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 03

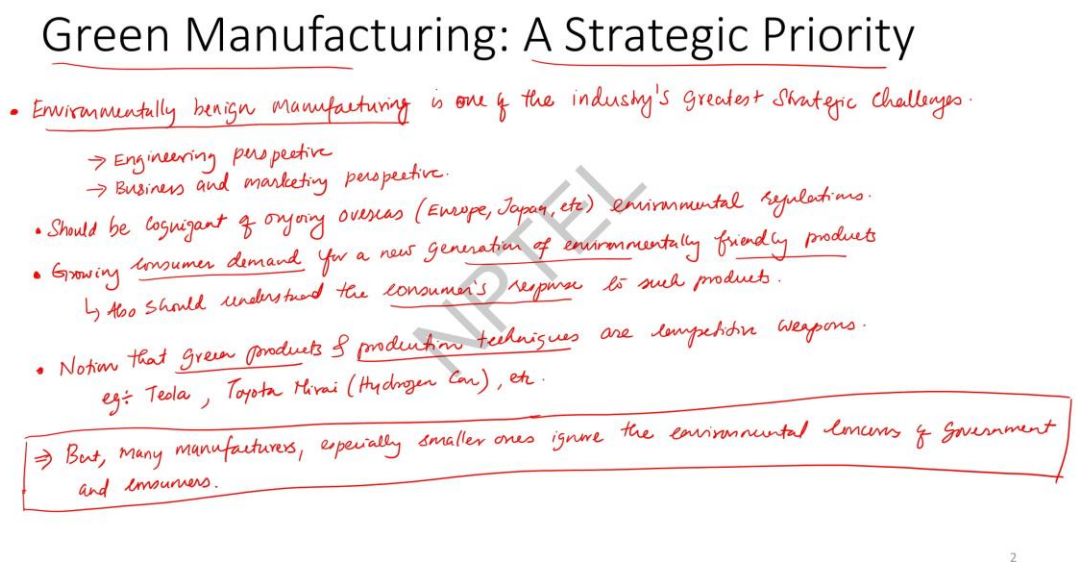
Lecture 13

Green Manufacturing

Good afternoon, everyone. Welcome to the NPTEL MOOCs course titled Carbon Accounting and Sustainable Designs in Product Lifecycle Management. I'm Dr. Deepu Philip and I'm from IIT Kanpur. And along with me in this course, the two other co-instructors, Dr. Amandeep Singh Oberoi and Dr. Prabal Pratap Singh. All three of us put together are teaching this course.

And we have gone through many topics so far. And we understood what is productivity, what is sustainability, what is global warming potential, Greenhouse Gas (GHG) emissions. And we also learned what is what's a carbon credit, what's a carbon footprint and how do you calculate carbon dioxide equivalence emissions stuff etc. In the previous lecture. And now as part of the syllabus, now we are moving to a new topic, which is called as Green Manufacturing.

If you see the slides, what we are doing is we are focusing on automobiles. The reason we are focusing on automobiles is because there is a lot of work being done in this area. So let us start by understanding some things.



So, one important thing that we should understand is green manufacturing is actually a strategic priority for many of the companies. And why?

The number one reason is environmentally benign manufacturing. Environmentally benign manufacturing, environmentally non-damaging manufacturing is one of the industry's greatest strategic challenges. So what we are saying here is, if you can manufacture something without harming the environment, environmentally benign manufacturing is no harm to the environment. That's one of the greatest strategic challenges. So there is two aspects to this.

One is the engineering perspective. The other one is business and marketing perspective. So, two aspects to this. So, what are some of those business and marketing perspective? Should be cognizant.

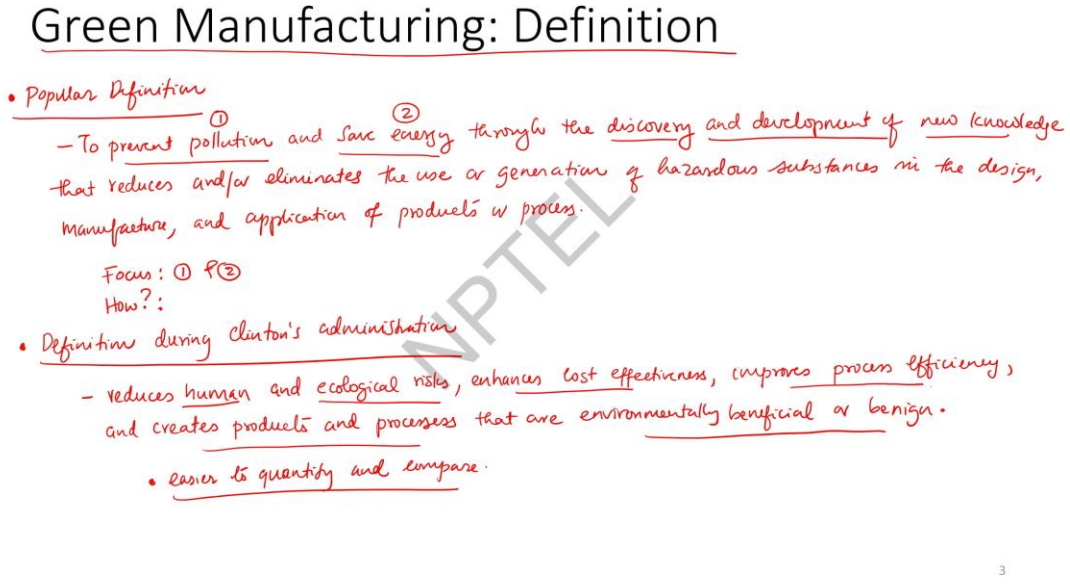
Or aware, should be cognizant of ongoing overseas, Europe, Japan, etc. Overseas environmental regulation, environmental regulations. So, we should be cognizant of overseas environmental regulations like Europe has Euro 6 emission regulations, Japan has new green tax, recycling norms, etc. So, we should be aware of that, should be cognizant of this. Also, we should be aware of the growing consumer demand for a new generation of environmentally friendly products friendly products.

So, the consumer demand is a growing consumer demand. The consumer demand is growing for a new generation of environmentally friendly products. Also, should understand the consumer's response to such products. So, one is the demand and how do they respond to those products. That also one should be understand.

Now, the other thing is you should also be aware of the notion that green products and production are competitive weapons. Okay. The green products and production techniques are competitive weapons. Some examples of this is Tesla, then Toyota Mirai, that's the hydrogen car, etc. So, you can see how the green products and production techniques are competitive weapons. How can you actually get more market out of it?

Tata is an example of this. Tata's electric cars now, but this is an important point. But, many manufacturers, especially smaller ones, ignore the environmental concerns of government and consumers. So many of the small manufacturers especially the smaller ones they don't pay much attention to the environmental concerns of the government and consumers. This is common across all place whether it is united states, whether it is india.

This phenomena is usually quite common. Alright now let us go to the next. And let's talk about the definition of the green manufacturing.



How do we define green manufacturing? So, let's first talk about the popular definition. The most popular definition that people use this to prevent pollution and save energy.

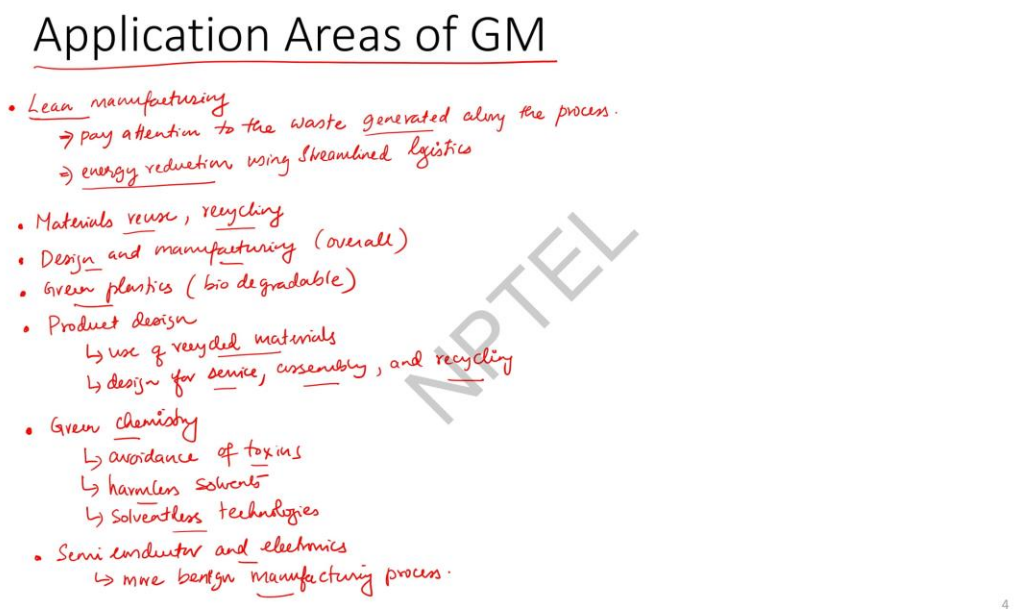
How do you say that through the discovery and development of new knowledge that reduces or eliminates the use or generation of hazardous substances hazardous substances. In the design manufacturing and application of products or process. So what they are saying is that the main focus is, the popular definition is to prevent pollution and save energy. This is the number one and number two focus.

So the focus of the one is one and two. Focus is prevent pollution and save energy. And how do you do that? That is the discovery and development of new knowledge. That reduces and or eliminates the use or generation of hazardous substances in the design, manufacture and application of products or process.

So, that are the two aspects of the popular definition. However, the definition provided by definition during Clinton's Administration. Bill Clinton, the American president, he was also a champion of environmental and green manufacturing, etc. So they, at that time, he created a, or he championed a definition, which is more relevant in this regard, in my opinion. Reduces human and ecological risks enhances cost effectiveness improves process efficiency and creates products and processes products, that are environmentally beneficial or benign.

So, what the definition was, it is the reduce the human and ecological risk. That's the number one. And enhances cost effectiveness. Okay. That's the number two. And number three is improve process efficiency.

And what it does is in that process, you create products and processes that are environmentally beneficial or benign. It doesn't harm. So, this definition is easier to quantify and compare, okay. So that was some of the main observation of this definition followed by that is used in the during the time of clinton administration so continuing.



What are the application areas of green manufacturing? Main application areas of green manufacturing. So, number one, where are many of these things gets applied? Number one is Lean manufacturing. So, that is the number one is pay attention to the waste generated along the way, along the process. That's number one.

Second part is energy reduction using Streamlined Logistics. By streamlining the logistics, you are reducing the energy. Then the other part is Materials Reuse, Recycling. You are reusing the materials or recycling the materials. Then Design and Manufacturing.

The design of the product itself start following the green manufacturing philosophies and also the manufacturing of the product continue this. Then Green Plastics. That means they are biodegradable. Use of green plastics that are biodegradable. Then in the Product Design, focal point is on use of recycled materials and design for service, assembly and recycling.

Then another part is Green Chemistry. What do you mean by green chemistry here? That is includes avoidance of toxins. Toxic material should be avoided. Harmless solvents, so like solvents that are used for paintings and also other one is solvents.

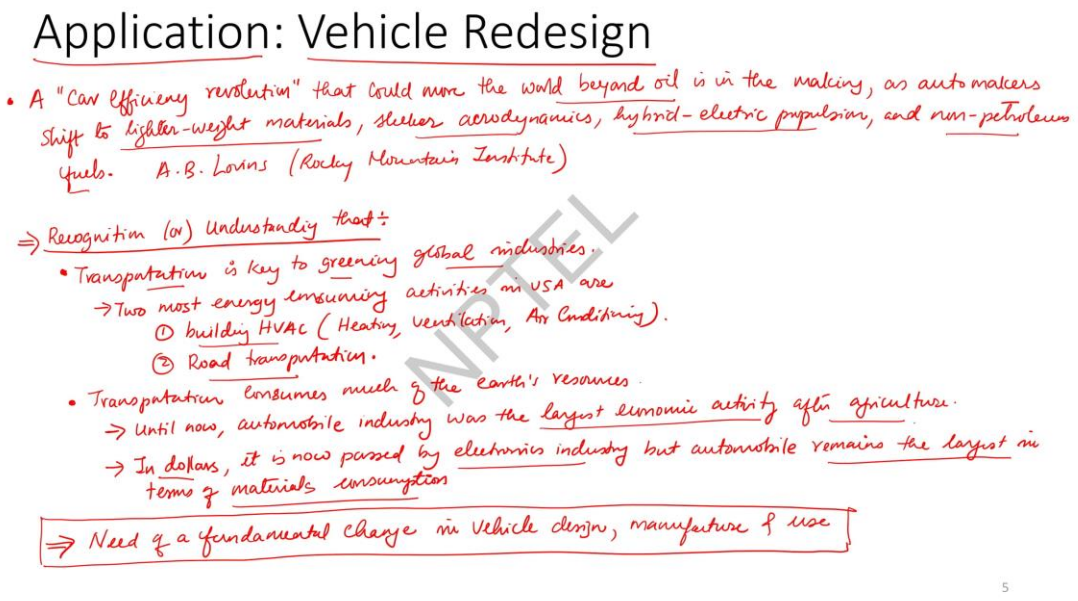
They are usually very harmful to the environment. So solventless technologies, that's also another aspect of green chemistry. So that's also one focal point, then what this is

Semiconductor and Electronics. So that is also another big polluting industry or weather and minimally harmful. More benign manufacturing process.

So that is also one other. So if you look into this, all these various aspects. The lean manufacturing is one aspect where you pay attention to the waste that is generated along the process and reduce the energy using the streamlined logistics. That's two aspects of lean manufacturing. Reuse and recycle of materials is another place where green manufacturing is applied in design and manufacturing, it is overall, okay.

Overall you focus on it then green plastics if you use biodegradable plastics, then that is better to the because otherwise the plastic doesn't get biodegradable. In the product design, if you use recycled materials more, then that is good. Also, you do design for service assembly and recycling. That means, even if you are doing assembly, design for assembly, then you may require only less materials. Similarly, green chemistry, where you avoid the toxins, you avoid harmless solvent or you develop harmless solvents or you develop solventless technologies.

And semiconductor and electronics where it is one of the most harmful industry, you use more benign manufacturing process. So, all these are applications of the green manufacturing.



Now, in the automotive thing, we have mentioned that we would actually be talking more about the automotive, okay. So, today an application we are going to discuss is the vehicle redesign, okay. The Vehicle Redesign Initiative that was championed at some point and that has caused to many of the new things that we see in the automotive industry, now including electric car.

So, what you call as a Car Efficiency Revolution. This was the initially the word that was used. So, the initial thought process was the car efficiency revolution that could that could move The world beyond oil is in the making as automakers shift to lighter weight materials, sleeker aerodynamics, hybrid electric propulsion, and non-petroleum, petroleum fuels. So, this is something that was discussed by Armory B. Lovins of the Rocky Mountain Institute.

So, the car efficiency revolution that actually moves the world beyond oil and people are focusing on that. He said it in a long time ago. As automakers shift to lighter weight materials, sleeker aerodynamics, better aerodynamics, hybrid and electric propulsion and non-petroleum fuels. And many of them are actually being achieved at this point. So, the idea was that recognition or understanding that, okay.

This is critical recognition or understanding that, what is understanding? Transportation is key to greening global industries. We are saying that if you want to green the global industries, transportation is the key. To most energy consuming energy consuming activities in USA are, number one, building HVAC. HVAC stands for 'Heating, Ventilation, Air Conditioning'.

Number two is Road Transportation. So US recognized that heating, ventilation and air conditioning and road transportation are the two most energy consuming activities of United States. Then other thing is transportation consumes much of the earth's resources, okay. So, one thing until now, automobile industry, was the largest economic activity after agriculture. In dollars or in value, it is now passed by electronics industry, okay.

So in a electronic industry is now in the term of value it is more, okay. But automobile remains the largest in terms of material consumption. So what we are saying here is that in dollar terms in value electronic industry is bigger than automobile industry. But automobile industry remains the largest when we talk about the material consumption, in this process, we have seen now that the transportation is very important or key to green the global industries. And the U.S. recognizing the fact that heat building or each

building, the HVAC, the heating, ventilation, air conditioning of the building and road transportation are the two most energy consuming activities.

And transportation consumes much of the earth resources and automobile industry being the largest economic activity after agriculture. But now in the time of value, the electronic industry has surpassed it. But automobile industry continues to be the largest in terms of material consumption. So, what does all of this implies? Need of a Fundamental Change in Vehicle Design, Manufacture and Use.

So, because of the transportation and its associated use of resources. And how automobile industry being the largest in terms of material usage and other things. There is a need of a fundamental change in the design of the vehicle, the manufacture of it and the usage of the vehicle. So, this is the basic aspects, the premises of green manufacturing and the vehicle redesign concepts. That is the foundation for this topic, what we are going to discuss now about the automotive green manufacturing.

And we will start with the partnership of New Generation Vehicles, PNGV project that started in 1993. Which actually paved the way for green manufacturing, the new type of vehicles, the transportation, the electric vehicles, the hybrid cars, the lightweight vehicles, better materials. All those things was the foundation was leaned by that project PNGV project, which actually morphed into multiple things later down the road. We will discuss all of that in the next class. Thank you very much.

Thank you.