[SQUEAKING]

[RUSTLING]

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RICHARD DE NUEFVILLE: Talks about a perspective LNG plant that I worked on with these colleagues, Cardin, Bourani, his thesis student-- Cardin and his thesis student, Bourani, and others with the Keppel Offshore and Marine Corporation, which is a big shipbuilding platformbuilding, metal bending government company in Singapore.

And they had this as a perspective case. And they had a commission, a design. They were working on it for some oil company, and we took this on as a way of thinking about can one do better, as I think indeed we can. And that's what this is about.

So it is, first of all, a parametric analysis, that is, looks at a significant range of factors. Instead of saying, this is the condition, it says, well, what if the economies of scale were longer? What if the uncertainty was different? What if learning was a different scale? So that it's designed to illustrate a range of possible conditions of how you might do it, rather than trying to specify a particular one. So I'd say design is a learning experience. I hope you'll find it so.

So the general idea is to do MITEX if you want, that homework in a much more detailed and complicated situation. And to what conclusions can we talk about in terms of preferred strategies? Notice again that I'm talking about preferred strategies because there's tradeoffs about the cost and the risk. There are tradeoffs about the political extent. And there's a variety of other factors that are involved in it. But here the focus is on the economic aspects.

So the key conclusion is a flexible can provide clear economic benefits. I don't say must. But it's pretty clear that they can provide it. These are pushed by discount rate effects and learning effects, discount rate because if you invest later on, it costs less in terms of present value. Learning, in fact, is that if you build several modules, the next time you do it, you'll avoid mistakes or improve design and so forth. And this comes with building often, but not necessarily, on some kind of modularity of design.

And these factors, discount rate, learning effects, module design, work against the economies of scale, which encourage people to build for all future capacity right up front, which was part of the task of the MITEX example that you worked through, was that many people had the normal reflex was, oh, that's what we need. We're going to build for it right at the beginning and not mess around with it.

But it turns out that common reaction is often anti-economic. And also the actual expected value of the CAPEX, of the project under uncertainty, is less than deterministic estimation. So that's where we're going.

So I'm now giving you, taking from it, our presentation, their presentation, of the analysis has given for a particular project at a particular conference and so forth. And let's go, so the motivation, looking through design alternatives, the methodology, the results.

So in location, we're talking about the state of Victoria, which is this bit here of Australia. This is where Sydney is, New South Wales. This is where Brisbane and the Gold Coast is. This is where the big mineral area is, or some of the big mineral on Western Australia, and Perth, and this is the great nothing, if I can put it that way.

And so we're I don't want to-- there's Tasmania, Tassie, down here. Here is Melbourne. And there are various sites for distribution. So the plan was to be here, and their sites for distribution of the product, which I'll describe in a moment, at these sites one through five.

So the whole idea is that you get LNG, liquid natural gas, from the offshore used to do a certain amount of processing and separate out the good stuff, get rid of the bad stuff. You somehow get it to land, and then you liquefy it. And it can be used for a variety of purposes.

But the idea here in Australia was the project was to market it for the transportation sector, that it would be cleaner than diesel fuel and so forth, and it'd be in not only an environmental benefit, but it would be a good business for the oil companies, which unfortunately in the past, have often simply burned off the gas, flared it, which is neither profitable nor environmentally desirable. So it's viewed, in this case, as a transportation issue.

In Europe, they use LNG, for home heating a lot and also for power plants. But they don't particularly need heat in Australia and South Australia. So there are three versions of the system I want to sketch out for you.

The original design that Keppel Offshore and Marine had developed was to have one big plant with the idea then that the liquid product would be distributed to various sites, the five sites that I mentioned, and from there they would use the fuel tanker trucks to deliver goods and whatever they were doing, so one big plant, economies of scale, very much similar to the big plant for the water, except that it was not modular in any way. It was one big thing.

So the first phase that we looked at, Cardin, me, and other, was to have modular plants. We said instead of having the whole size at once, we're going to say, what happens if we had modules of 25 tons, 50 tons, 75, 100 tons, and so forth? So what we could do about that was to phase it over time.

So we start off small because the demand was small. And we'd add them, very similar to the MITEX homework two example is that, all right, what's the best way to do this? And we did this through a simulation analysis, as I'll point out. So we can play around flexibility as to size, one, and also as to timing because of the size. What is the right size? And when do we time the additions?

But the third thing is we can also think about the flexible design so that we can locate the plant elsewhere, that as in many processes, electric power, for example, if you do everything in one large plant, power for example, you got to transmit it a long ways to where it's actually being used.

Right now in New England, we are getting a fair amount of power from Northern Quebec, which is transmitted through high voltage lines all the way down to Boston or the Boston area. And that's maybe economical as compared to building a plant, but it costs a lot.

So if you can avoid the transportation costs and do it locally, it might be better, so having a thought that maybe we'll have decentralized units of production. A standard issue, whether you're doing warehouses or electric power production or almost anything is not just how much capacity you have, but where do you have it at what time. So it's a generalizable example, applicable in thinking to many issues.

So here's the schema for the design. And it's very similar to the-- the analysis. The schema is very similar to the garage case. So the first step one was to say, let's build the model of how this thing performs as one single large plant. And then because of the parametric one, we say let's suppose we know what the demand is going to be. We assume that, do a deterministic analysis, and think about what is the right size for the plant we ought to build.

That, of course, depends upon the economies of scale so that depending upon the economy of the scale, you build it smaller and then expand it or not. This is the same kind of thing that man did in his very simple model that I showed you a couple of weeks ago, so deterministic model first. That's the base case.

Secondly, we said we recognize this uncertainty, so we're going to think about this, and we're going to generate a lot of demand scenarios and see how the standard model performs under uncertainty or the deterministic model performance under uncertainty. And what you see is that once you recognize uncertainty, the value of the project changes, decreases because it's capacity limited in this case, and secondly, often the actual design changes.

So this is very much like the garage case, except it's now applied into a much more complicated situation. Thirdly, we said given that we have the demand scenarios, let's think about having a flexible design that responded to the demand as it happened.

So if it was growing well, transportation uses were ballooning and going way up, then we add more capacity. If people weren't using it, we would not do it. And so we now had a design-- two designs. One is thinking that we had flexible module designs, but we were going to do all the plant in one place.

And the second one is to say, let's suppose it is possible and could be desirable to actually move some of the capacity to it. So we had a more limited version of only about the timing and a second version of design with timing and locational choices. And then we were thinking about overall calculating the value of flexibility, the economies of scale factor, and the sensitivity analysis.