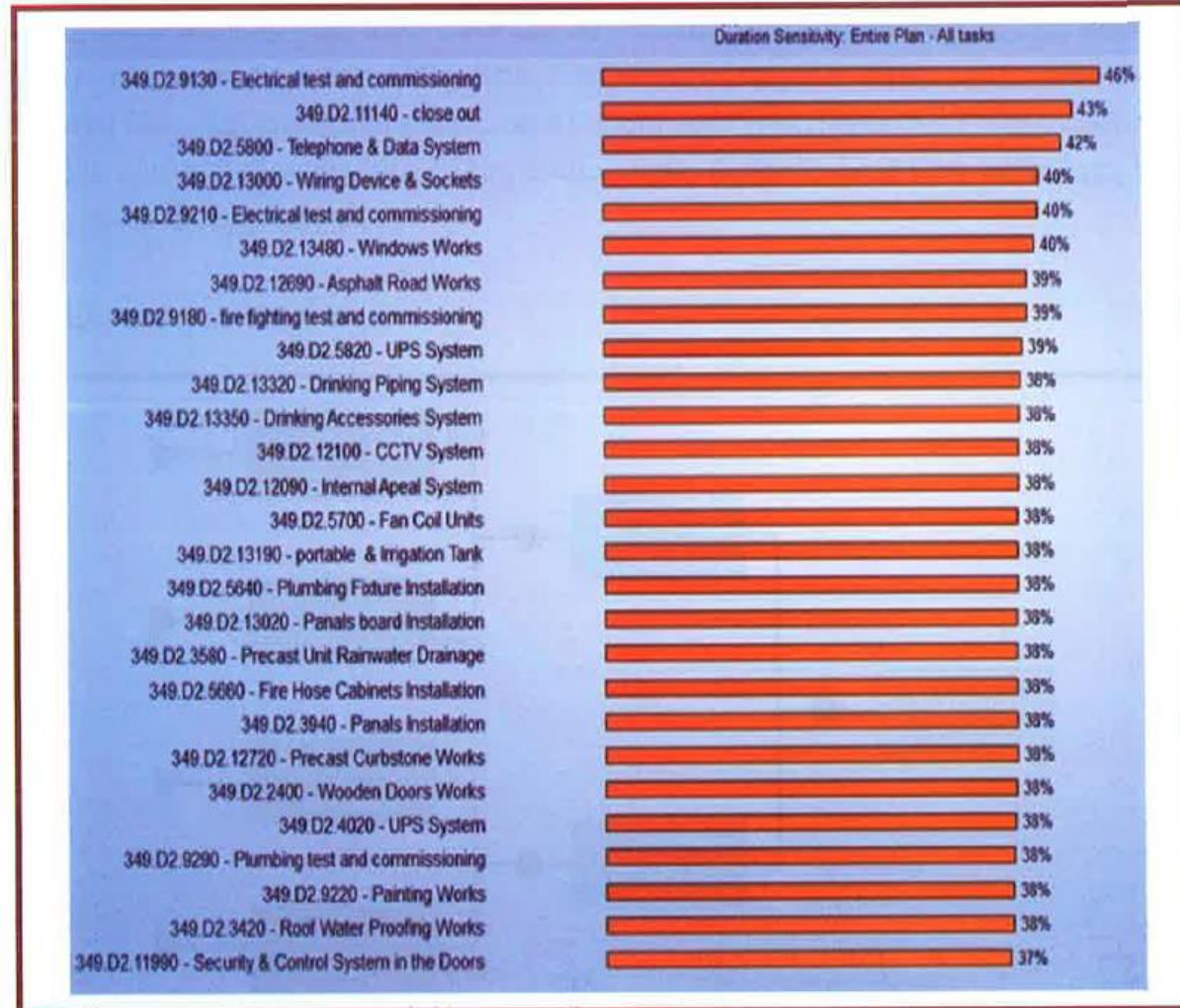
Utility scales are useful for risk-averse organizations and for those with multiple criteria. If using multiple criteria, your decision policy should describe the multicriteria value function. For every project scenario, we want a single number to measure the quality of the outcome.

The valuation model links to the decision model, and vice versa. The valuation model must generate a value for every possible scenario generated by the decision model. That is, every combination of decision and chance event outcomes is a unique scenario, and the decision model tells the casMow model what are the decision and chance variable values of the scenario.

If you have an existing template or economic model, we can often do this deterministic modeling step very quickly. For new problem types, creating the model might require considerable time and effort. Decomposition and sensitivity analysis are important modeling techniques. Work to keep the model as simple as possible for the purpose at hand. We seldom need to optimize every possibility. Discard (prune) alternatives as soon as you determine that they are inferior.

تحليل الحساسية Sensitivity analysis

يوضح أي من المخاطر الفردية أو أنشطة المشروع تؤثر بشكل كبير على مخرجات المشروع (الوقت والتكلفة). الشكل 18,11 يوضح نتائج تحليل الحساسية وهو المخطط الإحصائي (تورنادو) والذي يظهر أنشطة المشروع ذات التأثير الأعلى على زمن المشروع.



For unimportant chance events, set these to single values or combine the effects with other variables. Remember, we only need to do analysis to the point where we know the best alternative. For optimization or valuation problems, ensure that additional analysis work costs less than the incremental benefit.

على المدى الطويل	فورية	
ملموسة وعلى المدى البعيد	ملموسة وفورية	ملموسة
غير ملموسة وعلى المدى البعيد	فورية غير ملموسة	غير ملموسة

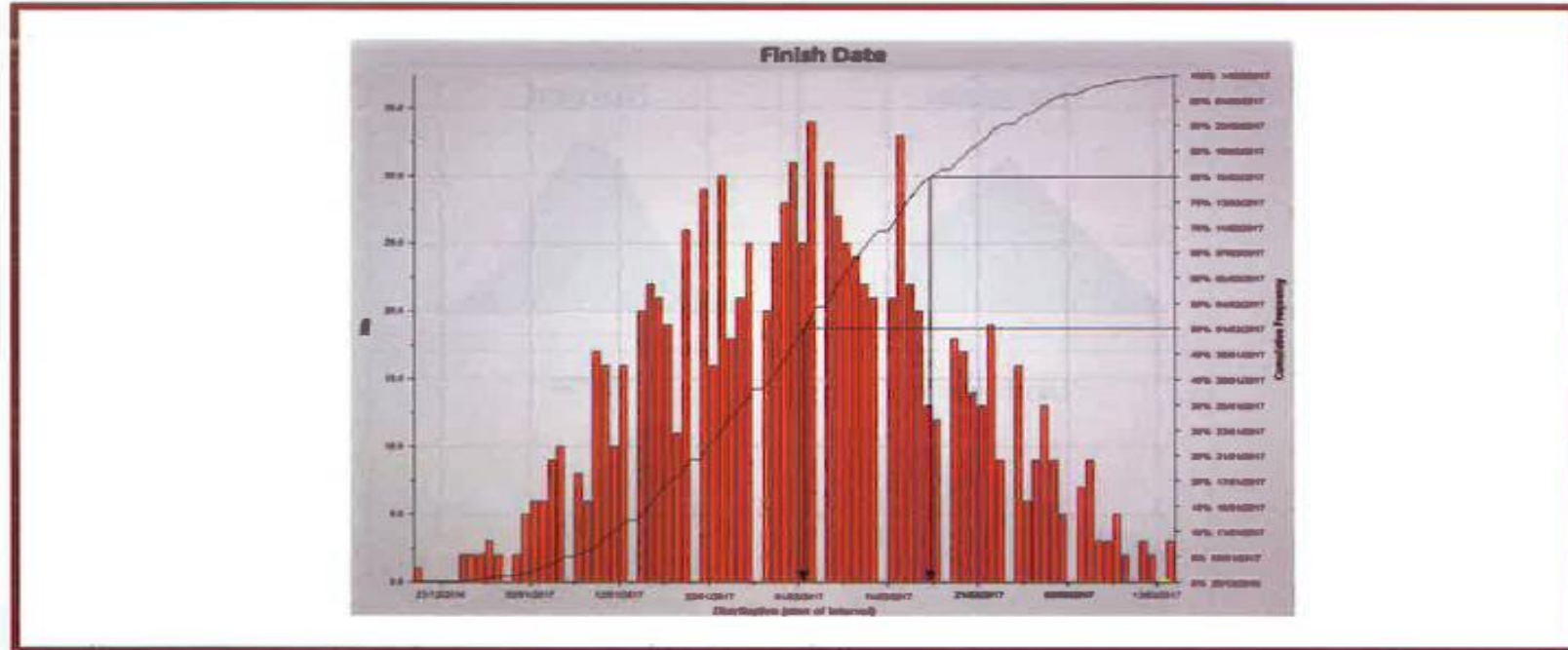
الشكل 6,8: التكلفة مقابل المنفعة

7. Calculate Expected Value for Each Alternative

Decision tree analysis and Monte Carlo simulation are the workhorses of decision analysis. There is a calculation method for influence diagrams, closely aligned with decision trees. Payoff tables and other methods are suitable for some simple situations. It is often expedient to use multiple expected value-solving methods in the same evaluation—for example, using trees for what trees do best and simulation for what simulation does best.

المحاكاة Simulation

- تهتم المحاكاة بالنمذجة و محاكاة دمج تأثير المخاطر الفردية وأي شكوك أخرى لتحديد التأثير على أهداف المشروع.
- تحليل مونت كارلو Monte Carlo analysis هو الأسلوب الشائع المستخدم لتقييم التكلفة وجدولة المخاطر باستخدام تقديرات التكلفة والأزمنة الخاصة بالمشروع كمدخلات.
- يتم إضافة الشكوك وعدم اليقين داخل التقديرات أو أنشطة الجدول الزمني و آلاف التكرارات يتم تنفيذها بشكل آلي باستخدام برمجيات الحاسب الآلي والتي تختار قيم عشوائية (من مجالات القيم المحتملة) لإكمال كل تكرار.
- تمثل المخرجات مجموعة النتائج المحتملة للمشروع مثل تاريخ انتهاء المشروع وتكلفة المشروع عند الاكتمال. الشكل 17,11 يوضح مخرجات عملية إجراء التحليل الكمي للمخاطر والتي يعبر عنها بمخطط بياني يظهر تاريخ نهاية المشروع ومستوى الثقة المناظر له.



شكل 17.11 : مخرجات تحليل مونتوكارلو

8. Rethink the Problem

Are you solving the right problem? Do the decision and cash flow models have the appropriate level of detail? Does this need to be solved now? Or at all?

While this ten-step process may look linear, often there is necessary rework because of new information or a new insight about the problem. You may need to loop back to an earlier step to include a new alternative or risk. What is the value of additional analysis? Are there cost-effective sources of information that would better define some chance events? Are there ways to add control to the strategies, mitigating threats and enhancing opportunities?

9. Implement the Best Alternative

We should consider who will implement the decision in our evaluation. Ideally, the person responsible for implementing the decision has also been involved in the evaluation process. Project feasibility analysis involves some early project planning. This carries forward into project implementation and detailed planning.

Monitor the risks and assumptions throughout the project life cycle. Anticipate where there may be decision points to reallocate resources. Continue looking for decision-making opportunities. Decision analysis methods are useful also for the many decisions a project manager faces.

10. Post-Analyze the Decision

Perhaps the most important single way to improve the quality of decision making in your organization is a post-implementation review [1]. Plan and budget to get the project team members together again to review the decision process. What did you learn? Did the decision model prove adequate? Were the outcomes of chance events in the middle regions of the distributions? Feedback is most effective when it is personal to the experts who provided inputs to the evaluation.

A variance analysis may be a useful tool. Analyze the factors and contributions to the difference (variance) between forecast and actual outcome. The learning organization is a popular concept in modern management. What are the lessons learned that you want to preserve to share with others in the organization? Models, templates, data sources, and such might prove useful to later teams.

Placing a copy of the decision analysis document might provide inspiration to others pursuing similar evaluations. The post implementation review is not a "search for the guilty." I suggest not inviting managers outside the project evaluation team. The primary purpose is to help team members recognize and learn from the experience.

The decision analysis process works best when everyone is motivated to provide his best, unbiased efforts. Nothing causes people to become conservative faster than a fear of punishment. We want to reward people for making good decisions-not for experiencing good outcomes.

Who Does All This Work?

You and your colleagues do! Except perhaps for Step 6, developing the deterministic valuation model, all of this work is best performed by people close to the problem. They are typically engineers, scientists, and others who understand the technology, problem, and project.

Usually, the technical problems are also people problems. The project evaluation team must often sell the recommendation to not only decision makers, but to other stakeholders as well. Involve these people early and throughout the process.

This ten-step evaluation process should save you time. There should be little or no need for separate "what-if" analyses; the decision model has already considered the possibilities.

I hope you will find this general problem-solving process useful in keeping the project team focused and directed to the evaluation task at hand.

Example for decision analysis: Tree Analysis

تحليل شجرة القرار Decision tree analysis

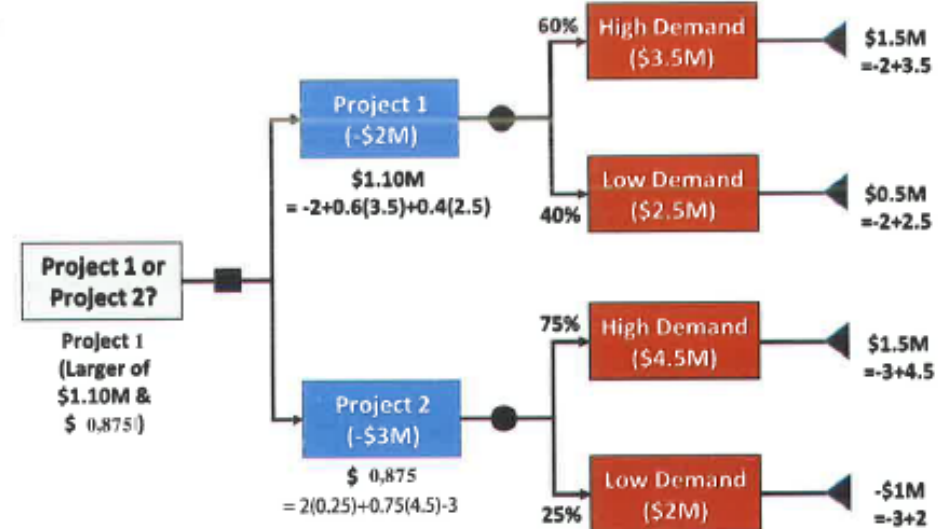
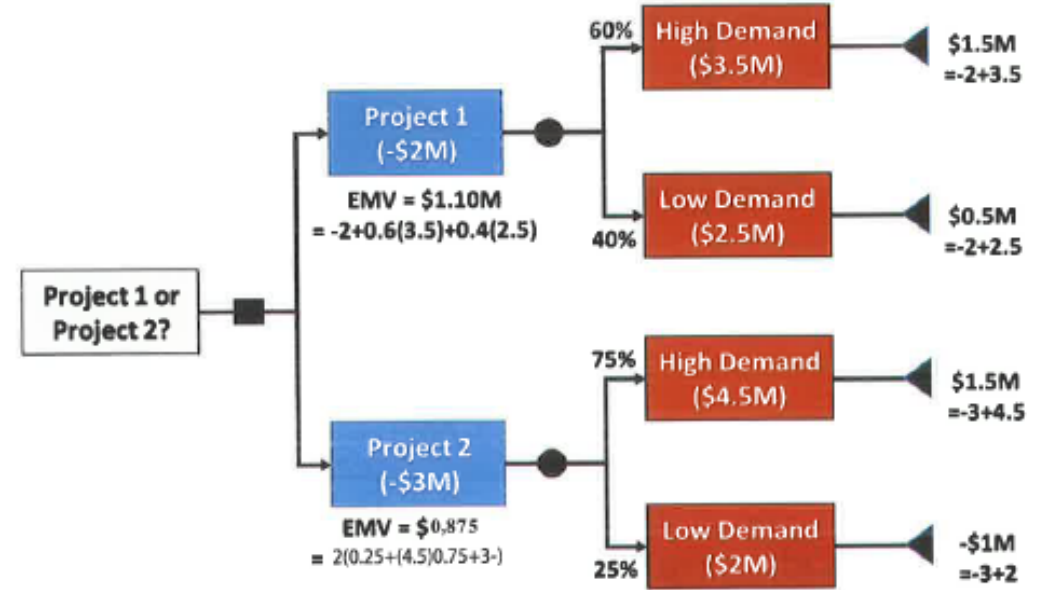
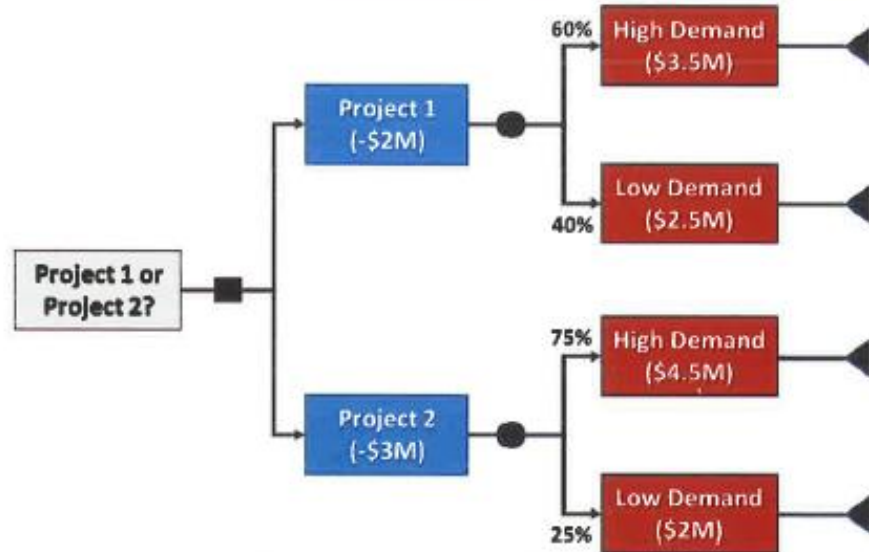
- تستخدم شجرة القرار لدعم اختيار أفضل مسار في عدة مسارات بديلة للعمل.
- تظهر المسارات البديلة خلال المشروع في شجرة القرار باستخدام فروع تمثل القرارات أو الأحداث المختلفة التي يمكن أن يكون لكل منها التكاليف المرتبطة بها ومخاطر المشروع الفردية ذات الصلة (بما في ذلك التهديدات والفرص).
- مخرجات تتبع مسار محدد قد تكون إيجابية أو سلبية.

مثال

تهدف منظمة إلى إنتاج مشروع واحد من بديلين متاحين، يتمثل هدف المنظمة في زيادة الأرباح. سيتكلف إنشاء المشروع الأول 2 مليون دولار، بينما سيتكلف المشروع الثاني 3 ملايين دولار. هناك احتمال بنسبة 60 % أن يكون هناك طلب كبير على المشروع الأول، مما سيؤدي إلى ربح قدره 3.5 مليون دولار، بينما في حالة انخفاض الطلب، فإن الربح سيكون 2.5 مليون دولار فقط. بالنسبة للمشروع الثاني، فإن احتمال ارتفاع الطلب هو 75 % مما سيؤدي إلى ربح قدره 4.5 مليون دولار، بينما في حالة انخفاض الطلب، فإن الربح سيكون 2 مليون دولار. باستخدام شجرة القرار، ما المشروع الذي يمكن اختياره لتحقيق أعلى ربح؟

ثم نبدأ بحساب قيمة المسار الصافية لكل مسار :

الإجابة: نبدأ برسم شجرة القرار.



Recourse:

RISK and DECISION ANALYSIS in Projects

Second Edition

By: John Schuyler

Chapter 2