

Multi-attribute Utility (MAU) Models

Multi-attribute utility (MAU) models are mathematical tools for evaluating and comparing alternatives to assist in decision making about complex alternatives, especially when groups are involved. They are designed to answer the question, "What's the best choice?" The models allow you to assign scores to alternative choices in a decision situation where the alternatives can be identified and analyzed. They also allow you to explore the consequences of different ways of evaluating the choices. The models are based on the assumption that the apparent desirability of a particular alternative depends on how its attributes are viewed. For example, if you're shopping for a new car, you will prefer one over another based on what you think is important, such as price, reliability, safety ratings, fuel economy, and style.

are open for all to see, it's possible to make any number of changes and review the results. For example, if it appears that some attribute is too important in determining the results, the weights can be adjusted to produce different results.

What are they?

Methods to evaluate alternatives. MAU models give you a way to score, evaluate, and compare possible alternatives. They offer a quantifiable method for choosing options.

Identify valuable attributes. To use a MAU model, you must identify all the attributes needed to evaluate the alternatives. They are assigned a weight that reflects their importance to the decision. You may assign a value of 3, 2, or 1 to each attribute, depending on its importance. Or you may use 100 points and distribute them over the attributes according to their importance.

Score your options. You then give a score to each of the alternatives for each attribute. You may use a scale of 1-10. Each alternative's score for each attribute is then multiplied by the weight of that attribute, and the total is calculated. That total represents the value (or utility) of that alternative, and can be compared to the same calculation for the others. If it is a group process, each member of the group scores the attributes for each alternative and the group's ratings can be totaled or averaged.

Explore potential consequences. A MAU model can be used to further explore the consequences of changing the attributes, their weights, or the scores they received. Since the criteria

are open for all to see, it's possible to make any number of changes and review the results. For example, if it appears that some attribute is too important in determining the results, the weights can be adjusted to produce different results.

What are they good for?

Clear selection criteria. One of the most useful benefits of using a MAU model is that it makes clear to all involved the basis on which the alternatives are being evaluated. This is particularly important in group decision making situations in which many different points of view and decision alternatives have to be reviewed and taken into account.

Some limitations and considerations

Requires group consensus. MAU models are typically used in a group situation. To be effective there, the group must be able to come to consensus on the attributes in the model and on the rough range of weights to be used. Achieving this consensus may be very difficult and time consuming, or even impossible with some groups.

Conflicts often arise. The level of detail and specification necessary in the discussion of attributes and their weights can result in considerable conflict and contention, rather than the move toward consensus.

For more information

Edwards, W. (1982) **Multiattribute Evaluation**. Beverly Hills, CA: Sage Publications.

SWOT Analysis (Strengths, Weaknesses, Opportunities, Threats)

SWOT analysis is a simple framework to help answer the question, "What are the prospects for this project's success?" The approach recognizes that any project should be examined for both positive and negative influences from internal and external perspectives. A SWOT framework prompts you to look in detail at both sides of the coin. That is, the strengths and weaknesses of your integration initiative are only meaningful in terms of the opportunities and threats in its environment. Good strategy means you must look both internally and externally. In writing about SWOT analysis, John Bryson quotes Sun Tzu, from the **Art of War** :

So it is said that if you know others and know yourself, you will not be imperiled in a hundred battles; if you do not know others but do know yourself, you win one and lose one; if you do not know others and do not know yourself, you will be imperiled in every single battle.⁴

What is it?

Identify SWOT elements. To achieve this knowledge of yourself (strengths and weaknesses) and of others (opportunities and threats) requires identifying the SWOT elements and analyzing them in depth. This is typically done in interactive groups where people can discuss, assess, and elaborate on what is identified in each category.

Maximize the positive, minimize the negative. The analysis and deliberation are designed to identify ways to take advantage of your plan's strengths and exploit opportunities, as well as minimize the impacts of weaknesses and protect against threats.

What is it good for?

Known objective. SWOT analysis is best suited to a stage in planning when the nature of the objective is reasonably well known. It is a useful way of testing the feasibility of your project objective.

Determine how to move forward. This type of analysis helps you start identifying what will be needed to move your project forward.

Express different viewpoints. The interactive process can provide people with an opportunity to express their views about the project and discuss their implications. Advocates of a project tend to emphasize strengths and opportunities. Opponents tend to emphasize weaknesses and threats. Neither creates the balanced or comprehensive analysis needed for successful planning. Using the SWOT framework provides legitimate exposure for both perspectives and an opportunity to reconcile opposing points of view.

More planning. The results of a detailed SWOT analysis also provide valuable material for continued planning and support- generating activities. The strengths can be presented and emphasized to potential supporters. Discussion of weaknesses and threats provides useful information for strengthening the project or plan where possible, or anticipating the effects of environmental threats.

Some limitations and considerations

Information quantity, quality. The key to effective SWOT analysis is the quantity and quality of available information. Participants' understanding of your project, its resources, and weaknesses must be deep and detailed. Similarly, analysis of the environment in terms of opportunities and threats must be based on thorough scanning and collection of data from a wide variety of sources.

Predict the future. Complete information about the environment is never available and projections about future events and trends are always subject to error. So the SWOT analysis must include consideration of the reliability of the information used and of the conclusions reached. Considerable technical resources may also be needed in some circumstances to provide forecasts and projections for assessing the opportunities and threats in the environment.

Shared goals. The process of SWOT analysis is based on the assumption that the participants all share the general goal of creating a good project and achieving your organization's objectives. This, of course, is not always true. Because the process is dependent on information provided by participants, as well as their collaboration, the analysis may be vulnerable to disruptive or subversive behavior.

4 John M. Bryson. **Strategic Planning for Public and Nonprofit Organizations**. San Francisco, CA: Jossey-Bass, 1995, p. 82.

Cost-benefit Analysis and Cost-performance Analysis

Cost-performance and cost-benefit analyses are ways of answering the questions, "Is this worth doing?" and "How will we know whether it was worth it when we're done?" These tools are methods for assessing the value of a project by comparing its costs to measures of its performance, or more generally to the value of benefits it produces. The analysis requires accurate cost data, as well as measures of performance in appropriate units and overall benefits. Cost- performance measurement is narrower in that it deals only with measures of performance as the basis for comparison.

Cost and performance data can be obtained from operational records, direct observation, surveys, or group meetings at which those who perform the operations report and discuss costs and performance measures. Both one-time costs and ongoing costs should be included.

What are they?

Measure system costs. Working out the cost side of cost- benefit analysis requires careful attention to what cost information is relevant, what's available, and how it can be interpreted and used. Although it can seem like a straightforward task, a comprehensive cost analysis can be quite complex and demanding.

While it is not possible to present a comprehensive description of cost analysis here, the basic framework table below provides a useful approach and guide for further detail work.

Cost Analysis Framework			
Reason for Incurring Cost (object of cost or expenditures)	Direct Cost	Indirect Cost	Opportunity Cost
Personnel			
Equipment			
Supplies			
Utilities			
Contractual services			
Facility construction			
etc.			

Definition of cost. A cost is something of value that is given up or exchanged for a particular reason. It might be as obvious as the financial outlay for some new equipment or as subtle as the extra time it takes a supervisor to explain new procedures to a staff member. An effective cost analysis takes into account who is involved in these exchanges, what they may be giving up (incurring costs), why they would be expected to do so, and what the organizational consequences may be. A framework for identifying types of costs is useful in this task, and is shown in the table. It is useful to describe costs in terms of at least two concerns: the purpose of the cost, that is, what is the result of the exchange, and the impact of the cost on the organization's resources.

In the table, the rows provide the places to identify the reasons for incurring the cost. A typical budget contains standard categories of reasons (or objects) for costs or expenditures. These can be in terms of program objectives (as in a program budget), or in functional terms (such as legal services, personnel, etc.), or by the specific goods, services.

Separate direct, indirect opportunities of costs. The impacts on the organization can be separated into the three types shown in the columns of the table: **direct** , **indirect** , and **opportunity** costs. Direct costs of a new system or integration initiative are usually the easiest to identify and analyze, since they typically are the financial costs that are part of ordinary budget making and planning. A carefully worked out and detailed budget for an integration initiative is a necessary part of the planning and business case development.

However, a budget is not a complete cost analysis, and may miss part or all of the other kinds of costs. Indirect

costs are usually based on estimates or pro-rating of shared resources, such as portion of infrastructure maintenance and depreciation or overall administration expense. These costs are usually more difficult to identify and analyze, since the estimates they require are often based on uncertain assumptions and limited knowledge of actual impact. But most organizations have developed ways of estimating these costs, and thus they should be part of the cost analysis.

The problem is a bit more difficult when it comes to opportunity costs, the losses or costs to the organization that result from implementing the new system rather than the alternative uses of those resources. The judge who spends several hours learning a new computer system, for example, instead of reading a law journal has incurred an opportunity cost. These costs are real and can be important, but are very difficult to measure and document. Participants in the development and implementation of a new system are often very sensitive to opportunity costs, since these affect their day- to-day work. But these costs are not part of any formal accounting system and so may be ignored by planners and budget makers, often to the detriment of implementation. At the very least, a well-developed business case should attempt to identify the possible opportunity costs involved in an initiative and discuss ways to ameliorate negative impacts.

Assess risks. The consideration of costs should include risk assessment. Risks may be inherent in any of the internal or external factors that could affect the success of your project. These may include such potential risks as staff and client resistance to change, immaturity of a new technology, personnel limitations, technology failures, and expected changes in the technical, political, or management environment.

Define benefits. The performance estimate also includes a list of the expected benefits of developing the system. Typical benefit categories include "faster," "better," and "cheaper." So the analysis should describe precisely how which products or activities will be better, how much faster they will be, and how much less they will cost.

Measure performance. The analysis should also include a statement of how each benefit will be measured to see if it has been achieved. Some measures will be relatively easy to describe in quantitative terms, especially those in the cheaper and faster categories. Others that we usually think of as qualitative (e.g. "client satisfaction") can often be translated into measures through surveys and interviews. To identify broader, societal benefits, you must think as much as possible in terms of outcomes and results rather than outputs. Outcomes are benefits in terms of how an agency staff member, business partner, or constituent will have their lives changed, rather than how many hits your World Wide Web page will receive. The benefit is the impact your effort will have on society rather than the number of clients served.

What are they good for?

"Bottom line" information. Cost, risk, and performance analyses produce the necessary bottom line information on which you base the final decision about whether to go ahead with your project. The integration project plans and expectations will have been fine-tuned by developing the other evaluation products described in this appendix. Before a final implementation decision is made on the project, however, the costs and benefits need to be anticipated and fully understood by the ultimate decision maker.

Project evaluation. The results of your cost-benefit and cost- performance analyses form an important part of project evaluation. After the project is completed, these measures can be used to evaluate whether it actually achieved its goals within its expected budget. This assessment is an important factor in planning for future activities.

Some limitations and considerations

Complex environment. A comprehensive analysis of your project's impact may be difficult to prepare because of the complex environment in which public sector programs reside, and the many factors that may affect the intended outcomes of the project.

Hit "cheaper" and "faster," but forget "better." Project managers are often more experienced with cost analyses, and it may be easier to develop projects that fit into the cheaper and faster categories. While these are definitely important, many innovative applications also address the better category. This typically often requires more resource-intensive assessment methods.

Risk Analysis

Risk analysis covers a range of techniques and analysis tools used to assess the likelihood of failure or undesirable outcomes from decisions or policies. As one researcher put it, risk assessment "is the application of...knowledge of past mistakes in an attempt to prevent new mistakes in a new situation."⁵ The methods rely primarily on mathematical modeling, statistics, uncertainty, and decision analysis.

What is it?

Find threats that can derail success. As applied to planning and decision making in IT projects, the most important elements of risk analysis are identifying the threats to success and assessing the probabilities and potential costs of the threats materializing.

Learn from past mistakes. Use a variety of modeling, statistical, and analysis tools to examine past projects, determine where mistakes were made, and devise methods to avoid repeating them.

What is it good for?

Identify threats, possibility of damage. Careful risk analysis is needed to provide two kinds of information. One is a clear and detailed identification of threats or possible mistakes that can damage an initiative. The other is an estimate of the likelihood of each kind of damage actually occurring.

Outline internal problems. A number of important risks are associated with innovations in business processes. These include internal resistance to change or even subversion of objectives by unhappy participants. The costs and complexities of needed changes may be underestimated, leading to insufficient resource commitment. An inadequate or inaccurate model of the business process may be used, or inaccurate data about that process may lead to mistakes. Differences in the cultures of the organizations involved may produce conflicts that undermine success. Competition or lack of trust can inhibit communication and collaboration. And it may be impossible to generate the support from top leadership to sustain large-scale changes.

Identify political opposition. Political opposition can lead to problems and barriers. Risk analysis should involve the positioning analysis described earlier, with special attention to estimating the strength of likely opposition from influential players. Risks can include failure to manage expectations about success or immediate results, as well as missing the possible influences of other large initiatives on the political agendas of supporters and champions.

Define IT risks. A number of risks are associated with the use of information technology, including rapid obsolescence and emergence of alternative technologies after investments have been made. Avoid the tendency to over-promise the benefits of technology or underestimate the effort of implementation- both lead to disillusionment and loss of support.

Describe environmental risks. Planning and risk analysis should take into account the kinds of policy shifts, as well as the sources of support and opposition to such policy changes, that constitute the greatest threat to your initiative. Demands and costs of human resources can also shift, due to labor market forces, and put a project in jeopardy. Careful environmental scanning can help mitigate or anticipate these possible threats.

Some limitations and considerations

Technical problems. The technical problems of statistical risk analysis can be substantial, since they depend on models of threats and probabilities. For complex projects, such models may be unavailable or even impossible to construct. In addition, statistical risk analysis often depends on historical information that may be unavailable for new projects, technologies, or collaborations. This problem may be mitigated in some circumstances by tools, such as system dynamics models or other simulations that allow for exploration of various scenarios or alternatives.

Long-term perspectives, short-term adaptability. This basic dilemma in mitigating and managing risk is especially acute in technology projects. IT plans and system designs based on current knowledge and technologies are unavoidably at risk. Systems built with smaller components or modules can provide for more flexible response to rapid changes, but their success depends in large part on accurate anticipation of technology trends, which is demanding and error-prone at best.

For more information

Kammen, D.M. & Hassenzahl, D.M. (1999). **Should We Risk it? Exploring Environmental, Health, and**

Appendix A. 4 Tools for identifying & evaluating options

Technological Problem Solving . Princeton, NJ: Princeton University Press.

Kemshall, H. & Pritchard, J. (1996). **Good Practice in Risk Assessment and Risk Management** . Bristol, PA: Jessica Kingsley.

Stern, P.C., Fineberg, H.V., & National Research Council (1999). **Understanding Risk: Informing Decisions in a Democratic Society** . Washington, DC: National Academy Press.

5 R. Wilson and E.A. Crouch, Risk assessment and comparisons: An introduction , **Science** , 236-267 (1987).