TOPIC: WATER QUALITY AND MINING

SUB-TOPIC:
PART D: COST BENEFIT EXAMPLE

Supporting Transcript (Learning Exercise)

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LEARNING EXERCISE VIDEO (COST-BENEFIT ANALYSIS)

So I'd just like to go through this cost benefit analysis flow sheet so you can have a go at doing one of these for yourself. So what I'd like you to do is come up with a potential mine project and this could be something like the remediation of acid mine drainage or enhancing metal recovery using a different technique that doesn't use cyanidation or amalgamation. I'd like you to do a bit of research into this, using the literature you can find, and have a go at filling out this spreadsheet. Effectively, there are 10 boxes here marked in yellow which need filling out, so we need costs, benefits and a lifetime of the project for these boxes, and then the spreadsheet will be able to calculate the cost-benefit analysis graph in the form of a probability of non-exceedance versus net present value, so you get something like this at the end and that will tell you whether your project will be making profit or loss.

Once you've done your research and you've decided each of these variables, what the spreadsheet will do is calculate a lower bound and an upper bound limit. So the lower bound is 80% of your base case input and that's the value that you estimate the cost or benefit to be. So say I've put two thousand million Myanmar kyat in here, this takes 80% of the value and this takes 120% effectively. And that does that for all of these input values so have a think about these for the individual items on the left here, so let's go through these individually.

We've got initial construction costs, we've got the land acquisition and then we've got site investigation, so these are costs associated with the immediate construction of the site or the project and these are going to be paid within the first year or so of the project and then we've got the operational costs, now these are paid on an annual basis as you've got maintenance, monitoring and externalities, now externalities are any negative effects that the project will have on any third parties so a good example of that is any pollution that's caused by your project. Now it's quite likely that your externalities are going to be quite low if we're talking about an environmental remediation strategy, but there still might be some that you need to think about here.

Equally, we can also apply this cost benefit analysis to something like the development of a mine and in that case the externalities are likely going to be very high from things like air pollution or the effects of acid mine drainage on the population.

So once you've got those the spreadsheet will calculate a total initial cost and the annual operating costs as a total. Then you need to think about what benefits there are to the project so for example there might be some metal recovery or there might be improvements to amenity because you've improved the quality of the water for, example. So have a think about that and then you've got the annual discount rate - now that is effectively a way of taking into account any bank interest rates. If I've got one unit of currency and the annual discount rate is 2.3%, the following year that unit of currency will be worth less in net present terms [i.e. at today's value].

Let's have a think about what that means really, well if I've got one unit of currency today, then next year in relative terms that would be 98% of the value that it was worth in the first year and so this is for the second year and for the third year and for the fourth year and so on until you have the last year, so the currency is slowly decreasing in value (in net present terms) so that's what that's about and if you wanted to find out more information on how exactly you would calculate this discount rate, or estimate it sorry, then I've provided a link here and also feel free to leave it as it is at 2.3% - that could be a realistic value for what we're talking about.

And then have a think about what the project will cost to clean up or decommission. And as we discussed in the lecture every project will need a lifetime or a lifespan so here I've selected 20 years and we generally know that this is the lifespan of the project so we don't need to put an upper or lower bounds here.

Since the operating costs are on an annual basis we need to incorporate the discount rate into these, so the initial costs are simply the initial costs, in this cell here, which are a sum of initial construction, land acquisition and site investigation, whereas the operating costs, let's have a look at what these are. So these are the annual operating costs times by the relative currency value for all of the years in the project. So that's saying the operating costs times the first year and then you're adding on the operating costs times the second year and then relative, in today's currency, and then in the third year and then the fourth year and so on and so on, and that way we'll get an operating cost that is relative to today's money and that's what we're doing with the interest rate here.

For the decommissioning costs we need to think about when this would likely occur so the decommissioning will be in the last year of the project so in year 20. In this case so it will be the decommissioning cost in today's value times the relative currency at year 20. So hopefully you can understand that and what's going on with these cells, but don't worry too much about the annual discount rate if you don't understand.

What this spreadsheet will do is it will calculate a random value in between your upper and lower bounds and it will do this for every single item on the left 200 times, so that's what the right hand side of the spreadsheet is about. Here we've taken a value in between 1600 and 2400 and the spreadsheet has generated a random number between these two to get 2296.

You'll see if you refresh the spreadsheet you get a completely different set of values and that will change the outcome slightly, but it should be relatively similar.

Each realization picks a number in between these bounds and it will then work out what the net present value is for this set of numbers, so that takes into account all the costs, the benefits and the interest rates and gives you a total worth for the project based on those set of values. What it will then do for each of these 200 realizations is it will (so that's your total net present value for that particular combination of input variables) it will then rank them from 1 to 200. Here this this has been assigned rank number 149
We can then work our probability of that net present value being achieved, by dividing this number by the number of realizations plus one. Once we've done that, we now have a net present value in this line and a probability of a non-exceedance in that line, so that's what this graph is showing you.

We've got net present value in the x-axis and probability of non-exceedance on the y-axis, and then you can use that to interpret your results. Then, based on this, you can make a judgment whether your project will likely make a profit or loss and then what I'd like you to do is, if your project is likely going to make a loss, i.e the plot is more to the left of the zero mark here, so this is the difference between profit on this side and loss on this side. If it is towards this side, I'd like you to think about how you would improve your projects in terms of improving any benefits or reducing any costs, so that might be completely redesigning the methods that you use.

Just have a play with that and as I say, you're just filling in these ten boxes, the spreadsheet will take care of the rest so don't worry too much if you don't understand the mathematics, it's more to just get you to play with a cost benefit analysis flow sheet.