Carbon Accounting and Sustainable Designs in Product Lifecycle Management

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Week 04

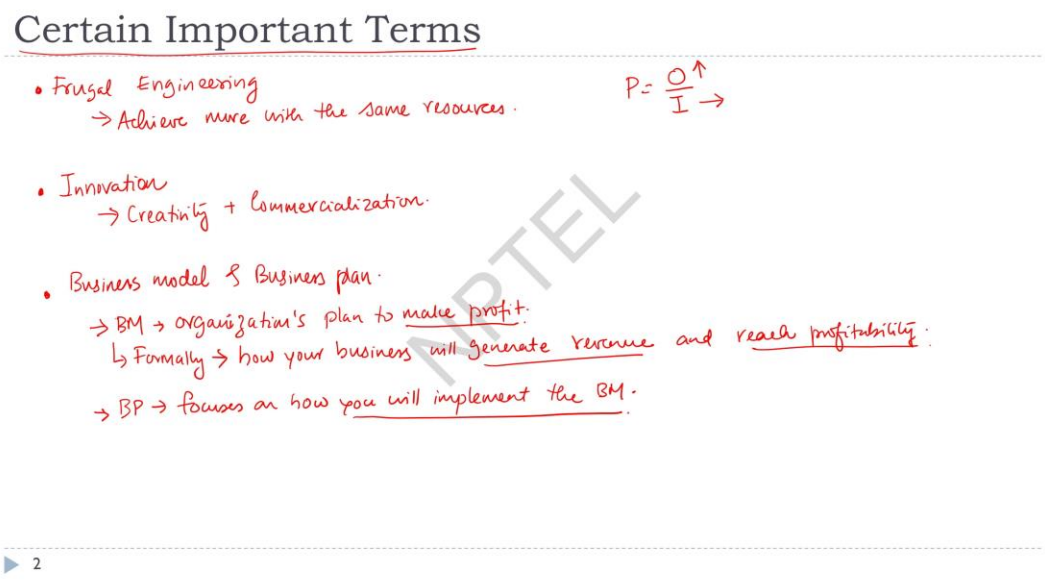
Lecture 16

Road to Product Lifecycle Management (Part-1)

Good afternoon, everyone. Welcome to yet another lecture on the course titled Carbon Accounting and Sustainable Designs in Product Lifecycle Management. This course is offered as part of the NPTEL MOOCs program from IIT Kanpur. My name is Prof. Deepu Philip. I am a faculty at IIT Kanpur.

And along with me, this course is taught by Dr. Amandeep Singh Oberoi and Dr. Prabal Pratap Singh. And we have been talking about various topics as part of this course. And we have already seen many topics, many aspects of it. And today we are going to get into the critical aspects of this and introduce you to the concept called Product Lifecycle Management. Very popularly known as something called PLM.

And how this PLM, and this is something that is being driving the industry now. And how this PLM and other aspects are critical for this course is what we are going to discuss now.



So before we get into this, let us discuss certain important terms and these are required for us to understand things better. So the first term that we would like to do is called frugal engineering, okay. And what is it? Okay.

So, there are many definitions and we can read those. But philosophically, the functional aspect is achieve more with the same resources, okay. So, if you remember your productivity, P is equal to output over input. If you maintain the same amount of resources or inputs, and increase the output, then this is achieved more with your same amount of inputs or same amount of resources. So, this is also in another way of thinking about frugal engineering.

So, this is also sometimes people also call as the efficiency model, but it is also now known as the Frugal Engineering. Then there is another word that we talked about in this case. Most of the time it is called Innovations. And there are many definitions of innovation available in the market. But for us and for the purpose of this course, it is known as creativity plus commercialization.

So, if you have a creative solution that is commercializable, that is marketable, where there is feasibility of people to buy that, then that is called as Innovation. Then comes two things. It is called Business Model. We will see this and business plan. This is also two critical aspects.

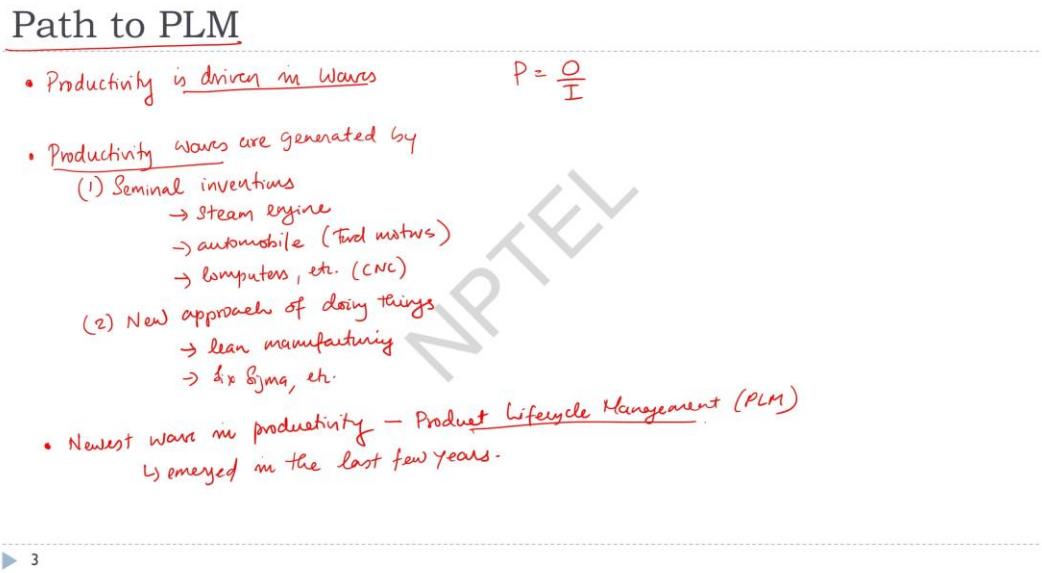
And there are many other definitions available for this. But we will only use what we would like to use in the class. So, what is Business Model? BM, the Business Model. It is, in a simple way, the organization's plan to make a profit. The focus is on profit. How do we make profit?

That's usually called as the Business Model. Formally, a little bit more nicer. This is not a very good, nice definition. It's basically very brute. If you look at it in a very nice, little bit more better version.

How your business will generate revenue and reach profitability? So, how would you generate revenue and through the process of generating revenue, how will you reach profitability? That is these two things put together is what you call both are ways. The simplest way to looking it is how an organization's plan to make profit is a business model. But a better way to say it is how the business will generate revenue and, through the generation of revenue, how it will make a profit.

Then there is BP, what you call a Business Plan. So, this focuses on how you will implement the Business Model, okay. How you will implement the business model? It is one step below. Your business model, how will you implement it and how will you reach profitability?

That is what we call as the Business Plan. So, these words we need to remember or these things we need to remember.



Now, let us talk about the Path to PLM. So, how did we reach PLM? Where are we with the PLM?

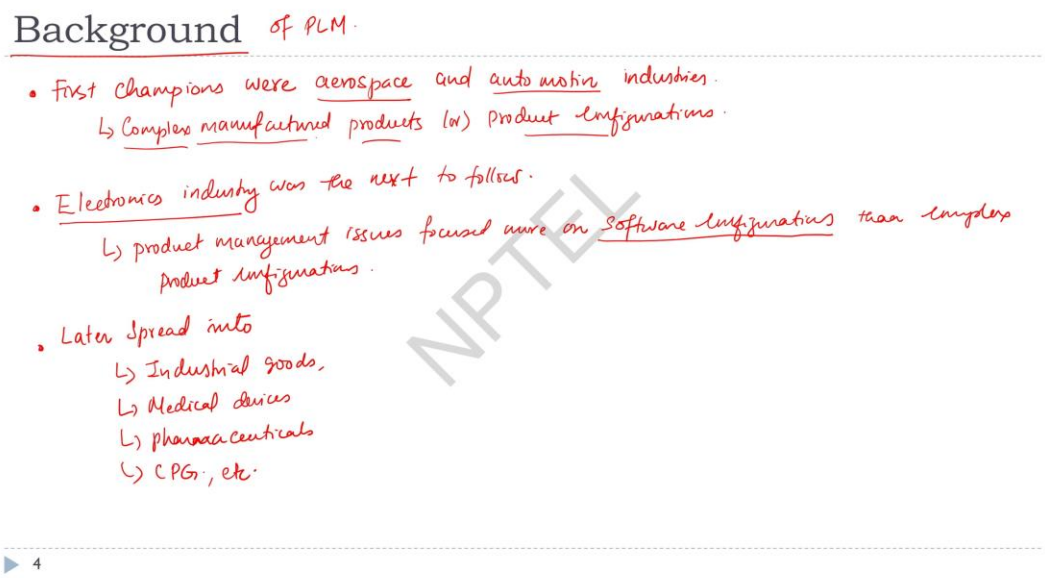
First thing you need to remember is, as I mentioned in the class earlier, productivity is driven in waves and productivity is the ratio of outputs over inputs. So, the productivity is driven in waves, always. It has been like this. And the productivity waves are are generated by, one, the two ways, these waves are propelled, or the motive behind these waves are, number one is, Seminal Inventions, or Innovations. Let us call it inventions, not innovations, Seminal Inventions.

An example of them are, steam engine, automobile, mass production, Ford motor. Ford motors are an example, the model T, then computers, etc. Computer is, you can think about a CNC, numeric control machines, computerized numeric control things. So, these similar inventions draw productivity. Same way, the second one is new approach. The other option is new approach of doing things.

That is the other wave that actually drives the productivity That is lean manufacturing or lean philosophy, Six Sigma, etc. So. These. Either the approach or the invention, seminal inventions, draw the productivity waves. That is the second aspect. The third aspect is newest wave in productivity.

What is going on now? That is the product life cycle management. Which is called as PLM? So, the newest wave is the PLM. This has emerged in the last few years, maybe a decade at the most.

So, the newest wave, what we are going to do, is this PLM and how it is actually driving the productivity wave.

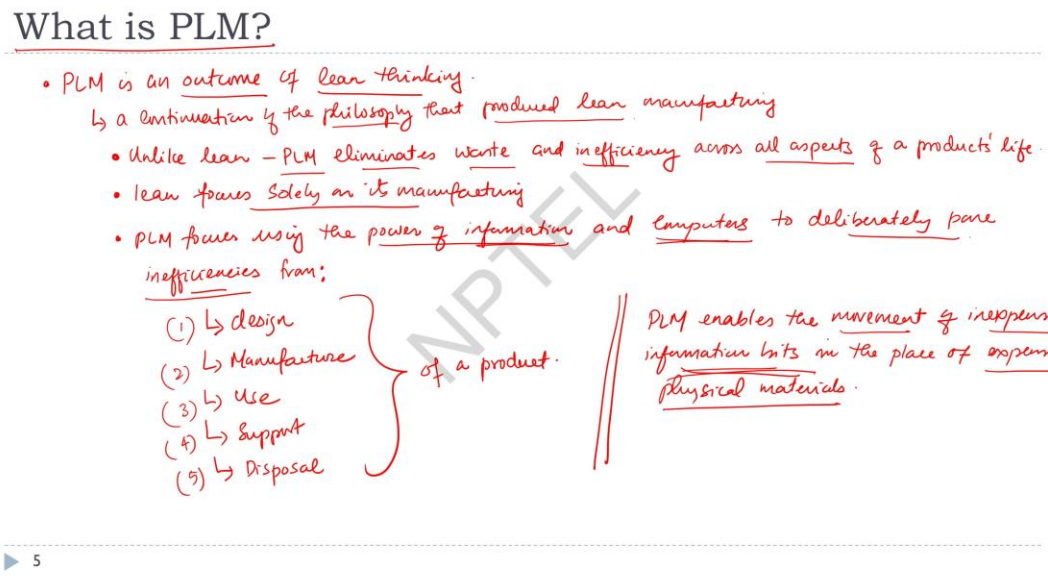


So, let us talk about the background of the PLM. So, the first champions were the people who, the industry who championed, first champions were aerospace and automotive industries. So the first champions of this PLM were both aerospace and automotive industries.

So, the reason is complex manufactured products. Both aerospace and automotive industries have complex manufactured products or product configurations. So, the products or product configurations are complex, and the manufacturing process is relatively complex in nature. Electronics industry was the next. Electronics industry was the next to follow.

After the aerospace and automotive, electronic industry followed. Here, the product management issues focused more on software configurations than on complex product configurations. So, the focus was on software configurations and then on complex product configurations, which were part of the aerospace and automotive industries. The PLM later spread into industrial goods, then came into medical devices, then came into pharmaceuticals. Then came to CPG or consumer produced, consumer product goods, etc.

Slowly, it started spreading into other industries. So, that is how the PLM or the background of the PLM came into picture.



So then let us now talk about what is PLM or let us formally decide or discuss what is PLM. So I will say that in a very simple way, PLM is an outcome of lean thinking. It is an outcome of lean thinking.

So what does it mean? It is a continuation of the philosophy that produced lean manufacturing. So, we continue to extend the philosophy that produced the lean manufacturing. So, here the major things are, unlike lean, PLM eliminates waste and inefficiency across all aspects of a product's life. So, what does lean do?

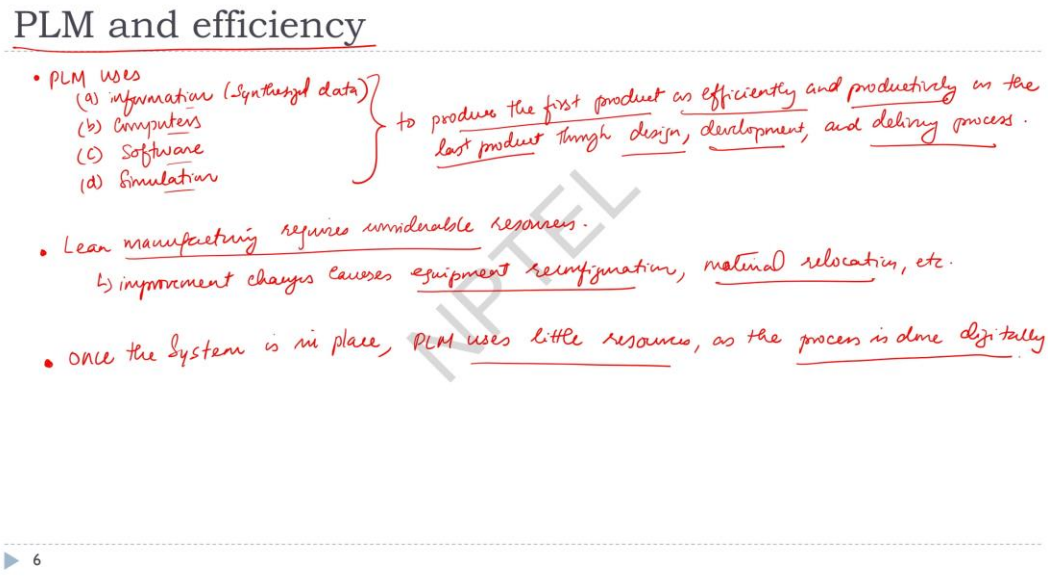
Lean focuses on, let's say, solely on its manufacturing. So while lean focuses only on the manufacturing side of a product, PLM focuses on all aspects of a product's life. Then PLM focuses, how does it focuses? Focuses using the power of computing or power of information and computers. It focuses, how does it do? Power of information and computers. It uses the power of information and computers to deliberately pair inefficiencies.

So, deliberately bring forth the inefficiencies. Where does it brings the inefficiencies from? That's from the design, then manufacturing, manufacture, use, support and disposal. All these five aspects of a product.

So what it does is it uses the power of information and computers, combines information and computers to bring forth inefficiencies from design, which is the first part,

manufacturing, then usage of the product, support and maintenance, and finally the disposal of a product. So, what it does, in another way to think about it, is that PLM enables the movement enables the movement of inexpensive information bits, inexpensive information bits in the place of expensive physical materials.

So, what we do is, we exchange, instead of moving expensive physical materials, PLM moves the inexpensive information bits. So, by moving the inexpensive information bits, you can, instead of moving the expensive physical materials, you can bring in the inefficiencies and then address them. This is another way of thinking about is, one way to think about is also the precursor of what we call as the digital twin as such.



So, now we talk about PLM and the efficiency. How PLM drives efficiency. So, PLM uses

A) Information

B) Computers

C) Software

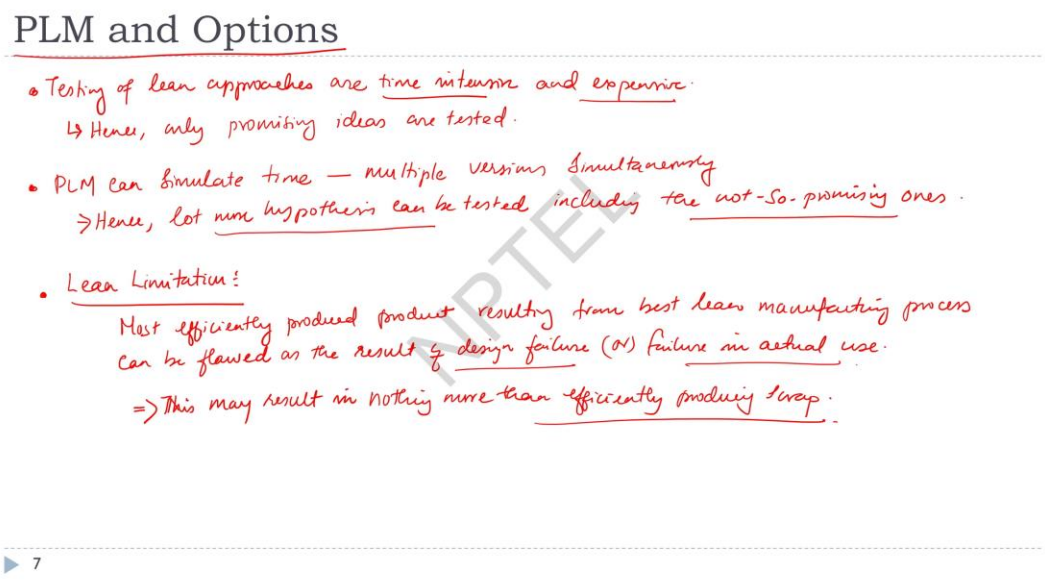
D) Simulations Information means synthesized data. You extracted stuff out of it.

So, all these things to produce the first product as efficiently and productively as the last product through design, development and delivery process, okay. So we produce, so what it does is it combines information, computer, software and simulation. I told you earlier also because I suggested the word digital twin, alluded to this, but this was way before even the management people coined the digital twin. So, these four things are combined to produce the first product as efficiently and productively as the last product. Because as we keep on producing, we have better learning and every revision of the product is better compared to the first version of the product.

But PLM strives to achieve the same efficiency that we achieve when we produce the last product by intervening in the design, development, and delivery processes of a product. So then, other thing also you should understand is lean manufacturing requires considerable resources. In manufacturing, do require considerable resources. Why does it require considerable resources? Okay. Because improvement changes.

The changes that you bring forth for improvement causes equipment reconfiguration, material relocation, etc. So lean manufacturing is expensive or requires considerable resources because you are still dealing with the physical materials and machines. And whereas I told earlier in this case is we are dealing with inexpensive information bits instead of expensive physical materials. So that is the logic behind it. And once the system is in place, PLM uses little resources as the process is done digitally.

As the process is done digitally. So, I said earlier use the word digital twin. So, the logic here is that because PLM focuses more on digital, the information, and computers and simulation, that's why it uses much fewer resources. And hence, once the system is put in place, PLM will end up driving efficiency in comparison to what we call as the Lean Manufacturing.



So now let us talk about PLM and options. What are some of the options that are associated with PLM? So the first one is testing of lean approaches are time-intensive and expensive.

Both time-intensive and expensive because when you test green approaches, they are time-intensive and expensive. Why? Because you are using the expensive physical materials. Hence, only promising ideas are tested, okay. When you do lean, it actually, they will only do promising ideas. They test only promising ideas.

But PLM can simulate time. And multiple versions simultaneously. So what we call as multiple options, multiple versions can be simulated simultaneously, which implies. Hence, a lot more hypotheses can be tested, including the not-so-promising ones. So, because you are using inexpensive information and computers, you can test lot more options, okay, including the not so promising ones. Whereas in lean, you are only testing the promising ones.

So, lean limitation. This is also something that you guys need to keep in your mind, okay. Lean limitation. Most efficiently produced product resulting from the best lean practices or lean manufacturing process, okay. So, the most efficiently produced product that results from the best lean manufacturing process can be flawed due to design failure or failure in actual use.

Because lean only focuses on the manufacturing side of it. It does not focus on any other things. So, then this may result in nothing more than efficiently producing scrap. So if your product is not good or the customer doesn't want it, then it results in a scrap. So all you are doing is if your design might have a design flow or an actual usage flow, which we may not catch because that's not part of the lean.

Hence, you may end up actually producing a product that nobody wants. So, that means you will end up efficiently producing scrap. So, this is a limitation of the lean process. And that is avoided in the PLM because it also considers the design and the usage and also the disposal. So, the entire life cycle is part of the consideration.

With this, we will stop at this point and we will continue the rest of the topic in the remaining class. So, thank you for your patient listening. Please read the assigned materials and do the homework as requested by the TAs of the course.

Thank you.