Developing a Feasibility Study with Multiple Planning Objectives

When to Consider Multi-Objective Planning

While they might or might not influence selection of plans to be recommended by the Corps for action, multiple economic, environmental, and social objectives are considered (implicitly or explicitly) during execution of every planning study. The roles served by multiple objectives and their influence on decisions are frequently inadequately explained, disclosed, and documented. Absence of their documentation is less noticeable when the multiple objectives do not measurably distinguish between considered alternatives or their effects. However, when measurable differences between alternatives or their effects are revealed during consideration of multiple objectives, documentation of those objectives and their influence on decisions becomes increasingly relevant in terms of both documenting the decision and justifying agency action.

Planning objectives are aligned with federal or non-federal interests and fall under a particular benefit category: Economic, Environmental or Social. Those objectives that are aligned with federal interests can be further characterized as those that are serviceable by the Corps authorities and those that are serviceable by authorities of other agencies. A plan that seeks satisfaction of multiple objectives may, and likely will, require consideration of authorities and funding beyond those available to the Corps. Careful organization, documentation, and communication of planning objectives considered during evaluation of alternatives and identification of recommended plans will be critical to justifying future actions of agencies and organizations involved in plan implementation (e.g., funding).

Overview: Multi-Objective Planning

National Planning Objectives can be used as a structure for organizing information associated with different types of effects. The different types of effects can be measured using indicators that might be found in existing agency policies or developed by the PDT to inform future decisions. Individual criteria (or metrics) can then be used to visually (via color-coding, etc.) or quantitatively (via subjective or objective scoring, etc.) illustrate the magnitude of change in indicators. By documenting what types of impacts are of occurring and at what scale (national or local) they are relevant, it is possible to identify which interests are affected and what information matters to whom (or which process). Figure 1 illustrates an investigation where only the Corps and a non-federal sponsor affect the planning decision. **Error! Reference source not found.** illustrates an investigation where other agencies/organizations might affect or otherwise influence a planning decision, or where non-Corps management measures might be become part of a recommended plan.

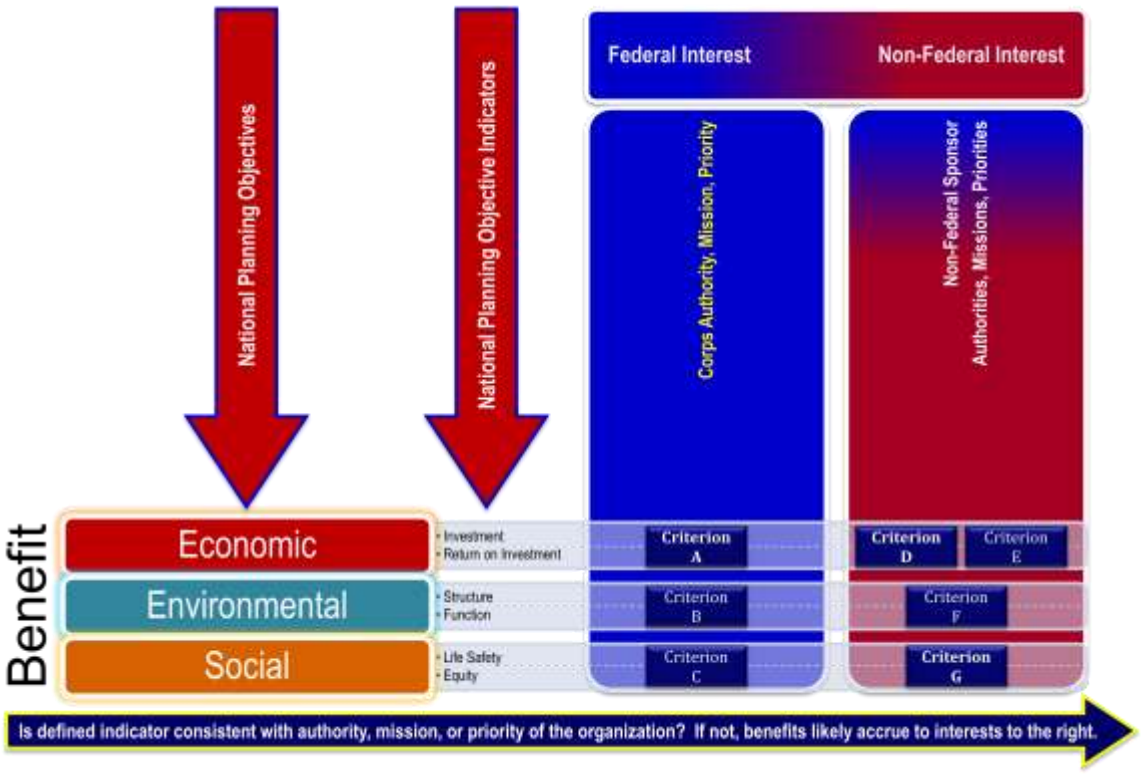

Figure 1 - Benefits Categories

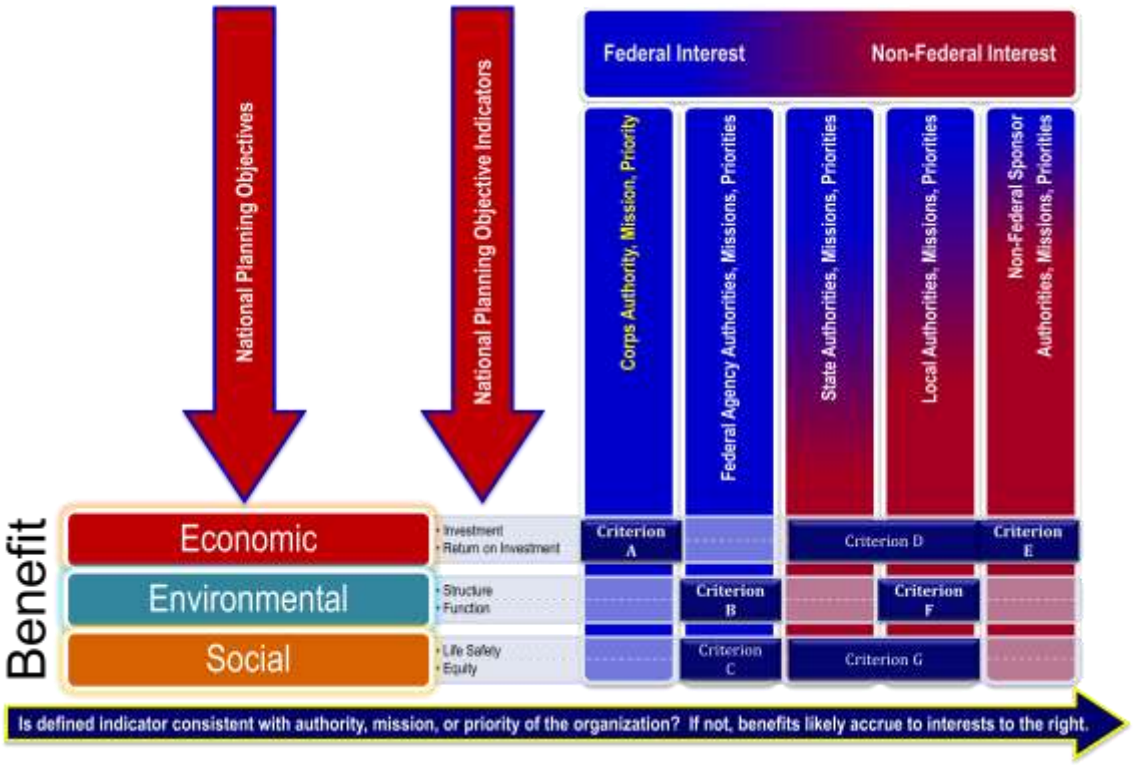

Figure 2- Different Interest Categories

For example, restoration of aquatic habitat structure and function may be of particular interest to the Corps and US Fish and Wildlife Service, while improvements in management of non-point sources of pollution may be sought by the local sponsor, local agencies, and/or US Environmental Protection Agency. In this instance: the most cost-effective solution(s) might require pursuit of actions for which the Corps lacks existing authority; or the most cost-effective solution(s) might require blend of activities spanning multiple agencies/organizations that must be synchronized to produce the full range of desired outcomes. ***In either case, the scope of and manner in which multiple objectives are considered during formulation and evaluation of alternatives must be transparent, must be effectively communicated with the vertical team, and ultimately must be met with approval of the Corps's decision-makers.***

Techniques for Multi-Objective Planning

There are a variety of techniques that can be applied to accommodate multiple planning objectives during evaluation, comparison, and selection of alternatives. Multi-Criteria Decision Analysis (MCDA) is a "catch-all" term used to describe a collection of techniques that allow for consideration of multiple pieces of information during an investigation. The information analyzed is either quantitative or qualitative and expressed in monetary or non-monetary terms. The techniques are as simple as a direct comparison of cost versus benefit, or as complex as considering the distribution of trade-offs that might be contained within the categories of costs and benefits. At times, those criteria (or underlying metrics) might be difficult to compare to each other (e.g., quantitative/qualitative, monetary/nonmonetary) or conflict with one another. **The goals of any multi-objective evaluation technique (MCDA or otherwise) should include: *increasing the transparency of the planning process*; *improve the effectiveness of communication*; and *increase understandings of each objective's/criterion's relative influence on planning team perceptions, tolerated trade-offs, and recommendations.*** The outputs can reveal rankings of plans, giving the planner an opportunity to critically think through how emphasis of different criteria might affect outcomes.

MCDA is an umbrella term used to describe a collection of different ways in which criteria can be normalized and weighted against one another. There are numerous approaches to MCDA, ranging from complex algorithms to simple rankings.

There are a number of different ways to evaluate the plans in Multi Objective Planning. Several broad categories are listed below.

1. Graphical Use of a matrix to display how well a particular alternative ranks in a particular criteria. This method may look like a consumer reports chart or it may show highlight a cell in a particular color. (implicit weighting)
2. Use of a matrix to display the information and supporting text to discuss why some criteria were more important than other criteria. (implicit weighting)
3. Use of a matrix and an algorithm to explore different weights and options for ordering plans. (explicit weighting) This involves the use of MCDA similar to what is found in IWR-MCDA suite or Criterion Decision Plus. The study team would still talk through the how the different weights affect the teams outcome, but they also have the flexibility to explore how changing those weights affects the plan selection.

Prioritizing Criteria

When teams are considering multiple objectives, they are either explicitly or implicitly prioritizing the information that informs the decision. ***Priorities (implicit or explicit) show the value that the team members and the Corps of Engineers place on the criteria.*** The team should determine the priorities or weights amongst themselves realizing that there is no "right" answer. A sensitivity analysis will be conducted to determine how differing the weights can change the outcome of the answer.

With greater transparency in our decision making, we will also receive greater scrutiny. Teams should be aware when they are picking the priorities for Federal Plan that a numbering system like Saaty's method is helpful for determining weights, but the team needs to think through the scale of the weights assigned. For example, if NED benefits are worth 75 and Loss of Life is worth 25, are the NED benefits really worth 3 times a life? Also, there are implications associated with Federal Advisory Committee Act (FACA) when using the public to help determine weights. Be sure to consult with counsel for clarification on FACA violations.

Teams should be prepared to answer why they chose the weights they did prior to the TSP milestone. Optimally, they can share with the vertical team their assumptions on the weights when they present their final array of alternatives. However, there is latitude to change the weights after the plan analysis but the team should be prepared to explain why that is in the Federal interest.

The team has the option of creating two sets of weights, one set for the locally preferred plan and another for the Corps plan.

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Objectives or criteria intended to reveal potential for future/further Corps action MUST be consistent with authorities under which the Corps executes its missions and be directly linked with the projects' planning objectives. Criteria are expected to evolve and become more refined as uncertainties are revealed/resolved throughout the planning process and such refinements are demonstrated to the vertical team to be justified. Criteria that begin as qualitative (yes/no, +/-, High/Medium/Low) at the screening phase, may become more quantitative as the investigation moves through formulation, evaluation, comparison and selection phases.

Incorporating Multi-Objective Planning in the Scoping Charette

A qualitative multi objective planning analysis will likely be conducted during the scoping charette that will help to inform the level of detail of the project. It is important to address these fundamental goals:

1) Illustrate priorities of key agencies/organizations
2) Frame relevant information in terms of interests served and roles to be considered
3) Recognize/highlight thoughts on what existing information suggests
4) Reveal potential uncertainties and their perceived relevance/influence
5) Understand potential sources of more refined information

Roles (PDT):

1) Describe proposed objectives

2) Describe proposed criteria/metrics
3) Describe proposed reporting/integration techniques
4) Describe interest and commitments of other agencies/organizations

Roles (Vertical Team)

1) Flag fatal flaws
2) Offer comments and guidance on objectives
3) Offer comments and guidance on criteria/metrics
4) Offer comments on proposed reporting/integration techniques
5) Validate/secure interest and commitments of other agencies/organizations

Screening Alternatives in Preparation for Alternatives Milestone Meeting

Screening of measures/alternatives for the Scoping Milestone meeting involves subjective or qualitative values of outputs for the criteria of interest. Criteria would still be clearly linked to the objectives formulated in the scoping charette, but they are populated using SMART Planning concepts with a heavy reliance on existing information and best professional judgment. After the initial scoping charette, further refinements to the criteria and analysis are based on existing and readily-available data and information. The refinements support the development of the scope of work for which alternatives would be carried forward for more thorough evaluation, comparison and ultimately plan selection.

Criteria intended to reveal potential for continued Corps involvement/support should be consistent with existing Corps authorities, missions, and priorities. To the extent that criteria might be suggestive of actions that are not supported by Corps authorities, missions, and priorities, the PDT should be explicit in its identification of the parties to be served by the criteria and the organizations who will likely be charged with any actions/measures that might satisfy the criteria. Prior to the meeting the study team knows

1. Federal Role and Objectives (economic, environmental, social)
2. Corps Role and Objectives (economic, environmental, social)
3. Stakeholders Roles and Objectives (economic, environmental, social)
   While developing your planning objectives, the PDT should keep criteria in mind. Planning Objectives should be measureable and specific. Therefore, your criteria should be your objectives, or directly tied to your objectives. Under the current P&G, criteria should be combined to reflect the individual Accounts. A general screening level inventory and forecast should be conducted, keeping planning objectives and constraints in mind. Potential management measures should be identified and their outputs should be assessed at the same scale as the inventory and forecast for the criteria identified.
4. A qualitative evaluation of measure outputs and costs should be conducted to identify the potential of a feasible plan or plans that could be implemented to address the planning objectives. Level of information developed should be rough order of magnitude.

Items for consideration prior to the Alternatives Milestone meeting.

Once the PDT has developed an array of alternatives it is ready to bring forward for evaluation, comparison and selection, it is ready to engage the Vertical team and hold the Alternatives Milestone Meeting. At this meeting, the Vertical Team will be briefed on the project scope and presented the array of alternatives. To prepare for this meeting, the PDT should be able to answer the following questions:

1) Have the Planning Objectives been clearly stated?
2) Are the relationships between preliminary planning criteria and planning objectives clearly defined?
3) Are relationships between planning objectives, preliminary planning criteria, and Corps authorities, missions, and priorities described (and accepted)?
4) What means to characterize or quantify each preliminary criterion have been identified?
5) How are the preliminary criteria likely to be used in Plan Formulation?
6) What other tools are needed to generate the criteria? What level of detail is needed to provide the inputs to these tools? Is it adequate to evaluate the effectiveness of the measure through the identified criteria.
7) How will the next iteration of the Plan Evaluation and Selection Process be conducted? This can be a general statement to show that the team is thinking through it. What changes, if any, are believed necessary and why? Are the management measures appropriate for eliciting the changes demanded by the planning objectives?
8) What weights (if any or deviating from equal-weights) are being applied to criteria? The team should show a ranking of the criteria if weights are going to be applied.

Using Multi-Objective Criteria during Alternatives Analysis

After the Alternatives Milestone Meeting, the PDT will focus on development of the alternatives identified for evaluation, comparison and selection. The PDT should consider the criteria used in initial screening, and if they are relevant to carry forward, either as they are or with refinements for more quantitative data. Additional criteria should be identified that are linked to the planning objectives and can discern between alternatives or measures within alternatives. Objectives should also be assessed to ensure they are still appropriate and relevant. There may be additional screening after the Scoping Milestone, but at the point that final alternatives are prepared and at a point to be evaluated, compared and a tentatively selected plan identified, targeted, specific and transparent criteria – including any use of weights/preferences – should be identified and agreed upon with the Vertical team in an IPR prior to the TSP Milestone Meeting.

Reasonably Maximizing NED/NER: Corps guidance requires identification of the plan that "reasonably" maximizes net NED and/or NER benefits. USACE leadership has concluded that the amount of effort and time spent in optimizing plans has often exceeded the intent of that requirement. The degree of plan optimization should be commensurate with the level of uncertainty in the data and methods used to estimate the benefits and costs of alternative plans. In many studies, considerable uncertainty regarding future with- and without project conditions precludes precise optimization.

Because of uncertainty, it may be sufficient to initially evaluate the final array of alternatives at similar scales or outputs to identify the candidate plan with the greatest net benefits as the Tentatively Selected Plan, followed by reasonable optimization of that single candidate plan after more design detail has been developed. The number of plan scales evaluated during optimization may be minimized, but the magnitude of the increments between the plan scales must be commensurate with the levels of uncertainty for costs and benefits, and the plan that reasonably maximizes net benefits must be bracketed by smaller and larger scale plans (except as specifically allowed by Corps guidance). Plan scales should be selected for evaluation based on major cost or benefit breakpoints.

PDTs are encouraged to think critically about the information required to make a decision about the appropriate level of Corps investment, and to coordinate with their Vertical Teams from the outset of the study on the degree of optimization required to "reasonably" maximize net benefits.

Items for consideration prior to the TSP Milestone meeting.

To prepare for the TSP Milestone meeting, the PDT should be able to answer the following questions:

1) Have the plans been evaluated relative to the perspective of the Stakeholders, Sponsors and Resources Agencies? Does it show different weightings for the varying perspectives? How do different preferences affect the relative ranking of alternatives (and/or benefits of federal interest that might be foregone)?
2) What is the NED/NER? What was the level of detail used to identify it/them?
3) Is everyone (Resource Agencies, Sponsor, PDT) in agreement on the TSP?

With Vertical Team concurrence on the TSP, the drafted feasibility study report goes out for public review. The PDT considers comments received during public review prior to bringing forward a single plan to the Agency Recommendation Milestone meeting.

Items for consideration prior to the Agency Decision Milestone meeting.

To prepare for the Agency Decision Milestone meetings, the PDT should be able to answer the following questions:

1) Did the project get public buy-in to the weights, criteria, and tentatively selected plan?
2) Were any changes made to criteria and/or weights due to public review?

Finalizing the Feasibility Study Report and the Chief's Report Milestone

After the Feasibility Report has been finalized, including addressing State and Agency Review, the Chief's Report is developed. During this phase, the PDT and HQ should be able to answer the following questions:

1) Did the project get public buy-in to the weights, criteria, and tentatively selected plan?
2) Were any changes made to criteria and/or weights due to public review?

If you are selecting an LPP and determining cost sharing on NED/NER, the percentage of costs sharing can be set at that level of analysis as opposed to carrying both plans forward for detailed analysis during Preconstruction Engineering Design.