Sustainability Through Green Manufacturing System: An Applied Approach

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Lecture - 02
Basics of Production Continued

Good morning welcome back to the second lecture of this is sustainable manufacturing, it is a continuation of our previous lecturer, the beginning introduction lecture about the production management and as well as aspects related to it. In the previous class we have discussed about the different type of production processes, and the like the single production processes, and the batch and the, as well as the mass production processes. And we also mentioned that are point that, depending upon the type of the process or the layout of the system, these strategies that are used to convert them into sustainable will also change.

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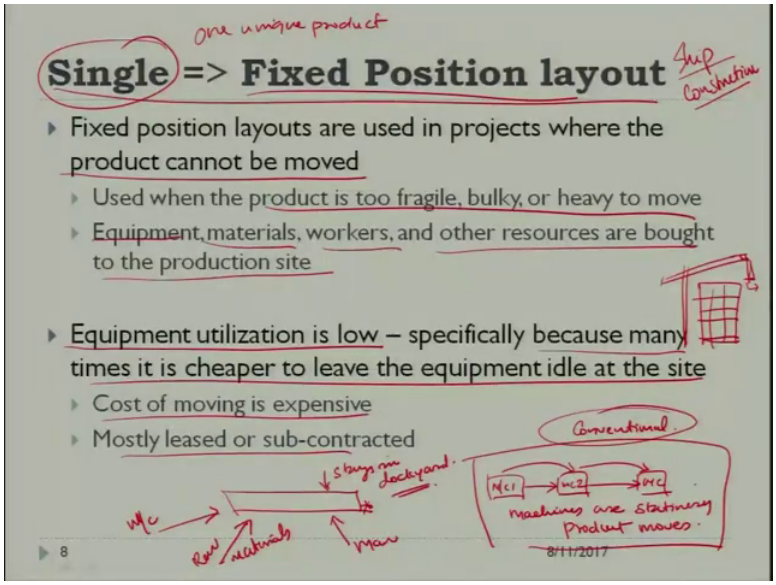

So, let us first talk about the initial one, which is called as a single or a fixed position layout system. So, a single one is, that you are basically making one unique product. The most important example of this is, let us think about a ship building, or construction. Your building a big building or you are building a big ship, battle ship, or an aircraft

carrier something like this. The main important thing that should be a realized is that, the products in this case, the products cannot be moved.

You are typically building products that are immovable, or in a way a ship moves, or you are like what you mean by movable product. The example is this, in a normal manufacturing, let us say you have machines like this, let us say this is machine one, machine two, machine three, and what happens is the product moves from one machine to another machine to another. So, the machines are stationary product moves. This is the conventional manufacturing; whereas, the single or a fixed position layout, it is also known as the fixed position layout, because in that case, the product does not moves. So, the product will remain here; let us say if you talk about a ship.

The product remains here, and the machines, raw materials, man, all of them move to the product. So, when you are building a ship, it stays in dockyard, or ship building facility, and the ship building facility the ship gets built, everything else comes to the ship, ship gets finished, and then it is used. Same is with building, a building the building remains on the ground, and all the other related man, equipment, goods, everything else come to the stuff. It is usually when the product is too fragile bulky or heavy to move ok.

So, the fixed position layouts, the products are big product, and the equipment, the materials, the workers and other resources are bought to the production site. So, the resources everything all this resources, typically travel to the product. The few examples of this is, of fixed position layout, or a single product layout, one unique product layout is, the equipment utilization is usually low. So, your equipment whatever the equipment you are using, the utilization is low. Specifically what is the reason why it is low, because many a times it is cheaper to leave the equipment idle at the site.

So, this is somehow the big brains that are build on construction sites, you will see this (Refer Time: 04:03) your building a flat, like this. Let us say this is a flat, you will probably see a big crane that is standing there. You will see that this crane is standing there even when the flat is finished, because it is cheaper, not to move the cranes sometimes. So, because the reason is the cost of moving is very expensive, and most of this time such equipments are leased or sub contracted, and hence if you want to make this as a sustainable process, then the strategies that are required to do this, is quite different. And same way the other things, where the system, where the conventional

system, where the machines remain stationary at the product moves, the approach will be different ok.

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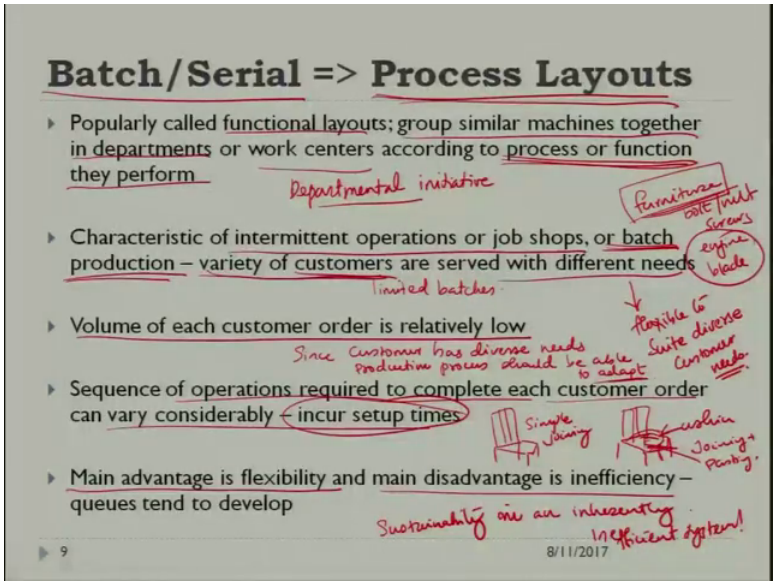

So, let us talk about the batch and the serial process layout. So, the batch and serial is also called as a process layout, because the factory or the facility setup based on the processes that are involved. It is also called as functional layouts, most of the time. What happens is in a layout because, group the similar machines together in departments, or work centers. When somebody talks about a works center or a similar machines grouped into your department, and then from there, this grouping is based on the process or functions they perform. So, if you have 5 lathe machines in your factory, all the lathe machines will be grouped into one department and it is called as a lathe department.

Ah if you have 10 drilling machines it will be grouped into one department and called as a drilling department. So, hence these departments are created based on the functions, based on the processes or functions that they do. That is why it is called as a functional layout. So, in this case, if you look into some sustainable initiatives, you might have a departmental initiative; why, because everything is grouped as per department, as per functions.

So, such type of layout are also called as, in the management time it is called as process layouts, because they are grouped by the processes that are involved. This is very common characteristic of intermittent operations or job shops or batch production. So,

here you are not producing too large quantities. Classic example of this would be furniture manufacturing, can think about us a bolt, nut, screws, engine, blades or mean aircraft engine blades. All of these kind of things are typically done as a part of a jobs shop. So, where, what happened is you produced it in small batches, or limited batches. And why do you produce in limited batches, typically the requirement of the customer varies, or you have a variety of customer. Your customer has diverse variety, and they have different needs.

So, one of the major advantage of this is, this process layout is, it is flexible to suit diverse customer needs. So, you will be in a furniture manufacturing you will see they are making chairs, but they will make many different varieties of chairs, wooden chair, the style of the wood will be different, depending upon the person who is manufacturing that, the cushion color will changed, the polish will change, the height will change. So, lot of aspects will come. So, there are diverse variety, and the customer who comes in they will say I want this particular type of chair, I want that particular type of table, and. So, to accommodate those kind of diverse requirements of the customer, you end up having this process layout or a functional layout, or where you group the machines as per the function or the process they do.

Second part is, we talked about limited or a small batch, because the requirement of each customer is relatively low. If a customer comes to buy a dining table, he were probably say I want 4 chairs, 6 chairs, 8 chairs maybe the maximum of 10 12 chairs, not more than that. So, you will never produce 200 chairs of a particular type. You would probably only produce limited quantities of the chair, because the requirements are changed.

So, what happens is, since customer has diverse needs, the production process should be able to adapt, or it should be flexible. Hence the process layouts are used for low volume or small batch production, in which variety of customer needs are suitable. So, there is really not much of a standardization, very limited standardization, and the parties, the sequence of operations that are required, or what are the steps that you need to do, to complete each customer order can vary considerably.

So, if somebody is say for example, you are building a chair like this, or wood, then you probably would just require simple joining, and polishing, but if the same person makes the chair with, what we call as let us say cushion. then we have what we call as joining

plus pasting, where your pasting the cushion onto the wooden frame will also come into picture. So, depending upon the customer requirement for the same design or whatsoever, you might end up making it, the operations required to fulfill the customer need or customer requirement, can vary considerably, and because of that you will incur setup times. We will talk about setup times later down the road ok.

The main advantage is as I said of this setup, is flexibility, and the main disadvantage is inefficiency. Say typically it is considered that batch or serial production is tend to be inefficient. So, if you are trying to achieve sustainability here. Here you are trying to achieve sustainability in an inherently inefficient system. Hence it should be clear, that you will still be able to achieve some level of sustainability, but you may not be able to achieve a very high level of sustainability as expected, because a process is inherently not very efficient.

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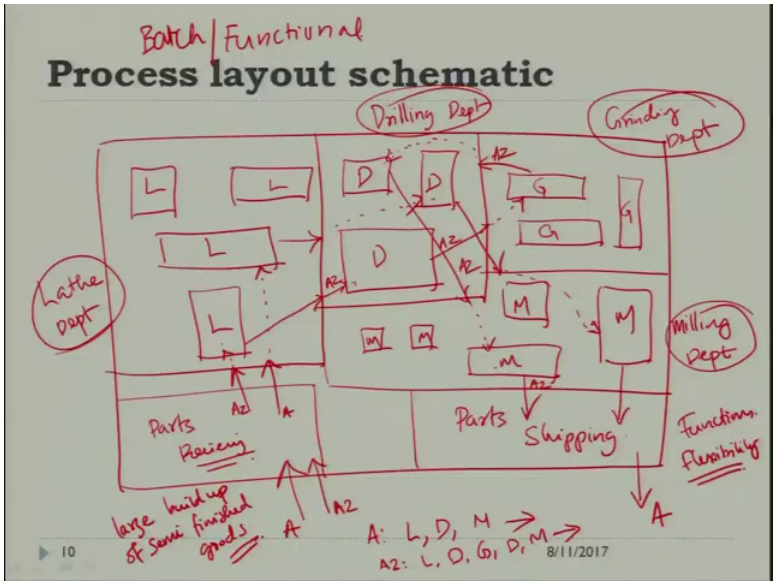

So, if you look at the layout, if you want to make draw a factory out of this. You can think about this, let say this is your, you are looking at the plan. So, this is your floor area, and let us say that there is a place where, you are receiving the parts. Let us call this as parts receiving or raw material. So, whatsoever it is, and let us assumes that these are all lathe machines, let us call these are lathes, different lathes. Then this whole thing, we can call it as the lathe department ok.

Then let us think about some other machines, let us call these are all drilling machines. So, then, this becomes the drilling department. Let us call these as grinding machines. So, this becomes the grinding department. And let us say we have somewhere here, you have the different milling machines. So, we will call this as the milling department, and here is where the parts shipping comes under picture. So, if you track a raw material there is coming in, let us call this as a, and if you say a requires a lathe, a drill and a mill and it gets out. So, then a will come here, then it will go to the lathe department. It might be assigned this particular machine so it will go to this machine. From there it has to go to the drill department, so it will go to the drill department, as it is assigned this particular drill. So, it will go to this drilling machine, and that it will come from there to the milling department, and let say it is assigned to this milling machine. So, it will come to this milling machine, and from there it goes to the part shipping, and then it will get shipped out.

So, the A will travel this way. Let us say product, another version of A, let us call this as A 2 comes in, it requires a lathe drill, grind, then drill and mill. Let us say if this is what is going to happen, then if that product comes in A 2 comes in, then A 2 will come to the lathe department, let us call this as A 2, this is A 2 comes to the lathe department. Let us say it is assigned to this lathe. So, it will come here, then from there it is assigned to this drilling machine. So, it will go from there to the drilling department and then goes to this drill and. So, this is A 2, then it has to go to grind. So, let us say it goes to the grinding department and let us say it is assigned to this grinding machine. So, it goes here. So, this is A 2 again, grinding department, and then it has to come back to the drilling department. So, it comes to drilling department. Let us say it is assigned this drilling machine. So, it comes to this drilling machine.

So, this is A 2 again. Then from there it has to come to milling. So, from here it will travel to milling department, and let us say it is assigned to this milling machine. So, will come to this milling machine, and then will go out. So, pretty soon I can see that the product flow. The flow of the parts the different parts in the system becomes too complicated pretty soon, things are moving all haphazard manner here there on all. Yes you can make diverse type of products, because these are general machines, generally functional departments. So, this is by the function of plaining, drilling, grinding, milling. So, they are organized by functions, and it allows flexibility, but in that process, you

have much more complications, because you have to travel. So, you can kind of see that the part goes to drill, drill goes to grind, grind comes back to drill, then goes to mill. So, all over the place you will see parts going here there.

So, the flow in this system is quite chaos or haphazard, and because of this kind of a haphazard flow, you will actually see large queuing, you will see large build up, build up of semi finished goods, is a part of such a system. So, this diagram to a large action helps you to understand how does a process layout, or what we call as a batch, or batch processing, or batch manufacturing, or sometimes people call it as a functional layout. How does this schematic, how does it work if you look from a birds are view point all right.

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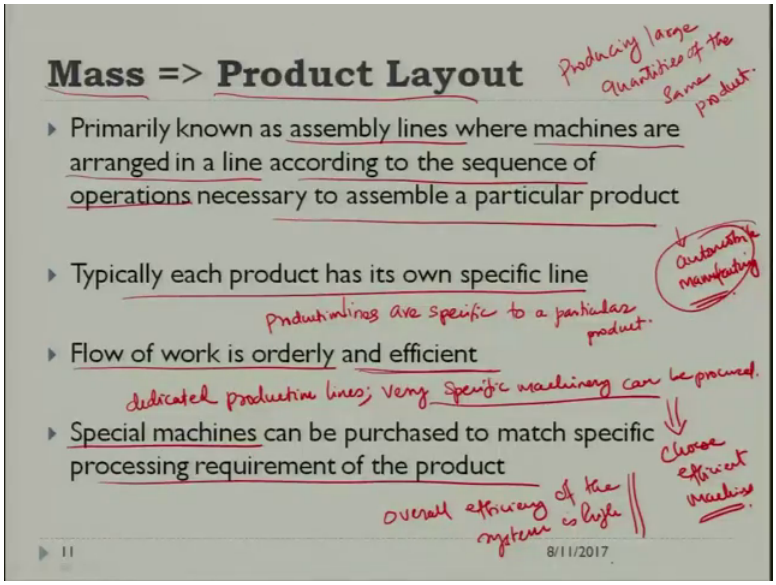

Then comes the mass layout, or which is one of the most, ah you know heavily utilized system it is also called as a product layout. So, this mass layout of the product layout to a large extent, they are in the business of producing large quantities of the same product. So, in the primary words, or the common management terms, it is also called as assembly lines. So, assembly lines, these called an assembly line, because the machines that are involved in manufacturing process, are arranged in a linear function, they are arranged in a line and the arrangement is for, how are they arrange in the line, not just in any random fashion. In the process layout you are seen that the machines are arranged wherever you find the space you put the machine there.

Within the department, but here they are arranged in a linear fashion, according to the sequence of operations. So, the sequence in which you are supposed to do the operations, the machines are arranged in that particular sequence in a linear fashion. So, that either product goes through each one of the machine at the end of the day, you can assemble the final product, it is called assembly line, because at the end of the day you are assembling a final particular product. The most common of this is automobile manufacturing. Automobile manufacturing is called this way, purely because of the fact that automobile is like, you have parts raw materials engines, gear box, tires, sheet metal, paint, they are all coming in as inputs in one way and they go through a particular sequence towards the end you get actually completely assembled car, completely a car ready to drive away ok.

The idea here is that each product that you are manufacturing has its own specific line most of the time the lines are specific to a product. Remember this lines, the production lines are specific, when you say lines; that means, their production lines, production lines are specific to a particular product. And here the main advantage is that, the work flow is very order, because the machines are arranged in a linear sequence, based upon the operation certain necessary, and hence it is also efficient, because its arranged in a fashion in which. So, there is no haphazard flow, things flowing the linear fashion and since you are actually dedicating, because dedicated production lines. The advantage is that you can purchase special machines, or very specific machinery can be procured, and what is the advantage is this is very specific machinery, you can choose efficient machines.

Because it is dedicated for a particular task, and only for doing the task hence you can choose very efficient machines, and hence the overall system is. So, its overall efficiency of the system is high, and hence if you try to do sustainability in this, you can actually get better results, because you are already dealing with an efficient system.

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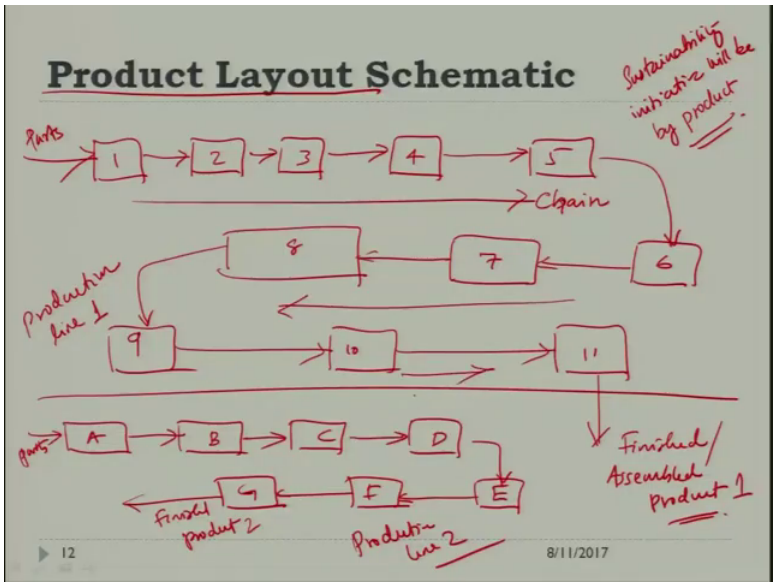

So, if you try to look at a schematic of this. So, then we can half something like this. My drawing is not very good, let us call this as different machines 1 2 3 4 5 6 7 8 9 10 11 something like this. So, the parts come here, and they move through this in a linear fashion, one after another, like this. They move through each one of those machines, and after the machine 11, you get a finished product, finished or slash assembled product.

If you want to make a different product, then you, this is, this you can call it as a production line one. If you want to make another one, then you have to do the same thing. Let us say you want to make a smaller different version of the product, then you require a something like this, machine A B C D E F G. Again the flow is linear, the product comes, a parts comes in they go through the machines in a linear fashion, and then you get the finished product, and the parts come here. So, this will be a production line 2. So, for each particular product that you are trying to think about, this is a finished product 2, this will be a finished product 1. So, for each type of product you will allow specific assembly lines, or specific dedicated production lines.

Hence as why it is called as a product layout, because the layout is by the product. Machines are arranged by the product. So, for a system like this, since its arranged by the product, and you are only producing that particular product on the production line, it is easy for you to increase implement efficiency measures or improvement measures in this regard. So, such systems you can. So, you can say that, the sustainability initiatives will

be by product. In the previous case it was by department, in this case it will be by product. I hope this makes things more clear to you guys all.

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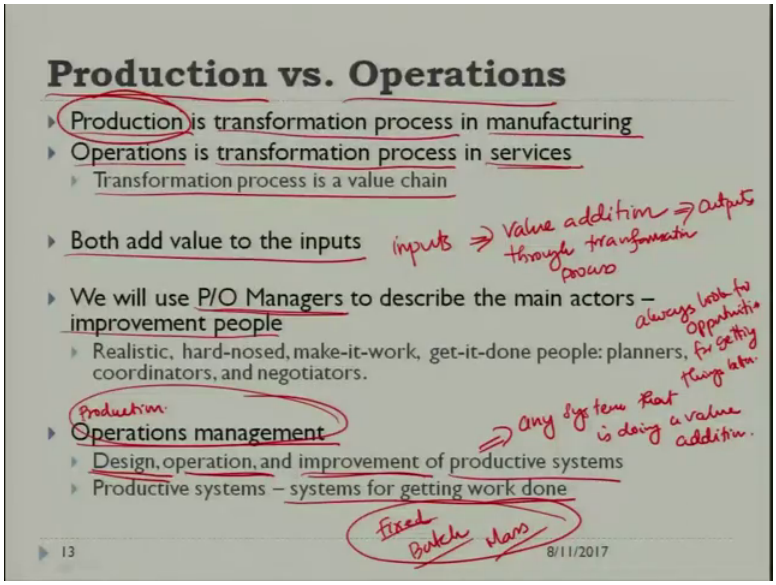

So, earlier we talked about production operations we kind of mix and match the term. So, at this point I would like to, distinguish between the two terminologist called production and operations. So, when you talk about manufacturing, specifically manufacturing, that production is transformation process, both production operation are transformation processes only, but production is transformation process is that is part of manufacturing. Whereas, the transformation process in services is called operations. So, in a way the transformation process is a value chain. So, in a product layout, if you look at this, this is the chain. So, as each, as when we moving each one of this chain, what we do is, we add value, every step in this chain adds value to the product, that is what we do we keep on moving in the chain. So, the transformation process in manufacturing is called production. The transformation process in services is called operations ok.

So, but typically people use this terms interchangeably, but when in this course, where we are talking about sustainable manufacturing, we will be more focused on this particular term called production. We are more interested in that aspect, and whether it is production or operations, both do add value to the inputs. So, you have certain inputs, and you do value addition. And how do you add value. The value addition happens through transformation process, then you get what we called as outputs. So, when this

output is a good or a finally, finished good or something, then that is called manufacturing or production, which the service it becomes operations. So, typically the people who work in this area, the people who look into this kind of things are called productions or operations managers, or sometimes known as P O managers ok.

The productions and operation managers, their main aim is to actually work on the system, and they are supposed to do improvement, they are supposed to better the systems. So, always look for opportunities for getting things better. So, when we talk about operations management or production management. Let us call this is production management also same way. It is about design operation and improvement of productive systems, any system that is doing a value addition, when productive system means any system that is doing a value addition; that is a productive system. Or in other way to do it is system for getting work done, you are adding value to the system. So, productive system is where you are doing value addition, or we are using it to get the work done, it could be a fixed system fixed position layout or single product system, or it could be a batch system, or it could be a mass system, or it could be a product layout, or a process layout or those kind of things.

So, whatever it is done, they are all productive systems, they get the work done, they produce things from there. So, when you talk about how do you design them, how do you operate them, how do you improve them, how do you make it them better a productive systems. So, it is a job or the productions and operations manager’s people to do that, and hence this is why this course is also relevant to that type of people.

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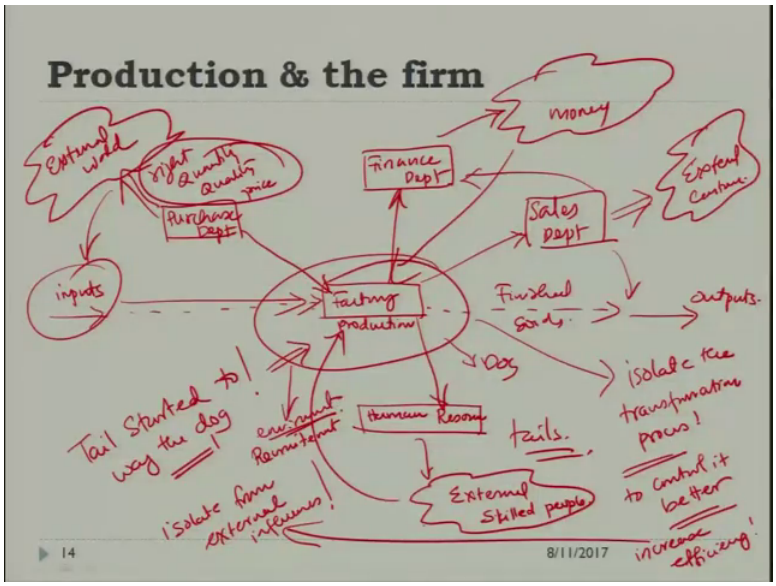

So, when we talk about the production and the firm. Initially how does this production business happened. So, initially think about it this way, there was a factory, let us called this is a factory, where the production happened. And you would like the factory to be as isolated as possible; you do not want it to be interacting with the external world.

So, you have inputs coming from one place to the factory, and outputs coming out of the factory. So, the inputs are like coming into the factory this way. So, factory people, they are focused on more run doing the operations making it efficient and those kinds of things. So, they are not worried about, where to go, where to buy the raw materials and everything. So, they created at department, let us say they call it as a purchase department, and then that all the purchase department, the factory people said, you deal with the external world. This is the external world.

You do tendering you do whatever you want to do, and find this inputs and give it to us. So, the purchase departments interacts with an external world, find this inputs of the right quantity, quality and price. They do this, and then they deliver them to the factory. Then the factory converts that into outputs, but the factory is also not worried about selling them. So, they created what they call us a sales department, and that on the sales department A, go find out deal with the external world, here is an external world. Find the customer, whoever is the customer, find the ways to find the customer and sells the product. So, they finished goods, get out of this. So, the sales department started

managing the sales of the finished goods, but then the factory cannot just run without human beings, you have to find trained manpower to do that.

So, then they basically said to the, let us called it as a human resource department, which is popularly known as H R, said you deal with the external world, find a skilled people. And we will tell you how many people are required and based on which you get us the skilled people to come and work in our factory. So, this is called as recruitment. So, we recruit people, to come and work in the factory. Then the meantime you got the raw materials, you got the people, and you got the machinery, and you got a mechanism to sell, but you also need money to buy things. So, then they created somebody, something called as a finance department.

Where they are said ok, we required this much money, you go to the external world again, and find money, through loan, big borrow, steal does not matters, and give us the money, so that we can produce, or we can use the money to produce things, like this. so, but soon what happened, is sells department will sell things, and then the money will go to the finance department on a joking on a light sense, then these all these guys, who are actually working, because there is a production process in between. There in now start to tell them what to do, in other way. So, or in a way, this is where I jokingly say that the tail started to wag the dog.

another sense we can say that this is the tail, and here is the, I called this is the dog, these are the tails right, I find it is offensive, this kind we can have some fun about when we are doing this. So, the production and the firm, the idea of all of this is that, isolate the transformation process. Why are we isolating the transformation process, because to control it better. Why are we controlling it better? To increase efficiency, the transformation process, if you can work on this transformation process, to increase its efficiency, that is where I; that is. So, hence that is why it is, because of this you isolate from external influences.

There is the primary reason, and hence sometimes, because of this isolation thing, many a times the identification of the environmental issues, or the perspective of the environment the external world, might have been lost from the production systems. And what in the sustainability, what we are also trying to do is. We are also trying to bring that perspective, whatever we are doing here, whatever happens here, has an impact on

the environment or the society; that is also an important consideration in the manufacturing systems.

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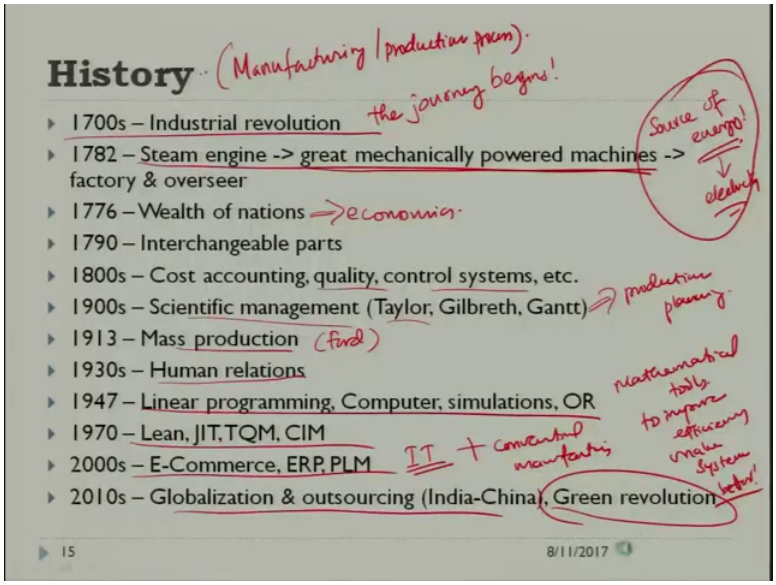

Also we need to take a little bit look into the history of the system, and the first one, this whole production process or manufacturing. We are talking more into manufacturing or the production process. So, it is started with the 1700 the industrial revolution. So, the journey begins, this is where it started, the industrial revolution created a scenario of developing factories, or isolated production facilities, which can actually, which focused on producing large quantities of the required product in the right quantity, right quality, right specification, all those kind of things ok.

Then after that we got into the business of what we call as the steam engine, which was created by, you know, and that is this steam engine became what we call as the prime over. So, the steam engine actually meant, what it does is. It created the prime over, or source of energy. So, steam engine started there from there. Steam engine was used to build electricity and all those kind of things, we know the journey, but after some point of time, the energy starter applying into the system in the introduction of steam engine ok.

Then comes to the wealth of nations Adam Smith about economy, and you know economics came into picture. How that is part of that, then came to the concept of interchangeable parts. If you build system with interchangeable part, if one thing goes

bad from somebody else and use it, then cost accounting quality, control systems etcetera came in 1800s. Then scientific management, the Taylor time studies, Gilbreth Gantt Chart, which is basically what you call production planning, all those kind of stuff come into this picture .

Then came mass production; the Toyota production systems, those kind of things are not Toyota production system mass productions, which is that time it is ford. Then came human relations, importance of H R, then was a part of mathematical tools, operation research tools, to improve efficiency, or make system better. This was going on. So, there is the linear programming simulations operations, that is all came into. Then came the lean J I T TQM C I M, all those kind of things, computer integrated manufacturing. In 2000 show the ERP PLM E Commerce, where in I T information technology was merged with conventional manufacturing. So, then intense, we talk about the globalization outsourcing, and we talk about green revolution. I am not talking about the green revolution of agriculture farming or something like that.

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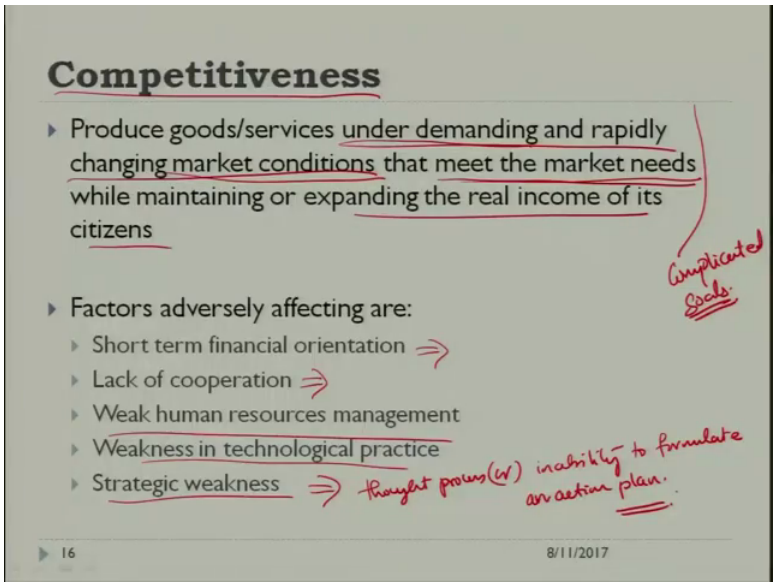

I am more talking about, what we talking about it has green, or making things green, or making sustainable manufacturing; that is the main part of what we talk here. Also one other aspects of manufacturing is that, manufacturing is also a competitive process. The process is competitive purely, because that. There is a demand, and the market conditions

change rapidly. For example, if I am looking to buy a small car how multiple options. So, if the product is not available according to my wish I will go to somebody else.

So, the market conditions are rapidly changing, and it is demanding conditions, because you need to satisfy the customer demand. So, your aim is to satisfy or meet the market needs and. So, in the whole process is, you in the meantime you are expanding the income, income of the citizens; that is also another aspect you need to do. So, to do all of these things, to produce goods and service at the same time, produce goods or deliver services at the same time, while satisfying all these complicated goals, requires you to be competitive, and in the drive for being more competitive. Sometimes the first thing that gets sacrificed is the environmental ecological or sustainability concept ok.

The main factors that are affecting the competitive, you know typically people who will are the short term financial orientation. So, I like I just want to make as much money as possible, I do not care about I am going to use the really bad quality mineral oil based coolant available, which is going to be harming the environment like crazy I do not care, I just want to make money. Lack of corporation, everybody says I will do, but will never do it. like for example, many of the companies in India will say that, we are in the process of controlling pollution, but they will not do anything to control or do a fluent treatment or something like that, and leadership human resources, weak human resources and weakness in technological practices, you do not really know, the latest cutting hair technologies, or how to manage the somehow the aspects related to it.

And; obviously, yes, here is what we call at what does say, you know strategic weakness implies the thought process, or inability to formulate an action plan. So, strategically some of the leadership might not be able to even address, competitive. There will say I will sacrifice sustainability for competitiveness, not necessarily. What we are talking about here is, being competitive and sustainable at the same time. And there is another term that will come out of this is, it is also called as productivity.

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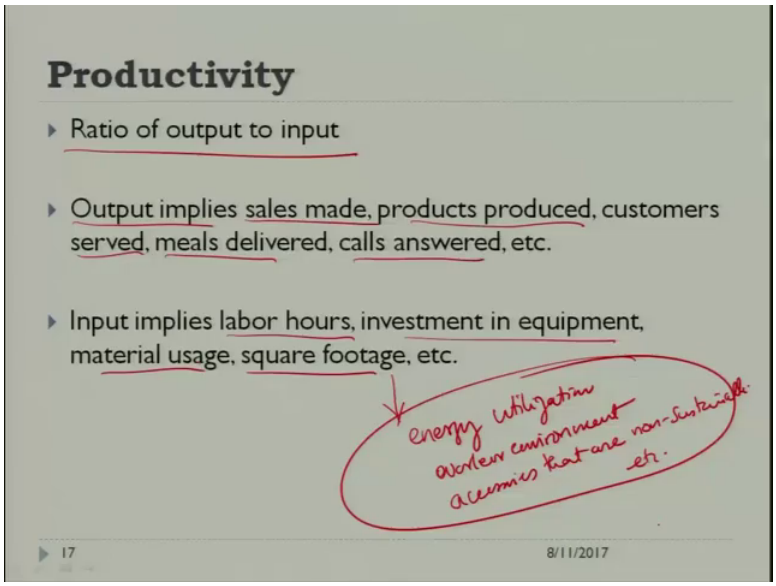

As I said earlier it is a ratio of output to input, it is also efficiency, because some people say I am working on efficiency, some say I am working on productivity. So, either way.

You are improving efficiency or you are improving productivity. So, the output implies, what are typical outputs. Outputs are the quantity solved, products produced, customer served, meals delivered, call answered, or many ways you can measure the output taken a bond which industry you are dealing with your output will change.

Input implies labor, man hours, equipment investments, material usage, how much of factories square footage usage etcetera are all different type of inputs. What are the input that is important in this will be energy utilization. We will also look into, you know end worker environment. There will be also things like accessories; that are non-sustainable etcetera. So, there are other aspects also, we will be considering as part of input output or where we will quantifying, so that productivity and sustainability can be measured.

So, typically people talk about productivity. We will come with additional measures in addition to productivity.

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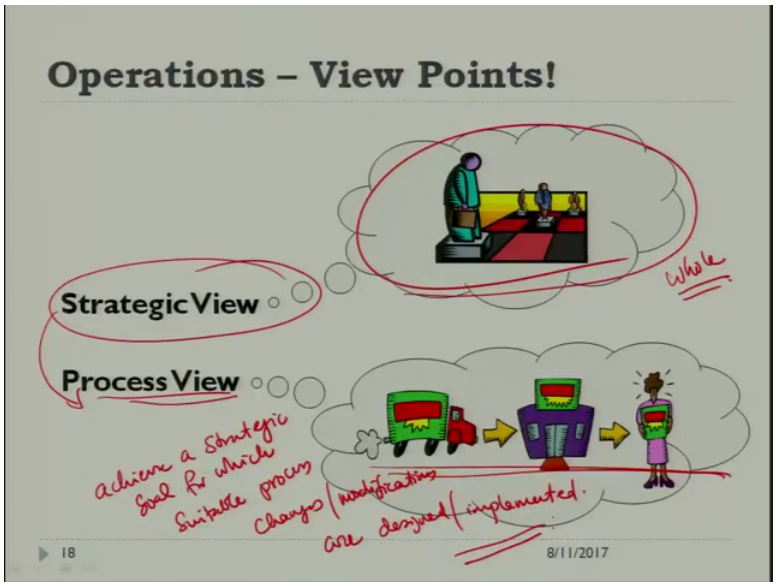

So, that we can probably measures sustainability. Let us told earlier, most of the time people look the system from, or process view. So, you look at individual steps, you focus on how do I get my basic job done. Instead of looking at a strategic view, trying to see the whole picture; the system in which you are interacting with entire system, the entire related environment and other aspects of it. So, my suggestion in this class would be, that we will be little bit more focusing on the strategic view, and we will see how the strategic view translates to the process view ok.

The strategy would be to achieve sustainability, or achieve greenness, and what are the changes that required in the process to achieve that. So, the aim is, achieve a strategic goal for which suitable process changes slash modifications are designed or implemented. So, that will be the aim in this course, is like we will use a strategic view point to come up with a goal, that, on which we will actually achieve the required goal through by modifying the process.

So, some of the issues, typically operation or production issues is that, some of the main things that we study in many of the places ok.

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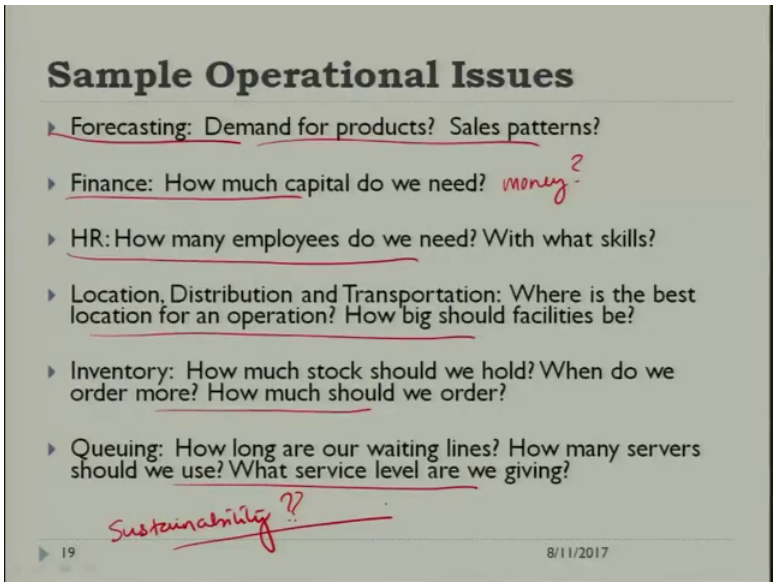

And one of the things that we do not really study there is a sustainability. One example is forecasting, it is always related to the demand, how much to produce, how much will be allowed sending. Finance is how much money is required. Here is the aspects of money, how much money is required in this. How many employees are needed; human resources, what is the best location for operation, how big the facility should be, how many trucks are required to transport things, how much we should buy and stock, how much we should make the inventory; that is another aspects.

How long our customers should wait. All these kind of things we study, different aspects of the, I mean different courses. The thing that usually gets not is, sustainability is rarely study thus part of this, where is the sustainability concept, and this course is an attempt to introduce sustainability also as part of a sample operational issue. With that we conclude todays lecture, and we will get into other details in the next class.

Thank you for your patience hearing.