Introduction to Industry 4.0 and Industrial Internet of Things

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Lecture - 23
Business Models and Reference Architecture for IIOT: Business Models – Part 2

The next lecture is about IIoT-Business Models, the second part of it. In the first part, what we have gone through in the previous lecture was some of the fundamentals of the business aspects of IoT. The business models, the different types of business models not just for IoT, but the different types of business models that are there in the literature. And then thereafter, we also went through some of the specific aspects of business models for IoT, the features of it, the advantages, the different challenges in adopting them for IoT and so on.

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And in this lecture, we will focus specifically on Industrial IoT, the business aspects, the business models for IIoT, specifically. In the Industrial IoT, IIoT context, for any business, there is uncertainty. So, uncertainty of different types, but any uncertainty as we know also has some associated risks, and this uncertainty and the risks can have either these can be either positive, they can have some positive impact on the business or it can be negative.

So, the entrepreneurship theory, basically encapsulates the positive aspects. So, positive aspects such as asset-driven opportunities, opportunities out of the assets that are created for instance. The service innovations which aid in the manufacturing; service-driven opportunities targeted at serving certain end-users and the information infrastructure ownership; so, these are the positive aspects.

But, there are some associated negative aspects, which are basically captured through the transaction cost theory, things like non-ownership contracts, performance contracts, performance means like any machinery, any instrument in the industry degrades it is performance over time, which basically can be optimized again, the performance can be optimized over time as well. These are the things that are captured under the transaction cost theory. These things will have to be considered, when we talk about the business aspects of IIoT.

These service innovations, they can aid in manufacturing. The service-driven opportunities targeted at end-users or the information infrastructure ownership. These are the positive aspects of behind this uncertainty or the risks that are created. And those basically are part of something known as the enterprise theory.

So, I also told you that the positive aspects are there, there are some negative aspects as well. So, negative aspects such as non-ownership contracts, performance contracts. Performance contracts means like the business is offering different assets. The assets are going to perform, for example assets means like machinery. They will have their own different types of performance different times; they will have different performance are going to degrade.

Contracts between the service offerors as well as the so basically the service providers and the service consumers; so basically the company as well as the end-users who are consuming. So, these are the different negative aspects that will also have to be considered. And these come under the transaction cost theory. So, we have the enterprise theory, and then we have the transaction cost theory.

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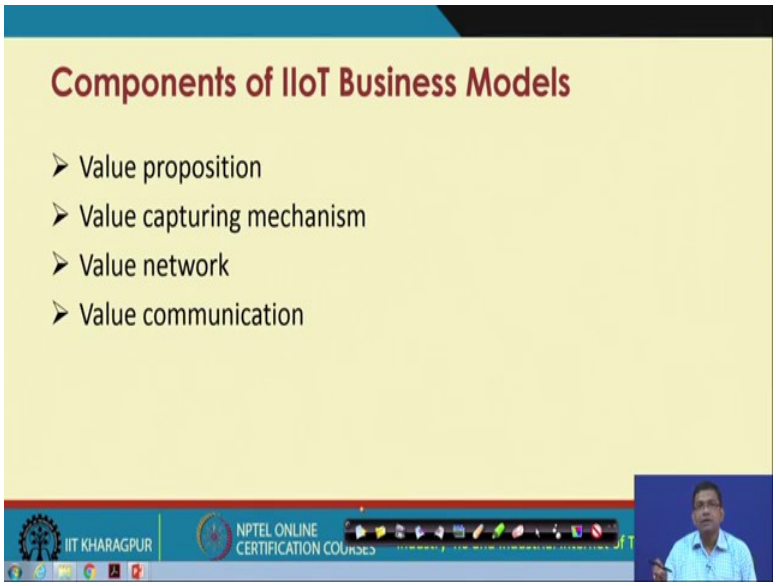

So, there are different components of IIoT business models; value proposition, value capturing mechanism, value network, value communication. Value means, value to the end-user. So, to the end-user what is the value proposition, how the value is captured, what is the mechanism behind it, what is the value network, how the information, is how the value are going to flow between the different groups in the end-user community or the customer community, and the value communication. How within that network, how the value is going to flow, how the value is going to be communicated across different groups, across different segments.

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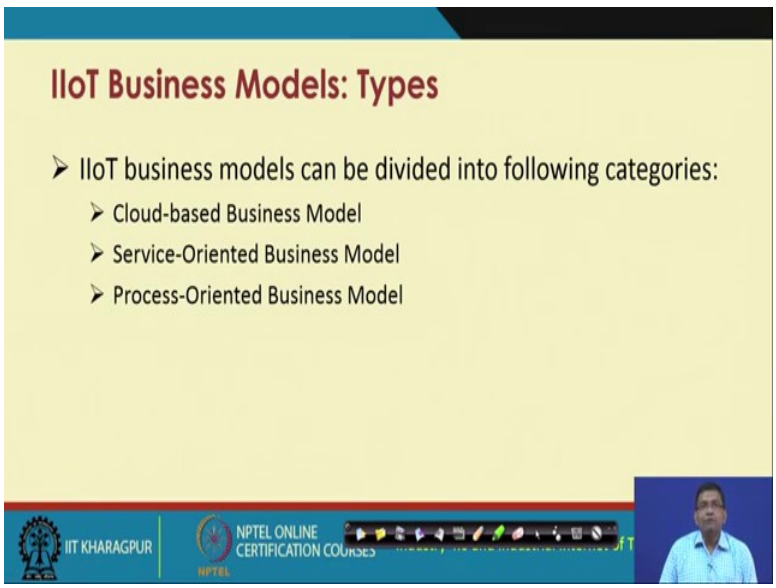

So, there are different types of IIoT business models. And they could be cloud-based business model, service-oriented business model or process-oriented business model. So, I am going to talk about each of these, in little bit more detail now.

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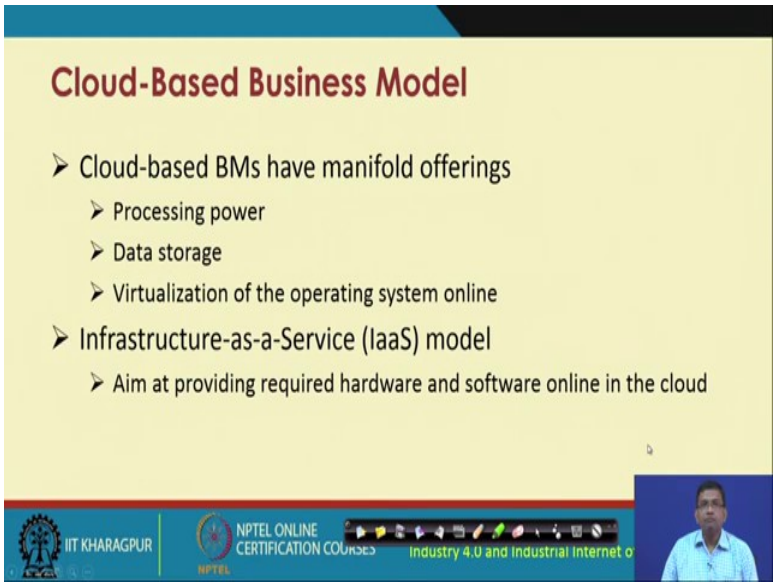

So, cloud-based business model as the name suggests is this kind of business model, basically are heavily based on cloud cloud-services. So, cloud-services means, we are talking about the processing, we are offering cloud-based processing capabilities, storage capabilities of the data, the data storage, the virtualization of the operating system.

So, these are like the different features, different aspects of the cloud-based business model. So, we have things like infrastructure-as-a-service model (IaaS), in this kind of model, some kind of hardware infrastructure, the computing infrastructure will be offered as a service, so we have infrastructure-as-a-service.

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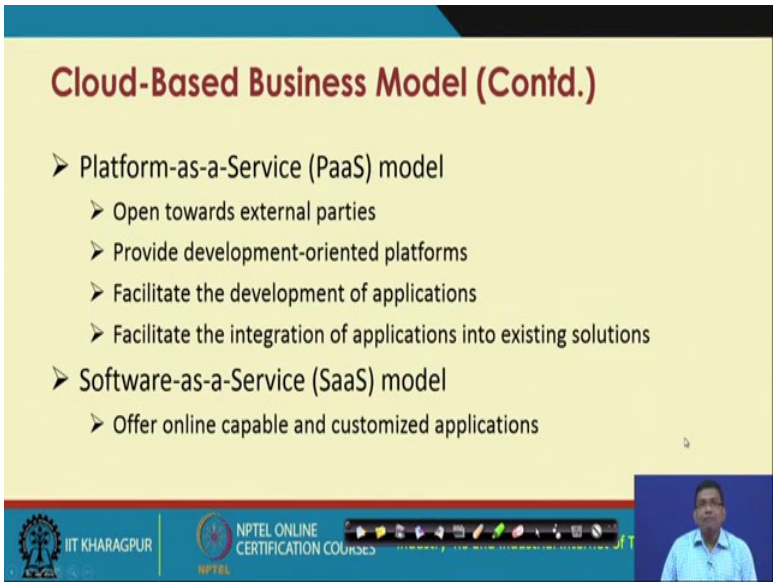

We have platform as a service, which is basically the computing platform, the development platform that is going to be offered to the customers as a service for further development of different applications, integration of different applications, which have been developed in different platforms integration of it under a common platform; these are platform-as-a-service model.

And then the last one is the software-as-a-service model, where we are talking about offering online capable a capabilities and customized applications to different customers. So, we have infrastructure-as-a-service model or we have platform is a service model or we have software as a service. So, primarily these are the three different types of service models, cloud-based service models. But, it started with these three, then we have different other, these as a service that as a service different types of other types of cloud-based service models are also available.

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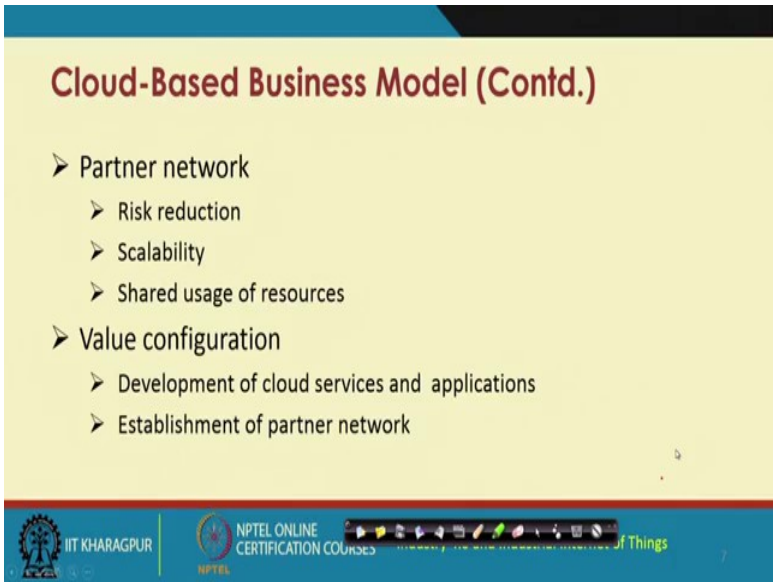

So, then we have in the cloud-based service models different aspects. For example, the partner network, this is very important. The partner network should be considered in such a way that the model is scalable, it reduces the risks, and the different resources are shared across the different stakeholders properly, stakeholders including the different partners. So, the different resources have to be shared across the different partners.

Value configuration is very important. So, value configuration with respect to the development of cloud services, and the different applications. And the value behind this kind of offering, this is very important. And the establishment of the partner network, this is also very important.

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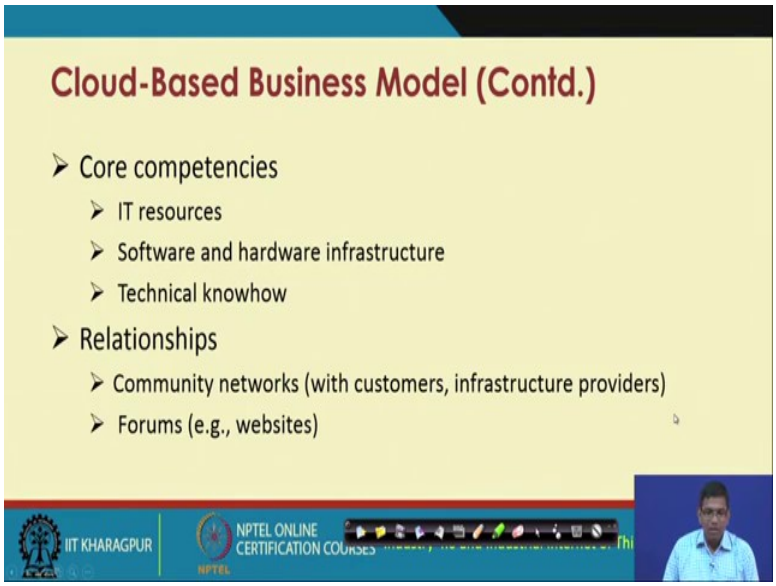

So, the next one is the core competencies. So, if we are talking about the cloud-based business model, what is very integral is the core competencies like the IT resources IT means, Information Technology resources, the software that is used, the hardware infrastructure that is used. The technical knowhow that is also very important, the overall the technical knowhow has to be considered, and that is also very important and these are the three primary, the IT resources--software, hardware infrastructure, and the technical knowhow, these are the key things to be considered under core competencies.

And the relationships; relationships, for example relationships between the different stakeholders, the community networks with the customer, with the infrastructure providers between them, across them and so on. And also things like the different forums that are considered, websites, different other, distribution lists, the different (different) forums, these are very important. And particularly in the cloud-based model, most of the services are offered through websites right.

So, typically these are end-user can get infrastructure as a service with respect to some kind of a compute platform. Certain units of RAM, certain units of CPU, certain units of storage, these are offered through some kind of a subscription, using a particular website. So, this is an important feature of the cloud-based business model.

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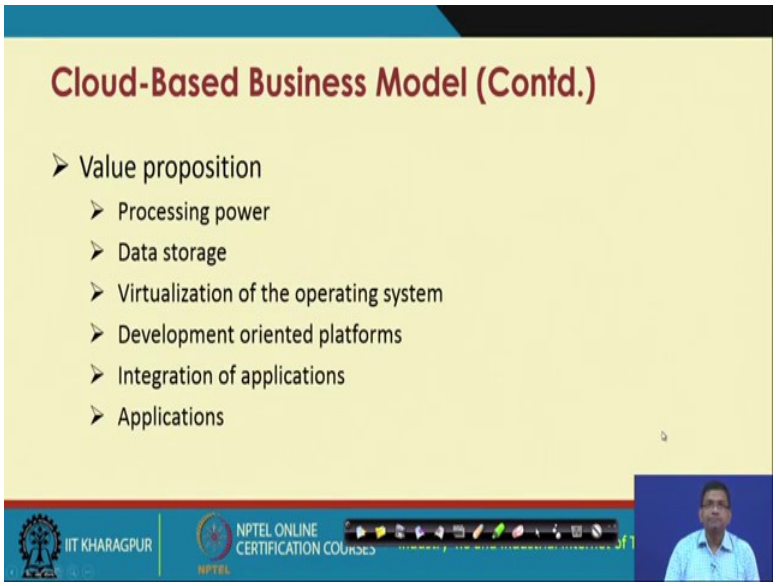

Value proposition with respect to the processing power, data storage, virtualization of the operating system, development oriented platforms, integration of applications, applications specifically the applications, so applications and their integration essentially; so these are the different value propositions. So, essentially we are again falling back on infrastructure infrastructure-as-a-service, platform-as-a-service, and software-as-a-service. So, different applications and their integration software-as-a-service; so, these are the different value propositions in the cloud-based business model.

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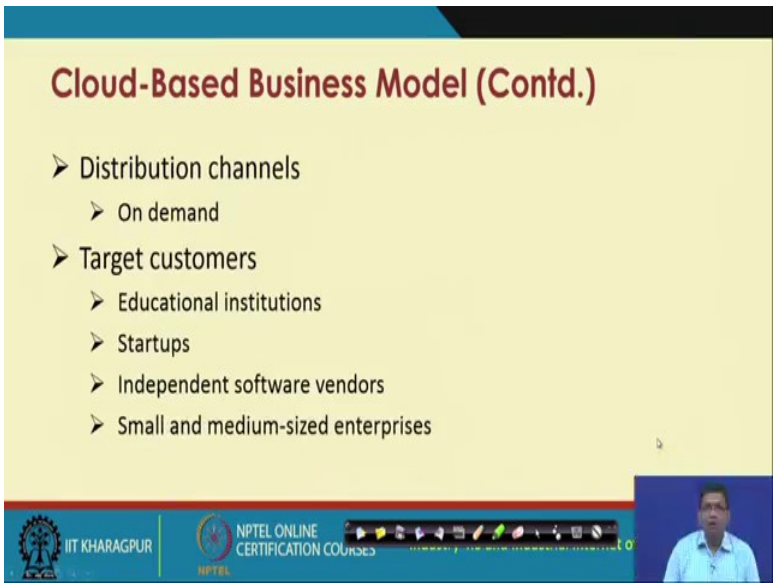

So, distribution channels typically, we are talking about in a cloud-based business model, we are talking about on demand. So, on demand whenever computational resources like infrastructure software is etcetera are going to be required on demand, these are going to be offered to the customers. And finally, let us look at who are going to be the target customers in the cloud-based business model. So, cloud-based business models are already very popular, they are used by different types of customer bases.

So, one type is basically the educational institutions; so presently worldwide, educational institutions use these cloud-based business model quite extensively. Startup companies are also falling back on the cloud-based business models, because that becomes cheaper, that becomes cheaper. So, startups typically have very small revenues to start with, they have very less capital to start with.

And it is often very convenient to adopt some kind of a online cloud service, instead of procuring infrastructure in the form of different types of servers, different other computing platforms etcetera, so that becomes more costly. So, start startups typically are heavily using the cloud-based business model. Independent software vendors, small and medium medium-sized enterprises, they are the different target customers of this kind of business model.

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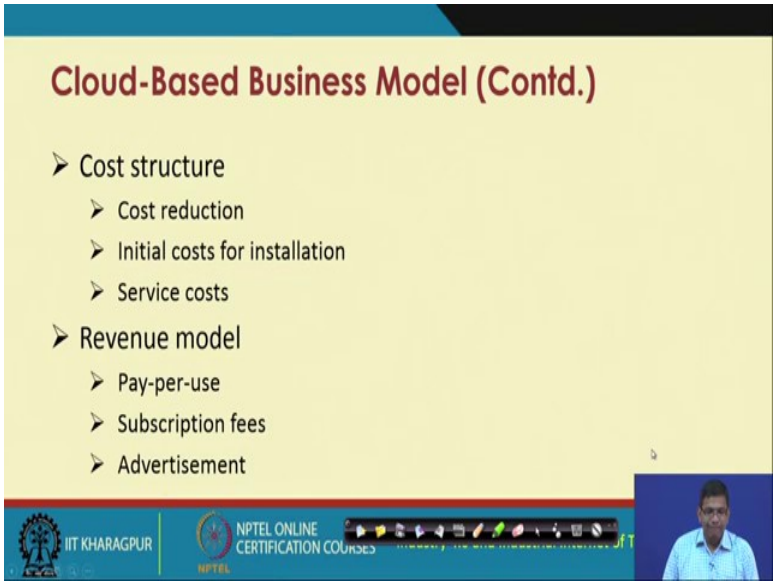

Cost infrastructure, sorry, cost structure, considerations are important. Cost reduction, initial costs for installation, service costs, these are very important considerations.

Likewise, the revenue model, for instance the whether the pay-per-used model is going to be used, this is the typical model that is used this kind of revenue model is typically used in the cloud-based business model. And subscription fees, advertisements, etcetera. These are the different considerations to come up with the revenue model in the cloud-based business model.

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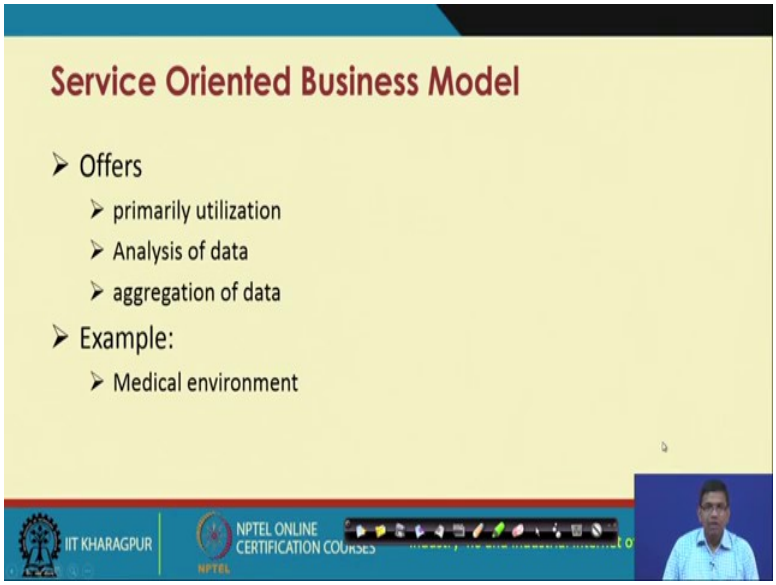

Now, let us try to understand the service oriented business model. The service body oriented business model, it is all about services it is all about services. Service offerings such as the primary utilization, the data that is collected, analysis of the data, aggregation of the data etcetera, are very important in the service oriented business model; examples are medical environments.

Medical environment, so let me just give you an example of it service oriented business model. So, in our swan lab in IIT, Kharagpur, we have developed the AmbuSens system, this is basically for this is an IoT based system for ambulatory healthcare. So, in the ambulances patients can be the health condition of the patients can be monitored.

So, essentially in this kind of model, we are talking about utilization of the data by different stakeholders like the doctors, the patients themselves, the near and dear ones of the patients, the paramedics. So, all are different users of this kind of system the AmbuSens system.

And there is huge data is generated, this data are aggregated at different levels in the system. And they this data are also analyzed and this analysis of the data is done, and that analyze data is again offered to these different stakeholders that I just mentioned. And they can get the different pictures from the analysis of the data from the data that are collected by from the patients that are in the ambulances.

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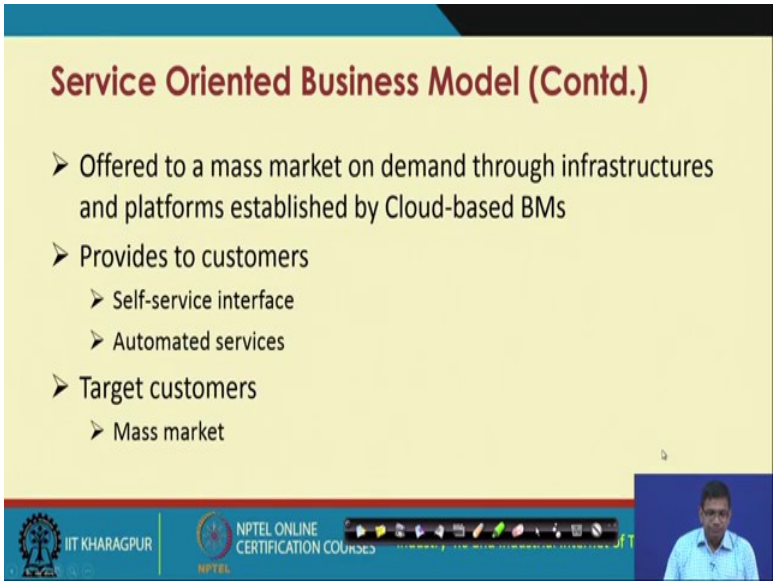

So, typically this kind of typically, but not necessarily; this kind of business model is an adopted in mass market kind of situations, where there is a mass market, and on-demand these infrastructures and the platforms could be made available, typically through some kind of cloud based service.

So, in the AmbuSens as well, we are falling back on the cloud based service for offering the services to the customers. A customers means, we are talking about the patients who are onboard the ambulances traveling from one hospital to another hospital. So, the customers are provided, self-service interfaces, automated services. And as I was telling you that the target customers are basically the mass markets, but not necessarily so.

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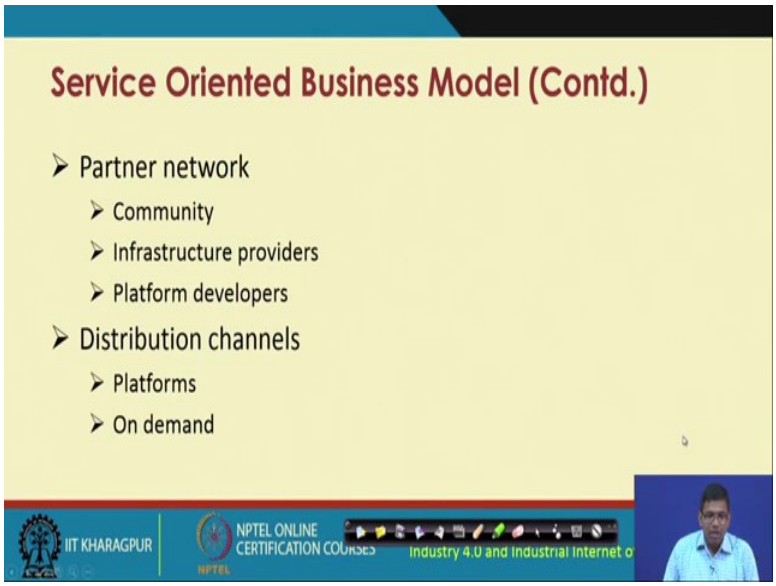

So, partner network is very important. So, the community that is there. So, the community the infrastructure providers, the platform developers, these are different, they are the different aspects that different people that join hands in the partner network. And the distribution channels on demand or the different platforms that are used, so these are also different important considerations in the Service-Oriented business model.

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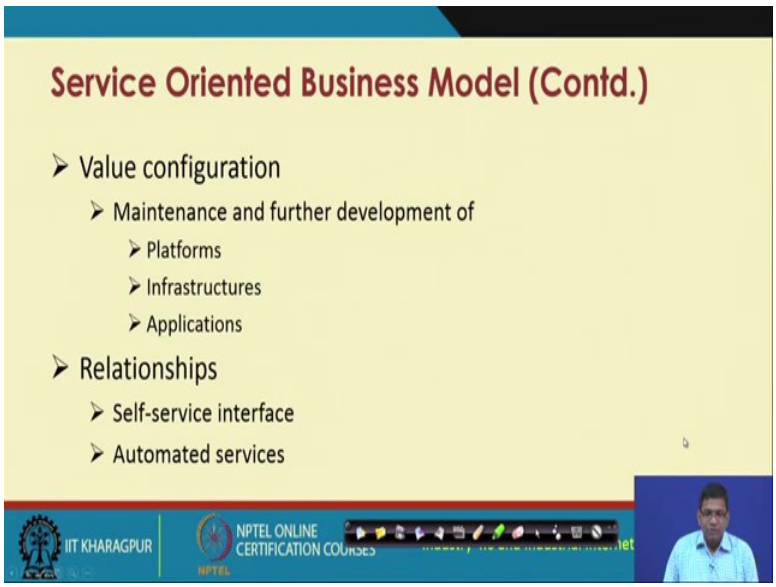

With respect to value configuration, the maintenance, and further development of the platforms are very crucial in this kind of business model. The infrastructure, the

platforms, the applications, the maintenance of them and not only maintenance, but for the development; these are very important in the service-oriented business model.

And the relationships; so self-service interfaces, automated services etcetera offered to the different customer. So, we have the business, who is offering it, and we have the end-users. So, between the end-users at the end-user as well as the businesses, the different interfaces, the self-service interfaces, the automated servicing interfaces etcetera, that are offered; these are very crucial features in this kind of business model.

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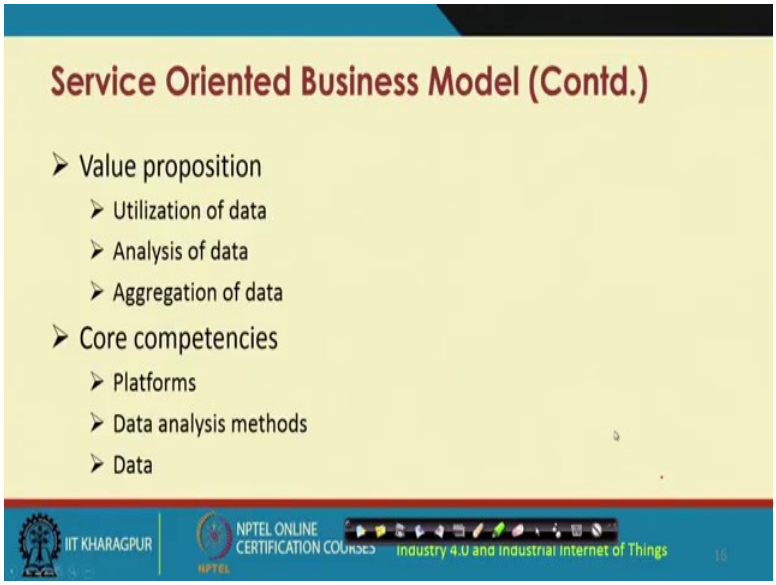

In terms of the value proposition, the utilization of the data, the analysis of the data, the aggregation of the data, these are important and also the core competencies such as the platforms, the data that is generated by itself, the methods, that are used to analyze the data that is generated. So, all these are important aspects of core competencies in this kind of business model.

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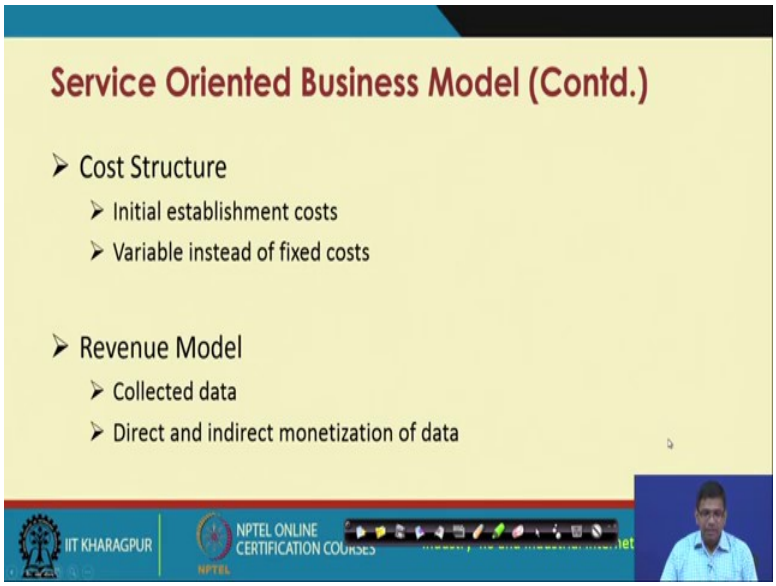

Cost structure. The initial establishment costs, the variable versus fixed costs, these are important considerations. The revenue model, collecting the data, and also monetizing the data that is collected directly or indirectly monetizing from the data that is collected; so collecting and monetizing from the collected data directly or indirectly, these are important aspects in this kind of business model.

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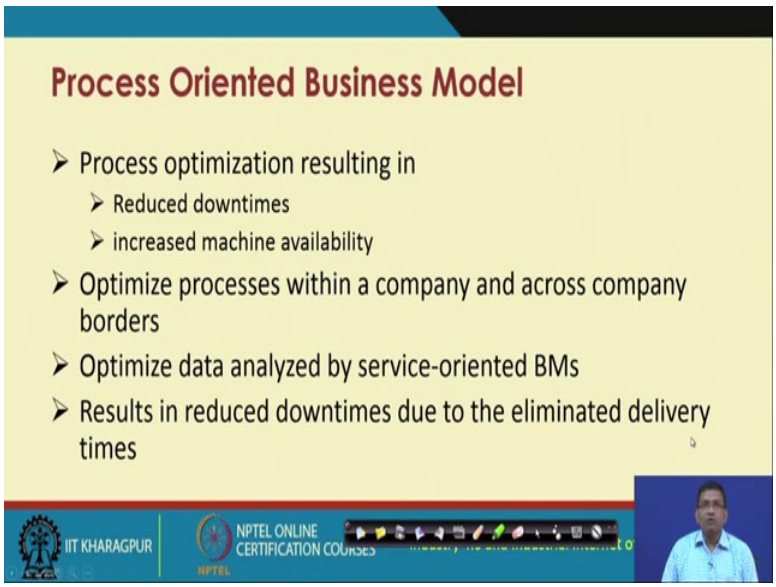

So, the next one is the process-oriented business model. So, here we are talking about the processes, optimization of these different processes, reducing the different down times of

the machinery that is available. And making these machinery available for increased durations of time to different (different) customers, this is the whole idea behind this process oriented business model. So, reduced down time, increased machinery availability, these are important considerations in the process optimization sorry in the process oriented business model.

So, these have to be optimized, that means, that you increase the availability of these machinery to different customers not just one customer, but many different customers, making these machineries available to many of them. So, the processes will have to be optimized within a company, and across different company border borders. So, earlier I was telling you about this particular thing, in a different context as well.

So, what is important in the IoT world; IIoT world, more specifically, is we are talking about not a single company, but we are talking about a situation a scenario, where these different companies, the borders between these different companies are going to be removed. And these companies are going to join hands for optimizing their resources, and the processes that are there, in the use of these different resources.

So, optimizing of optimization of these different processes; optimization of the data that is analyzed by the service oriented business model, that we talked about earlier. And the result of this process oriented business model is reduced downtime, due to eliminated delivery types.

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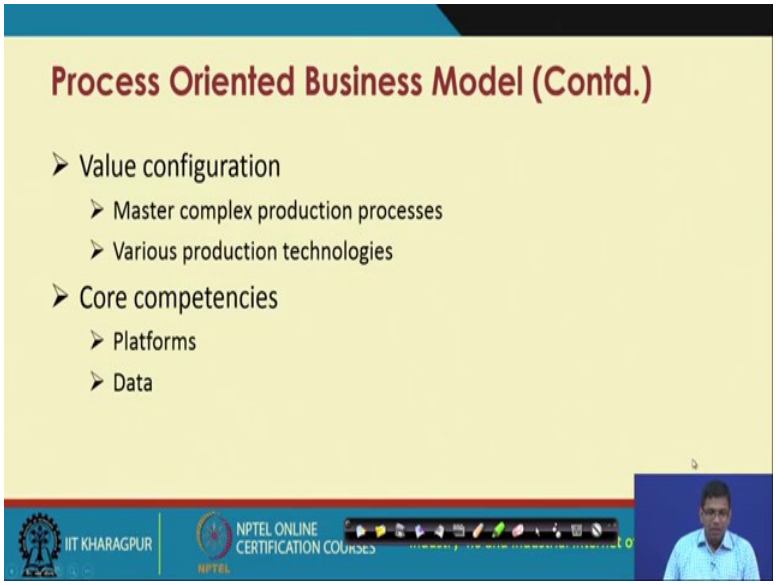

So, in terms of the value configuration, we are talking about master complex production processes. So, we are talking about a complex kind of production process, right. We are talking about the complex production process, where not just one kind of business will be involved, but multiple businesses might be involved as well.

So, mastering this complexity is very important. And also trying to deal with various types of products and technologies, this is very important in the process oriented business model. In terms of the core competencies, the platforms are very important. The data that is generated is very important. So, these will have to be dealt with very carefully in this business model, the process oriented business model.

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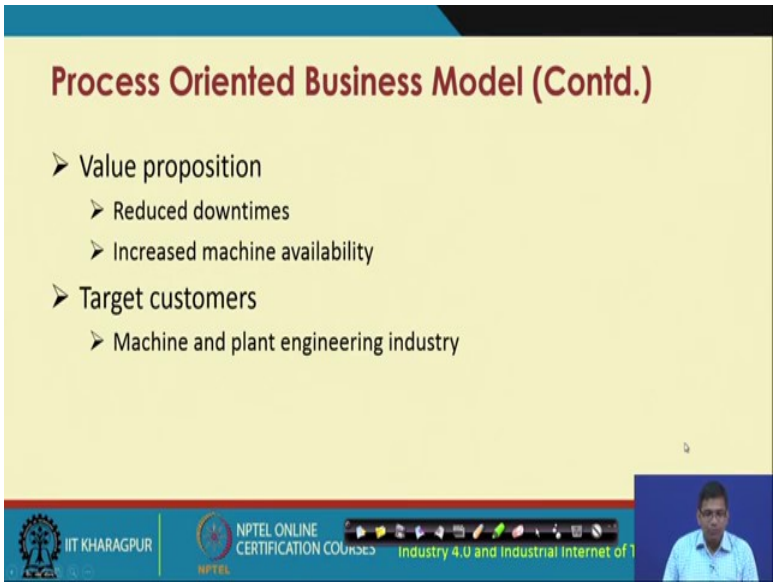

The value proposition is that this kind of business model leads to reduce downtime, increased machinery availability. So, these are some of the important features attractive features of that option of process oriented business model. And the next one is the target customers for use of this kind of business model the process oriented business model are basically the machines and the plant engineering industry, machine and plant engineering industry. These are target customers of this kind of business model.

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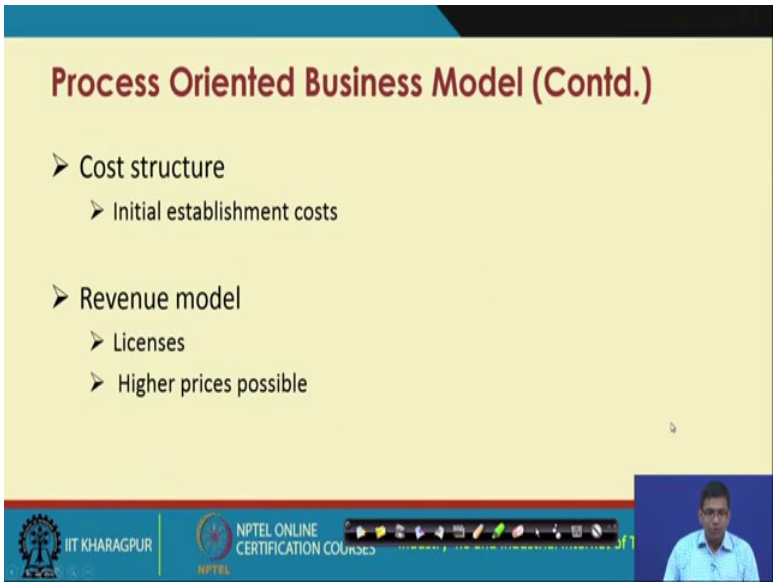

In terms of the cost structure, there is some initial establishment cost that is important, before one uses or adopts this kind of business model. And the revenue model, for example, the license costs are important the higher, higher prices might be possible in the in adopting this kind of business model. So, this is also an important consideration to come up with the license costs, higher prices possibility of higher prices, existence of higher prices; these are important considerations, while coming up with the revenue model.

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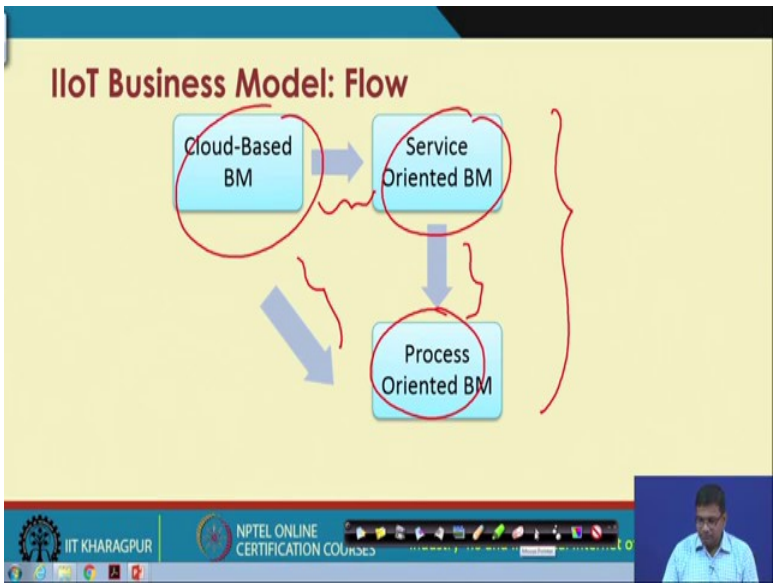

So, we talked about cloud-based business model, we talked about the service-oriented business model, we talked about the process oriented business model. So, so all these three we have individually talked about, but as we can see over here we have these inter-linking these different business models. So, there is inter-dependency between these business models. So, in other words they do not work in isolation, they are all interdependent, right. So, this is something that we have to keep in mind, while choosing the right business model for the IIoT scenario that we talk about.

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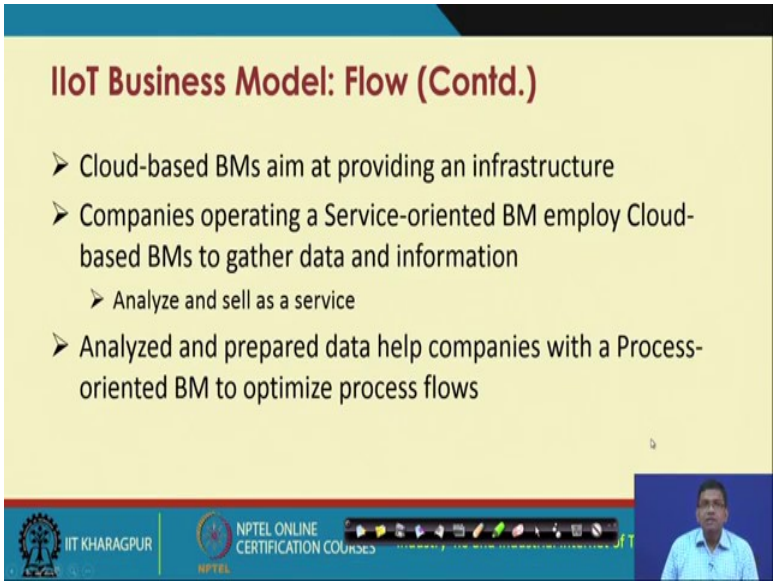

So, cloud-based business models aim at providing an infrastructure. Companies operating a service-oriented business model employee cloud-based business models to gather data and information. And this analyze data are prepared and they help the companies with a process-oriented business model, to optimize process flow. So, as we can see that we are not talking about any of these business models in isolation. But, in a real kind of IIoT setting, these business models are interlinked. So, they depend on each other, and they can be used, the choice of the business models should consider this inter dependency as well.

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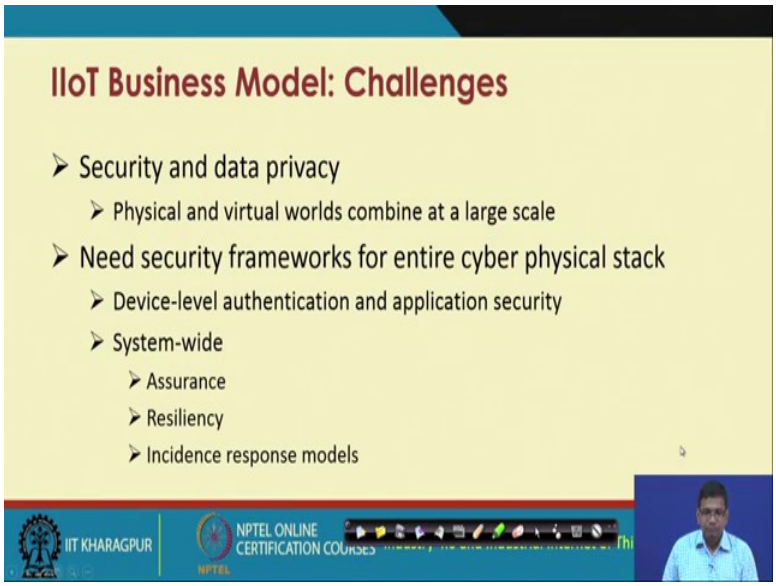

So, in terms of the challenges; security and data privacy, challenges are there. Obviously, so I do not need to elaborate on this. And there is need for securing the entire cyber physical infrastructure that is there. This is very important for IIoT, IIoT systems are typically, cyber physical systems, typically, but not necessarily these are cyber physical systems. So, security the physical security of these infrastructure the frameworks, and the associated infrastructure are very important.

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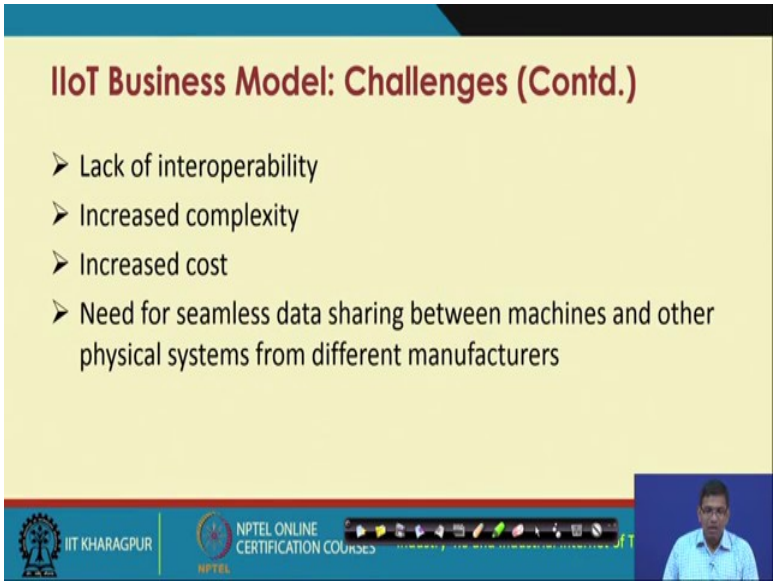

In terms of other challenges lack of interoperability is important. Increased complexity is quite obvious. Increased cost need for seamless data sharing between the machines, and other physical systems from different manufacturer, because different manufacturers, different vendors are providing different machines, that have been developed in isolation.

So, there is what is very important is to ensure that there will be when you are integrating all of these different machinery, there will be seamless integration of this data. And they are going to be shared, seamlessly between these different machines and machines, and the different other instruments, that are there in the cyber physical system. And they have been developed by the different vendors.

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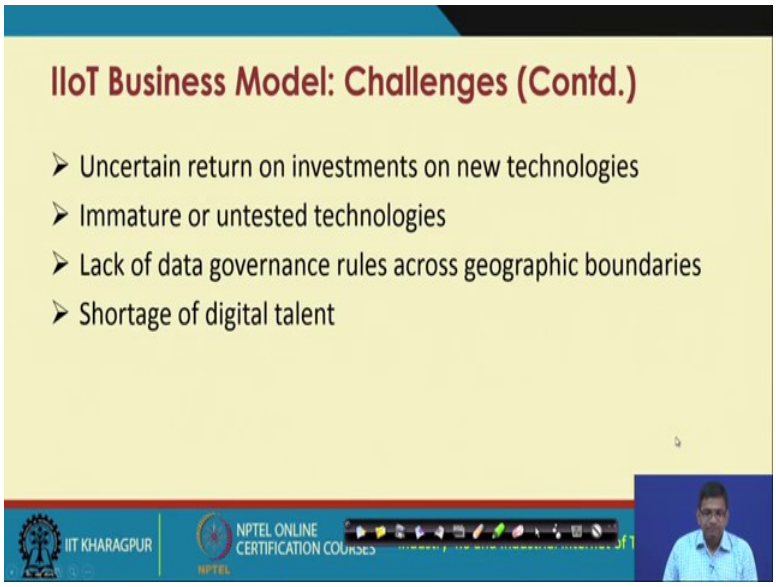

Other challenges include uncertain (Refer Time: 25:15) on new technologies, immature or untested technologies, lack of data governance, shortage of digital talent. So, these are the different other challenges that will also have to be considered by a business, before coming up with the adoption of a suitable business model.

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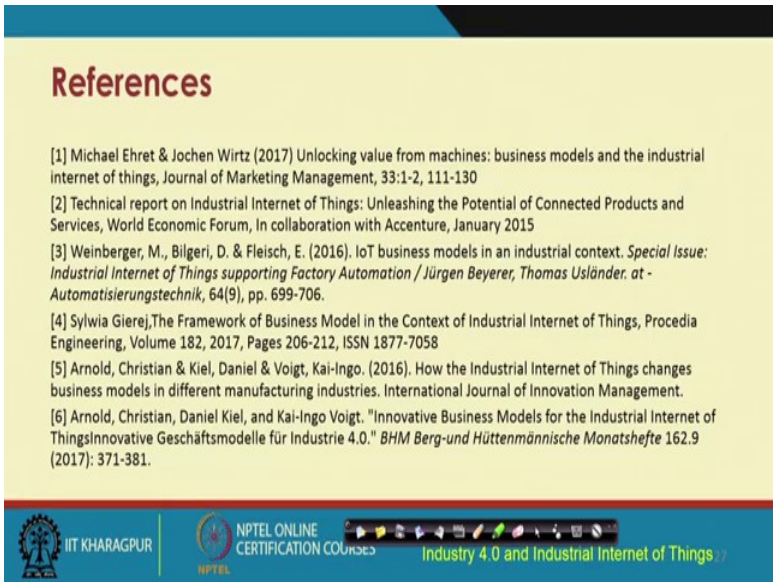

So, in this particular lecture, what we have gone through are some of the specificities in terms of business models, the business aspects of IIoT. When somebody is adopting IIoT in the company in the industry, then there are certain aspects with respect to the business, they are that will have to be considered. So, those aspects we have gone through some of the different aspects I mean these are not the only ones, but some of the important ones we have gone through. So, we have understood the different aspects of IIoT business models, the advantages, the features, the advantages, the different challenges, and so on.

So, with this in the previous lecture as well as the as well as in this particular lecture, we have gone through the different aspects of business, the different aspects of the features of the different business models, that can be used for IoT and IIoT respectively. And the advent advantages, and the different challenges, that are going to be encountered in the adoption of these technologies IIoT and IoT, in general, these technologies in a particular industry.

So, we have these are the some of the references that one can go through. In order to understand in more detail, but as I said earlier as well that this understanding should be sufficient about the business aspects, these understanding of the business aspect should be sufficient, in order to have the holistic view of holistic understanding about IIoT. The technicalities are covered in the other lectures, but these business aspects are also something that cannot be ignored by the technical folks in the industry. So, there has to

be some basic understanding about these business aspects, and this is what we have tried to ensure imparting you with this kind of knowledge. And so these references, if somebody wants to go through in further more detail. And with this we come to an end of the understanding about the business models for IIoT.

Thank you.