[AUDIO LOGO]

RICHARD DE NEUFVILLE: There's something important about this title. And it is that I'm talking about preferred projects. I'm not talking about best projects. And this is very much on purpose.

Basically, when we think about a system, a system which has lots of different performance characteristics, which has numbers of stakeholders who are thinking about it-- there's a financial side, there's a technological side, there's the human relations side, there's environmental sides, et cetera, different criteria for performance-- it is basically conceptually impossible to talk about the best. We may talk about what we think is our preferred choice, what is, in some ways, in our minds, the best. But in terms of an optimization, it's difficult.

And I think that we ought to recognize that and use optimization techniques to sort through dominated solutions, a concept I'll come to by the end of the class, but really focus on that we're not going to be able to optimize our systems overall. We can think about the alternatives.

And ultimately, we're going to have what I like to think about as a preferred project-- that is, one that has a balance, a trade-off between the different elements, between the different stakeholders and we agree is what we're going to do and we think it is the preferred solution, although it is not, mathematically speaking, an optimal. Let's go into that just a little bit.

So the fundamental question I can start off with is this-- is it meaningful to look for the best? what can we expect to do-- and then to think about, all right, if we're going to think about a goodness of some sort, we have to talk about value. And we have to think about what it means to valuate things where we have different elements of it.

We have different characteristics of it. We have performance technically. We have performance in terms of environmentally. We have performance in terms of financially. And we need to have a way to translate each of those performance indices into some value-functional-- I'll refer to it generally.

And a value function, by the way, from a technical point of view, is not the same as utility function, but it is the same kind of idea in a general language form. But technically, there's a great difference between value and utility of the sort that utility requires a lot of different assumptions and is very difficult to design. Then, having set the scene in this way, I want to talk about the several methods I'd like to suggest to you that we can use to evaluate and choose between different solutions.

So let's go down to think about, what is it meaningful to optimize in the sense to have a mathematical search for the best? Well, what defines best? Well, as we know, it's the extreme-- the high or the low of all possibilities.

So to be able to know whether you're the highest or lowest, you have to have a metric of performance. If I'm looking at altitude, I can calculate something is at 1,000 feet, 2,000 feet, 3,000 feet. I can know which one is the highest. Well, let's say it's Mount Everest.

Or if we can't have a single measure, we have some way of saying that, all right, we have different levels of performance. Take a hospital, say, that it is I want to be able to reduce fatalities. I want to provide the best service to cancer patients, that they have less after-consequences. I want to make sure that et cetera.

There are various measures of performance of it. And it might have economic efficiency put in there. And to be able to talk about the optimum from a mathematical way, we have to put these metrics into a single scale, like so many deaths saved are equivalent to so many dollars are equivalent to so many reduced cancer treatments-- whatever.

So the basic question is, is either one realistic or two realistic? Is it really possible that we're going to have a single metric of performance for any of our systems? And is it even possible that if we don't have a single metric that it's realistic to put everything on a single scale in a way that's acceptable? Are we going to put one life is equal to $3,822 or 10 times as much, whatever it may be? Is that kind of analysis or weighting possible? Just think about that for a moment.

In some ways, you'd say, well, yeah, of course not. We don't really know what a life is worth or how we have years of schooling translated into dollars or whatever. But the fact is if you look through the literature, there are all kinds of ways of saying, yes, we can do it.

We can have multi-objective optimization, which means that we have some kind of weight on factor one and another kind of weight on factor two and another kind of weight on factor three. And if we accept that those weights for those different factors, which are basically relative values between one or the other, if we accept those, then, yes, we can think about multi-objective evaluation.

But it isn't a thing that we can go through and say, well, those weights are sacred, and we really know what they are. They are assumptions. And even if they are locally reasonably acceptable-- locally in terms of over a certain range-- at summing, they're probably nonlinear weighting functions so that a person's function in terms of having enough to eat and enough shelter on them-- presumably, a first-order consideration is do they have enough eat and then when they have enough eat, it's not so important to have more, but it's more important to have better shelter. So there's a continuum of changes in what these weights are.

So what I'd like you to consider and I'm happy to discuss with you, but the issue is that it's unrealistic to suppose that we can have either a single metric of performance or that we can put all the other metrics onto a single scale that's acceptable and, therefore, that we can talk about a mathematical optimization to find the extreme high or low of all the possibilities. That is a fundamental thought I'd like you to keep in mind.