Carbon Accounting and Sustainable Designs in Product Lifecycle Management

Prof. Deepu Philip
Department of Management Sciences

Dr. Amandeep Singh Oberoi
Imagineering Laboratory

Dr. Prabal Pratap Singh
Department of Management Sciences

Indian Institute of Technology, Kanpur

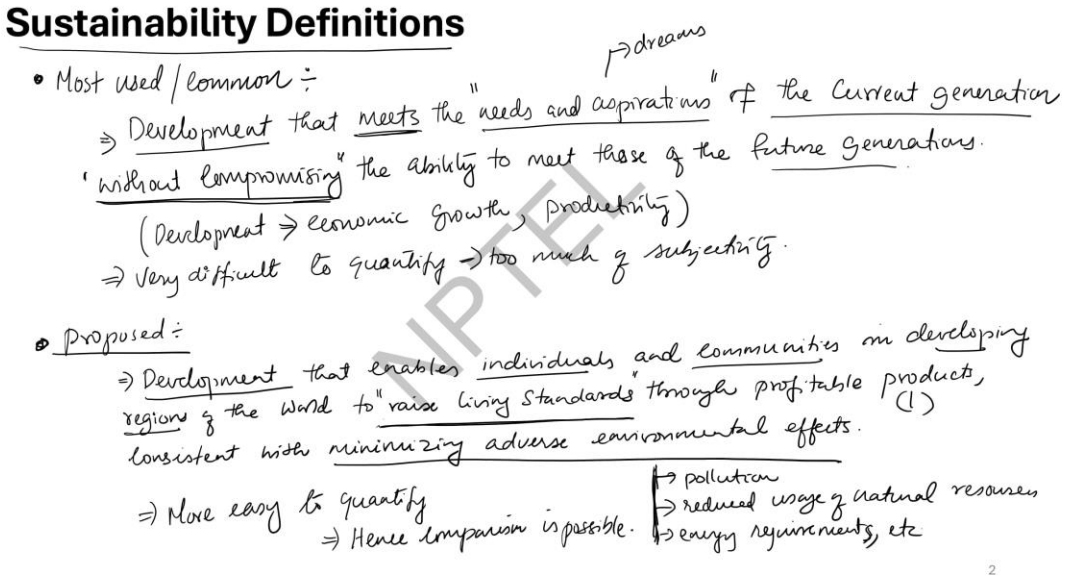
Week 01

Lecture4
Productivity and Sustainability (Part 2)

Good afternoon, everyone. Welcome to the course on Carbon Accounting and Sustainable Designs in Product Lifecycle Management. We have been offering a series of sustainability green manufacturing courses under the NPTEL MOOCs from IIT Kanpur. Specifically, myself, Dr. Amandeep Singh Oberoi, Dr. Prabal Pratap Singh, we've been doing many courses.

This is an advanced course, in this regard where we are also now trying to quantify the environmental impact using carbon accounting or carbon measurement or we trying to use carbon accounting as a way to quantify the sustainability of this. So, we already studied the Productivity which is the traditional aspect of manufacturing or the product life cycle systems.

But we are now going to look into what you call as a sustainability angle of it. So, the first lecture part we already completed. Now, this is the second part and I am Prof. Deepu Philip from IIT Kanpur.



So, before we get into this, we have to first talk about how do we define sustainability for this, okay. So, the most used or common definition, what is the most used or the common one? The Common one is, the development is what people use most of the time, development that meets the needs and aspirations of the current generation without compromising the ability to meet those of the future generations. So, this is the most commonly used definition where everybody uses this.

So, the key word is Development. Or you can talk about it as Growth. Some people, instead of development, may be replaced with economic growth. Or you can call it about as productivity. All those kinds of things are part of this. Okay.

So, the development that meets the needs and aspirations of the current generation. Whatever the needs and aspirations or, some people call, you also use the word dreams or needs, etc. So, it doesn't matter. Okay. Needs and dreams, needs and aspirations, this is all word play. Nothing major to it.

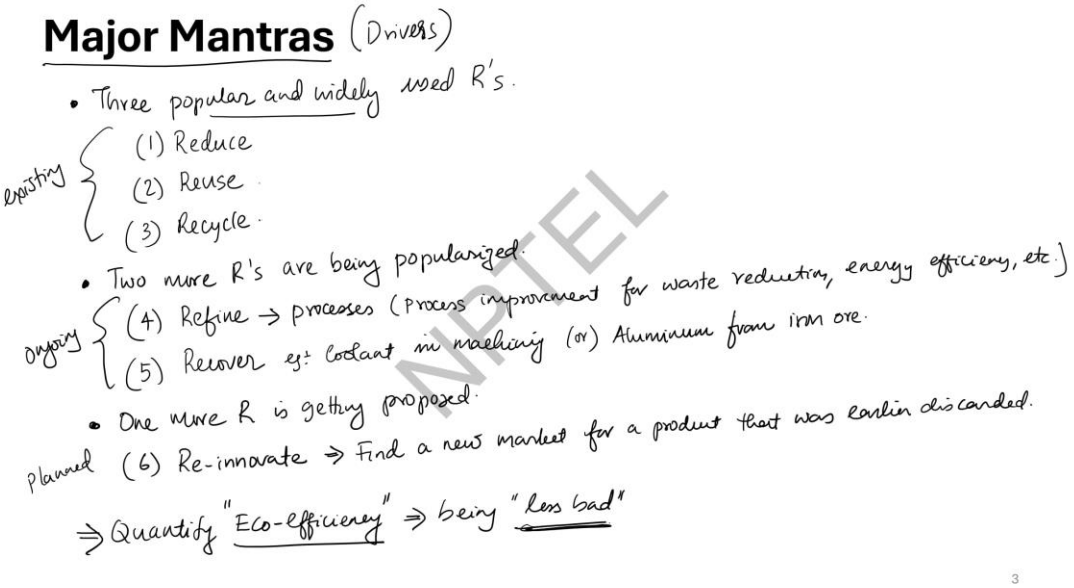
But, if you are allowed to meet this, but the key word is without Compromising. Let's not compromise the same ability of the future generations. So, whatever we do, so if in a simple way to say it is, if I am driving a car that has a 10 kilometer per liter mileage, the two generations down the road should also have the same capability to have that car, and drive it, and enjoy in that way. But this definition, the problem with this, it is very difficult to quantify.

This is too much of subjectivity. So, for the purpose of this course, let us use a proposed definition. So, let us talk about Development, the same keyword that enables individuals and communities in developing countries, in developing regions of the world. That's not called countries, developing regions of the world. To raise living standards through profitable products, consistent with minimizing adverse environmental effects.

So, this is more of an easier definition. So, what we say is, again a development that enables individuals and communities, we can talk about individuals or communities in developing regions that means they still have growth, there is a possibility to growth. And what is the measure here? The measure is "raise living standards".

You are intending to raise your standard of living through, what is the number one? Profitable products. You are focusing on the profitable products or you can have products or service. It's up to you. But then the idea is that these products should be minimizing adverse environmental effects.

So adverse environmental effects, some of them would be pollution, reduced usage of natural resources, energy requirements, etc. Okay. So, all of these things will actually in together will reduce the adverse environmental effects. So, this is easier to quantify. Okay. So, hence comparison is possible. We want to find out which system, which product, which society is more sustainable. So, if that is the case, if this is what the sustainability we talk about.



The next part of what it is the Major Mantras or we call it Mantras here or major drivers. I am going to use the word mantras or drivers. Mantras is more of this management word. I don't, I am not a big fan of it but some people like it.

So, we are adding. So, the first most important thing is three popular and widely used R's. Okay. So, the first part is the three popular and widely used R's. What are those three? Number one is reduced.

Number two is Reuse. Number three is Recycle. Everybody knows this as the three R's. The moss is very popular and widely used. Reduce energy, reduce consumption, reduce water, reduce pollution, etc.

Reuse is if you can find alternative use for it reuse the water bottle, reuse plastic caps, reuse packaging materials, so that you can find alternative use for it and recycle, if it is the vehicle becomes really old then recycle it to bring use the metal that is already in the car and to make new vehicles as part of it, right. Then what we have now is there is now 2 more R's, are being popularized. Okay. So, the 3 are already used.

Now, we are going to talk about 2 more R's. Okay. So, I am going to number them as 4 and 5. So, 4 is Refine. Okay. And 5 is Recover. Okay. Refine, in a sense, a lot of the time it's not refined petrol.

It is more related to refine the processes. Okay. So, this is a process improvement for waste reduction, energy efficiency, etc. Okay. So, that is the refined. Recover is like an example of this is, you can think about it as coolant in machining, is an example. Okay. Or aluminum from iron ore.

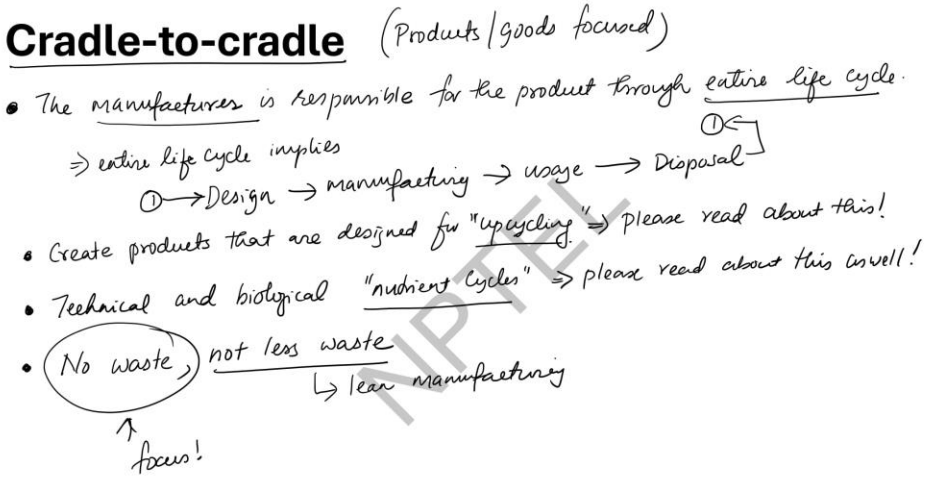
So, the iron ore sometimes contain aluminum, traces of aluminum on it. So, instead of throwing it away as trash, we try to recover that aluminum from it, okay. Then, the third part of it is one more R, okay, is getting proposed, okay. The 4 and 5 are being popularized. People are slowly getting the hang out of it.

And the one more R that we are now proposing in this regard, that is known as Re-innovate. Re-innovate in a sense, find usage for the item that might be there. So, like an example is, find a new market for a product that was earlier discarded. So, like for example, using fly ash in cement, etc. These are all re-innovation aspect of it.

So, ideally, there is this. These are the three popular ones. These are existing ones. This is ongoing and this is planned or people are working on it. So that's why we also mentioned about Innovation as a key one in the previous lecture.

So, the idea is, so then what are we going to quantify? We are going to quantify eco-efficiency. That is the thing that we are interested in quantifying. And how do we quantify? It is being less bad.

We are not talking about making it perfectly to begin with. But let us reduce the adverse impact, being it, making it less bad is the first focal point of this one. So, all these mantras and other things are motivated or driven towards making things more eco-efficient, achieving more eco-efficiency. So, now, how does these mantras get implied or get implemented?



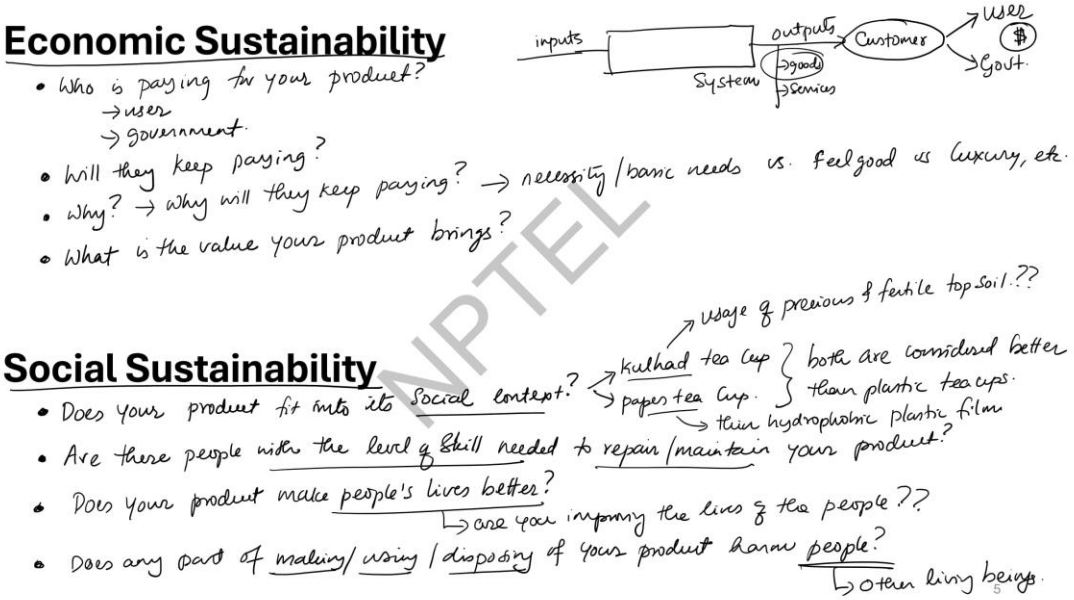
So, the logic here is Cradle-to-cradle. Okay, so the few points that somebody need to talk about or we need to discuss as part of this is, we are talking about more in this regard is, products or goods focused, okay. We are slightly keeping it to the one side to the begin with, so let's first focus on products because that is where the maximum number of resources and energy gets used So, the manufacturer is responsible for the product through entire life cycle. The manufacturer is responsible because the person who produces is responsible through the entire life cycle.

From entire life cycle, what do we imply by entire life cycle? From the design. So, let us, entire life cycle is, cycle implies, what are we talking about. Design, manufacturing, usage, disposal, okay. So, this is the, and sometimes this may go back to the design, also may refine the design, it is possible, okay. So that is the life cycle that we talk about at this point, okay, so then the second aspect of it is, also that create products that are designed for upcycling. We will talk about what is upcycling in one of the lectures coming up, so this is the time being please read about this,

What is upcycling, read about this, we will define upcycling later, uh not now but you can be ready by that, okay, then you have is technical and a biological and what we call as nutrient cycles, okay. That is another word. Okay, please read about this as well. Okay, so you are supposed to read about the, what is the nutrient cycle. We will discuss this.

Both of them we will define later down the road, but not now because you need to understand some more things before, I define that. And the other one is no waste. Okay. Not less waste. Okay. So, the not less waste is, what we call as the lean manufacturing. Okay. That is reduce waste. Okay.

Whereas the current focus is it is not less waste. This is the focus. No waste. Okay. It is difficult to achieve, we agree, but that is the point. Okay, fine.



So, now let us go to the two aspects of it. Again, as we talked about the sustainability, the two aspects I want to discuss to you guys is the economic sustainability and social sustainability. And after this, then we will look at few examples to understand what is going on, and then we will proceed accordingly. So, the economic sustainability is something, the fundamental question that we are going to ask is, who is paying for your product? The first question here is, who is paying for your product? Is it the user or is it the government? Okay.

So, if the user is paying for the product, it is more economically sustainable than government, because once the government starting paying, typically in the form of subsidies, and all those kinds of things, they are not very long sustainable model. So, like for example, even though people have different viewpoints on it, that's one of the reasons why everybody says farm subsidies, minimum support price, etc, all they need to be removed, from the government, and the user should actually be paying for it purely because of the fact that if the government starts paying, lot of inefficiencies comes into system.

The taxes gets increased and finally at the end of the day, the cost of implementing or cost of paying that is far higher than what it is. An example of this is the one kilogram of rice that we use in the Public Distribution System. The government that gives in Public Distribution System typically cost us about 67 rupees. This number varies depending upon when you are looking at inflation and all. But it's 60 to 70 rupees per kilogram cost of rice, which is typically what we get in the PDS for 2 or 3 rupees per kilogram.

That's the cost of it. But if that money is directly transferred to the account of the individuals, then 40 to 50 rupees, you can actually go and buy very good quality rice and eat it. So you can be, so the government paying for it might not be an economically sustainable solution, whereas alternates can be created. So, this is an example of it. Then comes the next part.

The second question is, will they keep paying? This is one other question that we need to, will the user continue to keep paying? Or will the government continue to keep paying? Is it possible? Is it sustainable?

Can you take it to the long run? That is the next aspect. And then there is a thing is, why. Why is, why will they keep paying? So, will you pay for your food? Probably, yes.

If you don't eat, then you will die, obviously, right. Will you keep paying for buying luxury cars on an annual basis? Probably, not. So that, because sometimes it is usually the necessity or basic needs versus, what we call as feel good, not felt, feel good versus luxury etc. Right, so the food, clothing, housing, people probably would do everything within their power to pay for it and continue to probably keep paying for it, whereas people may not buy a very expensive watch based on that because that may be something that might not be a regular thing then.

The other question also that need to be considered part of the economic sustainability is, what is the value? What is the value your product brings? Okay. So, this is the next question that we need to also think about. What is so great about the product? What is the value that the product brings in so that people actually go by this?

So, if you look into the system as such, as I said earlier, you have a system. Okay. And you have inputs, outputs and you have customer, so in the input we have goods and we had services, goods or products and here the focus is on goods and the customer you have, user or individual or you have government, so that's what we talked about and what their job is, they are bound by the money.

Point, will they keep on paying and why will they keep on paying and that aspect is what we were discussing here. Now comes the aspect called Social Sustainability, okay. Now, here the major questions involved or what you need to understand is, does your product fit into its social context? Okay. So, you may say that like an example of it is we have, let's take two examples. Okay. Cooled teacup and Paper teacup. Okay.

Obviously yes, in one point of time, this you can say that both are considered better than plastic teacups. But is it so? That's another question, so you are saying that in the social context, Kullad will actually support the Kool-Aid maker also, it is biodegradable, all those kinds of things. But in the cooler teacup, one thing that you need to think about is the usage of precious and fertile topsoil or pond clay or whatever you want to call it. What about that?

What is the impact of that? That many times we don't tend to discuss that aspect of it. The paper teacup, on the other hand, you can think about it as the thin hydrophobic plastic film that is inside the teacup. How is that affecting you, when you add hot water into it, is it going to affect your health? How this thin, fine plastic, will it biodegrade?

All those aspects that we need to talk and discuss about. So, you may say that, okay, it's a better product, but does it actually fit the social context? This is one critical and very difficult question to answer. Then, the second one is, are there people with the level of skill needed to repair or maintain your product? Okay. So, one of the aspects of this is, are there people with necessary skills that can repair or maintain your products?

So, an example is in earlier days, the cars, you could take it to a small workshop, Ambassador cars or Premier, Padmini, Maruti, old cars, still most of the Toyota or the Japanese vehicles, you can take it to a local workshop and many of the parts can be

replaced or repaired. Whereas many of the German manufacturers, what we talk about, like BMW, Mercedes and all, them getting repaired in a local mechanic is much lesser and that's the reason they do this because there is so much higher skill level because of the extensive use of sensors and iots and those kinds of things. so, from a social standpoint, if the repair of the car is completely, now a function of the manufacturer and not the local work mechanic, ecosystem is thrown out of this thing, then the social sustainability of the product is under question.

Then comes the third aspect that you need to think about is, does your product make people's lives better? By using your product, are you improving the lives of the people? So, the question here is, are you improving the lives of the people?

That is the main question that we need to ask on this part. Then comes the last part, which is the last question is, does any part of making or using or disposing of your product harm people. So, the idea here is that in the process of making, using and disposing of your products, does it harm people? That is an important question. So typically, single layer plastics, all those thin plastic bags, carry bags which are typically now banned in many other places is also something that is harming the environment, harming the people, harming the animals.

So, it is not just people, you can think about the other living beings also as part of it. So thus, using pesticides, organophosphate and organosulfates, those kinds of pesticides, is it also causing a problem to part of this. That's also an important aspect that we need to consider here. Now, the next session, what we will do is we will look into a few examples of how this has been accomplished by a few companies. We will use Toyota as an example and how they look into that.

And we'll also use Eats or people popularly known as Airbus, how they move towards achieving sustainability. And also, another confectionery company, called Mars Chocolate. We will take three examples in the next session to look into, some of these aspects and go from there. So, thank you very much for your patient hearing and we will be soon back with the next short session.

Thank you.