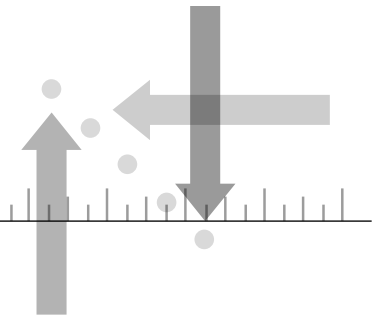

MULTICRITERIA ANALYSIS

Purpose

The purpose of multicriteria analysis is to systematically provide a quantitative comparison across multiple options.

Needs Assessment Applications

Multicriteria analysis is a valuable tool for making decisions on the basis of information collected during a needs assessment. This analysis technique, which is based on the multi-attribute utility analysis frequently used by engineers and architects to select materials,[1] provides a systematic process of assigning and weighing quantitative (or numeric) values to a variety of potential performance-improvement programs and projects. Thus, it provides you with a justifiable process for determining what actions should be taken. As such, multicriteria analysis is a worthwhile tool for comparing across potential improvement activities, which can be particularly beneficial in organizational sectors (such as financial, manufacturing, aviation, construction, disaster management, and so on) that especially value quantitative and systematic comparisons of alternatives.

Advantages and Disadvantages

Advantages

- Multicriteria analysis offers a systematic and quantitative analysis procedure for comparing potential options. This method can be especially valuable if one alternative improvement activity is particularly popular (for instance six sigma, training, coaching, wells, roads, irrigation sys-

tems), even though it might not be the most useful activity for accomplishing desired results.

- Additional variables can be added to the comparison as the field of potential interventions or activities is narrowed. In the end, you can make justified recommendations based on the interventions or activities that score best across a variety of variables.
- Variables in the analysis (for instance, cost, time, expected outcomes) can each be given a weighting that reflects the priorities of the project. For example, if budgets are very tight, then scores related to costs of alternative activities may be weighted at four times the value of expected time to implement the activities.

Disadvantages

- Multicriteria analysis requires a higher level of effort than does some other analysis procedures because information regarding each potential solution (intervention, activity, and so on) is necessary for accurate comparisons. As a result, additional time and resources may be required; therefore, you may prefer to use this method only for high-cost or high-priority needs.
- The multicriteria analysis process can be manipulated by only selecting comparison variables that favor a preferred activity. Or other participants can manipulate their weightings on variables so they produce the results they desire. Such challenges can be controlled, but you have to be aware of the risk in order to ensure that this manipulation doesn't happen to you.

Process Overview

1. Understand that the multicriteria analysis process typically begins when two or more alternative interventions or activities have been identified as potential solutions to a need. Although you can complete the analysis for as many potential solutions as you have, the time and effort required to collect valid information for comparison typically will necessitate that you limit the analysis to the most likely contenders. (For helpful sample templates to serve as job aids, see page 179.)
2. Identify (a) the most important criteria to making the decision and (b) the performance criteria (attributes or characteristics) required of

alternative solutions. Typically, consider no more than five to eight attributes for any decision. Example criteria could include the following:

- Results you can expect after six months
- Total time required
- Number of outputs
- Client satisfaction
- Feasibility of implementation
- Environmental impact
- Ability to accomplish desired outcomes
- Cost of the activity over the first year
- Safety expectations
- Number of people who will be working on the project in the first month

3. Note any "must have" (or "must not have") attributes. For instance, if an activity or intervention must not cost more than the budget set by the organization, then this attribute provides a cap at which alternatives that go beyond the budget are no longer considered. Likewise, if minimal improvements in results must be demonstrated after three months, then potential solutions that cannot meet those specifications should also be dropped.
4. Depending on the context of your decision and as a useful technique, apply weighting to the diverse criteria. The weights differentiate criteria according to their relative importance to the decision. For example, as you select among alternative irrigation technologies, the cost criteria may be twice as important to the decision as the time it will take to implement the technology.
5. To establish weights, discuss the criteria with those who will be part of the decision-making process. During the discussion (which could apply a survey, interview, or focus group technique as an alternative), you should ask questions to establish the relative importance of each performance criteria that you identified in the previous step.
6. In both establishing criteria to apply and weighing those criteria relative to one another, use a number of techniques[2] either separately or in combination, including the following
    a. To assist decision makers, consider using a 100-point system (or ratio method). For instance, of the 100 total possible points, a decision

maker may assign 60 points to the maximum achievement of desired results, 40 points to cost, and 20 points to the number of staff members assigned to the project. Each value can then be divided by the total so that a percentage can be calculated. For example, if participants indicate a weight, on average, of 70 out of 100 for the cost criteria, then .70 would be the weight assigned to cost.

b. Use hypothetical tradeoffs to prioritize criteria or set weights. For instance, ask partners whether they would prefer for the project to be completed several months late and achieve all of its objectives or for it to be completed on time but not achieve all of its objectives. Those establishing the criteria, thereby, have to make tradeoffs regarding which criteria are most important or should have the greatest weight in the decision.

c. Also include costs in the establishing of weights by using the pricing-out method combined with tradeoffs. This method would, for example, ask those establishing the criteria if they would prefer for the project to be completed two months late but on budget or for the project to be completed on time but 2 percent over the set budget.

d. Consider the *swing method*. Imagine, for example, that all of the criteria being considered were at their worst possible level (for instance, the project achieves none of its goals), then ask those establishing the criteria to identify which criterion they would want to "swing" to the highest potential level (for instance, the project achieves all of its goals), and assign this criterion 100 points. Next, ask which of the remaining criteria would be second-most important and swing its potential value. In points, how does the second criterion relate to the previous criterion (for instance, completing the project on budget might be assigned 80 points in relation to 100 points for completing all project goals)? Apply this method until you have identified the criteria to be applied or assigned weights to each criterion.

7. See how the examples in tables 3B.1 and 3B.2 illustrate how applying weighted criteria can influence the results of a multicriteria analysis. Now that you have your criteria (and weights for each when appropriate), it is time to rate each alternative activity on each of the criteria. It is important to use the same scale for each attribute. For example, if you select a scale from 1 to 10 for rating the attribute of client satisfaction (with 10 being given to alternatives that will achieve the highest levels of client satisfaction), then you would also rate the cost attribute from

Table 3B.1 Multicriteria Analysis Table Example

Comparison of Regional Government-Sponsored Alternatives for Providing Temporary Shelters after a Natural Disaster
Ratings: 1–2 = very low, 3–4 = low, 5–6 = medium, 7–8 = high, 9–10 = very high

	Criterion 1 rating Speed in meeting needs	**Criterion 2 rating** Affordability (per unit)	**Criterion 3 rating** Quality of the shelter	**Criterion 4 rating** Durability (up to 12 months)	**Criterion 5 rating** Ease in coordination	***Average rating***
Alternative 1 Canvas tents (small, per family)	9	7	3	2	9	6.0
Alternative 2 Canvas tents (large, 4–6 families)	7	9	3	2	9	6.0
Alternative 3 Construction of temporary wooden structures	4	5	6	7	5	5.4
Alternative 4 Trailers, prefabricated	4	1	9	10	2	5.2

1 to 10 for each alternative (with 10 being given to the alternatives whose cost are most closely aligned with the desired budget).

8. Create a table or spreadsheet with the performance attributes listed in the columns along the top and the potential solutions listed in the rows. For each alternative intervention or activity, include an estimate for each performance criterion.
9. Review the results of the analysis. Just because a single alternative scores the highest doesn't always mean that it is by itself the right choice. In tables 3B.1 and 3B.2, for instance, alternatives 1 and 2 scored the highest overall in the unweighted comparison, suggesting that a combination of alternatives might be desirable. However, in the weighted example, where the option to assign relative value to each criterion was applied, alternative 1 was somewhat superior to alternative 2.

Table 3B.2 Multicriteria Analysis Table Example (with Weighted Criteria)

Comparison of Regional Government-Sponsored Alternatives for Providing Temporary Shelters after a Natural Disaster
Ratings: 1–2 = very low, 3–4 = low, 5–6 = medium, 7–8 = high, 9–10 = very high

	Criterion 1 rating Speed in meeting needs	**Criterion 2 rating** Affordability (per unit)	**Criterion 3 rating** Quality of the shelter	**Criterion 4 rating** Durability (up to 12 months)	**Criterion 5 rating** Ease in coordination	***Sum of weighted ratings***
Weights	.30	.20	.15	.15	.20	
Alternative 1 Canvas tents (small, per family)	9 × .30 = **2.70**	7 × .20 = **1.40**	3 × .15 = **0.45**	2 × .15 = **0.30**	9 × .20 = **1.80**	6.65
Alternative 2 Canvas tents (large, 4–6 families)	7 ×.30 = **2.10**	9 × .20 = **1.80**	3 × .15 = **0.45**	2 × .15 = **0.30**	9 × .20 = **1.80**	6.45
Alternative 3 Construction of temporary wooden structures	4 × .30 = **1.20**	5 × .20 = **1.00**	6 × .15 = **0.90**	7 × .15 = **1.05**	5 × .20 = **1.00**	5.15
Alternative 4 Trailers, prefabricated	4 × .30 = **1.20**	1 × .20 = **0.20**	9 × .15 = **1.35**	10 × .15 = **1.50**	2 × .20 = **0.40**	4.65

10. In most needs assessments and as a useful approach, consider a combination of alternative activities rather than viewing each option as mutually exclusive. You might find that combining alternatives accomplishes desired results and mitigates the potential risks of any activity on its own. In the earlier example, even though alternative 1 (small tents) ranked highest, there might be some basis for choosing a combination of the top three alternatives (small and large tents, plus wooden structures), and eliminating the remaining alternative (prefabricated trailers).
11. Use the results of the analysis and your interpretation of those results as you present decision makers with recommendations about which alternative solutions they should consider.

Note: Also consider using the multicriteria analysis technique to prioritize or rank needs (that is, gaps in results). In this application of the technique, you would work with decision makers to identify the criteria on which they would compare needs in order to set priorities (for example, the numbers of people affected by the continuation of the need, the availability of partners to help address the need, the costs to meet the need, the increasing severity of the need over time, and so forth). Then ask decision makers to compare each option using those criteria.

Tips for Success

- Don't get carried away with adding too many variables to the comparison. It is best to stick to the top five or six highest-priority variables and then to collect valid information for each alternative intervention or activity.
- Remember that no rule says you can select only one activity or solution. As you complete the analysis, keep in mind that a combination of one, two, three, or more potential activities or solutions may be the right choice for your organization and the identified need.
- As another alternative, ask participants to choose from options that include different levels of performance characteristics (for example, would you choose a solution that achieves 80 percent of the desired results over the next three years if it costs twice as much as the solution that achieves 50 percent of the desired results?). Each question in this format should include at least two of the performance characteristics at opposing levels so that you can move participants toward making a decision about which are the higher-priority characteristics in relation to the others. This procedure is an adaptation of analytic hierarchy process, another form of multicriteria analysis.
- Use multicriteria analysis in conjunction with other tools and techniques described in this section to ensure that valuable decisions are made about which performance-improvement programs and projects should be implemented.

Notes

1. The technique also uses elements of the simple multi-attribute ranking technique (SMART), which is an alternative used by engineers for applying the principles of multi-attribute utility analysis.

2. Borcherding, Eppel, and von Winterfeldt (1991) compared four methods for establishing weights; the results of the research indicated that a mix of methods was typically best, with no one technique being superior to the others.

References and Resources

Altschuld, James W. 2010. *Needs Assessment Phase III: Collecting Data* (Book 3 of *Needs Assessment Kit*). Thousand Oaks, CA: Sage Publications.

Altschuld, James W., and J. N. Eastmond Jr. 2010. *Needs Assessment Phase II: Getting Started* (Book 2 of *Needs Assessment Kit*). Thousand Oaks, CA: Sage Publications.

Borcherding, K., T. Eppel, and D. von Winterfeldt. 1991. "Comparison of Weighting Judgments in Multiattribute Utility Measurement." *Management Science* 37 (12): 1603–19.

Roth, R., F. Field, and J. Clark. 2011. "Multi-Attribute Utility Analysis." http://msl1.mit.edu/maua_paper.pdf.

Witkin, Belle Ruth, and James W. Altschuld. 1995. *Planning and Conducting Needs Assessments: A Practical Guide.* Thousand Oaks, CA: Sage Publications.

Websites

"Analytic Hierarchy Process" can be found at http://en.wikipedia.org/wiki/Analytic_Hierarchy_Process.

"Answers to Frequently Asked Questions about Decision Analysis" can be found at http://www.infoharvest.com/ihroot/infoharv/infoharvestfaq.asp.

Multiattribute utility models can be found at http://www.ctg.albany.edu/publications/guides/and_justice_for_all?chapter=9&PrintVersion=2.

Samples of Job Aids

Multicriteria Analysis Template (no weights)

	Criterion 1	Criterion 2	Criterion 3	Criterion 4	Criterion 5	*Average rating*
Alternative 1						
Alternative 2						
Alternative 3						
Alternative 4						

Multicriteria Analysis Template (with weights)

	Criterion 1	Criterion 2	Criterion 3	Criterion 4	Criterion 5	*Sum of weighted ratings*
Weights	Insert weight	Insert weight	Insert weight	Insert weight	Insert weight	
Alternative 1						
Alternative 2						
Alternative 3						
Alternative 4						