Toyota Production System
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Module No # 01
Lecture No # 03
Production System

Welcome friends. So, we are now entering into the third session of this course on TPS. In our previous 2 sessions, we discussed that what is the basic meaning of Toyota production system and then we also discussed some of the important changes, which are happening in the global environment particularly with the reference of manufacturing. We saw that how the cost of input resources are decreasing, how the Chinese magic is also on the decline and how new manufacturing locations are coming up in different continents.

If we discuss it particularly from the India's point of view, we also saw that many new countries particularly in the Asian subcontinent also as well as in Africa and Europe, there are competitive locations which are coming up. So, from India's point of view, we cannot sit silent we need to be more aggressive and aggressive with respect to our excellence we have large amount of quantity, but we lack in excellence.

And therefore, this particular topic becomes more important from the India's point of view that how to promote excellence in our manufacturing sector. And if we can do that, because we already have large number of manufacturing organizations, we already have quantity, if quality is also coupled into that, there is no doubt that we can achieve a contribution of 25% in our GDP from the manufacturing sector. So, with this background, we have already started.

Now, in this third session, we are going to discuss some academic aspect of this title Toyota production system. Now, as we discussed yesterday, that production is basically a value addition activity. So, in this particular class, we are going to discuss what is the meaning of system. Now, if I take you to a different background, what is happiness now, each one of us define happiness in our own way, we have different meanings of happiness.

Similarly, the definition of system or the concept of system may have different meanings for different people, it is very difficult to say that this is the single definition of system, people define system depending upon their context. If I am a mechanical engineer, I will define system in a different way, if I am a scientist, I will define system in a different way if I am a doctor, I will define a system in a different way.

So, depending upon my domain of knowledge, depending upon my profession, I define system accordingly. Now for our purpose in this course of Toyota production system, we mean that system is an arrangement of components designed to achieve a particular objective according to plan.

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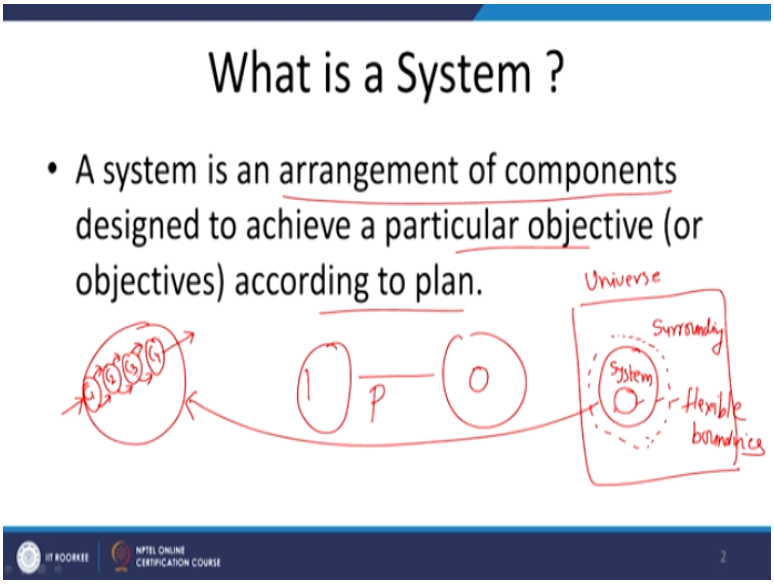

What does it mean that there are arrangement of components. So, there are various components which are arranged in a manner so, that you can achieve a particular objective we have yesterday discussed that how you have input then processing and then output so, input processing units and output may be considered the arrangement of components. Now within processing within input within output, there may be further arrangement of components.

So, that you achieve the whatever desired objective you have set according to a plan. So, where another point of importance in defining this system becomes that if this is my universe, now, out of that universal I want to focus on this particular area. So, this particular area becomes my

system and everything external to this boundary is my surrounding and surrounding plus system makes the universe so this is universe.

Now, this concept is very interesting, it looks very simple, that there is a system everything external to system is surrounding and surrounding and system they make the universe but it gives a very important responsibility on the researcher that depending upon my convenience, I will select the boundaries of system. For you this can be a system for somebody else this can be a system for the same problem and for somebody else, who is able to define problem more correctly for that person, only this can be a system.

So, our choice of system will vary depending upon our problem of under consideration, if we are able to see that what is the problem exactly I will focus only on that particular part. So, if you see a doctor, when a doctor is able to diagnose the problem properly, he or she is able to treat you more effectively. That means, he has actually identified this system very correctly, when the doctor is not able to identify the system correctly, then he starts treating you on a bigger system.

And when he is treating you on a bigger system, the chances are the probability of getting cured reduces accordingly. So, our ability our expertise is more important in defining the boundaries of system. So, depending upon my experience depending upon my exposure to that area, I will be able to define what is the system. So, the point is that boundaries of the system are flexible these boundaries are flexible, flexible boundaries.

You can choose the boundary of system as per your requirement, there is no such condition that you need to have the size of system that is one very important thing. Now, the second important thing in this definition is that in this system, if I have taken out of this, let us say to further elaborate that this is my system. Now, within this system, there are various components which are arranged in a particular manner so, that I am able to achieve the objectives according to plan.

So, these are the components C1, C2, C3, C4, these are the components which are arranged in a manner that I am able to get the objective which I have set for my system. So, these are for example, in a manufacturing system, these can be different machine centers C1, C2, C3, C4 can be different machine centers in a different educational setup, these can be C1, C2, C3, C4 can be the different departments.

So, depending upon what type of system, what type of objectives, you have set for your system, which are obviously coming out of a plan that becomes the arrangement of various components. So, these are the two things now, in this arrangement of component also, it is not necessary that you have a sequential arrangement of C1, C2, C3, C4 depending upon what do you want to achieve from this system, you may have a arrangement like C1 to C3 to C4 you can bypass C2 for somebody else, it can be C1, C2 and C4.

So, depending upon case to case you may have different types of arrangement. So, that is again the duty of designer that what type of system he or she is making. So, system is one very fundamental thing, because the whole discussion of operation management is based on systems concept, the systems theory is the basis of an entire operation management discussion. So, it therefore, we are devoting enough time for understanding the system that what is the system and how systems discussion is relevant for our course of Toyota production. Now another important thing, which I like to highlight with respect to system.

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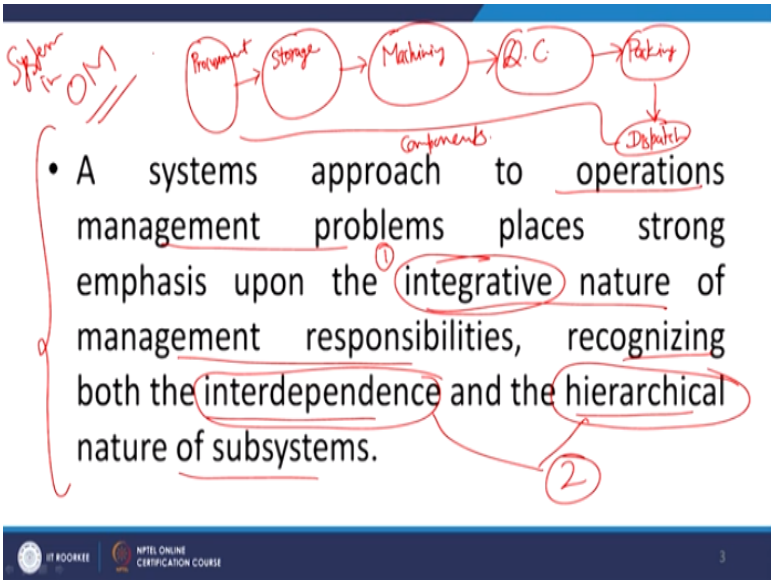

Is that a systems approach to operation management problem? Now, how system is relevant for OM problems, then it places a strong emphasis on the integrative nature of management responsibilities recognizing them, interdependence and the hierarchical nature of subsystem. Like, there is a procurement system where you are purchasing the raw material. Now from procurement system, it is going to storage system.

Now, from a storage system, it is going to move machining system then from machining system, it is going to quality control system, quality control system, it is going to packing system from packing it is going to dispatch. Now all these subsystems are having a very strong integrative role. Now, this integrative role is one key thing. Now, you see that procurement to storage to machining to quality control to packing and then finally, it is coming to dispatch.

Now, if that negative role is not there, it will not be possible to deliver the objectives out of this system. If you have excessive delay at the storage stage, if you are not able to procure raw material at the right time, if your quality control is rejecting too many things, if it is not able to do justice, with respect to the speed which is required, you will not be able to achieve on time delivery targets.

So, the objective is to have on time delivery target and for that purpose, we need to have a very integrated role of all these subsystems. So, that is one key thing like in our previous slide, we were discussing that how C1, C2, C3, C4 are required and that is the components. Similarly, in this particular case, all these subsystems are my components you can say that these are the components of my manufacturing system starting from the procurement and then finally, dispatch of the finished goods.

That is the components and how these components are arranged their integrated nature that is key for the success of my manufacturing system. And then the second important thing the first is this integrative rule and the second is that all these are interdependent and they have a hierarchical nature. So, these are two important things that it is a collective thing. And many of you may be aware of concepts like total quality management, you may be aware of integrated marketing, you also know about unity of direction.

In all these concepts, we talk of integrated nature of management, the time has gone, where we used to work in silos, now we require highly integrated efforts in achieving the objectives or in developing the competitiveness for by organization. So, that is the point number 1, the point number 2 is about that all these subsystems all these components are having some kind of interdependence on each other.

Like if my machining system is working properly, if they have a well-defined maintenance system, then only they will be able to produce products within limited variation. So, that will help the quality control and at the same time, if they have a proper machining system, then the storage system will able to provide the raw material components subassemblies etc in just in time.

So, all these things are interdependent and they were in a hierarchical manner. So, that is very important that this particular slide discusses the role of system in OM. The previous slide was about what is a system that was more generic at this particular slide is more specific that how system concept is applicable in operation management. So, I hope that we are not able to understand that the integrative nature of various components, the interdependence of these components and the hierarchical nature of the components.

These are some of the key things which are applicable from systems theory to the manufacturing systems. Now going further, if we see this in the pictorial form, we have discussed already this type of diagram in our session 1 where we have a linear system raw material is coming, you are processing.

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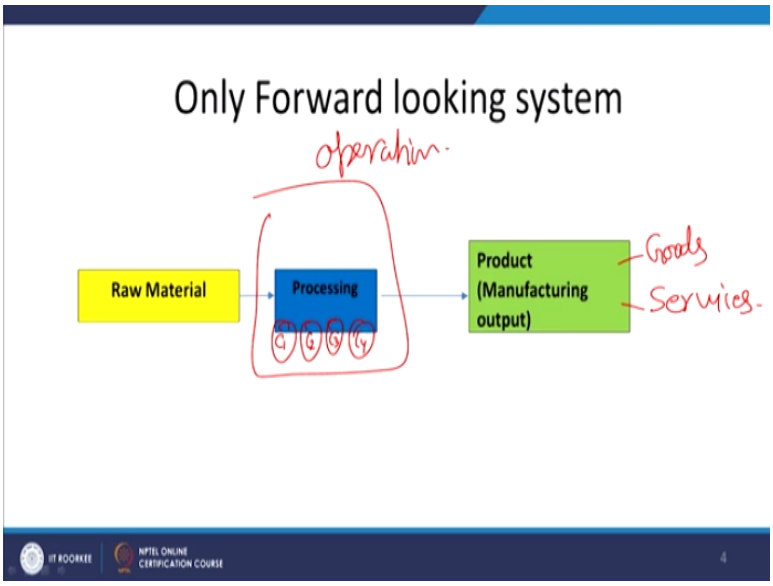

So, there are various you can say some component in the processing, we have already discussed them with the name of C1, C2, C3, C4. So, this is primarily the operation activity and then you are making finished goods that is the product in the form of goods or services. Then, this is the

traditional way of working, but what is happening in the present context. So, for that purpose, if you see that we have now circular systems.

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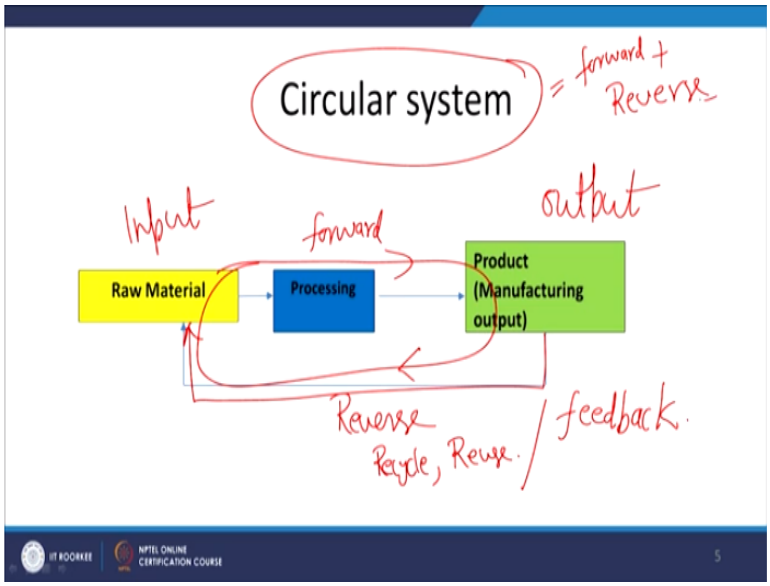

So, this is forward this is reverse and then you see that this loop this loop which is coming from output to input side, this is input side and this is output side. So, the loop which is coming from output to input side, this is the reverse loop and by seeing this you have now a circular kind of phenomena finished goods finished products are moving in one direction and then the projects which are defected projects, which have completed their useful life or for any reason, those products are not in use right now, these products are going back to the input side.

So, that they can be recycled, refurbished, re-machined, reused etc., and particularly, because of a lot of debate in the arena of sustainability, this reverse systems are also becoming very prominent. So, that is one important reason, but otherwise also this reverse logic, this reverse movement is happening to get the feedback. This is not only for the recycle reuse purpose, but it is also for the feedback purpose.

So, that we can improve our products, we can see that how my products are performing, whether these are meeting the expectations needs of the customer or not. And for that purpose, we follow this reverse movement of the goods also. So, that is the system from the point of view of the operations management, you have forward movement of goods and then you also have a reverse

movement of goods and that makes the concept of circular where you have combined forward plus reverse.

So, when we have combined both these systems, this makes my circular system. Now, let us see that in how many different ways and what are the different types of systems. So, we can classify systems according to different aspects the first aspect on which we want to classify system that is on the basis of creation. Now, on the basis of creation, you can have two types of systems first is natural system and the second is manmade system.

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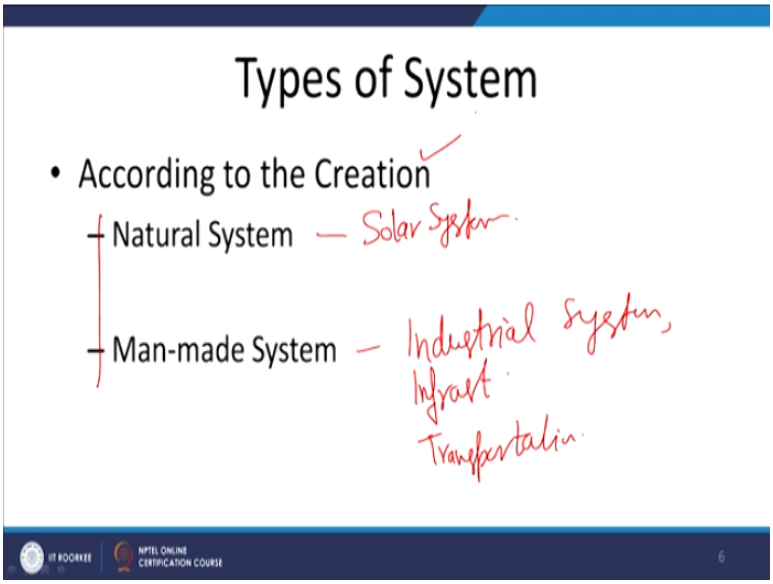

Now, the natural system like we know that solar system for an example, that is a very good example of the natural system that solar energy then you have evaporation of water, it goes into the form of clouds, it rains again and then again with the help of solar energy, those rainwater get converted into clouds and therefore, a kind of circular system which is not in the control of human power that is a natural systems example.

So, there are large number of natural systems where you train the advantage of those natural systems for the wealth creation and for making the life of human being more comfortable, that is one type of system the second system is the manmade. So most of the industrial systems, the infrastructure systems, transportation systems all these things are examples of manmade system. So, how the entire aviation industry is working, how Indian railway is working, these are some simple examples of manmade system.

So, man has created those systems. Therefore, these are manmade system nature has created those systems. Therefore, these are the natural system since you have clearly identified who is the originator of this system, therefore, this classification is based on basis of who is the creator on the basis of the creation of these systems.

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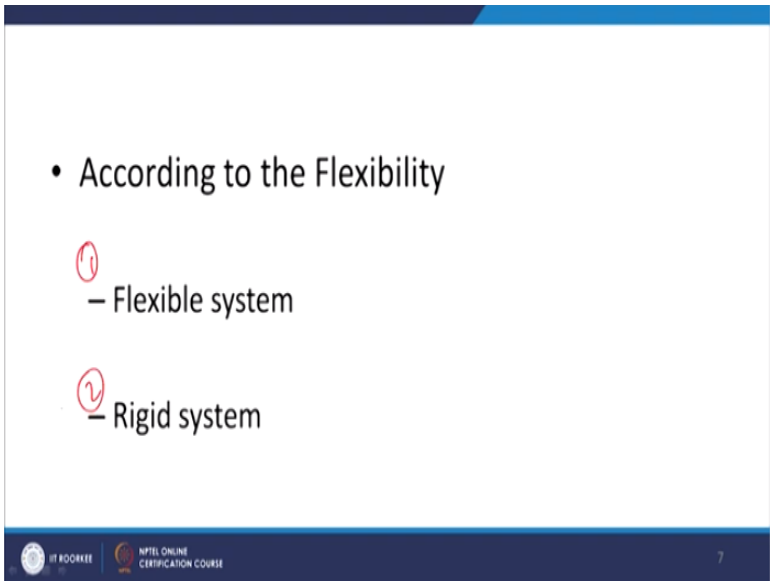

Then you have another important way of classifying these systems that is according to the flexibility. According to flexibility, it is very simple to classify systems, either you have flexible systems or you have a rigid system. So, you have flexible systems, which can respond to the changing needs, these are the flexible systems. Systems which cannot respond to the changing needs are the rigid systems.

So, like, if you have a system, where you can accommodate more number of people, when demand is high, you can produce more number of outputs, these are the flexible system, but a rigid system like you have a fixed amount of land and in that land you can produce a number of you can say some amount of food grain annually. Now, because the land is fixed the you cannot increase the output using the conventional tool.

So, that becomes for this purpose, a rigid system example, unless until you do a different kind of cropping you start using different fertilizers you start using different pesticides, you start using different technology of agriculture, then you can increase the output, but for a common

understanding that there are systems where you cannot change the output, there are systems where you can change the output, if you can change the output, if you can adjust the objectives of the system according to requirement, these are the flexible system.

But if you cannot change the output, that is the rigid system that is second way of classifying my systems then you can also classify systems on the basis of human involvement. How much involvement of human being in that system? There are systems which are totally human based system manual systems. For example, if you are going to a Ayurvedic expert, so that Ayurvedic expert treats you with his knowledge, his skills, and that is an example of completely manual system. But if you go to an industrial organization, where you are talking of industry 4.0.

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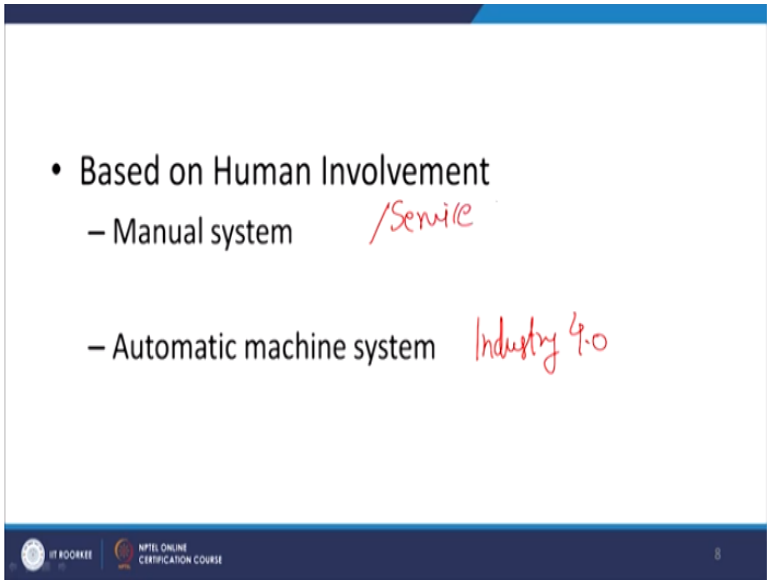

So, industry 4.0 where you are limiting the role of human involvement that is automated machine system. So, if I see from the elementary point of view, most of the service sectors you are going to a barber, you are going to a designer. So, here the manual involvement is very high. So, most of this services fall under the category of manual systems.

And when you go to some kind of industry, where some mass manufacturing is happening, assembly line, conductors production in these kind of things, if you go to a hydro power, so, there is very limited role of human being and therefore, that becomes a very good example of automatic machine systems. So, you are just pressing the button and by pressing the button, you are able to get the huge amount of output.

So, that is another way of classifying my systems on the basis of human involvement. Then, another way of classifying systems that is on the basis of output coming from that system. Now, on the basis of that, you can clearly have two types of systems.

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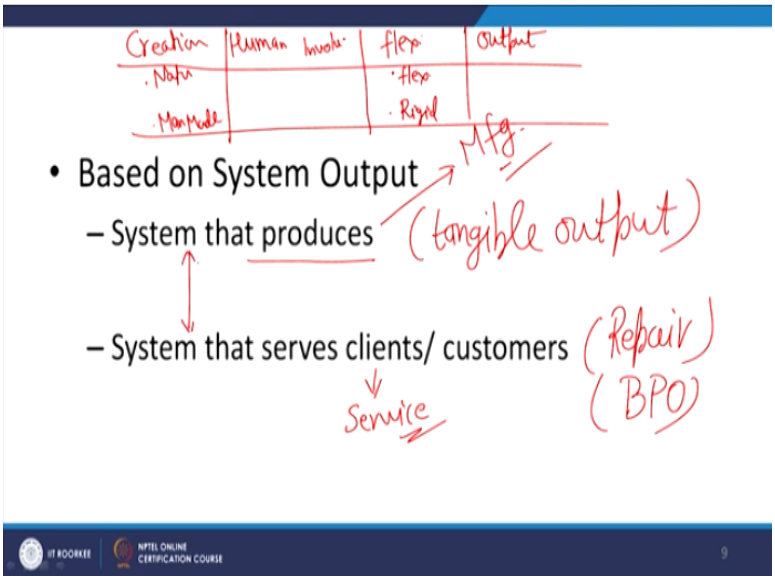

Systems that produces means, some kind of tangible output is coming. So, you can say that tangible output is produced and another type of systems are which are only serving the clients which are serving the customers like if you are having a repair shop if you are a BPO these are examples of that you are serving the customer, you are not producing something new.

If you are producing something new you are system that is producing something, but if you are a repair shop, if you are providing some sort of support to the client that is so, this is again more or less a service organization and this is more or less a manufacturing organization that is how you can understand that the output in the case of a manufacturing organization is some kind of tangible product.

And output in the case of those organizations, which are serving the clients and customer that is repair, maintenance helping customer to use that product in a more efficient way. So, that is on the basis of output. So, now, if you see that we have classified our systems on the basis of creation, we have classified on the basis of human involvement we classified on the basis of flexibility and we also classified on the basis of output.

So, these are the different ways on the basis of which we classified our systems and in all these categories, we have two types of systems. But, I also tell you that these are extreme cases, like system that produces and system that serves clients. So, these are two extreme, but in fact, in this also flexible we have either flexible system or we have rigid systems. Here also we have natural systems or manmade system.

But actually, it is not like that you can have these names for the sake of academic discussion, but in reality in practical terms, you have continuum of these types of systems. For example, what I am trying to say that these are two ends systems that produces and systems that serves. But even systems those producers and systems those serves that they may have some kind of joints systems that a system is producing as well as serving the client.

For an example, large number of automobile companies are there, these companies are producing something and at the same time to make the customer use their products in the more efficient manner they have services stations across the market. So, these companies are producing as well as also helping customers for their service requirements. So, many organizations are having body roles, when I am talking natural systems and management systems, no manmade system is possible without taking support from the natural systems.

So, therefore, it is not in silos, that manmade system are totally independent of the natural systems, all man made system takes some sort of help from the natural systems. So, human involvement, either you are totally automatic machine system, but in that also you have some human involvement who are operating those machines. So, everywhere you take help of some other system also.

So, from the academics point of view, you have these two classification, but in real life, you have different degrees of combination of these systems. So, from the point of view of this course, it is important to understand that what is system and how system concept is relevant from the operations management's point of view and what are the different types of system and we also discussed finally, that you cannot have a very specific type of system. In fact, any system is having different degrees of other systems, characteristics also into it. So, with this, we come to end of this third session thank you very much.