Carbon Accounting and Sustainable Designs in Product Lifecycle Management

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Week 07

Lecture 30

Carbon and business data (Part-2)

Hello friends, we are in the course Carbon Accounting and Sustainable Designs in Product Lifecycle Management and we are discussing about carbon and business data in this week.

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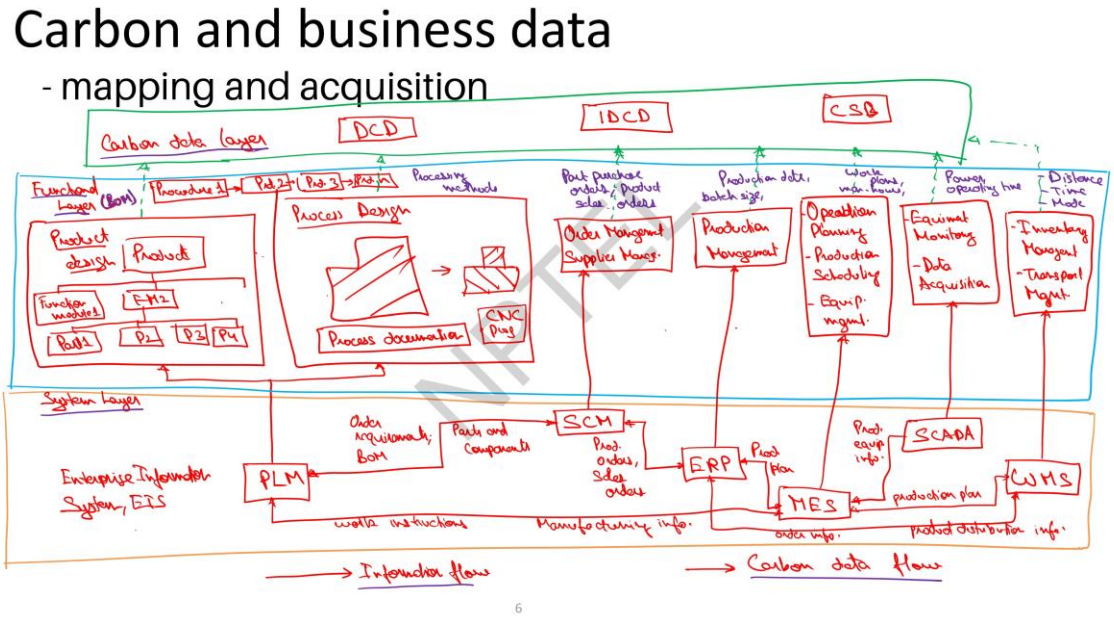
I have talked about majorly the steps and mapping and acquisition of the data in carbon and business. I will also talk about the digital transformation systems and operational technological systems in this lecture after completing my data mapping and acquisition connections illustration. So, we talked about the mapping and acquisition, we talked about the steps which are integrate carbon data with EIS, leverage PLM for design data. We talked about the next step that was utilize the ERP and resource tracking then we monitor equipment with SCADA and also inventory management through the warehouse management systems is important.



In this illustration, we try to lay down the functional layer in between the carbon layer and system layer. And carbon layer is that gets information from the functional layer, from the system layer, both of those. Now, let me try to make connections here proper and try to also jot down the various inputs taken by the carbon data layer which is our course of interest in this lecture. Now, here PLM is having two way interaction with supply chain management and definitely we talked about the PLM and MES integration. There would also be connection between PLM and MES.

So what do we have? Supply chain management and PLM exchange the information on order requirements. Then the bill of material also the parts and components information. Here supply chain management when it interacts with ERP they are talking about the production orders or sales orders production orders sales orders. Now, PLM and MES.

MES is giving what? It is giving work instruction and PLM is also getting manufacturing information from it. I will put it here. It is manufacturing information and work instructions. So between ERP and MES we have the production plan or again production orders and also there is a connection between ERP and warehouse management system.

Where there is majorly the order information order information, then we have material procurement information, real time inventory changes product distribution information. These are exchanged between various management and enterprise source planning and between MES and WMS as well the production plan would be shared. Production, plant and material information. Between SCADA and MAS (Manufacturing Aggregation System), production equipment information is there.

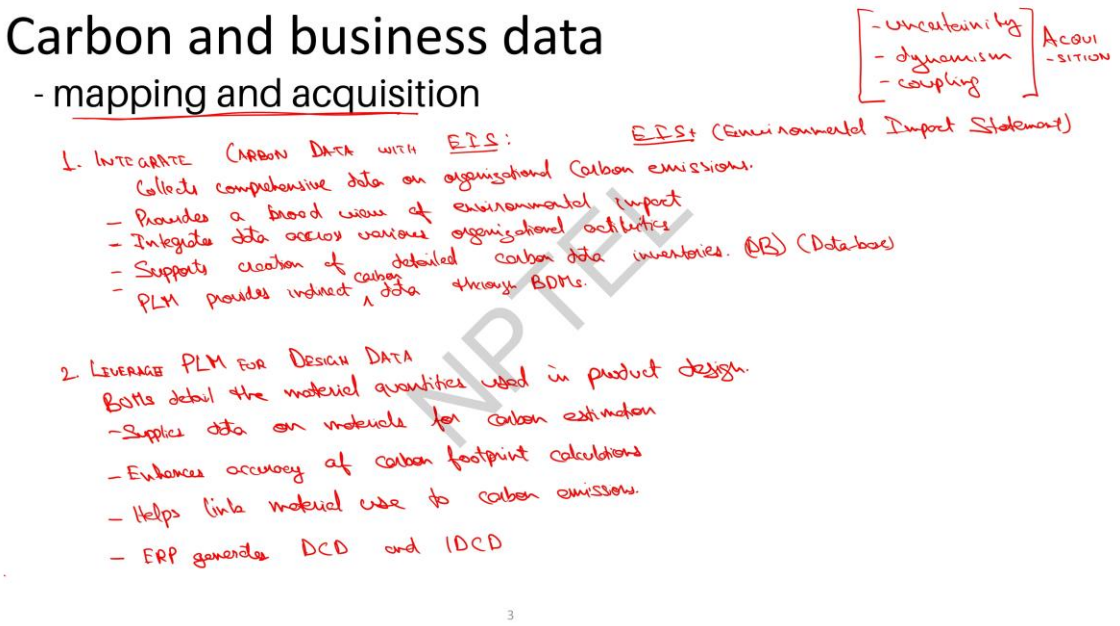
Now, the order management and supplier management, Production management, operational planning, equipment monitoring, inventory management. They are all giving data through the functional layer to the carbon data layer. So, what are the inputs specifically? Those are taken from here. So, I will just put their inputs here.

So, what are the inputs that they give? Inputs taken by the carbon data layer is in different forms. We have from the process design, we have the processing methods. From the product design, we have inputs that is the product bill of material. I will put it here bill of material goes here as input to the carbon data layer, that is the product design, when it is there the bill of material or the product different functions of the product which are there those all go in the carbon data layer as an input in the carbon data.

The carbon support data in the product design systems itself those are taken here now from the order management the part precise orders. The product sales orders these are taken from the production management the production date batch size or what are the things, resource consumption, etc. All those things go as an input from the operation planning, production schedule, equipment management, the production equipment type, work plans, all those go. Work plans, the type of equipment, the man hours. From the equipment monitoring system or the data acquisition system through SCADA, the production equipment power.

Then we have the operating time. Product use power, state, operating time, both the production and product, everything is going as an input here. Because we are trying to now acquire the data. Now, from the inventory management systems, the inventory time, the transport distance, distance from where the inventory is coming, the time for which inventories on hold, the mode of transport, all those go as an input here. So, essentially

we are trying to talk about the information flow and majorly focusing upon the carbon data flow here in these systems. Again, we have carbon data layer, we have functional layer, we have system layer.



Let me try to jot down certain points here which I mentioned about the EIS layer. integration about the design data through PLM. So, EIS system as we said helps us to understand the correlation between the reported activities. So, manufacturing organization exhibits stringent demands across various domains which includes design, production, management, service or so.

In light of the integration of the information technology within the manufacturing sector. It has become increasingly prevalent for manufacturing companies to use modern information systems. Currently, manufacturing enterprises primarily utilize their information systems which encompass various components such as, which are mentioned here, product lifecycle management, ERP, MES, supply chain management, WMS, CADA or so. So, here we are trying to now talk about majorly the roles of the different systems here.

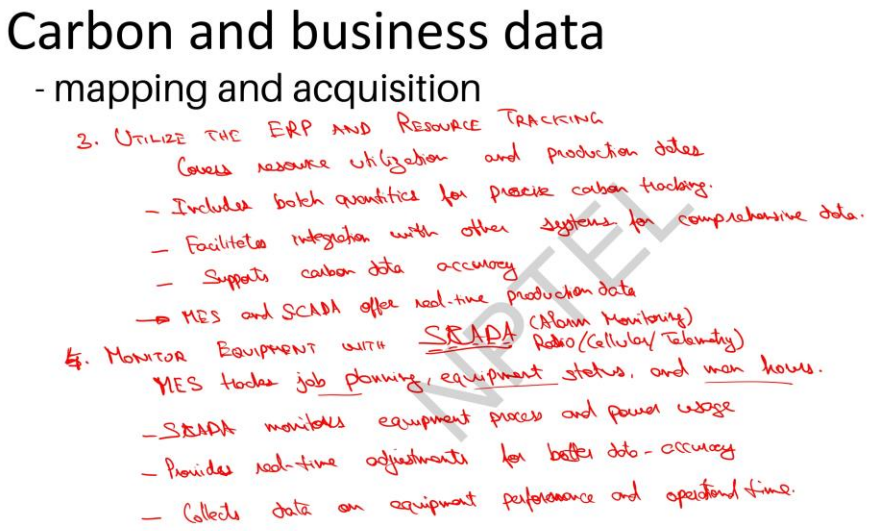
To product lifecycle management, the EIS system along with providing a broad view of environmental impact, while collecting the comprehensive data on organization carbon emissions, also integrates data across various organization activities. And it helps to

support a detailed carbon data inventories that is it supports creation of detailed carbon data inventories. I am talking about the database here. Now, PLM provides indirect carbon data through bill of materials here.

Indirect data indirect carbon data through bill of materials of the products. Now, in leveraging PLM for design data bill of materials detail the material quantities used in product designs further it supplies data on materials for carbon estimation. It helps us to enhance accuracy of carbon footprint. If not exactly carbon footprint in the calculations of carbon footprint. It also aids to link material use carbon emissions.

How? The use of material, what material is being used, is it the material that is recyclable, is it the material that is biodegradable, depending upon the material used and the consumption of the material which is used in the product design, in the process design, in the operation system. So, what are the support materials, not other than the basic raw materials. So, all those are linked through a PLM system to the carbon emission.

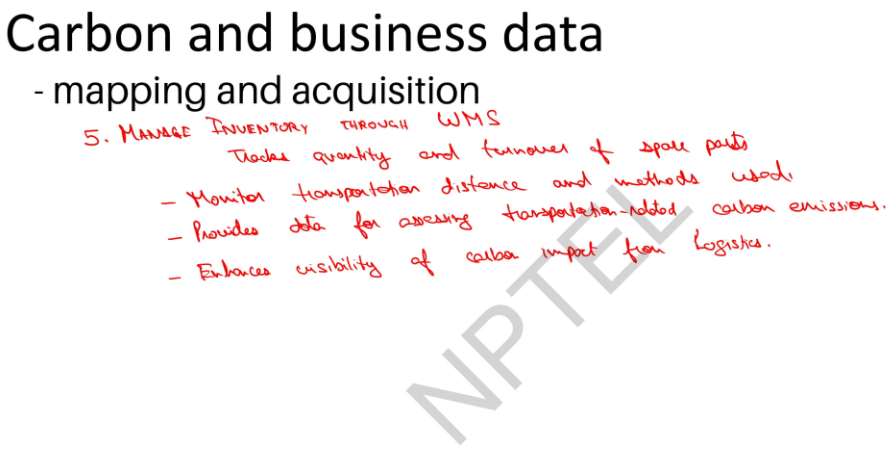
Now, also the next step that is there that is connected to here the task here one of those is ERP in the next step would help us to generate direct and indirect carbon information majorly.



So, here ERP is utilized and resource tracking is there. This covers resource utilization and production dates. This includes batch quantities for precise carbon tracking. This facilitates integration with other systems.

And this facilitation is required for the comprehensive data. That is a detailed data. It also supports carbon data accuracy. Now, the next step here is regarding MES a task that is connected through the ERP here. MES and SCADA takes input and it offers real time production data, right.

Which is mentioned that monitor equipment with SCADA. That is alarm monitoring, radio, cellular, telemetry, various sensors are used here. That is MES tracks, job planning, equipment status and man hours. That is SCADA monitors equipment process and power usage. Also as mentioned above it provides real time adjustments for better data accuracy and collects data on equipment performance, operational time also.



Then comes the inventory management system through warehouse management system or so which tracks quantity and turnover of spare parts. It helps us to monitor transportation distance and method used. And it provides data for assessing transportation related carbon emissions. This enhances visibility of carbon impact from logistics.

So having put down the major pointers about the mapping and acquisition of the data. Now, we are trying to see the overall system which is connected to the functional layer

and carbon data layer the mapping is done in this way. So, the different or the diverse data management needs of various manufacturing organizations and certain restrictions or constraints, which are imposed by measuring systems frequently hinder the direct acquisition of data, product-specific carbon data. Therefore, it is important to align carbon data allocation with organization's business activities to mitigate the inherent uncertainty associated with product-level carbon data and to ensure the availability of such data.

And now data acquisition and data mapping is one of the learnings we will take through this course. And to also analyze that data, we will also try to put small tools here in the coming weeks. So, with this I am closing this lecture on carbon and business data. And because we have talked about SCADA, we talk about operational monitoring, we talk about data acquisition and certain sensors we talked about. I will try to give a small introduction to digital transformation that has happened through last few years that is the Industry 4.0 using Internet of Things.

And we are trying to move forward to the industry 5.0 as well and certain operational technology which is being used nowadays certain connections between operational technology and our ERP system, we'll try to bring and certain examples will be quoted in the coming lectures or coming weeks we will try to see actually how the systems are being used.

Thank you.