The Future of Manufacturing Business: Role of Additive Manufacturing
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Lecture – 16
Manufacturing and IIoT - II

Welcome. We are on to the next section of the IIoT and the industry 4.0 connect. Here we go a little bit deeper into the architecture, the solution, and some of the innovations that are happening in the market in terms of startups focusing on specific areas that helps you to accelerate faster in a solution. So, let us go right into this.

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So, we need to understand a little bit about you know the key difference or loosely coupled difference between the IoT and the IIoT. IoT is given in the right-hand side, where you know it is primarily consumer, and it is a wearable phone, TV, appliance, home monitoring and home automation. These are the primary one and what is very important is the network connectivity.

That is very important here. Now let us look at the industrial IoT. The key point is that is on heavy machinery and the transportation, it will be there, smart cities will be the part of it and we focus on the factories, automation and healthcare. These are some of the elements of the IIoT, where the impact on the solution is on a scale that is at least one or two order higher than what we are typically seen in that.

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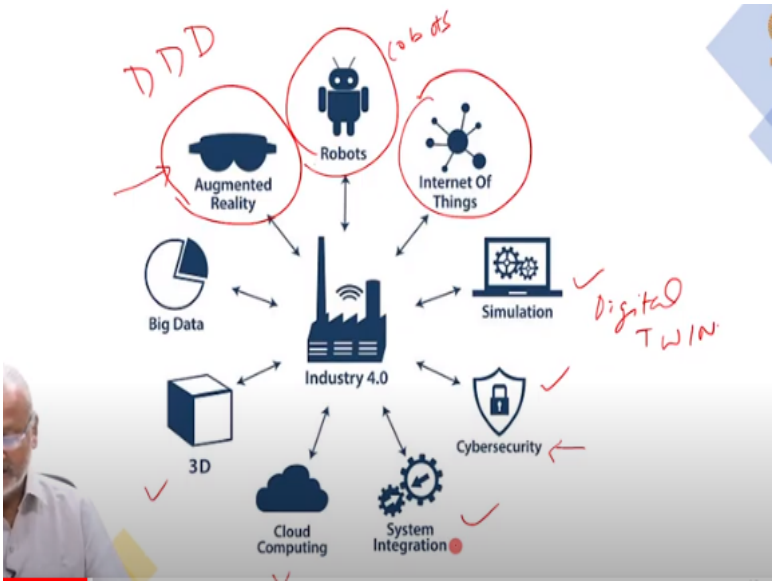

Now let us look into the next one. So, what are the area in which the industry 4.0 gets mutated with IoT. In some way, you could say Internet of Things is collecting data, but however, there are other parts in the industry 4.0 solution is having a very heavy influence on that. Let us take for example, internet of thing is there as one element.

Robots and cobot, we should say probably cobots here, rather than robots. We have seen the augmented reality as the wearable part of the Internet of Things itself. These are working very closely with industry 4.0 because augmented reality helps you in terms of they call it D D and D duplicate and dangerous job.

If you do not want to actually go to the physical area, augmented reality helps in understanding about the levels of danger at one level getting giving you the necessary distance between the actual environment and decouple you from the danger.

Sometimes you may not be able to see inside the machinery, but the information that you collected over that whether a cross section of a machinery that is under repair or any servicing that you want to do, and the sequence of disassembly that you have to do, all of them becomes very easy and effective in using the augmented reality.

This becomes an important solution in the industry 4.0. So, we collect data in all of this area; whether it is cyber area, simulation, system integration, Cloud, 3D. All the data comes here and we apply the big data architecture into that. It becomes very

important in terms of measuring and gather intelligence, curate the data and mine for appropriate solution here.

The simulation interestingly is going into another area called digital twin, which we will not talk here, but it is an important one as well. A very direct connection between a system and digital equivalent of that or a virtual equivalent of that will be there and it goes a little bit beyond the real time analytics whatever happens in your physical system happens also in the digital twin.

So, the simulation becomes a important one in terms of understanding the industrial process to innovate and make sure that we are making the right levels of decision and helps in terms of fine tuning the process and security becomes important because of I would say because of IoT and because of always on system.

When you say when more systems come in, more systems are always on, the data is going back and forth, obviously there can be a man in the middle attack and to make sure that when they are all connected, your data is protected, not necessarily encrypted. Your data is protected in a manner that your system is not compromised for any of the operation.

System integration becomes important because when you have a disparate system, when you will have multiple vendors in terms of managing your solution, whether it is augmented reality or sensors of the Internet of Things either platform or the vendors, robots and the digital twin or the 3D simulation, or any of the cloud computing vendor and as well.

How does it come together? Does it work? If it does not work, how do you make sure that it can be attended to. These kinds of challenges are also managing that. So, the industry 4.0 becomes an important one and it is very closely related to the industrial Internet of Things.

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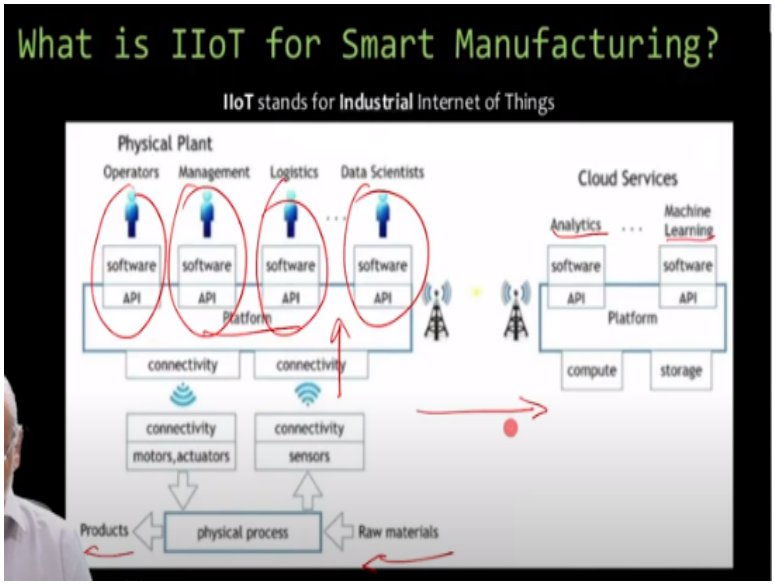

So, it is again connected very close to the smart manufacturing. Let us understand schematically what is happening. We have a diagram here. If take a physical plant, you have operators, management, logistics and data scientist and each of them if it is a digitally advanced factory, each of them will have a software implementation, whether it is a machinery, whether it is a logistics environment, and things like that.

So, what you see here is each of the work categories using the software and API communicates through the platform and they have the connectivity and it is kind of connected to the motors and activators in one level to do the processing and manufacturing and fabrication and another level, it is also simultaneously taking the measurement using the sensors and the connectivity goes back into the software platform.

Using these measurements, they are able to look at the quality of the fabrication or the process and able to do the necessary corrective actions on that. In terms of the fabrication units, raw materials are fed into the physical process and the products are coming out of the fabrication or assembly units if you will. This is the physical plant activity is one area.

We have lot of these data that keeps coming up. What you do with all these data. These are all going over to the cloud and the cloud have two parts to it. One has the compute part; another is a storage part. The storage part is where you have all the measurement logs or logs that are collected over a period of time, sensor data,

everything is done over there and then that is where you have the platform and it is looking at multiple components. What you see is analytic and machine learning here.

You could put more components into the cloud services. The analytics will look at different models for various process. It could be for supply chain, it could be for quality management, it could be for error detection, and the machine learning model could be for logistics, smart contract establishment and things like that. So, the whole system, if you look at it is the one that will help you to do the smart manufacturing. So, that is the part, you know that we need to understand in this.

In terms of the industrial IoT, if you are constructing it, the logical structure will come to this kind of a environment if you will, this kind of structure if you will. Let us look into some of the other pieces that we are going to be seeing.

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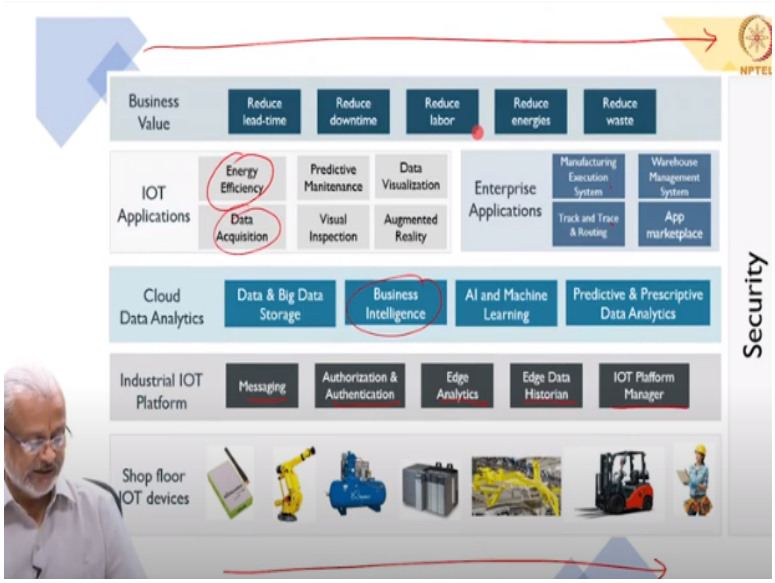

This is the rough schematics you can say of the IIoT that you want to implement in a factory environment. So ,it needs to very closely connect to the business value that we are doing and this is at the top level and the bottom level very interestingly is it has to connect through the IoT devices or the shop floor.

If these two does not happen, then your implementation will not be comprehensive at all. So, at the shop floor, some of the machineries, and the interfaces that are getting more innovative, and more distributive, this kind of things happens. So, you could build layered approach for implementing IoT in your environment like you have this

shop floor IoT devices, from data collection to assembly to logistics and storage management, and to the field level data collection, if you will.

Above that is the industrial IoT. Very interestingly notice this messaging, authorization and authentication. This is needed for your security. Edge analytics is, when you collect the data, are they instead of waiting for the data to come to the center and do analysis at the edge itself, you may be able to do some optimization, do some automatic validation, and things like that.

You know it could be something like a camera registered for a set of authorized users. At the edge itself you could do the image validation, and manage the authentication. Edge data historian, this is more from the time perspective, over a period of time what happens. It could be like a particular sensor tracking the traffic. Something like an indoor mapping.

What is the traffic that are happening within the factory, and if we want to collect over a period of time on what is the optimum route for moving your goods very effectively you may need data like this. Finally, the IoT platform manager. These are very close to the factory side we have seen. Then you go to another higher level where all the data goes to the cloud.

That is where you have the analytics data and big data storage is one and you will be able to do the business intelligence, AI machine learning and go deeper and you will be able to get predictive prescriptive data analytics at the machine level, at the process level. There are several activities that you will be able to optimize in this area.

Finally, very interestingly on top of it is you may be able to build the IoT application and because you collected all the data, you will be able to do the energy efficiency, data acquisition, predictive maintenance we have already seen, visual inspection of the shop floor, data visualization and augmented reality are IoT based application.

That is, that will help you to be productive and efficient and build accelerated acceleration into the solution in a very effective manner. Now at the enterprise level also you can have a very interesting solution and efficiencies. Manufacturing and

executing system, track and trace routing, warehouse management and application marketplace.

Each of that if you look at it becomes important in terms of your overall delivery capability in a very comprehensive manner. Especially track and trace routing will help you to figure out which batch had the particular defect and what you need to do to fix it in the future. Finally, all this should lead in terms of reduced waste time, reduced downtime, reduced labor, energy and waste everything getting reduced and so on.

So, this could be your cheat sheet in terms of managing the or planning a journey map into the industrial IoT.

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Now I want to look into the trends of the IIoT. So, before we go into that we need to understand what technologies are influencing this. 3D printing, we call it additive manufacturing, where in traditional manufacturing or fabrication, you take a block, remove all the wastage, anyway you always have the wastage.

You need to figure out if you are going for circular economy, what you need to do in order to absorb the wastage and things like that. In 3D printing, we start with the nucleus and then you keep growing it up to the edges and absolutely, zero wastage on that. In terms of technology, 5G, artificial intelligence, augmented reality, are the one that we already seen.

Automated guided vehicle is the one this is more in terms of within the industry, within the work environment. Shop floor, what are the things that you need to do in order to eliminate waste and manage the material movement in an effective fashion. That is where it is going to help. Blockchain is one technology, there has been a lot of hope around that.

Especially for the industry 4.0 there is a particular hope that it can build, help build the smart contract. Cloud, cobots, cyber security, digital twins, and edge computing are the ones that we already seen. Drones becomes important in terms of manufacturing and also in terms of supply chain delivery, delivery mechanism and things like that. IoT and IoT platforms we covered.

Virtual reality we covered. Let me spend a minute or two on machine vision and quantum computing. Machine vision becomes very important in terms of managing the quality control within your post fabrication or post manufacturing the end product. So, you will be able to take pictures at various level.

Whether it is infrared or the actual visual picture to figure out alignment, quality and various aspects of even post failures, nondestructive testing, several things can be managed using that. There is a lot of hope on the quantum computing, because it gives you a singularity point for lot of computational capability. So, the factories will need a lot of computational capability.

From that viewpoint, people are looking at this as a very important one in which, it is going to empower the industry 4.0.

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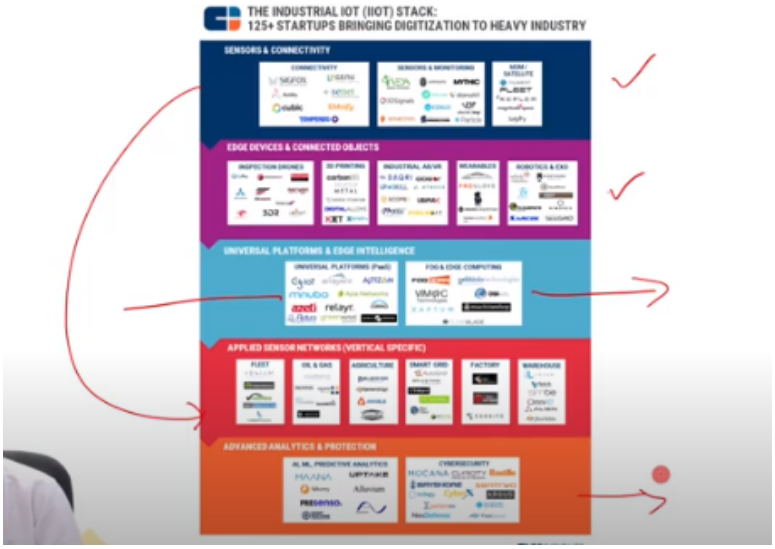

Let us look at some of the IIoT stack. It is probably upside down here. Sensors and connectivity if you look at it, connectivity, sensor monitoring and MPM satellite. What I wanted to bring it to notice here is the startups arena that we are talking about. Startup essentially focus on one specific problem and build accelerated solution.

So, if you partner with them, you may not have to reinvent the wheel, you may be able to quickly build up your solution or build the fabric for your solution in a effective manner. Sensors and connectivity, we have seen and edge devices and connected object is the next one into that. So here, we see the vision-based solution in which we have inspection zone, 3D printing, industrial AR VR, wearables, robotics, and XO objects.

It is a skeleton is one example are the one that will take you into the next level in terms of the IIoT. The in terms of platform you need to figure out about universal platform that you see. Another trend that we are seeing is the fog computing that is trying to do additional analysis at the middle layer. Both the fog and the edge is more towards the edge rather than at the central level.

So, these solutions again, help in terms of overall delivery speed of solutions if you will. The sensor network has an application area as well. For example, if these two are connected the for fleet, oil and gas, agricultural, smart gate factory, warehouse, all these area the sensors at the sensor level itself, you are able to build the applications together very effective manner that manages the data distribution and have some

control effectively, so that you can move more towards low code environment is happening here and finally, the advance analytics and protection is the one that takes the overall solution in a very rapid manner to deliver it for the heavy industry.

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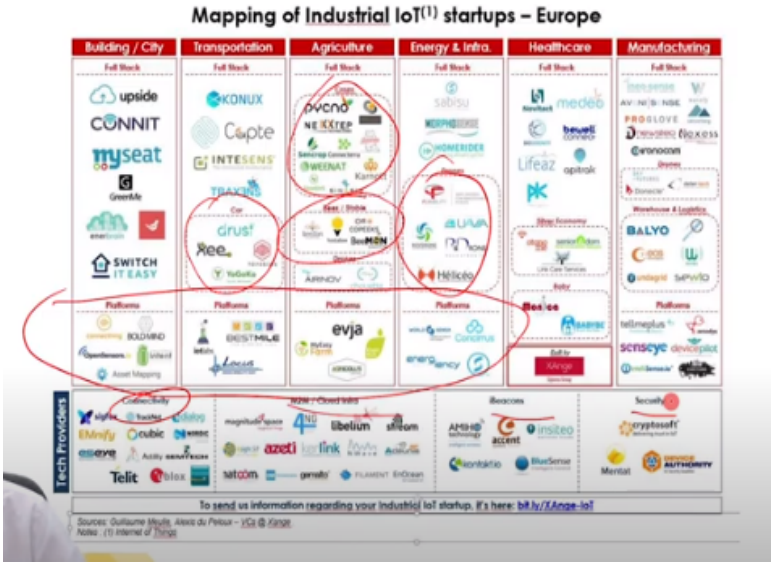

So, these are the vertical level innovations that are happening. So, please pay attention to in each of the solutions. You have the full stack solution in each of the vertical area. Building, city, transportation, agriculture, energy and infra, healthcare and manufacturing. You have smaller box here, which is related to automobile, crops and bees and stable and drones.

At the bottom, you have the platforms that are manufacturing that and at the lowest level, you will see the technology provided for each of them in terms of connectivity, M2M, iBeacons and security. So, this is another slice of view in terms of understanding what you do not have to build so that you get the advantage of already built an effective solution.

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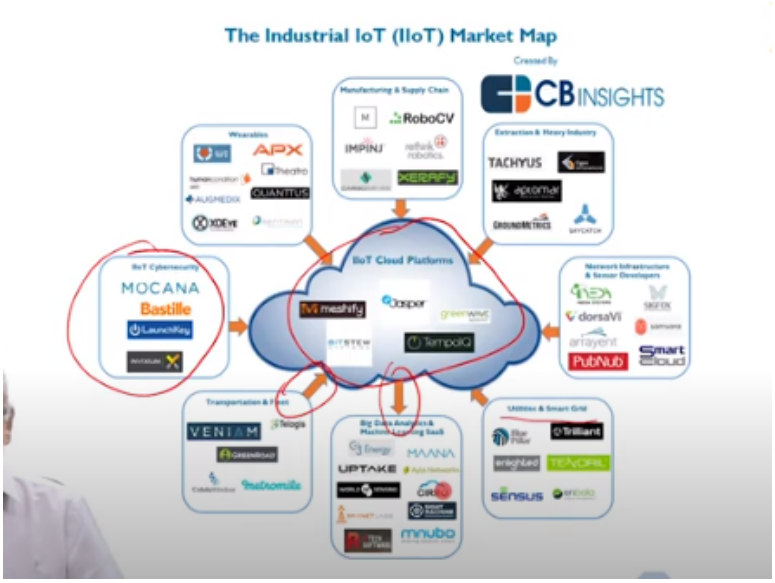

This is another view. This one is the IIoT market. The earlier one is from the European viewpoint. This is a crunch-based report. But interestingly what you will notice here is the way this one is organized is slightly different from what you have seen here. The earlier one goes a little bit deeper into the verticals and the technology stack and the platform and additional subdivisions in that if you will and kind of ended with the connectivity related technology provision that are needed.

Whereas here, it is only talking about the IIoT related that is industrial internet of things related trends. That is what is more than here. For example, the IIoT security that one alone a group of companies or startups of Fortune 100. IIoT has a separate Cloud Platform. So, though you have a generic one, the one that is exclusively for IIoT is given in the central one.

Very interestingly all the one on the peripheral when you see the arrow mark inside, it is kind of feeding the data in and when it gets outside, it is getting data out. So, the transportation and fleet, the wearable, manufacturing and supply chain, extraction of the heavy industry, network instructor and sensor developers and utilities and smart grid.

All of them are sending the data into the cloud platform and what is coming out is the big data analytics and machine learning SAS solutions is the category within which you have about 10 companies offering the solution. Now when you build the solution, you saw the structure the stack already.

Here is the stack that you will be using and here is probably the stack or the architecture that you want to use. Here are the vendors that you want to shortlist and make sure know that they are effectively connected into your system.

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So, if you in terms of what you have is there are about 433 startups are there. In this there are some IIoT that are getting analyzed. There are a few things that are standing up. It is in terms of what are the capabilities that are out there. So, of this, the top five vendors are listed here. So, you can look at them.

Look at their capabilities and figure out if their solutions or if their consultancy or advisors will be useful for you. So, again here are this particular report tells you about how they have shortlisted and how they have gotten these five vendors out of this.

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And finally, I want to give a list of industry 4.0 vendors. Now industry 4.0 consists of several things together. Remember we talked about the industry 4.0. Here are the various components and who are the vendors and how we can leverage them. Now here, again pay attention to the blocks that you have. Connected industry block, other industry 4.0 support blocks.

So, in terms of hosting, IoT platform, analytics, microchips, sensors, connectivity hardware, cyber security and system integrated. These are the connected industry. That is I would even say something like a digital platform. If you want to make it happen, you need to look into this. Now additive manufacturing, augmented virtual reality, collaborative robot, connect and machine vision, drone UAV, self-driving and transportation.

These are advanced technologies. So, what it gives you is an interesting way to or as slides to look at and then select the vendor near. Earlier one is all startup. Here, you will also see some of the veteran vendors also. Somebody like ABB or somebody like IBM are also there. Here, it is more in terms of what are the industrial 4.0 capability. This again is more like a cheat sheet to figure out.

Let us say you want to implement augmented virtual reality. Then you have a list of people that you will be able to target. But if you want to look at the latest solution in the utilities and smart grid, then what you see here will be the more appropriate one. So, in industry 4.0 what I have given is apart from explaining you the fundamentals of

it, which vendors will provide you what services and what document you will be able to review and you will be getting the information is the one that is covered in this.

With this we have come to the end of the second session. So, to recap, the first session we covered the sensors, connectivity, network and wearable. In the second session, we delved deeper into what is IIoT and the way in which you can develop the architecture and what are the ways in which you will be able to identify the solution, identify the vendors and stitch your solution together in a very effective manner.

Thanks for listening and if you have any questions, we have our contact information here. Please reach out to us. Thank you.

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