Introduction to Industry 4.0 and Industrial Internet of Things

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Lecture - 22
Business Models and Reference Architecture for IIoT: Business Models – Part 1

So, far what we have covered are basically the different fundamental concepts in Industry 4.0 and IIoT. In this lecture, what we are going to go through are some of the fundamental concepts, behind the business aspects of IIoT.

Although this course is technically oriented, but from a holistic perspective, I think the understanding will be clearer, if we go through, if we have little bit of knowledge about what are the business aspects of IIoT, and particularly because IIoT is supposed to be used in the industrial settings. And thereafter, we will go through in the other lectures, we are going to go through the more in depth aspects of the technicalities of both IIoT as well as Industry 4.0.

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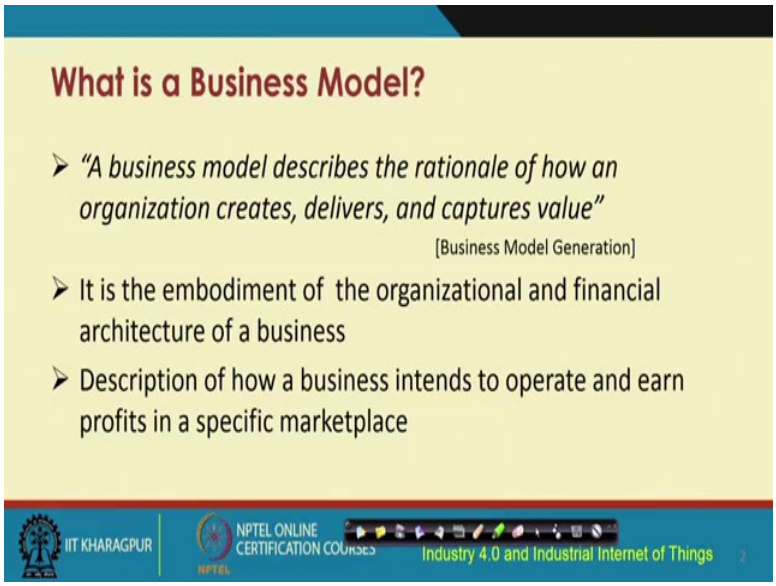

Let us now look at some of the fundamental aspects of IIoT. So, from the business perspective, we need to understand what are the different business models? And first of all the question is that, what is a business model? So, a business model basically it captures the different aspects such as the rationale behind how the organization is

created, how it is going to deliver value to the customers, capturing the value, delivering the value, and so on.

So, these are the different aspects that are captured in a business model. And it is basically this business model is an embodiment of the organizational and the financial architecture of a business. So, these models basically will give the description of how the business wants to operate, its different operations, how it is how they are going to be performed. And how it is going to the business is going to be positioned with respect to the different finances, the financial aspects, how it is going to earn the different profits, and how it is going to be positioned with respect to the specific marketplace that it is going to cater to.

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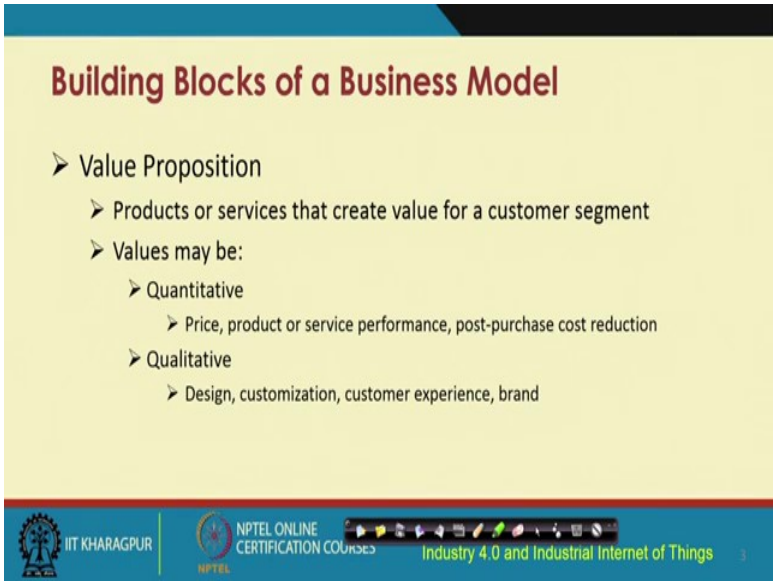

Let us now try to understand; what are the different aspects of the business model, that we should try to understand, before even we go through the different the different aspects of the business model for use in IoT, as well as IIoT.

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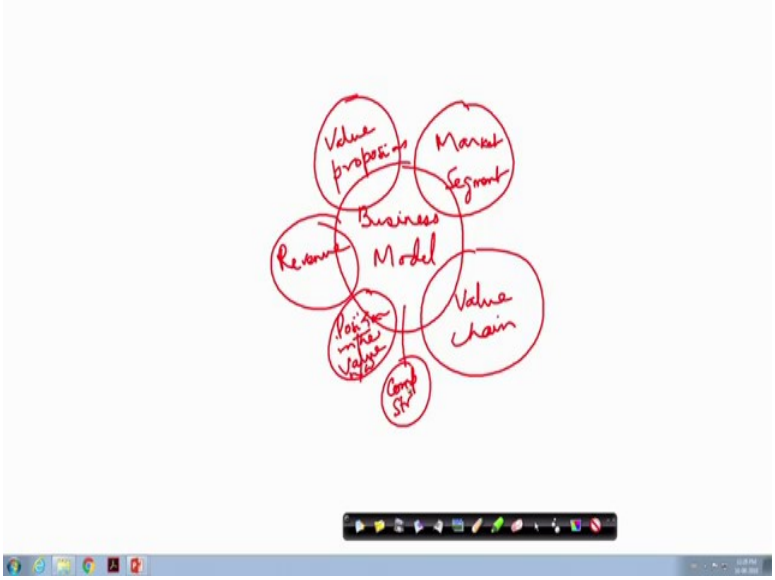

So, let us try to look at the different aspects of the business model. Let us assume, that this is the business model, let us consider that we are talking about the business model. So, what are the different building blocks of it. So, the first one that we should understand is what is the market segment.

The market segment the business is supposed to cater to. Then we should understand the what is the structure of the value chain. The different value propositions, the revenue generation, and what are the different margins in that revenue model. And what is the position in the value network. And also another very important thing is the competitive strategy.

So, these are the different broadly, these are the different aspects the building blocks, let us say of any business model. So, these concepts are very important in the next things that we are going to discuss on how these business models should be understood in the context of IoT. And thereafter, in the next lecture about the different aspects in the context of IIoT as well more specifically.

So, having understood this let us now go back to our different building blocks that we have seen in the little while back. So, the first one is the value proposition, let us take up the value proposition first. So, value proposition we are talking about offering values to the customers. So, what are the different products or the services that will create the values for the customer segments that the business wants to consider. These values could

be quantitative such as the price aspects of price, product, service performance, etcetera or these could be qualitative in nature such as the design that has to be considered the customization, the customer experience, the branding, etcetera etcetera. So, these are basically the value proposition aspects.

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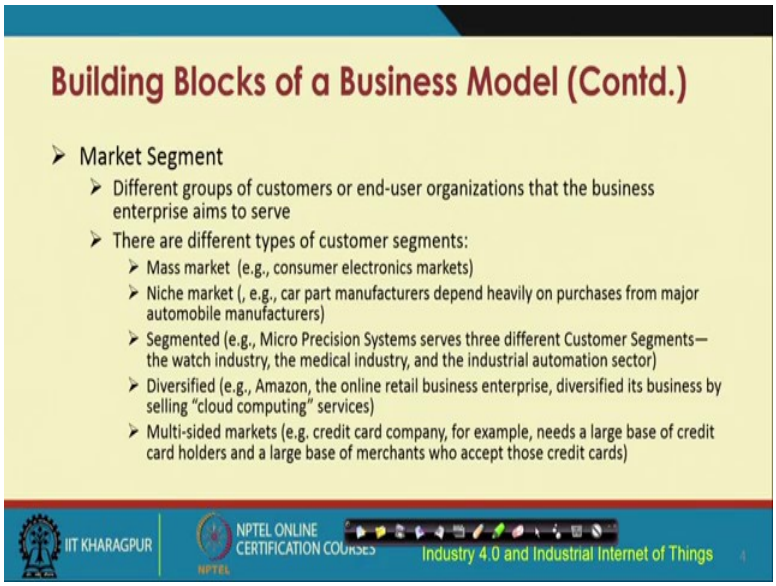

The next is the market segment. Markets segment basically talks about what are the different segments of the market that has to be considered. So, different groups of customers, the end-user organizations that the business enterprise aims to serve. And there could be different types of customer segments. For example, one customer segment could be something like the mass market. Mass market means, like for instance the whole market. So, the whole market that is going to be considered, for example the consumer electronics market is an example of a mass market.

Niche market means, the specific type of market that will be considered by the business. For example, if we are talking about a car manufacturer, so the car manufacturer basically heavily depends on the purchases from different automobile manufacturers. Thereafter, the segmented customer segment which means like the micro mechanical micro sorry micro-precision systems that it is going to serve, the different customer segments of it. For example, the watch industry, the medical industry, and the industrial automation sectors; these are all like different segmented customer segments.

Thereafter, we have the diversified one. So, diversified customer segment means like a particular business might be serving, a particular type of customer base for some time. And thereafter, they want to diversify to another type of customer base. For example, for example the company Amazon. So, Amazon is originally primarily, it is a retail business online retail business enterprise. But, in recent times it has diversified its business to selling cloud computing services.

And this is diversified customer segment and we can also have multi-sided segments. For example, if we are talking about a credit card company, so credit card company has to deal with the credit card holders on one side, and the merchants, who are going to accept those credit cards; so, those on the other side. So, these are like multi-sided markets.

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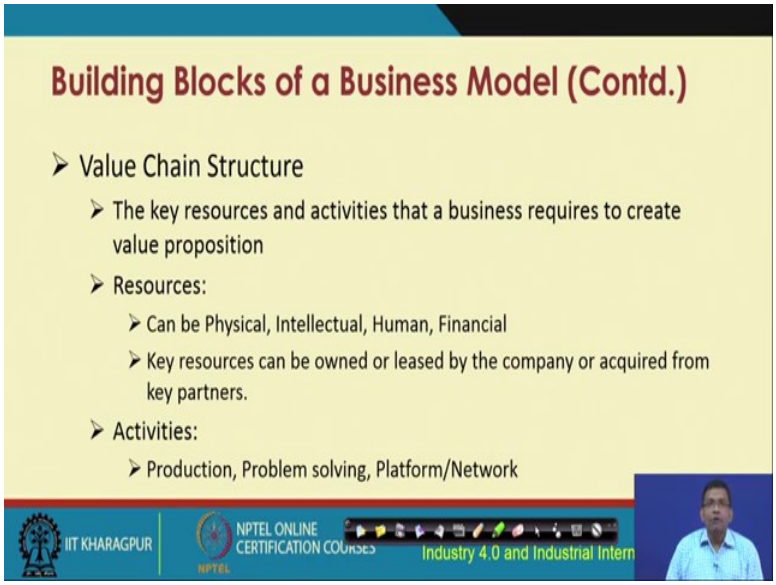

So, next one is basically the value chain structure that is the third building block that we should try to understand. So, value chain structure basically these are the key resources and the activities that a business requires to create the value proposition. So, these value chain structure depends on the different types of resources that are being used, and the different activities that are performed. These resources could be physical resources, intellectual resources, human resources, financial resources, and so on.

And these key resources can be owned or they can be leased by the company or they can they can be even acquired from different partner's business partners. So, these are the different types of resources, these are very important in the value chain structure. And the

activities, activities for example production, problem solving, platform that is considered the network etcetera, these are the different activities. So, these together are important considerations of the value chain structure.

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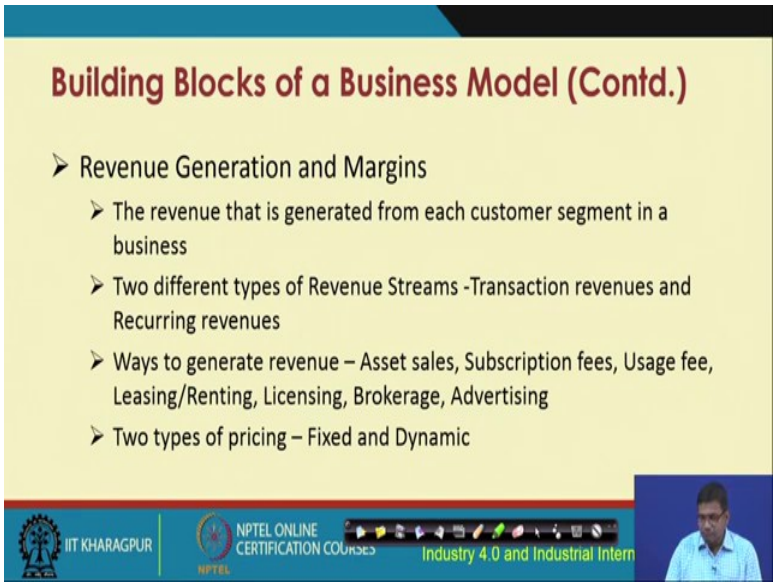

The (third the) fourth building block is basically the revenue generation and the margins, which basically talks about the revenue that is generated from each customer segment in the business. And these different revenues could be streamed from two different sources. So, one could be the transaction revenues, and this could be the recurring revenues. So, transaction revenues means, the revenues that are generated from the different transactions that are performed. And recurring revenues means, like there could be a revenue model from which in a recurring fashion, the revenues are generated from the customer base.

So, these revenues could be generated in different ways. These revenues could be generated from sales of assets from subscription fees, from usage (fee) fees or, from fees, that are obtained from the rental or the leasing out of these different resources or the services, the licensing fees, the brokerage, the advertising, etcetera (etcetera).

So, there are two different types of pricing that can be considered in any revenue model. One is the fixed pricing, the other one is the dynamic pricing. So, we do not need to really understand about each of these in too much of detail, I think this much of information will be sufficient for you to understand the more important aspects, like how

this information would help in in setting up an IoT or rather an IIoT kind of infrastructure, and generating revenues in that kind of environment.

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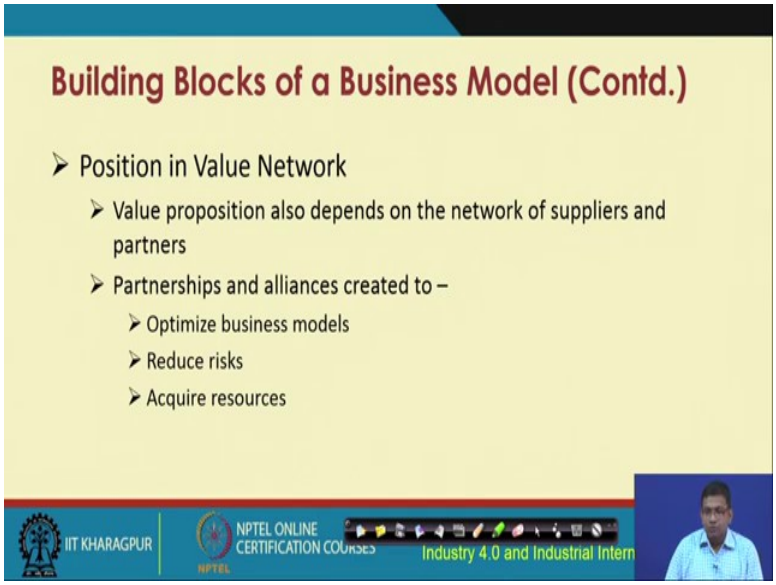

The next building block is the position in the value network position in the value network. So, this position basically also depends on the different networks of suppliers and the partners. And these partnerships and these alliances will be created to optimize the business models, to reduce the risks, and to acquire the resources.

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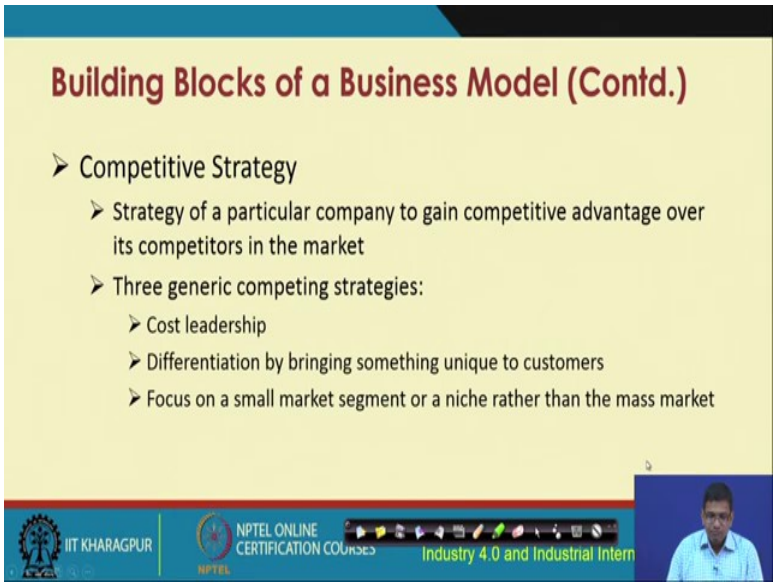

The next building block is the competitive strategy. So, competitive strategy means, the strategy of a particular company to gain competitive advantage over its competitors, in the market segment. So, there are three different types of competing strategies that typically a business considers. The first one is the cost of leadership, the second thing is the differentiation by bringing something that is unique to the customers, and the third is the focus on a small market segment or a specific type of market segment, a niche market segment, rather than considering a mass market, if a bigger market.

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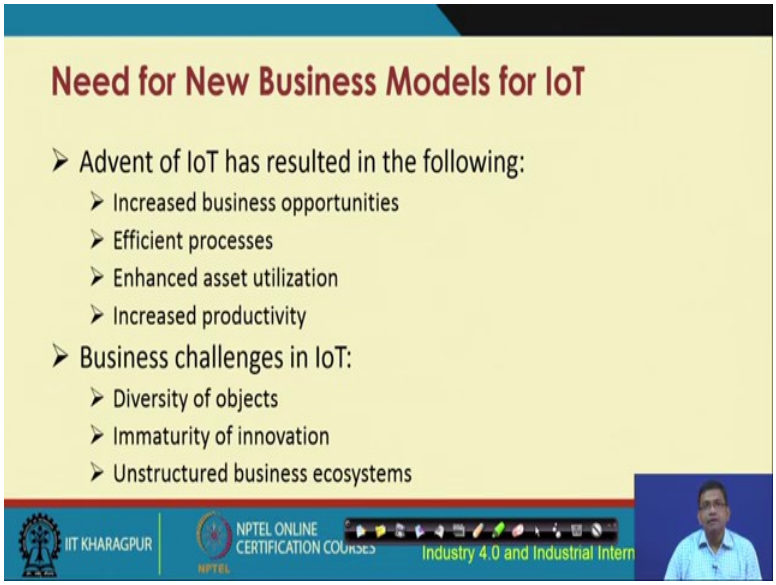

So, having understood all these different types of building blocks of any business; let us now switch our here, and try to understand that why we need these business models, and how they are important for IoT, in general. So, if we are talking about IoT, the advent of IoT basically has resulted in different (different) features from a business perspective. It has advent of IoT has increased, the opportunities for different businesses. IoT is IoT infrastructure can help in improving the efficiency of the processes can help in improving or enhancing the asset utilization, and increasing productivity.

From although there are so many different types of advantages of IoT, from a business perspective; there are different business challenges as well in the adoption of IoT. The first one is basically the diversity of the objects, and this is very key because in the IoT world what we are talking about is diversity of different aspects. Fundamentally, diversity of the different physical objects, the things that are connected.

So, we have we are talking about in the IoT world, we are talking about an internetwork of different physical objects. These different physical objects will have different sensors, and these sensors will acquire the data. And these data are going to be sent across to some remote server, for further processing.

Basically, these different objects typically in the IoT world, they are of different types and are interconnected together, so that basically only technically, but from a business perspective, this aspect of diversity of interconnecting different objects, it poses a huge challenge for the businesses.

The second thing is the immaturity. IoT, IIoT is also new, and the innovations that IoT posed to the business. So, from that particular perspective, because the innovations are new, there is lot of immaturity in terms of innovation, that has to be dealt with in the businesses, in the business. So, this is very important for consideration, when we are talking about the adoption of IoT in a particular business setting. The third one is that the business ecosystems, they are not structured in the IoT world. They are typically unstructured business ecosystems that are typically encountered in these IoT environments, unstructured business ecosystems.

And this unstructuredness, it arises because of this diversity that I talked about at the very beginning, there is diversity, there is immaturity, and as a result of which these business ecosystems, are typically unstructured. And we are talking about not one business in a true IoT world, we are talking about connecting different business segments. And these different business segments are not all, they do not all function in the following a particular business model and because of which this unstructured behavior, this property of unstructured, this arises in these business ecosystems.

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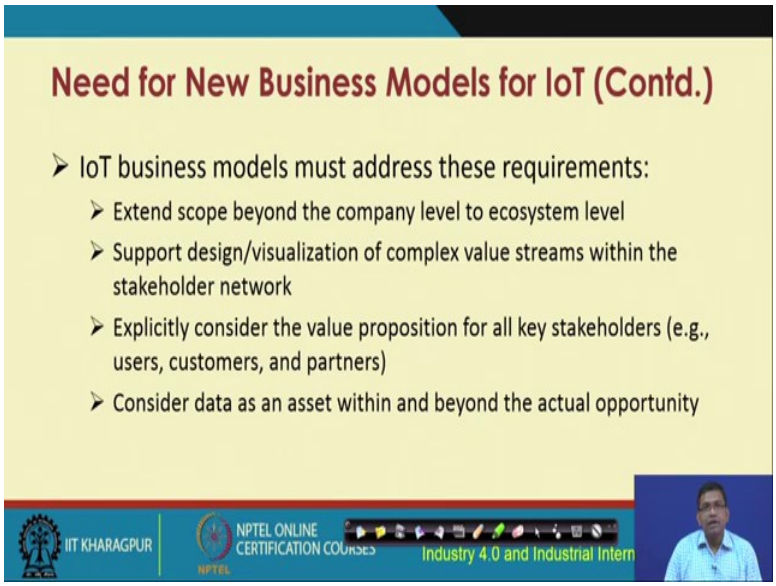

So, these IoT business models must address different requirements, this would extend the scope beyond in the company level to the ecosystem level. This is what I actually I was talking about in the previous slide. So, we were talking about that we are not talking about single companies, we are not talking about IoT serving a single company. So, we are talking about a business ecosystem, where several companies are going to play different, different roles. So, this is a very important requirement, if we have to come up with a business model for IoT the companies should, the industry should consider this very seriously.

The second consideration with respect to the business models for IoT environments is that there should be support for design as well as the visualization of complex values is value streams within the stakeholder network. So, there are different stakeholders and these different stakeholders have different requirements, from a business perspective. So, there should be support for the design as well as the visualization of this complex value stream that will be created from this stakeholder network.

The next one is basically the explicit consideration of the value proposition for all the stakeholders, which includes the users, the end-users, the customers, the different partners with which the business they have different MOUs or they have different understanding between the different other businesses. And the last one is basically the consideration of the data as an asset within and beyond the actual opportunity that is

created. So, when we talk about IoT in a business world, we are talking about lot of data, data that is generated. And this is a very important consideration in IoT. And this data it is very important, because it serves as an asset beyond the fixed infrastructure assets that are there in the company that. So, this data the IoT data is very important asset within the company. And this is not only within the company that it is an asset, but also beyond the actual opportunity that is created within the company.

So, in other words, this data can serve as an asset to other organizations, other partner organizations or even the other organizations within the geographic territory of the company, where it is operating that means within the country or, within the region and outside the region. So, it does not have any limits, this data is an invariable asset for the company, that has created this data that has collected the data, and also for the other companies.

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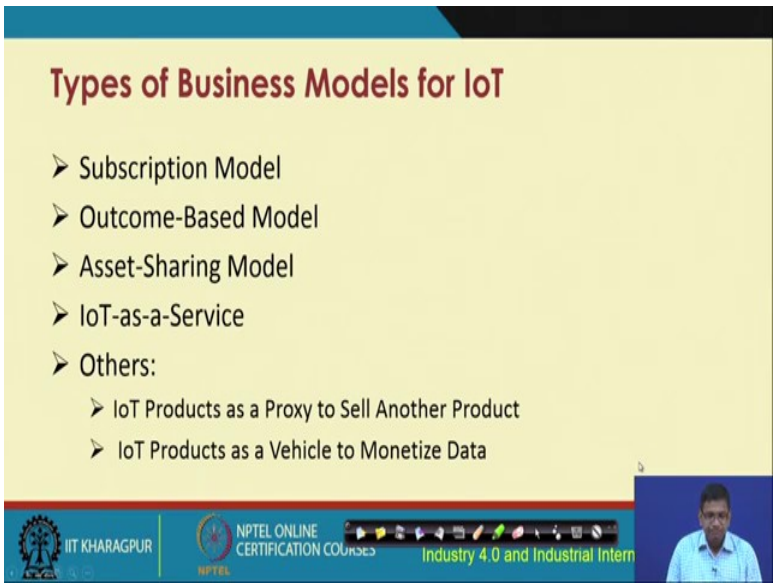

So, there are different business models for IoT. The first one that we should understand is the subscription model. So, we will go through it what it means by the subscription model so subscription model. The next one is the outcome based model. Asset-sharing model, and IoT-as-a-service plus I am also going to go through some of the other types of models that are there in the literature for use in IoT.

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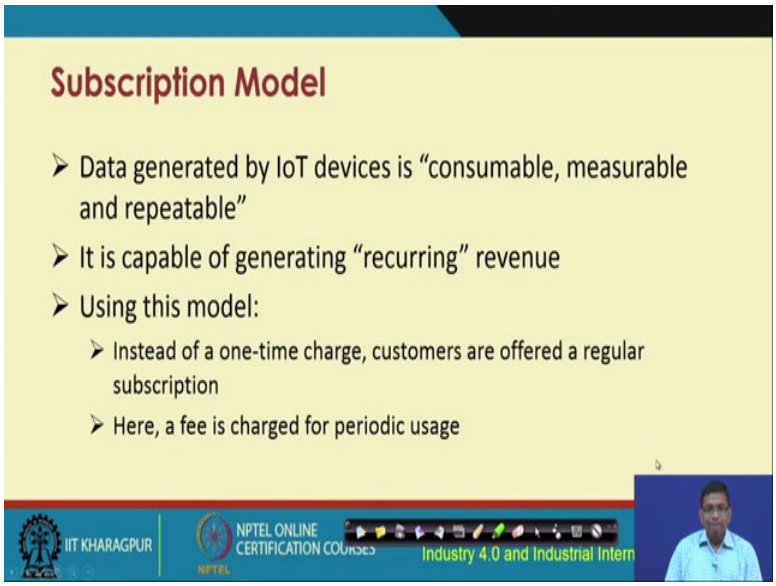

The first one is the subscription model for IoT. So, essentially what is happening is the data that is generated by the IoT devices. These data are consumable, they can be measured, they are measurable, and they are repeatable. So, it is basically this data that is generated, it is it has different facets. And it is also capable of generating recurrent revenues for the organization.

So, using this kind of subscription model, you are not talking about is one-time kind of charge to the customers, but these customers can be offered some kind of services. And they can be charged based on the subscription that is offered.

So, basically IoT services, the customers are going to subscribe to and they are going to be charged based on the units of subscription, that the customer has subscribed to and the units of usage. So, there so what is going to happen is we are not talking about a one-time kind of charge, and we are going beyond this one-time kind of charging mechanism that already exists for other types of businesses. And on a regular use on a paper use kind of basis, based on the periodic usage, the fees are going to be charged to the customer.

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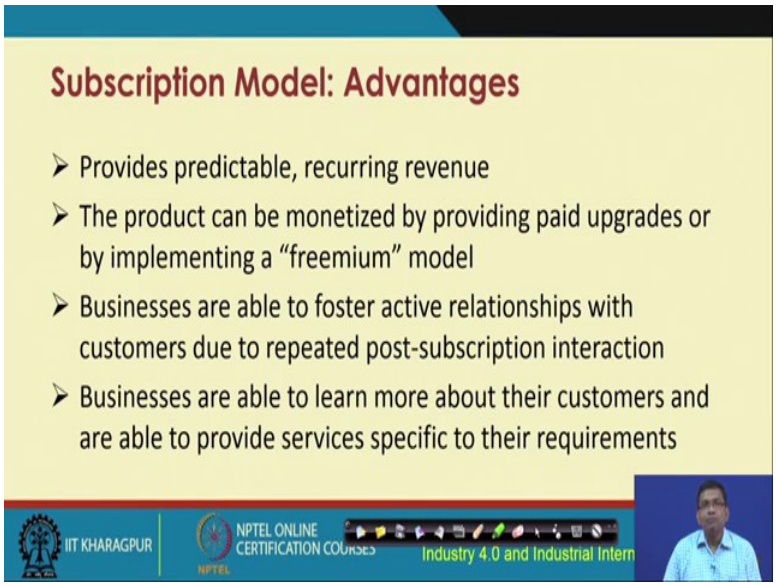

So, there are different advantages of the subscription model, it is a predictable kind of model, where you can predict how much revenue is going to be generated. The product can be monetized by providing paid updates or by implementing a freemium model. So, freemium means, like the certain levels of service the basic services, they can be made free to the customers and the premium services can be charged.

And other advantages are the businesses are able to foster active relationships with customers, due to the repeated post-subscription interaction. The businesses are also able to learn more about their customers to using this kind of subscription model. And they are also able to provide, feedback back to the back from the customers. The customers can provide feedback to the businesses, so that the improved services can be offered by the business.

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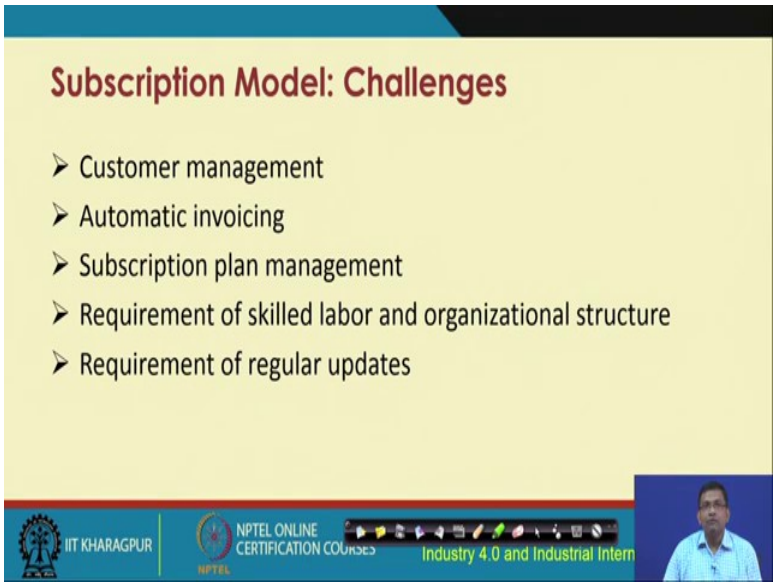

So, there are different challenges as well. So, advantages we have understood, there are different challenges behind the use of the subscription model. So, all these things like customer management, automatic invoicing, because that is required. And different types of based on the different types of usage, automatically you have to invoice the customers.

So, automatic invoicing, subscription plan management, requirement of skilled labor, requirement of regular updates; these are different requirements, which are also posing as different challenges to the businesses. So, these challenges have to be considered by the businesses, which go by the use of this kind of model the subscription model.

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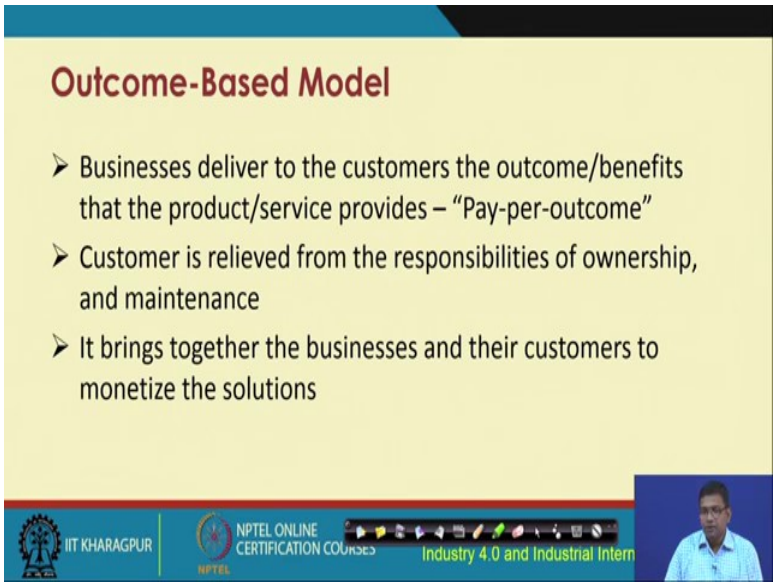

The next one is the outcome-based model, where the businesses they deliver to the customers the payment, the outcomes or the benefits that the product or the service provides. So, basically it is a pay-per-outcome kind of model paper outcome. So, based on the outcome, the customer pays based on the outcomes. So, customer is basically relieved from the responsibility of ownership, and maintenance. And it brings together the businesses and their customers to monetize the solutions. So, these are some of the different features of the outcome-based model.

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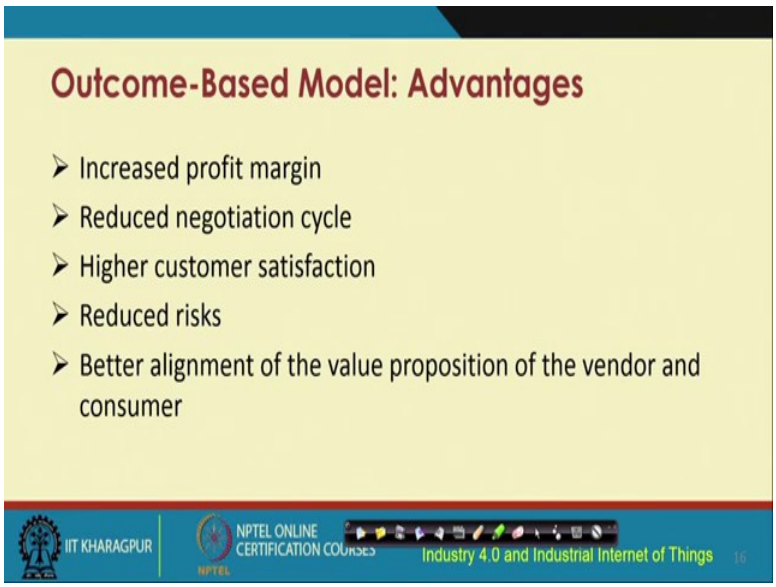

So, like the subscription based model, there are separate distinct advantages of the outcome based model as well. These outcome-based model, it leads to increased profit margin, reduced negotiation cycle, negotiation cycle with the customer. So, between the customers and the business this the negotiations that happen, the outcome based model basically reduces it.

The third one is the higher customer satisfaction, increased customer satisfaction let me call it that way, reducing the overall risks in the business. Better alignment of the value proposition of the vendor and the consumer. So, these are different advantages of the outcome-based model.

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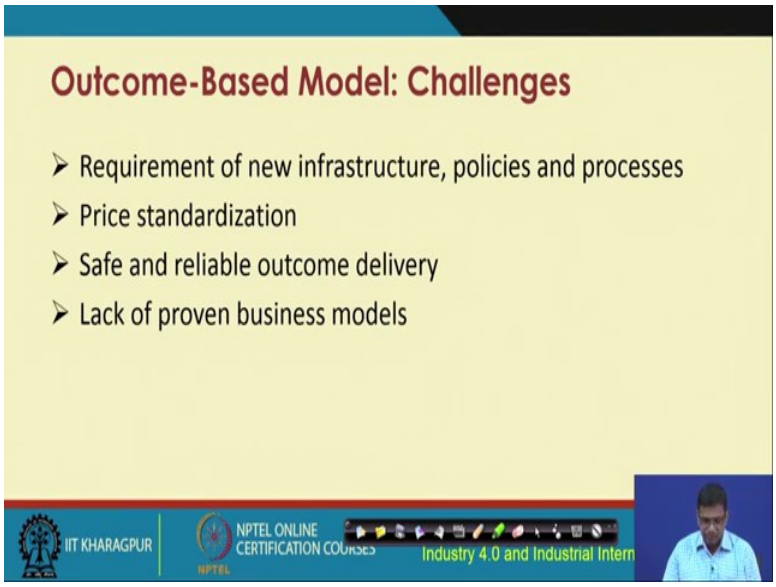

Similar to the subscription based model, there are different challenges also. If somebody if a business is adopting, the outcome based model, there are different challenges. Challenges with respect to the standardization of the price, challenges with respect to the requirement of new infrastructure, policies, processes, safe and reliable outcome delivery, lack of proven business models etcetera, these are different challenges behind the use of outcome based model.

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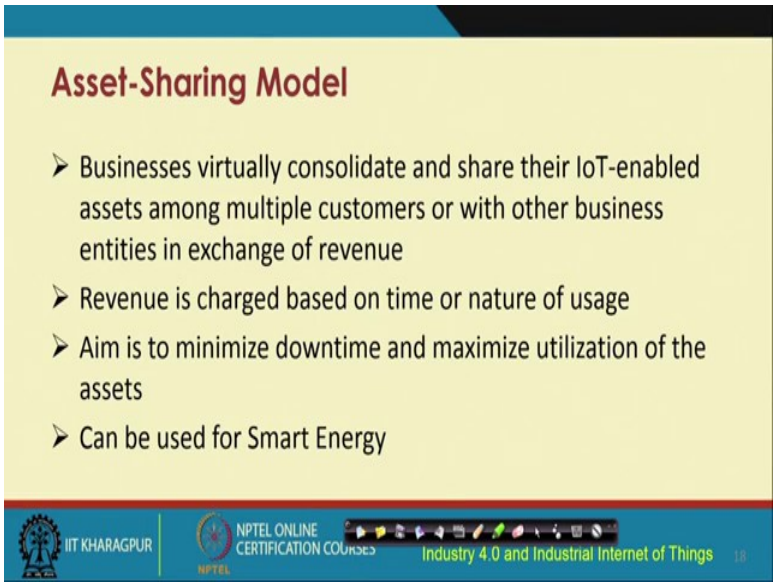

The next one is the asset-sharing model, where the businesses virtually consolidate. And share their IoT-enabled assets among multiple customers or with other business entities in exchange of revenue. So, this is something like we have seen the use of tractors for example. So, somebody owns the tractor and that tractor can be given in exchange of some kind of revenue to the other customers, so that this is basically a kind of asset sharing model, this is an example of an asset-sharing model.

So, their customers are basically charged with the revenues based on the time or the nature of the usage, how much duration the tractor has been lent or any other machinery by the industry, has been lent to another customer. So, they can be charged, the revenues can be charged, based on the duration, and the nature of usage. You know what are the different what are the different aspects of the machinery that is used by the customer, so that is also an example of how the customer can be charged with the revenues, based on the nature of the usage.

So, the aim is basically to minimize the downtime, and maximize the utilization of the assets, so this is very advantageous. Because, if the customer, if somebody if a business has a particular machinery. If the business was using just for their own purpose, then it is quite likely that the machine will be used for certain duration of time. And for other durations of the time, it will be left unused. Instead using the asset-sharing model, what

can be done is that other people can use the same machinery. And they can be charged with the charged based on the time of usage, and the nature of usage of the machinery.

So, for example smart energy smart energy in IoT, this is an example of assets-sharing model. So, somebody has the energy generation infrastructure, and the energy that is generated can be used by different customers. So, and so this is basically an example smart energy is an example of asset-sharing model.

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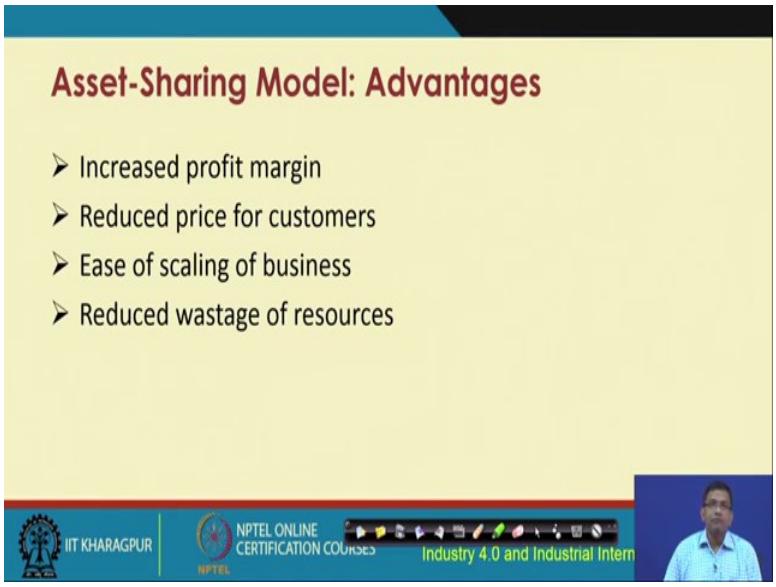

So, like the previous models that we have discussed so far. There are different advantages of the asset-sharing model as well. For example, increasing the profit margin, reducing the price of the customers, easing out of the scalability of the business, reducing the wastage of resources. So, these are some of the different advantages of the use of the asset sharing model.

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There are different challenges as well; challenges with respect to the security offering the security of the products and the services. So, once you lend out these different assets to other users, so security of the physical security of the products, the physical security of the services that are offered. These have to be considered separately, the security of aspects of these, they are very important.

The other challenges are like for example, the mutual arrangements among the different business entities will have to be taken into consideration, asset configuration is very important, and the device synchronization, and the synergies between these different devices, these are very important in the asset-sharing model.

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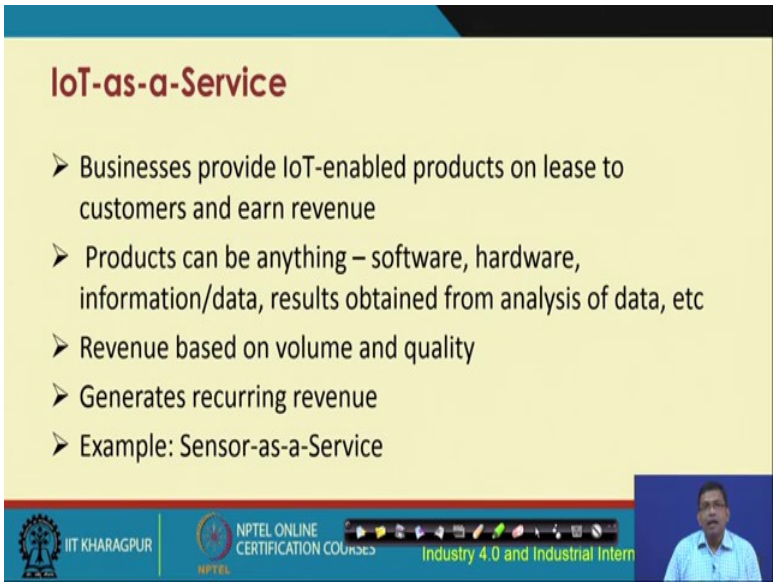

The next one is IoT-as-a-service. So, you will find, some literature talking about offering IoT-as-a-service. So, as this name suggests, we are talking about businesses providing IoT-enabled products on lease to customers, and then earning revenue from that leased out IoT infrastructure. So, these products can be anything software, hardware, information or the data, the results that I have obtained from the analysis of the data. Basically, anything can be a product in the IoT-as-a-service model.

The revenues are generated in this model, based on the volume of the data that is generated, the volume of the different resources that are used, the quality of the resources that are offered. So, all these different (different) aspects will help in coming up with the revenue model in the IoT-as-a-service. So, sensor as a service our research group, the SWAN research group, at IIT Kharagpur. We have done a lot of work on offering sensors-as-a-service. So, this is basically a specific instance of IoT-as-a-service. And this is very important in the IoT world this kind of business model is very important in the IoT world.

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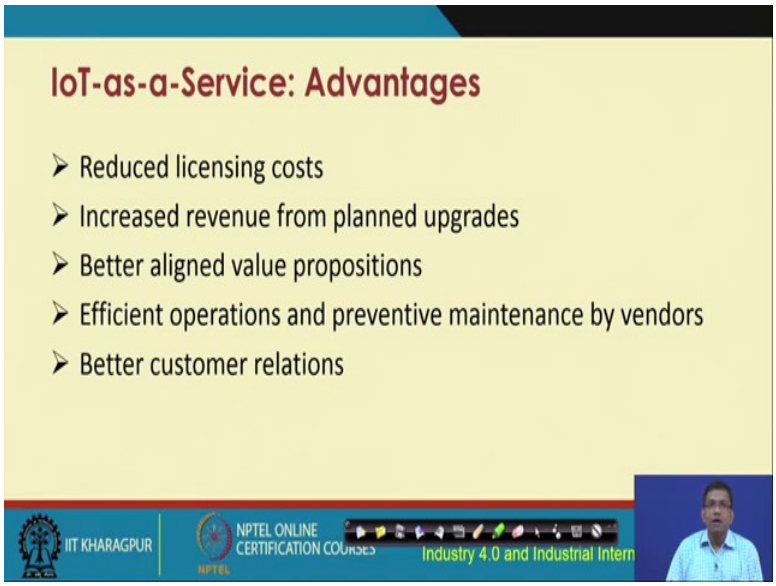

So, here are different advantages of IoT-as-a-service. For example, reduced licensing costs, increased revenue from planned upgrades, better alignment of the different value propositions, efficient operations and preventive maintenance by vendors, improved customer relationships customer relations. So, these are different (different) advantages of IoT-as-a-service.

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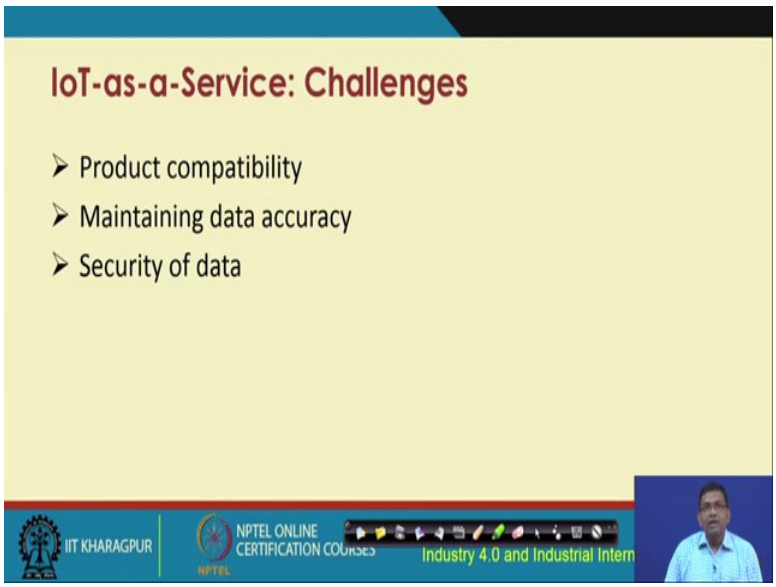

So, on the other side, there are different challenges also. Product compatibility, maintaining data accuracy, security of data, these are different challenges with respect to the adoption of IoT-as-a-service.

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So, as I was telling you earlier; so there are beyond these different business models, there are different other business models, that are also available, that have been proposed in the literature. So, let me just talk about some. So, IoT products as a proxy to sell another product is another kind of business model; so IoT products can be used as a proxy to sell another product.

In other words, IoT products are sold at the cost price or at a loss to sell other products. For example, IoT devices can keep track of the status of the products and perform the actions accordingly. And these can be used by manufacturers to sell products which require refills. So, this is a type of model that is attractive for IoT-based products.

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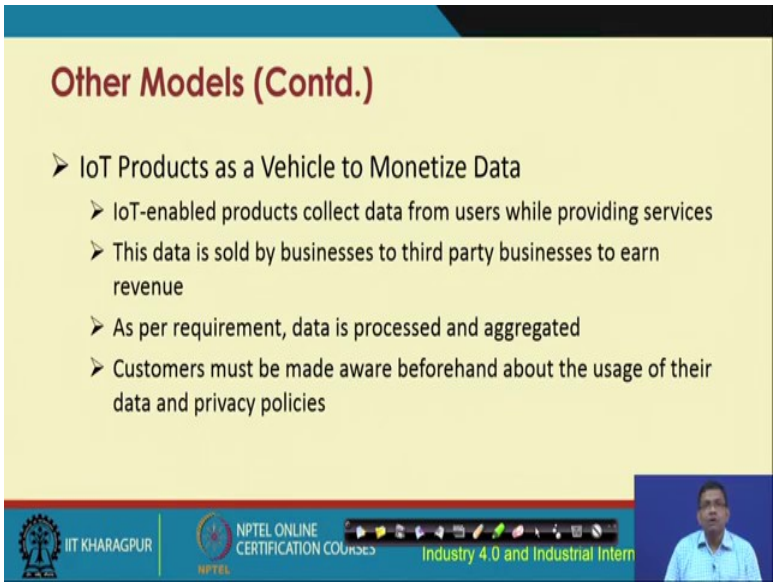

IoT products as a vehicle to monetize data; this is another type of model that is used for IoT based services, IoT based products. So, this is a kind of business model that is very attractive in the IoT world. So, IoT-enabled products collect data from the users, while providing services. And this data is sold by the businesses to the third party businesses to earn revenue. And as per the requirement, the data is processed and aggregated. And the customers will have to be made aware beforehand about the usage of their data and the privacy policies. If they are adopting, if the business is adopting the; this kind of business model in the IoT world.

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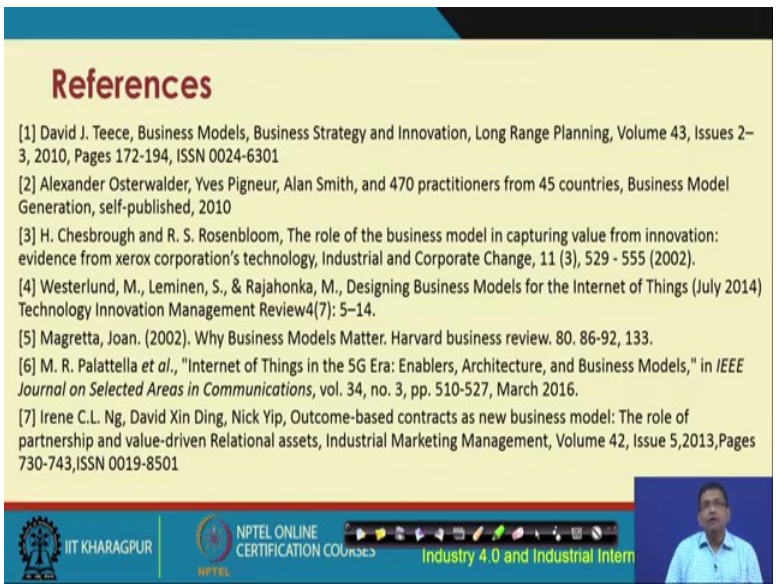

So, with this we come to an end of the first part of the business aspects of IoT. So, we have initially we have gone through the different business models, that are available and the different types of business model, that are available in the literature not just IoT, but any kind of business model the different types of it that are available in the literature.

Thereafter, we have gone through the IoT specific business models that are attractive in the community. And some of the businesses are already adopting these different proposed business models for IoT. And we have also gone through the different not only the features of each of these business models for IoT, but we have also gone through the different advantages and the challenges in the adoption of each of these different business models for IoT.

So, these are some of the references that you see in front of you. So, if you need to understand any of these things in more detail, then you can go through these different references. But, I think from the holistic point of view of understanding IoT, IIoT as well as Industry 4.0, the concepts behind it, only this much of understanding should be enough in order to understand the business aspects of IIoT.

So, far in this lecture, what we have covered are only the business models, the business aspects of IoT. And in the next lecture, we are going to look into the business models and the different other related aspects for IIoT, Industrial IoT. So, there we will diversify a bit, and we will talk about the specific issues of IIoT, and the business aspects concerning it.

Thank you.