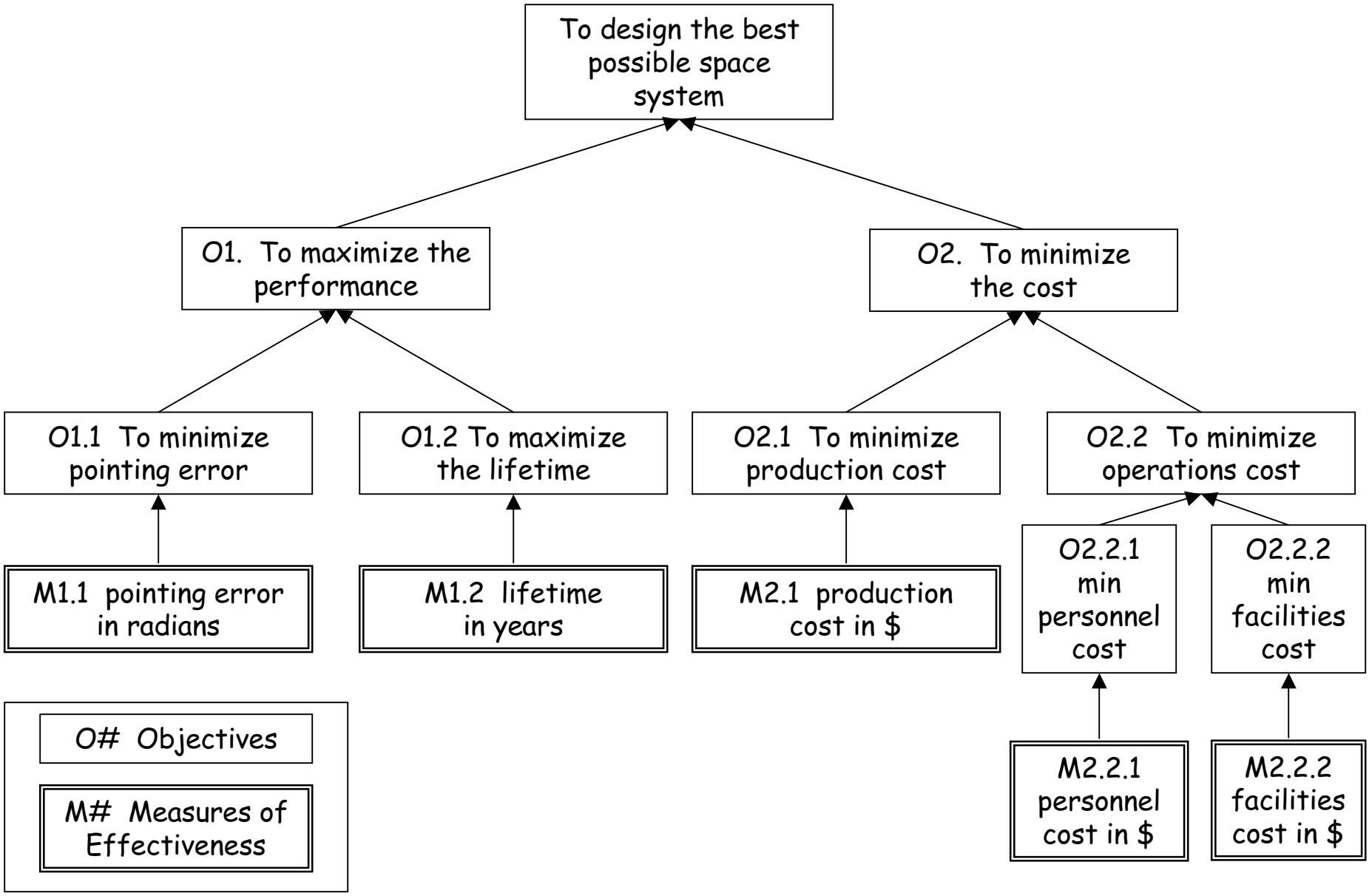
Objective Hierarchy



A Value System Design Example

This example illustrates the Objective Hierarchy for a *simple* Value System Design. Your VSD and OH should include substantially more detail than this example.

Suppose you have two Objectives (O1 and O2), each with two sub-objectives (O1.1,O1.2, O2.1,O2.2), and sub-objective O2.2 has 2 sub-sub-objectives (O2.2.1, O2.2.2). See the attached figure, which shows the objectives and, at the bottom level, the Measures of Effectiveness (MOEs). To determine the Value of a particular alternative, you'll need to determine values of the MOEs for each of your alternatives (developed in the System Synthesis step) using the models you develop in the System Analysis step.

Because these MOEs all have different units and magnitudes, you'll need to scale them. As we did with the Orbit Design example, you should scale them all so that the values range between 0 and 1 (or between –1 and 1). Then you can select weights to assign relative importance to the different measures. These weights should be developed by the team based on your knowledge about the particular objectives. You should pick all the weights at a particular level of the hierarchy so that their absolute values sum to 1.

Remember that you're trying to maximize the value V, so those MOEs that you want to minimize should have negative weights (but this applies only to the weights at the lowest level). Another approach is to scale the "minimize" MOEs so that they take values between 0 and –1, with 0 being the best and –1 being the worst. Conceptually, this may be the easiest approach to understand and use, and is the approach used in this example.

In this example, you might talk to some experts and then decide that O1 is twice as important as O2, so w_1=2/3 and w_2=1/3. Similarly O1.1 and O1.2 are equal in importance ($w_{1.1}$=1/2 and $w_{1.2}$=1/2), O2.1 is 3 times as important as O2.2 ($w_{2.1}$=3/4 and $w_{2.2}$=1/4), and O2.2.1 is only slightly more important than O2.2.2 ($w_{2.2.1}$=9/16 and $w_{2.2.2}$=7/16). Note that at each level, the weights add up to 1. Now, when you compute the MOEs for each lower-level objective, you can compute the Value as

$$V = w_1(w_{1.1}M_{1.1} + w_{1.2}M_{1.2}) + w_2(w_{2.1}M_{2.1} + w_{2.2}[w_{2.2.1}M_{2.2.1} + w_{2.2.2}M_{2.2.2}])$$

The attached spreadsheet does some sample calculations for six different alternatives. Based on these (made-up) numbers, the alternatives should be ranked (in decreasing order of value) as follows: Alt6, Alt4, Alt1, Alt2, Alt5, Alt3. So, we would probably want to continue development of Alternatives 6 and 4 (and maybe 1) and eliminate the rest from further consideration.

Value System Design Example

This spreadsheet computes the Value of 6 different alternatives, based on 5 different measures of effectiveness and 8 different weights.

The measures that have negative values are measures corresponding to "minimize" objectives.

	M1.1	M1.2	M2.1	M2.2.1	M2.2.2	V
Alt1	-0.1	0.4	-0.3	-0.2	-0.9	-0.017
Alt2	-0.3	0.5	-0.3	-0.7	-0.2	-0.048
Alt3	-0.4	0.3	-0.6	-0.5	-0.7	-0.232
Alt4	-0.4	0.8	-0.2	-0.6	-0.4	0.041
Alt5	-0.2	0.3	-0.6	-0.5	-0.4	-0.155
Alt6	-0.2	0.7	-0.3	-0.4	-0.5	0.055

Weights	
w1	0.667
w2	0.333
w1.1	0.500
w1.2	0.500
w2.1	0.750
w2.2	0.250
w2.2.1	0.563
w2.2.2	0.438