[SQUEAKING]

[RUSTLING]

[CLICKING]

RICHARD DE NEUFVILLE: So I recommended a process of how to approach. The five steps, they're one way to think about it. You can have six or seven. In the text we wrote some time ago, we had seven put out because we went to more complexity. But I'm now going to talk about these central five but it's mostly to cover the basics. Five is not the magic number.

So the first one we need a valuation model. And for those of you who are filling out your initial project form, a number of you weren't quite understood that what was involved when I asked about having a model of your system.

But you need to have some way of saying, OK, if I design the model or I set up my model in my system in a particular place, which is not only the machinery and the production of a process but also my employees, my marketing, my sales, my productivity, and so forth, you need to have a way of transforming those assets and [? ERUs ?] into some kind of valuation. It can be an economic valuation as in this particular case or it can be a performance valuation. I'm running an emergency medical effort to, say, combat Ebola.

How quickly and how well do I contain the disease? So it may be performance based rather than money based. And in this case as from the garage, I have things about the demand, the capacity, the revenues, cost, and so forth. And I have a present value and so forth. So I need a model which says, if the following happened and you've made these design decisions, here's what the performance is going to be.

Secondly, you need to think about which are the most important uncertainties. As you can imagine, and as those who filled out the initial project report were doing, you can list them. And there are lots and lots of uncertainties. All kinds of things can happen. The question is what should you really pay attention to. So you need to think about which are the issue, the uncertainties, that you want to focus on, not that all of them exist, but some of them are second order effect. So which are the first order effects?

One of the ways to do that is to use a tornado diagram, which I will illustrate here but I'll describe in more detail later on in the course. But you need to have some way of filtering out the important issues to focus on. In the garage case, it was the level of demand.

I didn't talk about the strength of the concrete, or parking registrations, or things like that but focusing on the right issue. And I say that in the context that here from the garage case, you can have all kinds of uncertainties that are playing out. And each of these will give you different results at the end. So which ones am I really going to focus on? I don't want to be swamped by everything else.

So one way to do it is a tornado diagram, which the end result is that you have various uncertainties that is taken from somebody's project some years back. The demand, the revenues, the operating costs, et cetera down here. And from the base case, that is the median case that you want, the forecast case, you have a performance. And if the demand went up in one way or down, it'd have this range of effects.

And it's called a tornado diagram because, when you look at the sensitivity to each of these uncertainties, you stack the results so the ones that they're least sensitive are at the bottom. The ones that are most sensitive are at the top. And therefore it has this funnel shape. And that's why it's called a tornado diagram because it is the way a tornado looks like prototypically.

So the idea is basically you think about how much your uncertainties might vary within a standard deviation and if it's symmetric or not symmetric. And you run the analysis with those extremes. And you see which are the ones that have the most effect.

And in this case, for example, the demand is the most important one in this particular case. And so this if you focus on, the revenue may be next. But the other ones don't make that much difference so that, at least for the beginning, we focus on the top ones and proceed ahead.

So at some level, once you consider that things can be uncertain, you may be swamped by all the possibilities, all the things that can happen. And you don't want to do that. You want to have some way of focusing our attention on the things that matter. And a tornado diagram is one way to do it. You may also want to think about how things may change over time.

This was the basic forecast that we use for the garage case. I'm not pretending it's the right one, but I'm simply saying it's an illustration of the kind of issues that you have. So you start at a particular level. And you think it might grow particularly quickly at that time. And it might level off. And then one of the forecasts that we were looking at today, which was the renewable energy-- the energy production by renewables, you saw that many forecasts had a growth and then it leveled off.

So thinking of this may be appropriate for your problem is something you will do. That is your forecast may have a certain uncertainty all along, but it may be around a particular pattern of growth, which might be an S-shaped pattern. It might be this shape. It might be a straight shape. It might be exponential. But you want to think about a distribution aspect over time, not just at any one time.