# Carbon Accounting and Sustainable Designs in Product Lifecycle Management

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**Week 04**

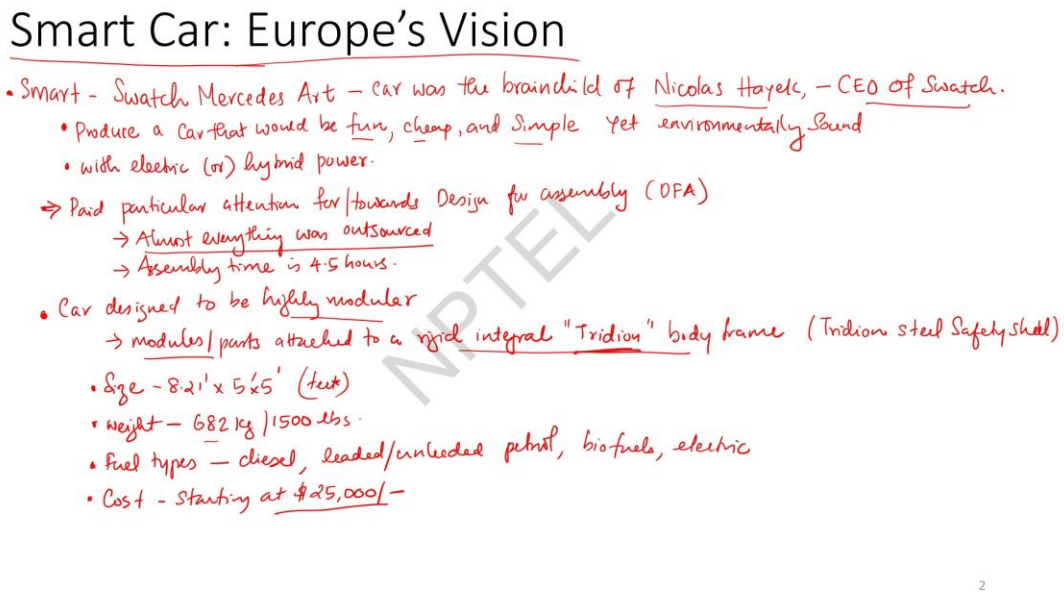
**Lecture 15**

**Smart Design and Engineering**

Good afternoon, everyone. Welcome to yet another lecture of the NPTEL MOOC's course titled 'Carbon Accounting and Sustainable Design for Product Lifecycle Management'. I am Prof. Deepu Philip. I am from IIT Kanpur. And along with me, Dr. Amandeep Singh Oberoi and Dr. Prabal Pratap Singh are co-teaching this course.

And we have been going through major topics like Productivity, Sustainability, what's Carbon Footprint, what are Greenhouse Gases, Global Warming Potential, how do we do emission reduction, what is Carbon Sequestration, what is VCS, CDM, all those kinds of aspects we have gone through. And we have also seen how the sustainability and the carbon footprint of different activities, how to calculate what the carbon dioxide equivalence is from cars, especially burning petrol, electric appliances, flights, etc. We have seen that as well. And then we went into something called the Green Manufacturing.

Specifically, we took a focus on the automobile industry because that is one of the champions of sustainability, especially in sustainable manufacturing. And we have seen through what you call the PNGV partnership for the futuristic vehicle, green vehicle. And then we talked about what you call ULSA, which is an ultralight steel auto body enclosure, that future vehicle that we would discuss how Toyota achieved that. And so, the US and Toyota are two aspects we discussed.




And today, if you look into what we are going to do, we are going to talk about the smart car, which is Europe's vision.

Smart car is something that was championed by Mercedes in Europe. And then we are talking about what it is. So smart actually stands for, Swatch. Swatch is a company that make watches. Swatch Mercedes R, that became the smart.

That became the smart. So, this car was the brainchild of Nicholas Haig. Child of Nicholas Haig, who is the CEO of Swatch, okay. So, his aim was, what is that? It's a produce. A car that would be fun, car that would be fun, cheap and simple, yet environmentally sound with electric or hybrid power. Hybrid power.

So, the interesting part was that the Swatch Mercedes or the Smart car, Nicholas Hayek, the then CEO of Swatch, it was his brainchild. So, his aim was to produce a car that would be fun, cheap, and simple, yet environmentally sound and use either electric or hybrid power. Then, what we also say is that particular attention was paid to design for assembly, okay, DFA (Design For Assembly). So, it was paid particular attention towards Design for Assembly. One first thing is, almost everything, everything was outsourced. And assembly time is 4.5 hours, around 4.5.

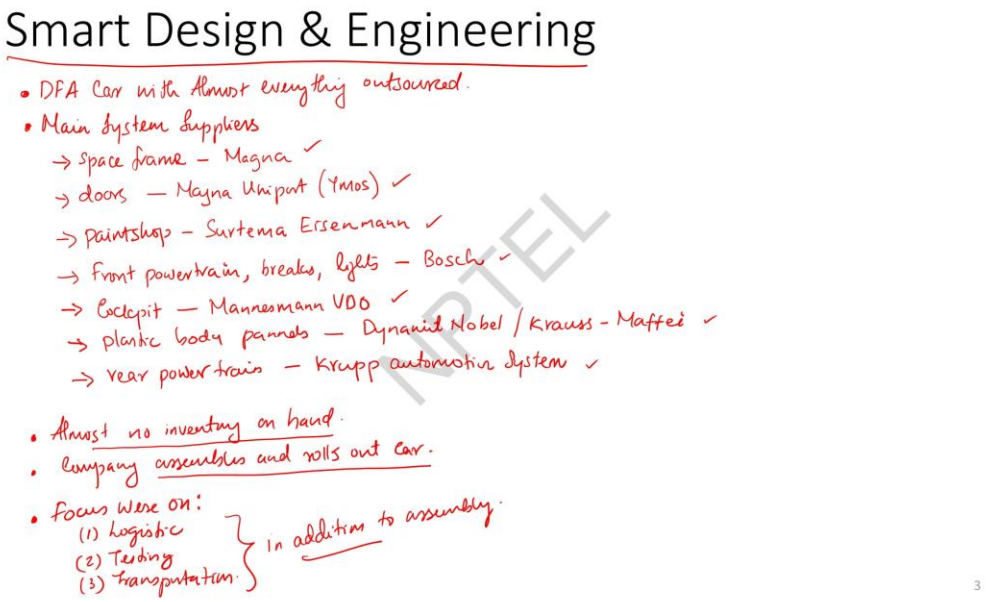
It is now reduced, but it was about 4.5 hours when it was started. Then, another aspect of it is that the car is designed to be highly modular, okay. Which means modules or parts

are attached to a rigid, integral Tridion body frame. So, the modules and parts are attached. This is a highly modular car, but it is attached to a rigid, integral Tridion body frame.

So, what is Tridion? It is a tridion steel safety shell. It is a steel safety shell, but this body frame, this Tridion safety shell, on which different parts are attached to it. And some important aspects of it are the size of the vehicle. If you think about it, it is 8.21 by 5 by 5.

So, that is the size of the tridion. Then weight. It's very lightweight, okay. It is 682 kg or 1500 lbs, okay. Pounds and fuel types.

It is either diesel, leaded or unleaded petrol, biofuels, or electric. So, these are the fuel types, okay. And then, cost, starting at $25,000. So, at 25,000, at the cost-effective thing, whether with the system of having either diesel or unleaded leaded petrol, biofuels, and electric, the weight of 682 kilograms and size of 8.21 inches by 8.21 feet by 5 feet by 5 feet, not inches, feet, this is in feet, okay. So, that kind of size is what was envisioned in this. And the car is designed to be highly modular, and all these modules are attached to a Tridion body frame.




So, with this, let us now look at how the design and engineering of SMART actually happened. So, as we said earlier, almost everything is outsourced and designed for

assembly. So, the main points are just DFA: the car with almost everything outsourced. The main system suppliers are the space frame, which is also known as the Tridion frame, okay, and that was supplied by Magna. The doors was Magna Uniport, okay, Wimos, they did that.

Then, paint shop, That was Sotema Mannesmann. Then the power train, the front power train brakes and lights. Okay. This was supplied by Bosch. Then the cockpit or the driver side.

They call it cockpit in this one. Menace Man video. Okay. And then the plastic body panels, okay. There are two suppliers for this. Dynamite Noble and Nobel or Cross Maffei is the Cross Maffei.

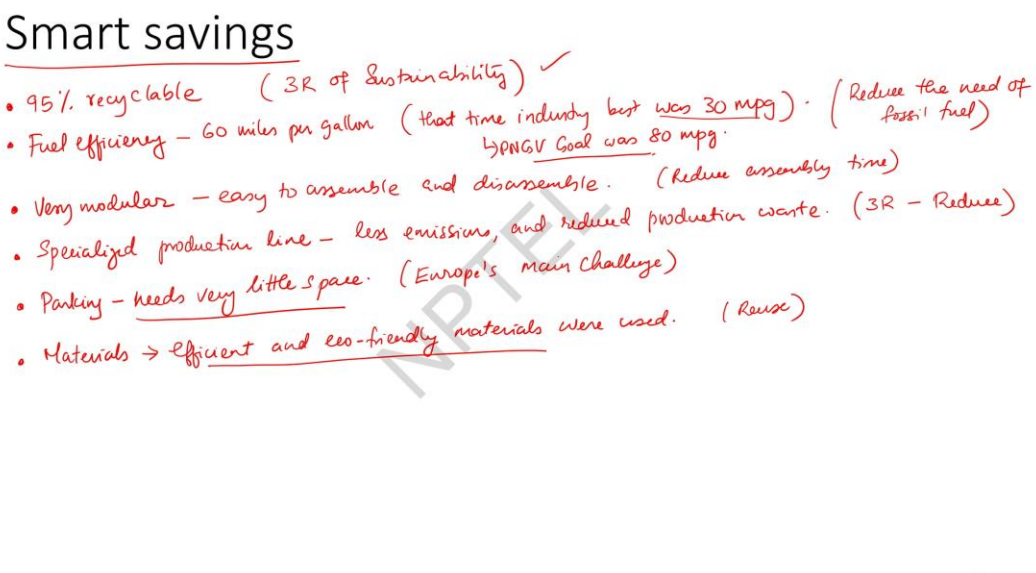
And the rear powertrain, because remember, this is a hybrid system. This is the Krupp Automotive Systems. It's part of the ThyssenKrupp group. You might have heard about this company called ThyssenKrupp, the same thing. Now, so these are the main things.

Magna supplied the space frame. Magna Uniport supplied the doors. The paint job was done by Sotema Mannesmann. The powertrain brake slides were supplied by Bosch. Mannesmann video supplied the cockpit.

Cross Mafé or Dynamite Nobel, depending upon the type, they supplied the plastic body parts. And the rear powertrain was done by Krupp Automotive Systems, which is part of the subsidiary of ThyssenKrupp. Then also you should understand that almost no inventory on hand. There was never any inventory as part of this one. The company assembles and rolls out cars.

So, unlike other automotive manufacturers like Toyota and Honda, who manufacture their own engines and stuff, they did not do anything. They just assembled and rolled the car out. That's all. So they, because they could do this because no inventory was, because everything was coming from other suppliers and they were, the Swatch was just basically assembling and supplying this, okay. So their focus were on, what did they focus on?

Number one, was logistics, number 2 was testing, and number 3 was transportation. So, these 3 were the, in addition to assembly. In addition to assembling the car, they focused on logistics, testing and transportation. Otherwise, they had no inventory in hand.




So, then what did smart ended up achieving and what were the savings of the smart? So, the major thing was 95% recyclable. That is 3R of sustainability. So, they were very much able to achieve 95% and fuel efficiency, that is about 60 miles per gallon, okay. That time, industry bust was 30 miles per gallon, okay. So, remember if you remember the PNGV. PNGV gall was 80 mpg, miles per gallon.

Remember, we said that the partnership for the global vehicle, it actually had a goal of 80 miles per gallon thing. Smart came very close to it, about 60 miles per gallon that they achieved. By the time the compact cars in US and other places were giving 30 miles per gallon. Then it is very modular. I told you this is all done very modular.

That means easy to assemble and disassemble. So that is the second part, easy to assemble and disassemble. Then they have also very specialized production line. I told you that they were focusing only on the assembly in addition to transportation, testing and logistics. So, because they had a very specialized production line, they could do less emissions and reduced production waste.

So, they could do less emissions and reduce reproduction waste. So, this is another 3R, Reduce, okay. And Reduce emissions, Reduce waste. Then another one is parking, okay. Needs very little space.

So compared to other cars or other typical compact cars, it only requires very little space to parking. And this is Europe's main challenge. Parking space. It's a big challenge in Europe. And then the last part is the materials. And what they have done is efficient and eco-friendly materials were used.

So, efficient and eco-friendly materials were used in this part of this. So, that is what it turned out to be. So, if you look into this, they were able to achieve recycle, which is 95% recyclable, which is the 3R of sustainability. They improved the fuel efficiency. So, this is the reduce also.

So, like for example, fuel efficiency was reduce the need of fossil fuel. That was part of this. And then very modular, assemble and disassemble. So, the reduce assembly time. And specialized production, I told you again, 3R Reduction happened there.

Parking reduces need for the parking space. And efficient and eco-friendly materials, so that would allow you for reuse kind of a thing. So, they were focusing mostly on the 3R's of the sustainability. So, with this much, we would come across, we will come to the conclusion of this green manufacturing site. And we are in week 4, but what we have now done is go through a lot of those topics.

Our next topic will be more about, how do we do Product Lifecycle Management and the importance of it in which we will cover in the coming session. So thank you very much for your patient listening. Please go through the lecture notes and also read the material that is given to you for better preparation.

Thank you very much.