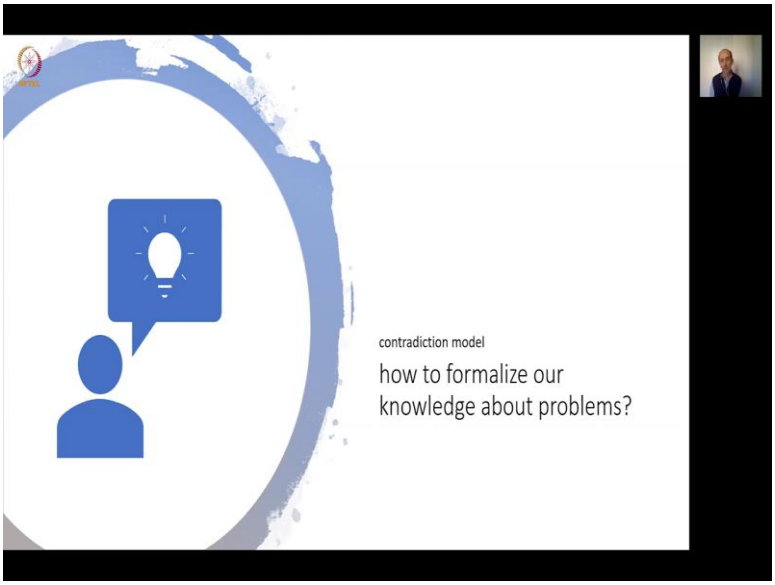
Technology forecasting for strategic decision making - An Introduction
Professor. Bala Ramadurai
Indian Institute of Technology Madras
Professor. Dmitry Kucharavy
EM Strasbourg Business School
How to formalize our knowledge about problems?

Professor Dmitry Kucharavy: Hello, welcome back to our technology forecasting for strategic decision-making course. And now we are going to discuss a bit more in detail how do we transform the problem, which will perceive to the contradiction, which helps us to understand root cause of problem and to understand our problem more formally. And this, in fact, will help us not only to understand the problem, but it will help us also to find an adequate solution.

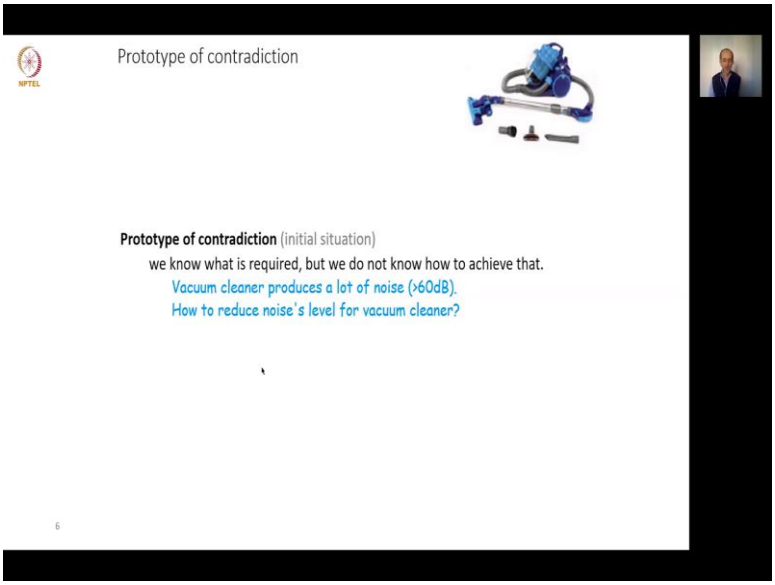
(Refer Slide Time: 00:56)



So, how to formalise our knowledge about problems? For that purpose, we can use the contradiction model, which was well developed in border of research about Theory of Inventive Problem Solving, which was originated somehow in the end of 60s in former Soviet Union and this is a famous theory that today is applied for building different methods for problem solving, for design problem solving, for a different kind of situation where we have more solutions ready to use, but our purpose is to use this model is not so large.

Our purpose is to see how can we use this model, in order to purposefully learn about problems, but let us start with some example. How do we learn about problem situation?

(Refer Slide Time: 02:10)



Let me get an example about vacuum cleaner and vacuum cleaner we like a lot because it can clean our room. But we do not like it so much because normally it is a very noisy device which consumes electricity, but not so much electricity, but it is produce a lot of noise and usually we cannot use this device at the night because our neighbours definitely will not be agree about it.

When we face, when we realise a problem, for instance, like in this situation that we would like to reduce the noise of vacuum cleaner, we arrived for the question like how to reduce noise level for vacuum cleaner? So, as soon as we arrive to such a question, we always are looking for the solution, but before looking for the solution, the good idea is to understand what is behind this initial situation.

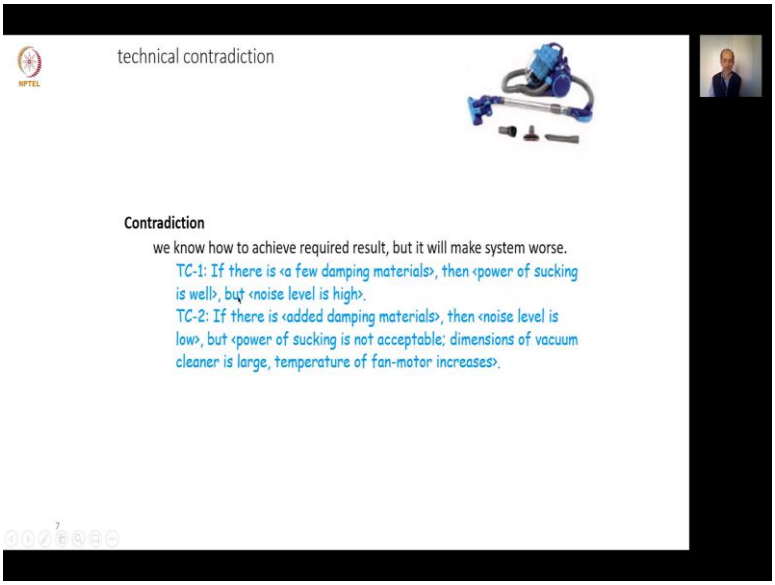
The initial situation we know what is required, we know what do we want, we know what is the desired result, but we have no idea how to achieve that. But if you ask the same question from engineers, the experience engineers, will say that, okay, so if you have a problem with a noise. Normally, how can we reduce the noise? We can add some damping materials, if you add some damping materials like sponge inside of the case of vacuum cleaner, the noise level will be reduced.

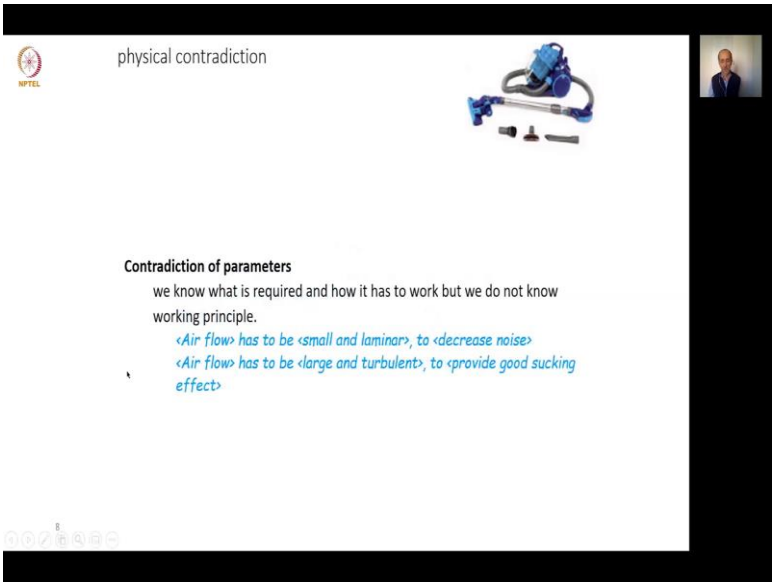
So, but in these situations, we have also degradation of other parameters, such situation we can describe as a couple of contradictions in border this case, they name it technical contradictions. And, this situation can be represented in words like, if there is a few damping materials then power of sucking is well. So, our vacuum cleaner is very efficient, but the noise level is high. This is most vacuum cleaner that you can find on the market.

But if there is added damping materials, remember what experienced engineers suggest to us, you need to reduce noise add damping materials. In this case, the noise level is low it is true, but the power of sucking is not acceptable because the damping materials they will reduce airflow inside the dimension of a vacuum cleaner will be larger because we need space to put our damping materials and what is also important the temperature of fan motor increase because the cooling effect of fan motor will degradate also.

So, technically speaking, we faced with a situation where improvement of one characteristic like reduction of noise level led us to degradation, not acceptable degradation of other characteristic of our technical system. So, this situation we described that we know how to achieve required result, but it will make system worse.

(Refer Slide Time: 05:43)





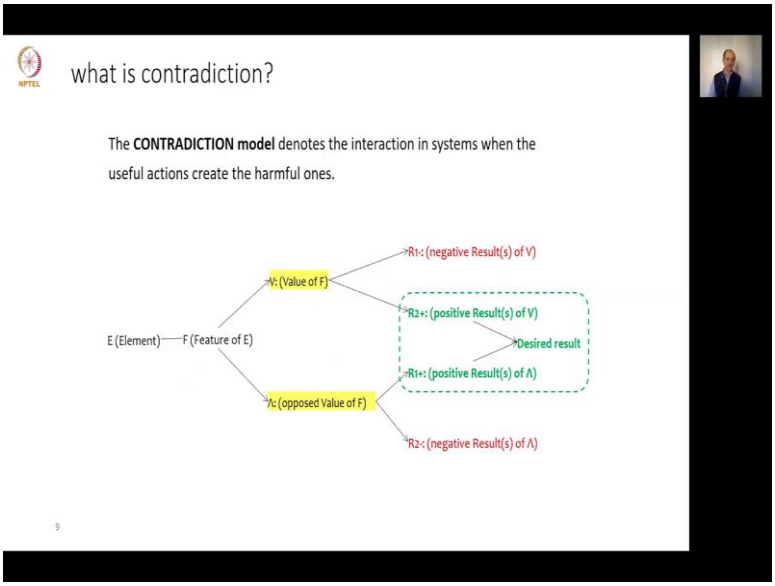
This is exactly what we named the technical contradiction, if there is a few dampened materials and power of sucking is well but noise level is high. We know how to, but it makes our system works. When we continue to study this situation, we arrive to the physical contradiction or contradiction of parameters when we know what is required, and how it has to work, but we do not know the working principle.

From point of view of physics, why do we have a lot of noise because our air flow is turbulent, it is large and turbulent, large and turbulent airflow produce a lot of noise, but it produced also good sucking effect. The airflow has to be small and laminar. In this case, it will not be noisy. But the problem is that this small and laminar airflow will not provide goods sucking effort. The contradiction of parameter, this is a level of a physics of the process.

If previous contradiction was mostly formulated on the level of technologies, applied technologies, like let us add damping materials, or let us remove damping materials. The physical contradiction explained to us why, why do we have noise at all? And resolving physical contradiction, if you are capable to resolve physical contradiction produce us much more powerful solution, then resolving technical contradiction, which is the matter of optimization. Let us add few damping materials or let us add damping materials in a different way. And let us optimise it with the power of sucking.

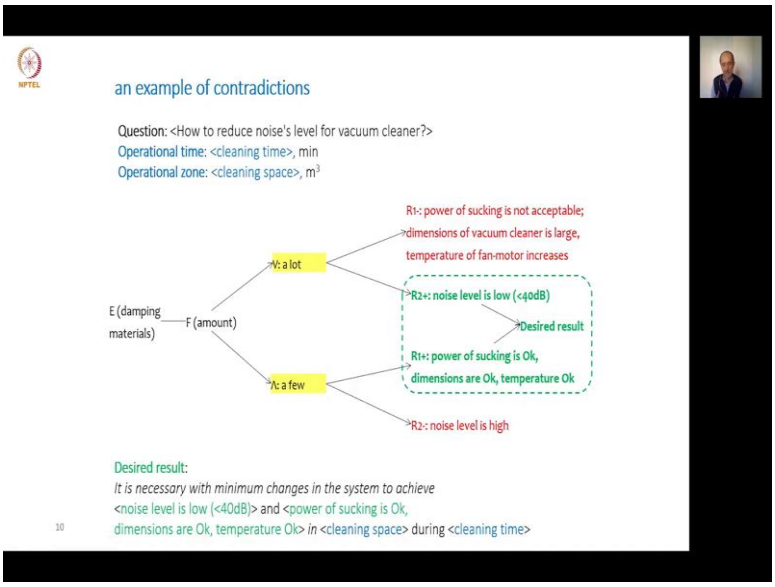
In our case, in order to predict the future of technologies, we use more generic representation of contradiction, which include both the technical context and physical context.

(Refer Slide Time: 08:21)



What is a contradiction? The contradiction is a model, this is a model that we use to describe the interaction inside of the system when useful action creative powerful one. So, and the pattern, the basic pattern of contradiction of a model that we use for forecasting purpose, we put what are we interested to achieve? In which situation it will happen, what kind of element feature of element and value of feature responsible for that, and of course, what will be the negative consequences and the opposite value of the feature of the same element, which leads us that this negative result will become positive, but unfortunately, our positive result also will become negative. Let me illustrate it using the same problem about on vacuum cleaner in order to make clear how do we fulfil these variables?

(Refer Slide Time: 09:36)



The contradiction usually is described also in context, it described in context of question to answer. You remember our prototype of contradiction; it is described in context of specific time and specific space. In our case, our operational time is clean time within this time in the cleaning space this can be the room, it can be something larger, or it can be something smaller. We are interested to answer your question how to reduce noise level for vacuum cleaner.

Well, our desired result is noise level is low less than 40 decibel. And we know that we can achieve this result, if we will put amount of damping materials a lot, but in this case, as we already discussed, the power of sucking will not be acceptable, then mention of vacuum cleaner will be larger and temperature of a motor will increase.

When we will put few amounts of damping material, we will achieve adequate level of power sucking, our dimension of vacuum cleaner will be acceptable and the temperature of our fan

motor will not increase, but the noise level will be high. If you sum up these parts of exercise, the desired result with minimal changes in the existence system, we have to achieve noise level is low and the power of sucking dimension of vacuum cleaner and temperature are acceptable.

But not all the time, only within the cleaning time, and only in cleaning space this is very important details that we have to always specify where and when, in which time and in which space, and we can always measure it. In fact, we have to resolve this contradiction not all the time, but just dozens of moments when we are cleaning, it can be up to one hour. At in the cleaning space and so that we are talking about noise, this is more metre cubic because the noise propagates through the air normally, if we have no air, we have no noise.

So, the representation of the question how to reduce noise level for vacuum cleaner in a shape of contradiction, these are the key in order to understand the problem more profoundly. And what is also important, when we build for each question, for each problem, for each perceived problem, the contradiction we can interconnect them to the map. And this map can help us to answer the questions through their phenomena that problem, when problems are interconnected, we have a systemic view to those problems.

This was a part that I tried to discuss with you a bit more in detail in order to help you to understand how do we make transition from the problem perceived to the deep understanding of the problem, which helps us to predict the future of our system. Because, in fact, the resolving of this contradiction depends on what kind of resources we are going to use in order to satisfy these opposite requirements.

We have not to have a lot of damping materials not a few, we probably will do it even without damping materials, but what is our target is the noise level is low well the functioning of our vacuum cleaner is what is required adequate. So, in the advanced course, if you are going to follow it, you will use this model in order to formalise all your perceived problem, all collected problem, collected source to the drivers and barriers and thanks to the system operator.

You will use this model in order to formalise your knowledge. This was almost all that I would like to share with you the introductory course about contradiction. Of course, when you start to practice it, you will know much more interesting thing. Do you have any question Bala?

Professor Bala Ramadurai: Very quick summary and something from my experience also. So, the summary is that this step requires that we take one barrier that we have converted into a question, which is how to and then look at what is the operational time what is the operational zone, or conflict time, and conflict zone? That is, where is the contradiction? And when is it a contradiction, nice example that you gave us with the vacuum cleaner you can relate to that. And then formulating it into this model of element, feature, and value, and then expanding it. So, that is my summary.

My own experience is that, for getting better at this, take up anything that you see around yourself, any problem that you see around yourself, you are not able to do something, formulate it in contradictions over and over again. And it becomes a sort of a habit, and I find it extremely useful in order to think of any situation you are in, in terms of a conflict model, I find it extremely useful, thanks to experts, like colleagues like Dmitry, who have introduced me to this way of thinking, thank you so much. That is what I wanted to share. There are no questions from my side.

Professor Dmitry Kucharavy: Thank you, Bala. And we hope to see you for the next part of our course. And for this part that is all, thank you very much.