Sustainability Through Green Manufacturing System: An Applied Approach

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Lecture – 01
Basics of Production

Good morning, today I welcome you guys to the lecture of sustainable manufacturing, this is a new course in NPTEL and probably course that is aimed towards exposing you to the theories and as well as the practical side of how to achieve sustainable and green manufacturing. This course to large extend is a flavor of engineering plus management and we will actually start today is their course by an introduction to what is a production and the activities that are related to production and different aspects of manufacturing and then we will talk about the inputs outputs and how what are the steps that it can be avoid used to convert manufacturing into green manufacturing sustainable manufacturing.

So, that the entire value addition of manufacturing becomes eco-friendly more sustainable more efficient and with utilizes minimum energy less materials etcetera. So, without wasting my time let us get into the first module today which is the basics of production and I am Doctor Deepu Philip, I am from IIT, Kanpur.

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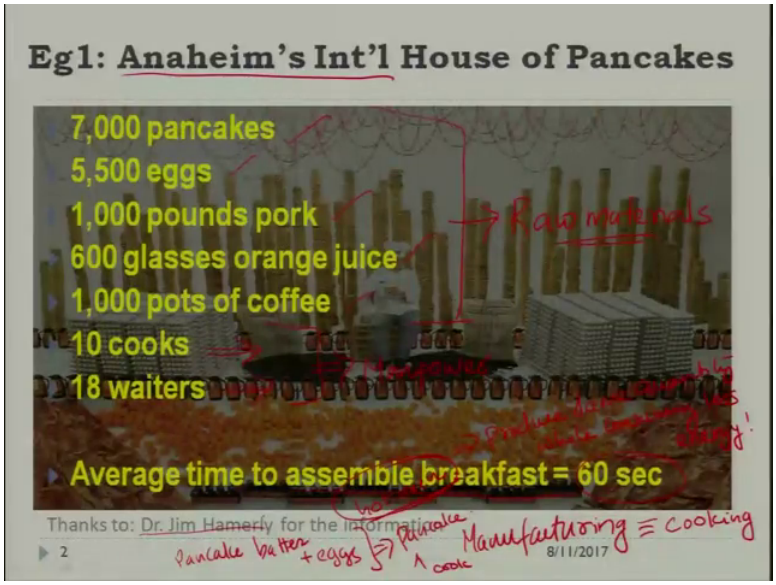

So, let us take first example and will start with few examples. So, if you talk to any person who is part of the production or manufacturing the most important thing that they will look into is what to produce and how to produce in the most effective manner and the cost effective manner we will talk about that. So, here is an example of an agency called Anaheim's international house of pancakes; pancakes is like the European and American version of Indian Dosa and this is a one of the biggest breakfast joins where lot of people go there for breakfast, they make somewhere close to 7000 pancakes about 5500 eggs, 10000s pound of pork, orange juice about 1000 pots of coffee, 10 cooks work on there to make this happen and eighteen waiters they do serve this.

So, if you look at this these are to an extent, we can call typically this as the raw materials; the raw materials there are used to create or develop the breakfast. And this you can think about it as the manpower or the human resource that is used to that makes and delivers the pancakes and what they say is that the average time to assemble the breakfast is 60 seconds. So, one an order comes in it takes them 60 seconds to manufacture it an or produce it or cook it and give it to you here the manufacturing inside of the manufacturing or producing or production the activity here is cooking. So, we are using raw materials. So, for example, pancake batter plus eggs together might make the pancake. So, you require a cook for this and you require a hot oven which would require some energy.

So, the course in the later down this course what we will be looking at is how do we minimize the energy and how do we make this process more green so that we can produce a same number of pancakes with lesser energy. So, one aim is to produce same quantity while consuming less energy this is one option there are other things also you will also like to minimize the waste that is part of this. So, here is an example; one example for you and the credit of this example actually goes to Doctor Jim Harley Hamerly; sorry, not Harley, Hamerly; another example.

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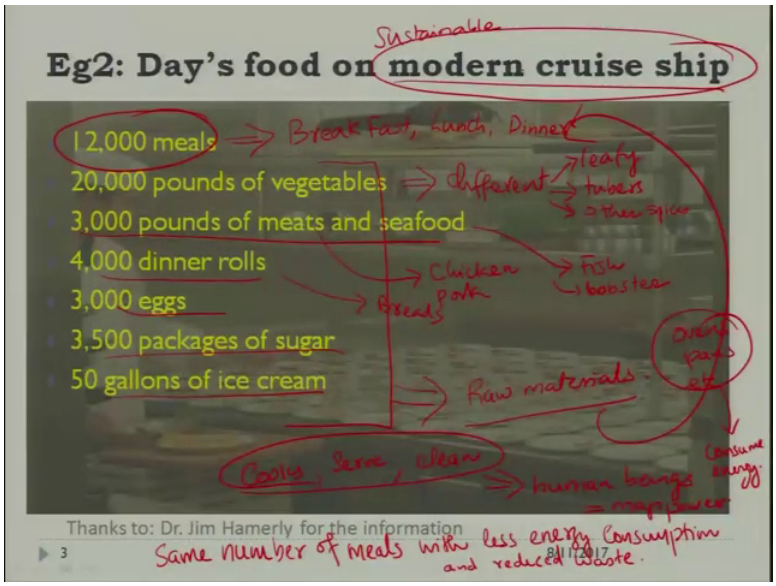

Let us take about is a modern cruise ship cruise ship is a example where people take this journey for vacation, it is a big ship like a big floating hotel in which people stay in the rooms and they have a they and it goes to all exotic places expensive.

So, we think about it a ship typically serves somewhere close to 12000 meals this meals will include breakfast lunch dinner people will have different taste for this breakfast lunch and dinner and in the process; they would have used they will there will be different menu or different options for the people to choose from. So, to cook these meals they would require vegetables these vegetables would be of different type it can be leafy vegetables it can be tubers like carrot beetroot something like this it could be onions a chilies you know other spices stuff like that then meat and sea food that is for the let us say non vegetarians meat will include this would be like chicken, pork, etcetera.

Sea food would involve fish lobster etcetera. So, then the dinner rolls dinner rolls are for example, breads. So, different type of breads eggs we all know what eggs are sugar ice cream. So, these items the vegetables meat all of these together becomes what we call as raw materials. Veg are used to cook, this 3 different lunch breakfast lunch and dinner and; obviously, there will be additional resources like cooks there will be people who serve this and that there will be people who clean this, etcetera. So, these are done by human beings which we also called as the manpower, then to cook this raw materials to

what we call as this different meals you would require ovens, pans, etcetera, all of these do consume energy.

So, in a cruise ship they are more interested in serving cooking and serving this meals if you are talking about a sustainable cruise ship then what we are talking about it is serve a same number of M. So, in quantity; so, we can write at this way same number of meals with less energy consumption and reduced waste. So, this would be one example of attaining sustainability in the business of a modern cruise ship which is a luxury business. So, we took both of this examples to give you guys an idea of that sustainability can be bought in any concept it; it does not how to be just doing stuff in a manufacturing facility, but yes we mostly we will be in this course focusing on manufacturing facility which he has to do with basic you know conversion of raw materials into finished goods which follows us basic unique manufacturing process is stuff like that.

But the philosophy is the thought process the methods the processes the experiments that we do in this class are equally applicable to other industries as well like a cruise ship or a restaurant stuff like that hopefully you guys have a clear idea of this. And then we will further go down.

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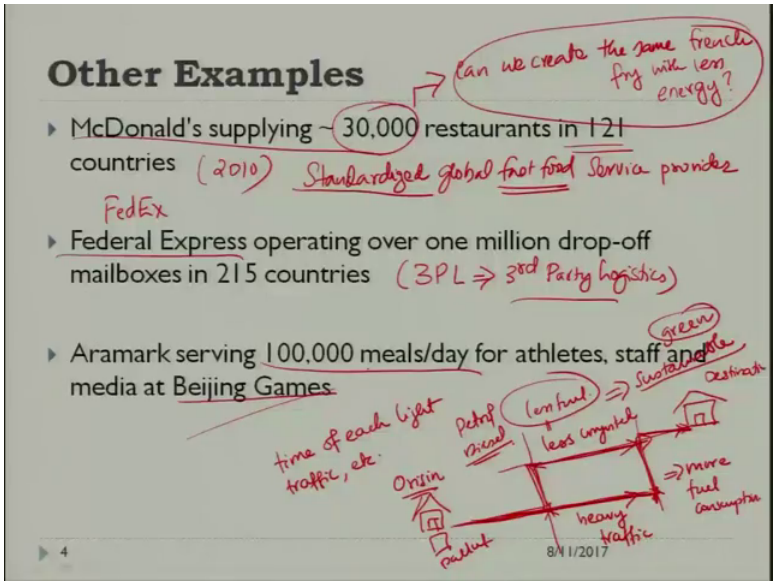

Other examples where this principles can also be applied and other than manufacturing is McDonalds they have multiple restaurants I mean this is all data this is about 2010 data I

believe this number is much larger now. About 30,000 restaurants 121 different countries people know what McDonalds is they kind of provide the same type of food wherever you go in the world you if ask for French fries then the French fries from McDonalds will as suppose to taste exactly the same all those kind of things.

So, this is an example of a standardized global fast food service provider. So, they are the business of fast food and, but the thing is what McDonalds is done is they done; what is called standardized fast food. So, wherever you go you supposed to get the same exact type of food anywhere in the globe.

Another example is federal express most popularly known as FedEx I think you its might of heard about this time is one of the this kind of a organizations are called a 3 PL which is called as third party logistics companies and their main job is to collect packages from one person or the origin and then deposit at the destination. So, it is like a postal services, but much more different than postal services because postal services they have limitation to ship they. So, the postal services are mostly into shipping letters and other stuff.

Here the ship almost everything you can with the ship things like organs they ship stuff like animals blue I mean whales or orca whales, stuff like that. So, it is pretty much logistics providing facility and they ship across the globe. So, the idea here is that how can you make that standardized. So, one example in the federal express what they do is like for example, let us say the, let us think about at this way let say here is the origin, let us call this as the origin where the package is originating and it has to be shipped to this place this is the destination and let us say the road travels like this and these are two major intersections.

So, the one way the FedEx would do this is they will let say the here is a traffic light and here is also traffic light here is a traffic light there is no traffic light here. So, federal express my think about it fine which way I should ship should I go like this should I go like this or second option should I go like this then it will depend upon the time of each light traffic, etcetera. So, if we find that this stretch of road is let say heavy traffic; that means, if we travel by this road this particular road it might result in more fuel consumption whereas, if this road is taken, it is less congested. So, you might consume less fuel.

So, you accomplished the same the delivery of this packet this is a packet that is to be delivered from origin to destination with a less fuel been consumed then you accomplish the same operation, but this is more of a sustainable or let us call this instead of sustainable let us call this as a green approach because you are consuming less fuel or less fossil fuel and let us talk about petrol or diesel one of them we are consuming less so; that means, our impact on the environment is also less. So, hence if. So, the same thing can be done in a much more fuel efficient manner all right.

Another example of this is also about the famous Aramark delivering about 1 lakh meals or 100-1000 meals per day for a meal staff and everything in the Beijing Olympics. So, that is another example. So, anyway you can say that in all possible cases we can come up with something better like even with the case of as I forgot to mention in this case of McDonalds, they have they always look at can we create the same French fry same French fry with less energy.

This is a big question. So, if you could change the process in such a way that the all temperature is not that high and you can actually reduce the energy consumption then yes another option is also that after cooking if the amount of oil that is wasted at the end of the day if that can be reduced that is also another example of a green initiative. So, all this organizations spend energy on to these kind of activities. So, these broad examples give you different way points in which where you can also apply the same principles. So, sustainability that we study like in a third party logistics company or a global standardized.

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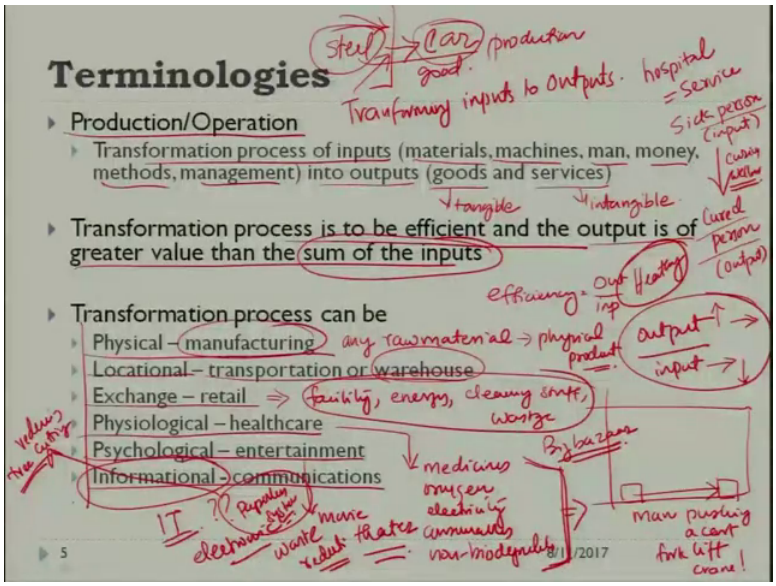

You know fast food or you are also about a serving meal and a Olympic even which happens once in specific time period, all those kind of things before getting into the details of this we are also need to be very particular about the terminologies that we are using in this because many of the words that we use in this course might appear different and new to you.

So, the first word term that we need to look into is production or operation there is a certain difference between these two phrases, but for the time being we will learn take the must the same and then later down throughout we will split them into we will split the hair in that case when somebody says I am in the business of production or operation what they are intrinsically meaning is it is a transformation process you are transforming inputs.

So, transforming inputs to outputs what are the inputs the inputs can be materials man machine man money methods management all those kind of things these are the inputs these inputs are inputs to the system or a machine or a factory does not matter is whatever is input and then that this translated to output; output can be goods; goods are like products. So, these are tangible items physically understandable touchable we know or services; services are intangible we will see what are some of the examples of intangible services.

For example in hospital provides a service give a good and the service there is that you are sick. So, if you think about a hospital it is a service. So, the service is that in a hospital sick that is the input the output is cured person. So, the transformation process there is curing or wellness we can think or treatment we can think about all those kind of things us the transformation process. So, you are transforming a sick person to a cured person or a healthy person you can think about a say healthy person that is the output. So, that is that concept is what you called as a service whereas, if you take steel and then using the transformation process you make a car then this is actually called as production and this is not a service this is a good car is a good; good means it is a tangible system.

So, the one of the important thing is almost all the businesses in the world wants the transformation process to be efficient. So, efficiency we typically define it as how do we define this it is typically output over input. So, if you want the efficiency to be increasing. So, then either; so, if you think about it output by input is the efficiency if you keep the input the same the way to increase the efficiency would be increase the output or if you want to keep the output the same then one way to increase efficiency is decrease the input.

So, to a large extent this is the concept that we will be operating upon either we maintain the same input and the increase the output or we maintain the same output, but decrease the input. So, the idea is this output is of greater value than the sum of the inputs. So, in a transformation process when we say they think about it as will draw in the next diagram, but you have to see think that the cost of the steel and the cost of the car cost of the steel plus the paint the tires the salary of the employee everything put together these are all going into the transformation process and the car that comes out the value of the car should be more than all these inputs that has gone into the system.

So, that is when you say that as an efficient process also. So, the cost is also an aspect of it. So, some of the examples of the transformation process in this regard is for example, when we talk about a physical transformation process when you taking a physical any raw material, let us take that is an example and we transform into a physical product transform to a physical product then that is typically called as manufacturing. So, when we talk about green manufacturing this is the process that we are talking about we are talking about physical a tangible absorbable object, but the same philosophy are also applicable for locational transformation processes which are typically transportation or

warehouse. So, transportation as I showed you it could be a third party logistics transformation or locational transportation or it can be a warehouse within which. So, we think about in a warehouse like a big building and your served something here and you moved this to another location.

So, this movement using a can be a man pushing a cart or it could be a fork lift or it could be a crane many as options. So, this also involves energy. So, the locational changes locational transformation changing the location of a product or a good is also another transformation process which since and we since we are expending energy there also the concepts of sustainable manufacturing is also applicable in this regard similarly exchange retail this is also important because here also the concepts is applicable for example, if you go to a big retail shop then; obviously, there is a facility they there consumes energy it has cleaning stuff wastage etcetera.

So, there are multiple ways in which a retail facility where you think that you are just buying things like for example, if you go to a Big Bazaar shop it we can still find a way is to operationalize the a product operationalize the or come up with a better way of doing it. So, that the same output can be reached by less amount of input or for the same input more output can be reached health care again the same thing you go to a hospital to get well and hospital uses you know medicines oxygen electricity then consumables non bio degradables there quite a lot of things that are used by a hospital. Now, if you talk about the sustainability in health care, then we are might be looking into minimizing the input of usage of these to derive the same output of a healthy person or we find a way that for the same quantity that we consume we are able to convert more sick people into healthy person.

So, that also is applicable there then entertainment they go for a movie. So, movie theater is an example can we do can we reach the same sustainability can we bring the sustainable goals the green goals into entertainment definitely you can do that same way an information or communications this is also one other important thing because everybody talk about the IT; information technology. So, can sustainability part of the IT that is a one big question one example is the electronic waste how do we calculate that or for the same amount of storage can you store more information for the same quantity or the same storage space then you are minimizing the amount of. So, usage of hard disk.

So, like then; that means that much of electronic waste is reduced. So, electronic waste reduction is one example.

Then another example is paperless system. So, if you go with electronic filing then you are minimize the usage of paper you minimize the usage of paper then you are end up reducing tree; tree cutting once you do in that then the environmental impact is also less. So, it may not appear directly to you, but yes there are other impacts within which you are able to use it and sustain things out of that. So, even though the transformation process is can be different, they all can be bound in the same strategic goal of goal of sustainability or eco-friendly or grain we are using this terminologies in exchange we will define this terminologies in a much better way clear way later down the road as of now we are generally overview in things. So, that is why we are using this technology terminologies interchanged.

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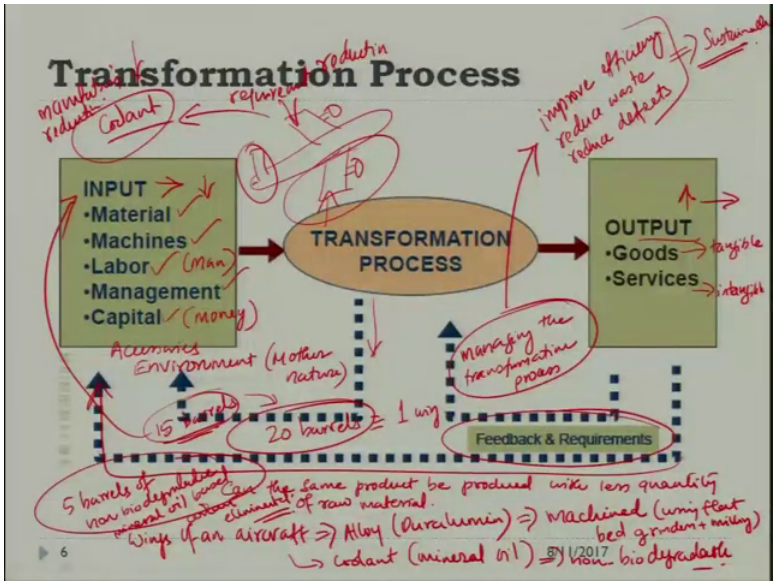

But once later down the road we will clarify this much more better. So, the transformation process as we said earlier if you diagrammatically think about it is there are inputs. So, there is materials machines labor management capital; capital is another way to think about it is finance or money finance is a lose time again let use the word money not finance actually because finance is different actually.

So, we will use money here labor is also equivalent to man and then another thing is there are many other things accessories like if is in a factory you are using cool and tool

bed those kind of things that there is an environment that is also another aspect of it your mother nature that is called mother nature. As one part of it these are all inputs to the transformation process and the transformation process delivers what we called as an output which is a good or a service good as a said it is a tangible product this is intangible and in this process you get what we call as a feedback and requirements and the feedback and requirements they go into the transformation process. So, to a large extent this is where you are you are this loop focuses on managing the transformation process.

The management here is what are we doing in this managing the main thing that we try to do in this managing is improve efficiency then reduce waste then reduce quality defects or not reduce quality actually reduce defects I am sorry reduce defects those kind of things. So, the management process do lot of things, but in that process some of them will result in making the process more sustainable not all of them; some of them that is one part of it what are those things that is part of this course some of this feedback and requirements will actually go back to the input. So, one example is the one question here is can the same product be produced with less quantity of raw material.

I will give you an example here. So, if you think about an aircraft you have if you look at an aircraft you have with let say; let us look at the aircraft from the top view. So, here is a fuse large of the an aircraft here is a tail this an empennage and it has two big wings you looking from the aircraft from the top it is under which the engines are hanging down assume that this r this wings. So, wings of an aircraft these are typically made of a alloy called duralumin and it is typically machined using flat bed grinding grinders or milling something like this. So, this alloy you take the big giant piece of it and then you machine it into shape. So, let say in this process one of the material that gets used these coolant typically a mineral oil based coolant which is non bio degradable.

So, there is a non bio degradable coolant that is used. So, let say that you are for manufacturing one of this wing let say twenty barrels of coolant is required it will give you one wing. So, one example is if you come up with some changes since way that this twenty barrels of non bio degradable mineral oil based coolant can be reduced to 15 barrels that is a reduction in the input. So, this reduces the input in that process what happens is you get the same output a one wing, but with a lesser amount of coolant now how was this becomes sustainable the sustainability is the fact that you have eliminated

the need of 5 barrels of. So, 5 barrel of non bio degradable mineral oil based coolant eliminated. So, then that is a sustainable initiative; that means, you have impacted the environment in a good way. So, that the adverse impacts of disposing of this coolant on the environment has been reduced.

Also you have helped they process that because you only require twenty more only require 15 not twenty. So, in the manufacturing the people who manufacture these coolants they can also they do not need to produce twenty barrels any more they only need to produce 15 barrels and because of that their requirements energy requirements manpower requirements everything come down and in that process what happens is. So, you have an aircraft manufacturer from whom they are procuring coolant. So, in a reduction in requirement here requirement reduction here results in a manufacturing reduction. So, it is not just one in this the effects are not just instantaneous.

The effects can be felt higher up the chain higher up the value chain higher up the supply chain of the system. So, you have reduced the usage of coolant you saved money here and you became a sustainable process in manufacturing the wing and the same type the coolant company does not need to produce that much of the non bio degradable coolant. So, they have reduced their inputs and that process there also become more sustainable. So, I hope that how we end up impacting the inputs and as well as the outputs and one another thing also is that sometimes certain information from the transformation process in itself will go back to the input scenario so that you can reduce some of the utilization.

So, at the end of the day the same aim is the same either increased the output with the same level of input or maintain the same level of input output for decreased level of input that is the two things that we try to do as part of a this exercise. So, we will get into the next concept called production management.

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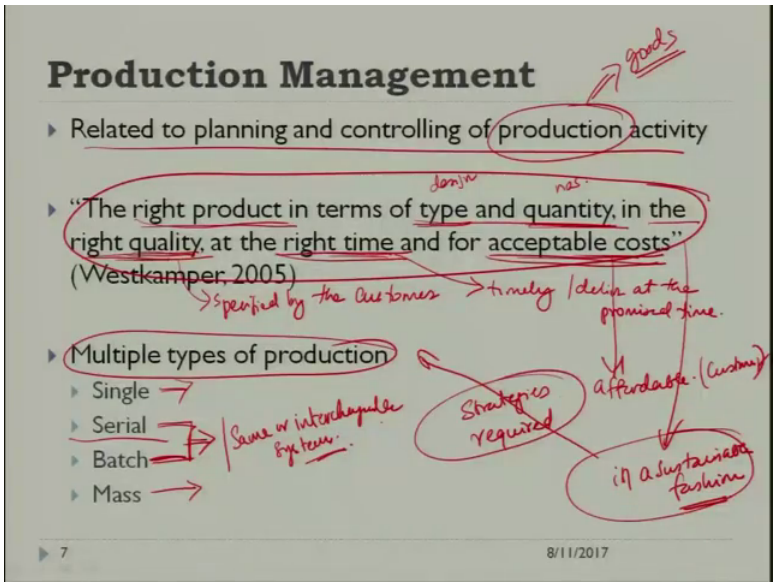

The production management is a terminology that we recur to know; now this point is we are starting to move closure towards manufacturing. So, the production management to a large extent the term is related to planning and controlling of production activity. So, the here we talk about production activity then you talked about production and operations we will describe it a later down the road, but production to a large extent is related to goods or in other ways we are in the process of manufacturing tangible products goods.

So, the all planning and controlling of the goods manufacturing activity or production activity is what we called as a production management and most of the what is production management what is the aim of production management, it is to produce the right product or take necessary steps do sufficient action to produce the right product in terms of type and quantity. So, produce the right type of product produce the right quantity of product. So, with the type and the quantity are two important things such part of this and with the right quality quantity is one this is where we talking about the numbers type is the design or form all those kind of things quality is whatever the customer wants. So, quality is specified by the customer.

Specified by the customer and then it should be done at the right time or we should be doing it in the timely fashion or deliver at the promised time that is one aspect and with acceptable cost so; that means, it should be acceptable in a sense it is affordable that is the important aspect. So, customer should be able to who is whom should be, it should be

affordable it should be affordable to the customer that is idea. So, doing producing the right product in terms of the type the design the quantity the right number and with the right quality getting the customer specifications in the right time the promised delivery time is met and within acceptable cost or acceptable cost means affordability of the customer this was a definition given by West Kamper and it is an very well known people accept this definition quite a lot. And in our case what we are trying to do is in a sustainable manufacturing or sustainable production management we are trying to do the same thing all of this things are we trying to do.

The main important part is in a sustainable fashion that is what we are more interested in can we do it in a sustainable fashion and there are multiple types of production as well available and the this strategies the way you will attain this sustainability depends upon the type of production process that you are going to deal with. So, the major type of production process are the single production process is single then there is a serial and a batch typically people kind of serial and batch are merged together and then there is a mass production. So, single serial batch and mass are the 3 different base some people do distinguish between serial and batch per for the process in our case for in this for this course, we can consider both of them to be the same or interchangeable.

Interchangeable systems; so, we will see what are these type of production process is in detail and then we will go from there. So, this is an depending upon the type of the production process is that you are using what is the specific type of production process is you are using this strategies this strategies required to make the process sustainable might be different some changes might be necessary and that we will discuss in detail as we progress.

Thank you for the patience hearing we will continue in the next topic.