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 04

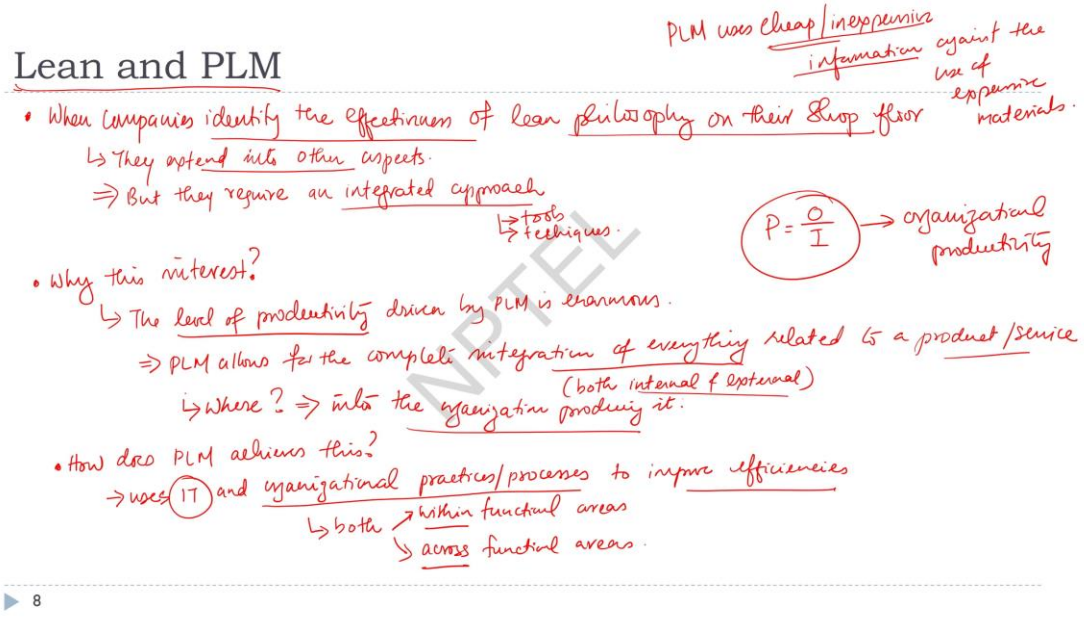
Lecture 17

Road to Product Lifecycle Management (Part-2)

Good afternoon, everyone. Welcome to yet another lecture of the course titled Carbon Accounting and Sustainability for the Product Lifecycle Management. This course is offered as part of the NPTEL MOOCs from IIT Kanpur and I am Prof. Deepu Philip.

And along with me, Dr. Amandeep Singh Oberoi and Dr. Prabal Pratap Singh are co-teaching this course. We have already covered a lot of topics as part of this course.

And we have been in the current topic about the path to PLM or the Product Lifecycle Management. And we have seen what the philosophy of PLM is and how PLM and Lean Manufacturing are interrelated. And so today we will continue on what we covered in the previous class.



So if you look at the slides, the title is Lean and PLM. So, what is the logic behind it is that when companies identify the effectiveness of lean philosophy on the shop floor, they extend into other aspects.

They want to move forward with other aspects. But they require an integrated approach, so how do they achieve an integrated approach with tools and techniques? For them to extend the concept of lean into other aspects of manufacturing, from the shop floor to other areas, you need an integrated approach that requires specific tools and techniques to accomplish that. So, the idea is why this interest exists? Why do companies show this interest?

Why do they want to extend it to their other things? Because the level of productivity driven by PLM is enormous. So PLM can drive a very high level of productivity. And productivity, you remember, it is the ratio of outputs over inputs. So PLM allows you to drive a lot of productivity.

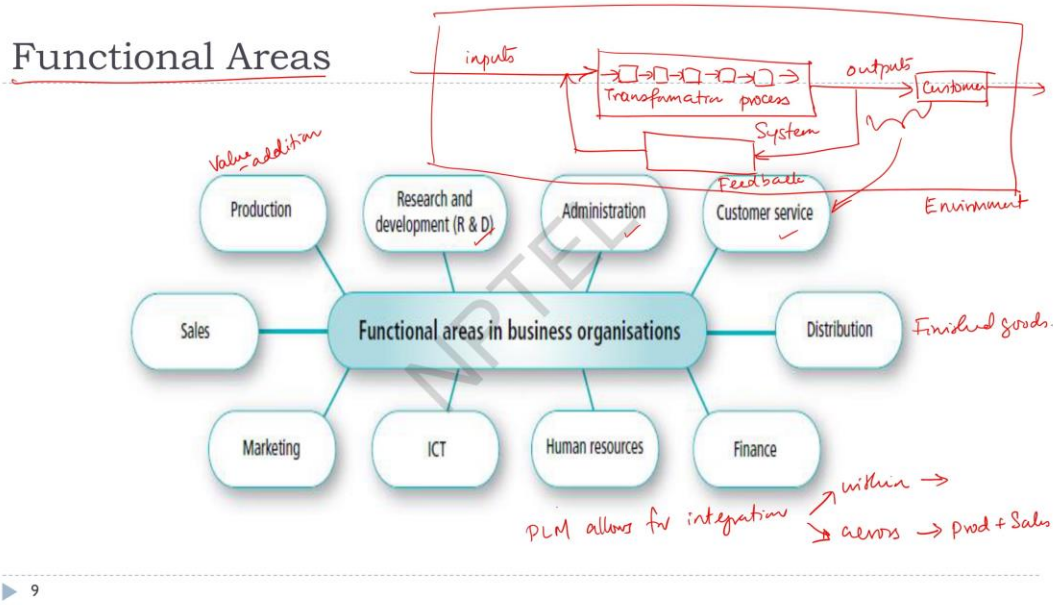
So in another way to think about it is, PLM allows for the complete integration of everything. Everything means what? Everything related to a product. So, PLM allows you for the complete integration of everything related to a product. And where does it allow?

Product or service? Okay. This integration, complete integration of everything. This everything is both internal and external, okay. So, everything related to a product or a service can be, whether both internal and external, can be integrated, okay. Where is integration?

That answer is into the organization producing it. So, what happens is that PLM allows the integration of both internal and external aspects related to a product or a service into the organization that is producing it. So, when everything is integrated, then you can drive productivity. So, this productivity you can drive it as an organizational productivity instead of driving just an activity or a functional department productivity. So, how does PLM achieves this?

How is PLM solving this problem? It uses IT and organizational practices or processes, okay. Organizational practices or processes to improve, to improve efficiencies. So, it uses organizational practices or processes to improve efficiencies. Both within functional areas, across functional areas.

So, within and across the functional areas, it allows the integration. Both practices and processes are integrated using IT (Information Technology). Because remember, we mentioned that PLM uses cheap or inexpensive information against the use of expensive materials. So instead of moving materials, man, machines, etc., PLM uses cheap and inexpensive information. So once you have information moving from one place to another, a lot of the inefficiencies can be caught up.



Now, if you look at the functional areas, I just mentioned within and across functional areas. So what are the major functional areas? So if you start from some point of time, let us say production is one functional area.

So if you think about this, as we said earlier, you have a system, okay, which has inputs, outputs and a customer and you have a process inside this. It is called the Transformation process. And then we also have what we call feedback, this is what we did most of the time or we studied as the way to look into it.

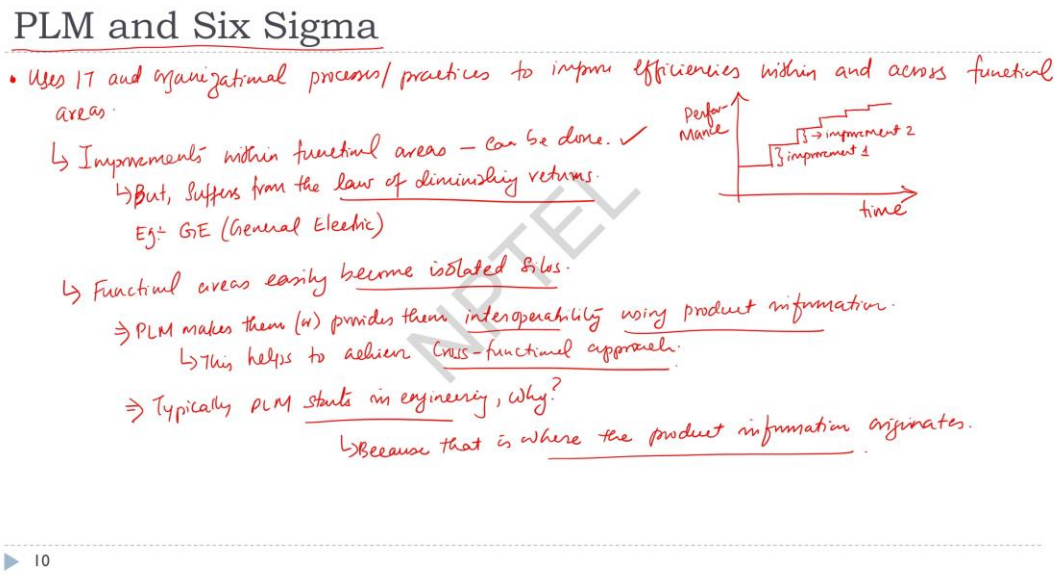
But when you look at the business, it also has things coming from the environment, okay. You can say this is environment. So, lot of other aspects comes into picture. So, lot of the time the production is where you do the value addition, okay. Where you create the goods or the service that you want to produce.

Then you have research and development. This is basically developing the new product. Administration is managing the whole thing, making paperwork, compliances, etc. Customer service comes at this side almost immediately. Then distribution, that is how from the factory, the finished goods, from factory to the warehouse to the customer.

Finance is how do you manage the money. Human resources is the human capital or hiring, firing, HR, all those aspects as part of it. ICT (Information Communication Technology), marketing, sales, etc. These are the major functional areas and PLM allows

for integrations within and across, okay. So within means you can do within the, so it can be within marketing, within production.

Across means between multiple departments, okay. So, it is production plus sales. Something like this, okay. So, it will be across the departments in that regard, okay.



Fine, so, now, there is another concept that we also need to understand is PLM and Six Sigma. And Six Sigma is a very popular concept in the manufacturing. So, let us look into how PLM and Six Sigma and how is that actually connected.

So, as I said earlier, the PLM uses IT and organizational processes or practices to improve efficiencies within and across functional areas. We have already seen this. PLM uses IT and organizational process practice to improve efficiencies within and across functional areas.

So, there is one aspect you need to understand. Improvements within the functional areas can be done as it is possible, but suffers from the law of diminishing returns, So, what do you mean by the law of diminishing returns?

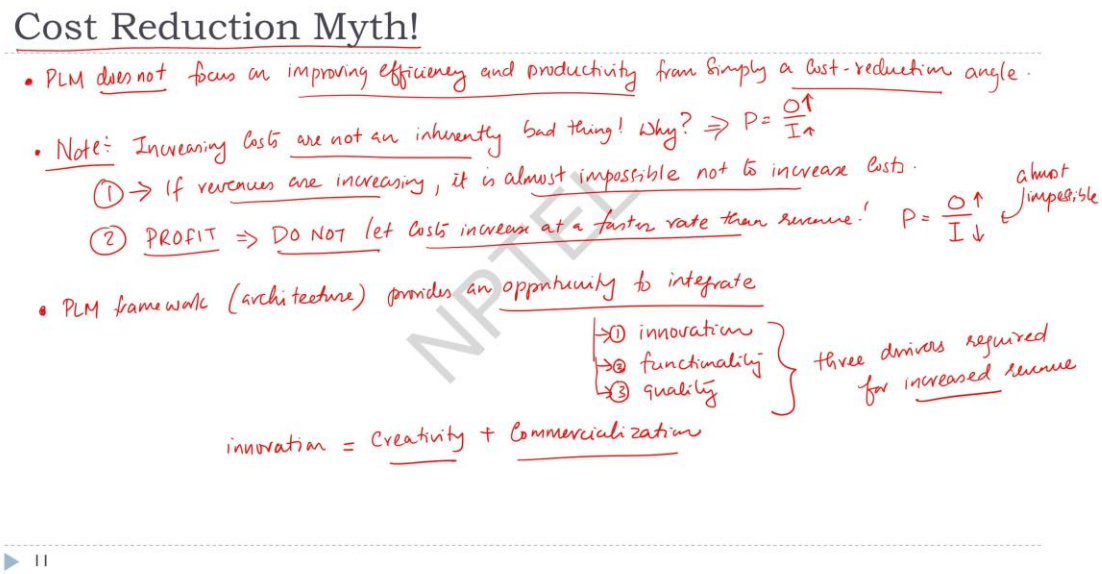
That means, in another way to think about it is, if you have a time here and you have performance on this axis, let's say the system performance happens and Six Sigma works like small steps; like this, okay. So as time progresses, this is the improvement 1.

This is improvement 2, like this. So as time progresses, you can see the size of the step size of the improvement reduces. So as time progresses, it suffers from the law of diminishing returns, okay. Example, GE or general electric. General electric has embraced the six sigma, but you can see the GE suffered from law of the diminishing returns.

Now, functional areas easily become isolated silos. So, isolated silos means they are usually does not interact with anybody. They do what they want to do, stuff like that, right. PLM makes them or provides them interoperability using product information. So how does PLM ensures interoperability? How does it prevents the silo formation? It uses product information, okay. And it sends within department so this helps to achieve Cross-functional approach.

So, once you start sharing the product information across different functional areas, silos, so then the cross-functional approach comes into picture and the silo formation gets broken down.

So, typically, PLM starts at engineering. PLM starts in engineering. Why? Why does it start in engineering? Because that is where the product information originates, okay. Because engineering is where the product information, the origin of the product information actually happens in engineering, okay.



Now, let us move forward to the next aspect of this, what you call as a Cost Reduction. And a lot of the people talk about the cost reduction myth. So, the main thing is people say that PLM may reduce the cost. So, one thing everybody should realize that PLM does not, okay, this is a critical word, does not focus on improving efficiency and productivity from simply a cost reduction angle.

So, it doesn't focus on improving efficiency and productivity, just not from a cost reduction angle. So, note, this is something that you need to remember. Increasing costs are not an inherently bad thing. So what we are saying is that if you are increasing the cost, it's not inherently a bad thing. Why? Why is it not inherently a bad thing?

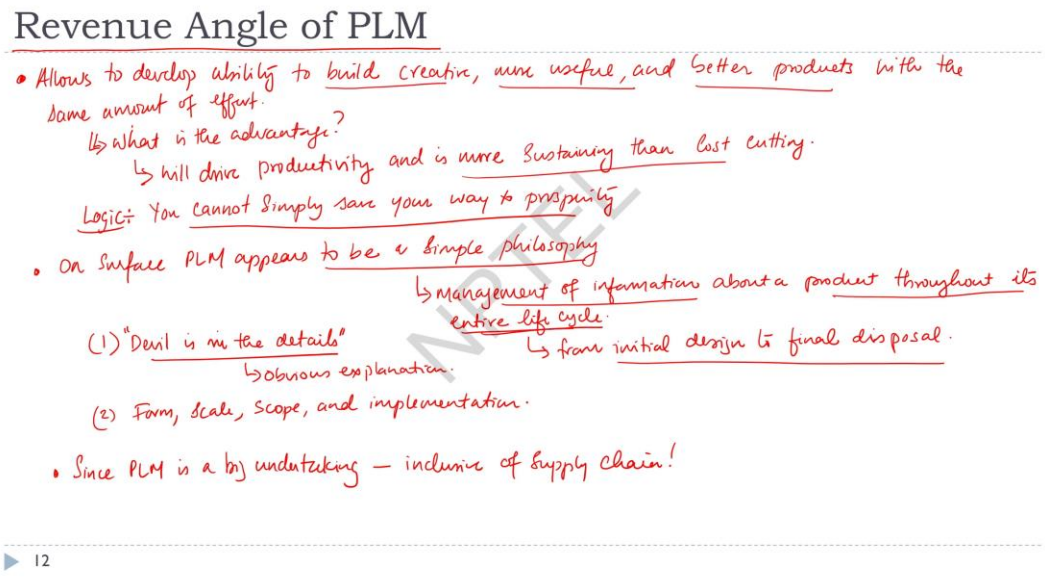
Number one, the first reason is, if revenues are increasing, it is almost impossible not to increase cost. So, if revenues are increasing, then it is almost not impossible not to increase the cost. Remember, the productivity is output over inputs. And we said that lot of the people want to do this. It's almost impossible.

So, what we are talking about in this case is instead, what we were talking here is slightly increase the input, then drastically increase the output, that kind of a thing. So, if you increase drastically the output, then your revenues will increase, that kind of an argument, okay. So, number two, let us talk about profit, okay. Everybody talks about this, okay. And how do you achieve profit?

Profit, the logic behind it is do not let costs increase at a faster rate than revenue. The important is that do not let the cost increase at a faster rate than the revenue. As long as costs are increasing at a lower rate than the rate of increase of revenue, you will keep making profit. Then the third point is PLM framework or what he called as the architecture. The product lifecycle management architecture provides an opportunity to integrate.

It is inherently providing an opportunity to integrate, okay. So, what does it give you an opportunity to integrate? The first one it allows you to integrate is innovation. Not just the design, but it allows you to do everywhere. Innovation, functionality, and third one is quality.

So it allows an opportunity to integrate innovation, functionality and quality. So these three you can call as the three drivers required for increased revenue. So if you have a innovative product, which has lot of functionality and quality, then that is what will drive the revenue. And remember, we also had mentioned that innovation = creativity + commercialization. So that means you have a creativity which is you are addressing a need in a creative manner but you are also doing it in such a way that it is commercially viable as well.



So now let us talk about the revenue angle of PLM. We talked about the cost. Now let us talk about the Revenue Angle. So the first thing is it allows to develop ability to build creative, more useful and better products from or with the same amount of effort, okay. So it allows to build it allows to build creative more useful and better products with the same amount of effort remember we talked about creativity with commercialization is innovation, right.

What is the advantage for that? If it allows you to do that, what is the advantage? The answer to that it is, it will drive productivity. It will drive productivity and is more sustaining than cost cutting, okay. So instead of just cutting the cost you can focus on build creative, more useful and better products with the same amount of effort, okay.

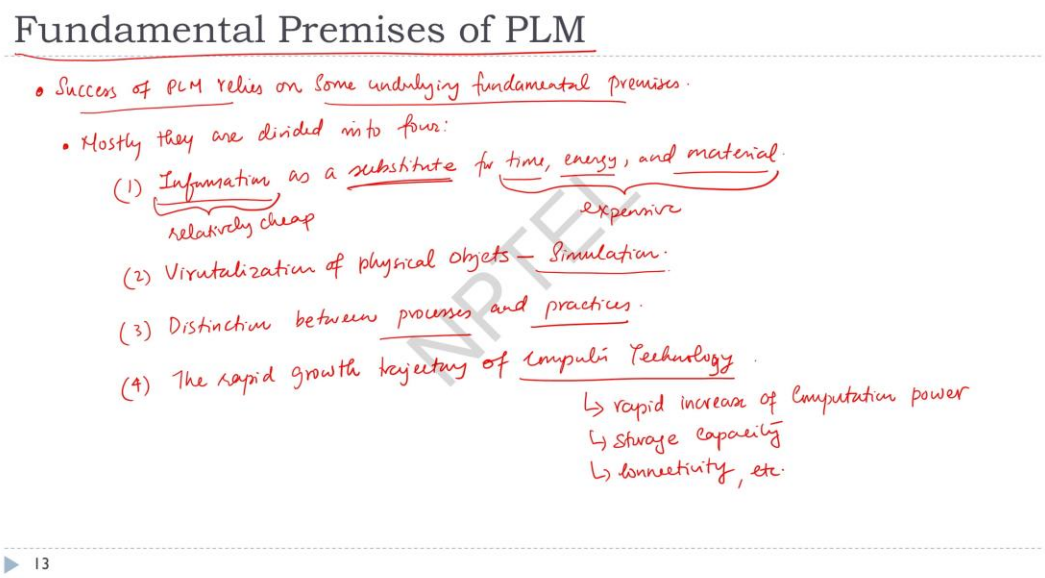
So the logic behind it, you cannot simply save your way to prosperity. Which means that you have to make investments, whether this investment is in the form of capital, capacity, new products, innovation, etc. It doesn't matter. But you cannot basically say that I am going to do just cost-cutting. It will become a big profitable business.

That really is not a sustainable model in that regard, okay. Then, on surface, PLM appears as to be a simple philosophy. And what is that simple philosophy? The simple philosophy is the management of information about a product throughout its entire life cycle. So, you are just focusing on managing the information about a product throughout its entire life cycle, right.

So, which means, what is that entire life cycle? Entire life cycle is from initial design to final disposal. So, even though it appears to be a simple philosophy, but it is not necessarily. So, why it is so? So, two points that you should understand.

Devil is in the details. This is the obvious explanation. So, if you are looking at all the details and you are managing all the details, then you will actually do good, okay. Now second part is form the shape, scale, scope and implementation. Since it is not just a manufacturing system, we are from the, through its entire life cycle, from the initial design to the final disposal, the form, the every aspects is considered as part of this, right. So, since PLM is a big undertaking,

It's a very big undertaking, okay. It's inclusive of supply chain. So, the movement of information, goods, services, products, etc., from one place to another is also part of the decision process.



So, now, let's talk about the Fundamental Premises, okay. What are the major aspects, what are the fundamental criticalities of associated with the PLM.

So, success of PLM, the success of the PLM relies on some underlying fundamental premises. So, the PLM success has some fundamental premises which it is usually dependent upon. Mostly, they are divided into four.

There are four of them. Number one, first one, information as a substitute for time, energy and material. So, the logic is take the expensive time, energy and material and substitute it with the inexpensive information.

So, all these three are expensive. While the information is relatively cheap. That is the logic, relatively cheap, okay. Then, second aspect, okay, second fundamental premise is virtualization of physical objects, okay. It is also, some people call it a simulation, some people call it as digital twin, etc.

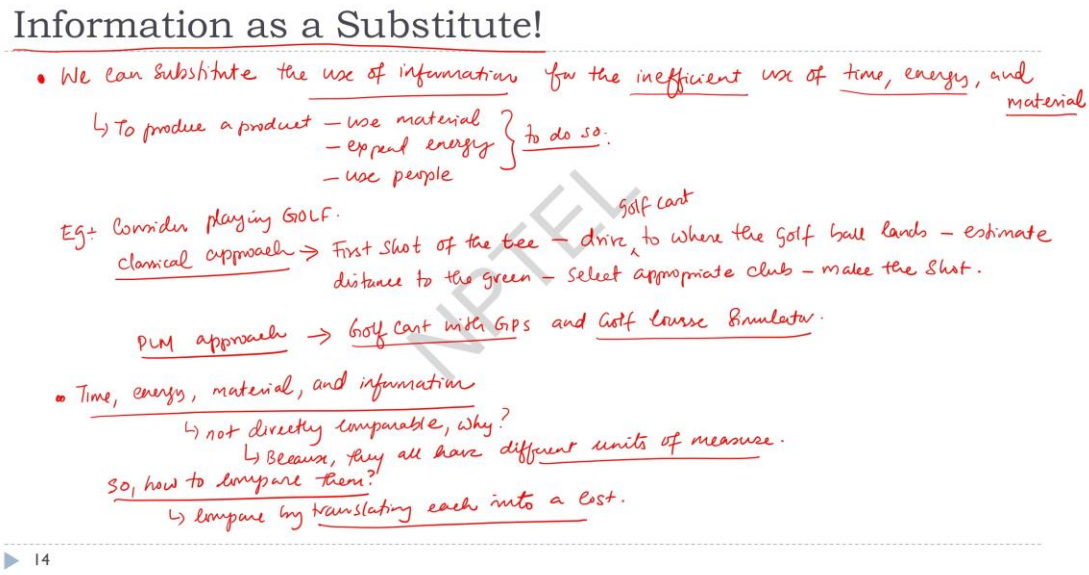
But by virtualizing the physical objects, okay, or using simulation, you can actually speed up lot of the processes, okay. Number three, distinction between processes and practices, okay. So, it distorts between processes and practices.

And we will talk in the class what is a process and what is a practice in the few coming up slides. But both are very distinct, okay.

We cannot say that one can be substitute for the other, okay. And that the last part is, last underlying factor is the rapid growth trajectory of computer technology. So the computer technology grows very fast. Like from the simple chips to all the way to the current expensive computers and stuff like that. So the computer technology grows faster.

This implies that rapid increase of computation power, storage, capacity, connectivity, people talk about Internet of Things and stuff like that, etc. So, all these aspects actually, because the computer technology is growing so rapidly, it also drives the success of PLM. Because more powerful computer, you can do more things. Or you can process more information. When you process more information, you can replace or substitute.

The key word is substitute. Substitute the expensive time, energy and material with cheap information.



Now, we get to the major aspect of Information as a Substitute! So, we all talk about, we have mentioned many places that information as a substitute is one of the main driver of this. So, the premises of PLM, the PLM logic here is, we can substitute the use of information.

We can substitute the use of information for the inefficient use of time, energy and materials. So, this time, energy and material, as I mentioned earlier, they are the

expensive ones. And instead of inefficiently using them, we can substitute the use of information, okay. So, the logic is that to produce a product, use material, expend energy, use people to do so, okay. To do so means to produce a product, okay.

So, an example is that, okay. Let's think about an example, okay. Consider playing golf, okay. We are thinking about playing golf. So, the classical way, the classical approach or the traditional approach. What do we do in the traditional approach?

First shot of the tee. Drive to where the golf ball lands, okay. Estimate distance to the green, okay. Select appropriate club then make the shot and repeat, okay. The PLM approach will be the classical way is that you take the shot and drive what are you driving drive the golf cart, okay.

Or walk to where the golf ball has landed, estimate the distance to the green, select appropriate club and make the shot again. In the PLM approach, it's a golf cart, it will be just a golf cart with GPS and golf course simulator. So, what would happen is, you will have a golf cart with GPS and a golf course simulator. So, by the time you drive that cart to a specific location and then the golf course simulator should be able to tell you which club to take, how much power to put it in and which direction you should hit it. So, the other aspect is also that time, energy, material and information, okay.

These things not directly comparable, okay. Why? Because, they all have different units of measure, okay. So, how to compare them? Okay. That's an important question. Because we have different units of measure, it is not directly comparable.

So how to compare them? Okay. Compare by translating each into a cost. Okay. Then, if you can compare or translate each one of them into a cost or an associated cost, then the different units of measure. Because energy has kilowatt hour, time has seconds, material has kilograms, information is in bits. So, all of them are different units of measure.

But if we compare them into cost, then it is easy for us to compare or consider one-on-one with this regard. So this is how the PLM system actually understands or identifies the associated or how substitute the information. Or how it uses information as a cheap substitute for the expensive time, energy and materials as part of this. So with this we have come to the conclusion of this particular lecture. And we will talk about the information inefficiencies and the waste and other kind of things in the coming lecture associated with this topic.

Thank you.