Toyota Production System
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Lecture – 27
Sustainable Manufacturing-I

Welcome friends, in our previous sessions, we have discussed about Toyota production system, we extended the concept of Toyota production system to the modern term that is lean manufacturing and then in our previous session, will discuss that lean is the inward looking that how to minimise the cost, how to minimise the waste but there is one outward looking phenomena also and that is agile manufacturing.

So, on one side you have to see that how to minimise the waste, on the other side you also need to have a customer orientation that how you can fulfil the varied demand of the customer and therefore in our previous session, we focused on the combination of lean and agile that to have efficient systems, to have systems which can produce high quality products at lower cost, you need to have lean manufacturing but those products whether these are required by the customer or not.

And how your system is able to respond quickly to the changing demand of the customer that is agile manufacturing, so long these are the important consideration of the manufacturing but nowadays, there are different type of problems coming in the environment, every day you hear about global warming and one of the important you can say, causes of the global warming is exploitation of natural resources.

Manufacturing is only possible when you use natural resources know therefore, this is additional pressure on the manufacturing that apart from minimising the waste and fulfilling the customer expectations, you also need to maintain a balance, a harmony with the external environment and therefore, in this particular session, we are going to focus on sustainable manufacturing and some of you may know this with the name of green manufacturing also.

So, how now, you can see that multiple dimensions of pressure are there and these are only possible when you have this kind of holistic vision of manufacturing where on one side, you see your internal systems on the other side, you see your partner's, your customers and then you also should have a very holistic outside vision, where you are able to see that how my system, how my businesses are contributing in making a good environment.

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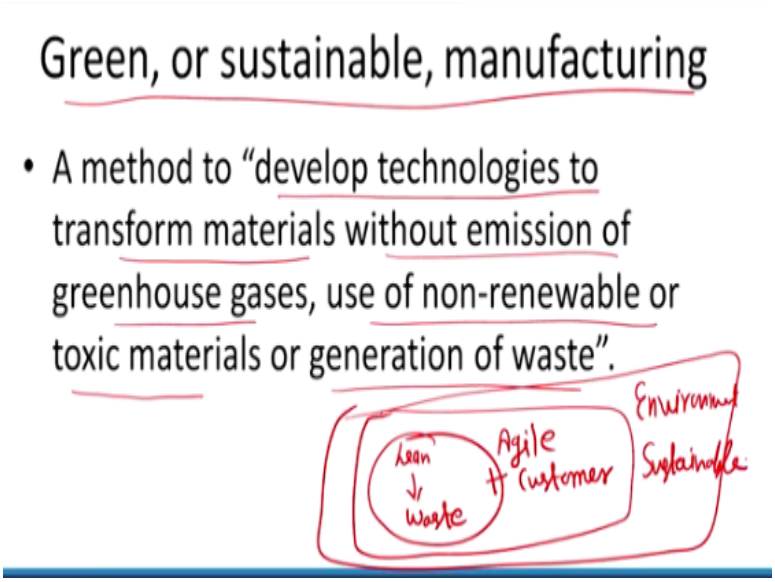

So that is what we talk with the name of green or sustainable manufacturing, so green or sustainable manufacturing is a method to develop technologies to transfer materials without emission of greenhouse gases, use of nonrenewal or toxic materials or generation of waste, so when you are eliminating all these things in your business processes, in your manufacturing activities then probably, you are a green or sustainable manufacturing organisation.

So, how things are happening at the moment that this is your organisation, so when I am talking of lean, you are focusing on waste and we have already discussed there are 7 types of waste and then when you add human waste that becomes the A types of waste, so that is the focus of lean manufacturing, then agile is there, that focuses on the customer so, we have already in our previous session discussed that we need to have lean as well as agile.

Now, finally when you have this manufacturing system, how these manufacturing system is impacting the environment, when you take environment into your consideration, it becomes

sustainable manufacturing because for fulfilling your requirement, you take lot of air, you discharge your hazardous gases into the environment, you discharge your chemicals into the river water, you discharge your chemicals into the surrounding lands.

So, you are polluting the environment and slowly and slowly, these are going to be so dangerous that it will be almost impossible to live in that kind of surrounding, so your manufacturing is only possible when there is a well of society. If well of society is not there, what will you do with your manufacturing; if people are not able to consumer your products or you say that if there are no people because there are no people, you have no industry.

So, it is very important to understand that industry is there, only when society is there and if society is not there, there is no point of having the industry, so therefore this concept of lean, agile, now need to be extended to the sustainable manufacturing therefore, we are discussing the sustainable manufacturing concept and not only from this point of view but lot of regulatory issues are also involved in the discussions of sustainable manufacturing.

There are agencies particularly EPA; Environmental Protection Agency of US that is the one of the important agency which is looking after that how manufacturing organisations are following the sustainable manufacturing practices, so that is what we are going to discuss in this particular session.

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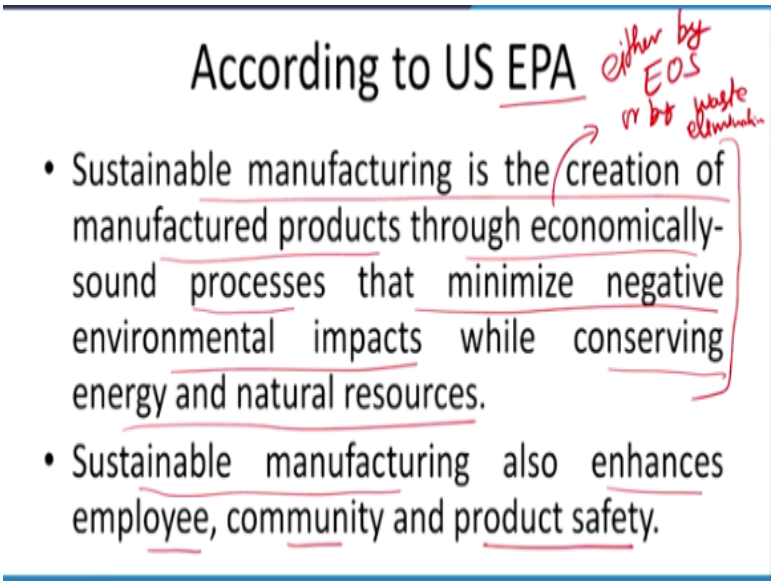

Now, according to this agency of United States that is Environmental Protection Agency; EPA; USEPA so, they have also given a definition of sustainable manufacturing and according to them, sustainable manufacturing is the creation of manufactured products through economically sound processes, so one thing is that it has to be economically sound that minimise negative environmental impacts while conserving energy and natural resources.

So, there are 3 important things which this definition says, one is that you should have economically sound processes, do not waste your resources and that actually matches with the idea of lean manufacturing where again we say that if you are able to minimise the waste, you will be able to achieve lot of economies in your manufacturing process, economies will not only come by the way of economies of scale.

The normal understanding of economy is with respect to economies of scale, so here it is very important to understand that in present circumstances, economies of scale is not the only way to bring economies to your processes, when you minimise the waste that can also bring economies to the processes so, it is very important to understand at this moment that economically sound processes are possible either by economies of scale or by waste elimination.

So, these are the 2 ways through which you can bring the cost of production lower and then you also need to see that how you are minimising the negative impact of your processes, you are

creating some kind of you can say discharge and that discharge is actually dangerous to the productivity of nearby land, that discharge is creating lot of loss of flora and fauna, so all these are the negative impact of your manufacturing process.

So, therefore it is very much essential that you should have affluent treatment plants in your manufacturing activities, so that whatever discharge is going that discharge is without any hazardous chemical that is one of the important aspects of sustainable manufacturing and at the same time, you should be able to conserve the energy and natural resources. How your manufacturing can help in conserving the energy and natural resources.

So, for that purpose, if you start using more and more solar energy, more and more wind energy for your manufacturing activities, one example is like when we say that sugar industry so, people have different type of perception about this sugar industry, some of the people say that sugar industry is a very polluting industry but to some extent, it is almost a reverse of that, sugar industry I particularly feel is one of the most environment friendly industry.

Because they are able to fulfil their entire energy requirement by their internal processes and their way, they are not contributing in getting anything from the fossil fuel based energy plants, so that way they are helping in conserving the energy and other natural resources, so that is the one aspect of this environmental supported manufacturing activity. Then another thing is sustainable manufacturing also enhances employee, community and product safety.

When you are taking care of the environment, when you are taking care of your surroundings, so when we are talking of care word, it automatically helps in protecting the well-being of your employees, the society around you and the product also, so all these 3 things are possible with the help of sustainable manufacturing or green manufacturing or the environmentally conscious manufacturing.

Now, the traditional waste, we already have discussed many a times in this particular course and now, with respect to those traditional waste, what type of environmental impact we are going to have, let us see quickly about that because we have discussed the waste in terms of cost that if

you have these waste either you will be incurring higher cost or you will be having the lower quality but with respect to all these waste, you have some kind of environmental impact also.

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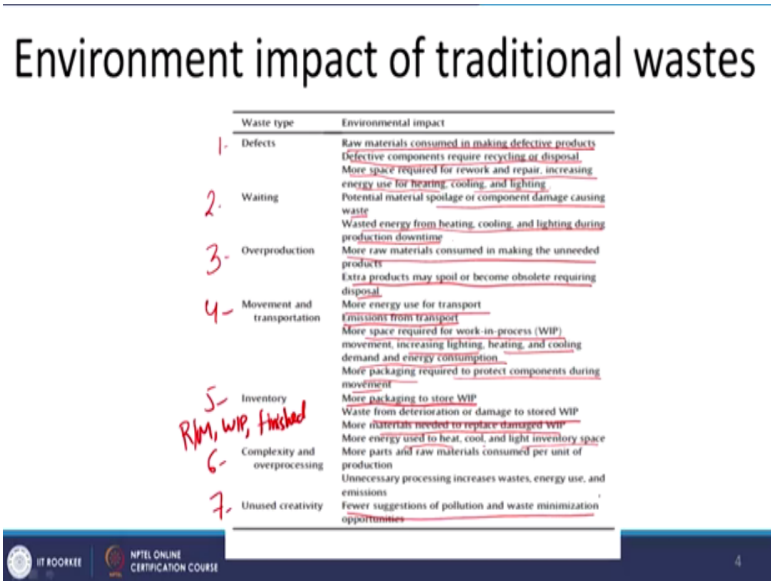

And let us see what is that environmental impact of these various traditional waste so, first type of waste which we are going to discuss here that is the waste because of defects. Now, when defect is there, you have already processed your raw material, your spare parts, your end components and then you have recognise that there is a defect in this kind of semi processed item. Now, because of that let us see what are the environmental impacts?

Raw materials consumed in making defective products that you have already consume, so some type of material consumption is taking place, so that is; that may be a natural resource also, maybe this is processing of wood, so that is you are creating wastage of natural resource. Defective components required recycling or disposal, so because more resources now will be invested on those defective pieces.

Because they will require some kind of either recycling or you have to do some kind of disposal, so if disposal is there, then the total loss is there, so that is also a kind of environmental impact. More space required for rework, repair and increasing energy use for heating, cooling and lighting because of defects, you have to do some kind of reworking etc., so you have to stock them somewhere.

And when you are stocking them, they take space and now, for bringing them into the workable condition, so that you can again work on them, you can do some kind of machining on them, it may require some kind of heating, cooling or some other kind of treatment may be require, so that you can make them workable and all these things will consume some kind of energy and when energy is consumed, it means you are creating some kind of negative impact on the environment.

So, because of additional requirement of working, reusing, additional requirement of resources for the disposing of those products, all these things are creating negative impact on the environment. The second type of defect we very often discuss is the defect of waiting, now when the defect of waiting means either people or WIP; works in process are waiting for their turn to be processed.

And in that case, potential material is spoilage or component damage causing waste, wasted energy from heating, cooling and lighting during the production downtime, so when some components are in waiting, it is quite possible that there may be some kind of spoilage in those components because they are waiting for their process and by the time their term comes, there may be some spoilage in those WIP's.

So that is a generation of waste that you are losing your precious resources, the second is; it is also possible that machine is down and because machine is down, these components are in queue for their turn to be processed. Now, when the machine is okay again after some time but by the time machine becomes okay, these components have become unusable, so again as we discussed previously, you have to again heat them, cool them, so that they again become workable.

So that is again, wastage of energy resources so, even in waiting also, many a times these things are becoming creating lot of environmental negative impact. Third is the waste related to over production, so over production when you are not having the requirement and you are producing those products because of your push approach and therefore, more raw materials is consumed in making unneeded products?

Because, you are following the push approach so, you are having some raw material and therefore, you are producing products based on those raw materials, so excess raw material; excess inventories are required for producing these unneeded products that is again a type of negative impact because your requirement of raw material will increase because of your habit of storage.

And then extra products may spoil or become obsolete requiring disposal so, like in case of fashion, in case of foot wear, in case of many such products, where you keep inventory but because of some reason, these things become obsolete because of new fashions, new trends etc., so either you have to compromise on the pricing you have or sometime it may also require to dispose of these unneeded products.

So, when you are disposing these unneeded products, you already can understand that how many resources right from the raw material to the processing, your energy, your time everything you have invested in making those products and finally you are not generating any value out of it, so that is also a type of negative environmental impact out of your over production waste. Then, another waste we have discussed many a times, the motion; the transportation.

And because of motion and transportation the when you are moving from one place to another place and it is not adding any value then obviously, you can understand that more energy uses for the transportation purpose, so when you are moving from one place to another place, whether it is a battery-operated system, whether it is a petrol operated, whether it is electric operated anything it is not without energy, your movement require some kind of energy.

Or you are using on your own, even then your personal energy is wasted in that so that is the negative impact you are not getting anything positive out of it and you are exhausting your energy and when you are using some fossil fuel, so the gases which you are generating the emissions that is very, very dangerous rather that is the most talkative point with respect to negative environmental impacts.

So, more space required for WIP, movement, increase in lighting and heating, cooling demand, energy consumption, more packaging required to protect components during movement, all these things are actually suggesting that if you have excessive movement, excessive transportation, there will be requirement of excessive production of your products and excessive production of products will require more energy, more material and more energy, more material will again contribute negatively to the environmental.

Then, another waste is the waste of inventory that is again, a very common waste we have discussed. Now, in case of inventory, if you have raw material inventory, you have WIP inventory, you have finished goods inventory so, these are the different stages of inventory which are possible. Now, with respect to all the steps of inventories, you have more packaging to store WIP, you need to protect your work in process, otherwise whenever you have the WIP ready for working, you will find that there is some kind of spoilage.

So, to protect those spoilage, you need to have a better picture of your WIP's, better production of WIP's will require more material, more energy for the consumption of those purpose, so therefore this is also a type of negative environmental impact. Waste from deterioration or damage to be store WIP, more material needed to replace damage WIP, more energy is used to heat, cool and light inventory space.

So, all these things are negative environmental impact, if you are keeping inventory in your system, then another traditional defect is the over processing, many a times, you do not understand that how much processing is required, how much processing to make it more simpler that means how much value actually to be added and we always feel that we should add more and more value and therefore, we end up in doing lot of over processing.

If you see many of our buildings and in the designing of the buildings, if you see the pillars are over designed that much load is not coming on those pillars but we have over designed those pillars that is simply an example of over processing so, in your life you can see many things around you where we have over processing, we have over specifications, you take the example of Indian Railways, so our coaches of the rail, these are over specified, so heavy so bulky.

So, lot of things are involved in the dead weight of that particular coach so, the lightweight is much smaller as compared to the dead weight, so things are happening in a reverse way in India, we are creating a lot of waste because of over processing also, so that is also very important in our place and when you would go for over processing that much material is not required, let us say, I can make a this pillar with 4 iron bars and that will take sufficient amount of load which is going to come on this pillar.

But because of my habit of over specification, I am putting 8 iron bars, so lot of wastage of material takes place because of this over processing, you are putting more iron in your railways coaches, so that is again the consumption of extra material for that purpose so, unfortunately we believe too much in over processing and therefore that also gets into the lot of negative environmental impact.

So, all these things are there and then, another you can say this addition of this traditional wastage unused creativity, if you are employees, you are human beings, they are having some kind of potential but you are not using that potential that is also a type of waste and because of that you will have fewer suggestions of pollution and waste minimisation, when you are not involving people into your creative activities, then you will not have much suggestions that how to minimise these waste which are contributing negatively to my environment.

So that is the environment impact of my traditional waste but apart from this traditional waste, there are few ways which are very much related directly to the green manufacturing and most of these waste are given by USEPA that is Environmental Protection Agency and according to them, like permit compliance that is one type of concept which is important for the green manufacturing and according to this, you have to have a complied with respect to necessary guidelines.

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Wastes according to Green Manufacturing

Concept	Description
Permit Compliance	Compliance with applicable permits.
Toxic Release Inventory (TRI)	Over 300 chemicals subject to release.
33/50 Chemicals	A subset of TRI chemicals identified by the EPA as priority candidates for voluntary reductions by industry.
Clean Air Act Toxics	189 chemicals listed in the Clean Air Act as air toxics.
Risk-Weighted Releases	Toxic chemicals weighted by their relative toxicity.
Waste Per Unit of Production	Percentage of production lost as waste, generally measured by weight.
Energy Use	Total energy use by all aspects of corporate operations; also expressed as carbon dioxide.
Solid Waste Generations	Total solid waste going to landfills or other disposal facilities.
Product Life Cycle	The total impact of a product on the environment from raw materials sourcing to ultimate disposal.

So that is one issue, then what is your toxic release inventory that how much chemicals you are releasing, so there are around 300 chemicals in this particular waste and if you are releasing any of those 300 chemicals, you need to have some kind of certification, then 33 by 50 chemicals that is another very specific subset of these TRI, then clean air act toxics, so in this around 189 chemicals are listed which are considered to be the toxic for the year particular thing.

Then you have the risk weighted releases of waste per unit of production, energy used solid waste generation and product life-cycle so, these are the different types of concepts which are very, very important and there are specific guidelines with respect to each of them and these guidelines may vary from country to country, but it is everywhere now, in India also we have a specific descriptions for all these concepts.

Now, going further that; what are the reasons to have this sustainable manufacturing, so as you already had enough idea that it is environmental friendly manufacturing, it is green manufacturing which reduces the impact of manufacturing to the environment.

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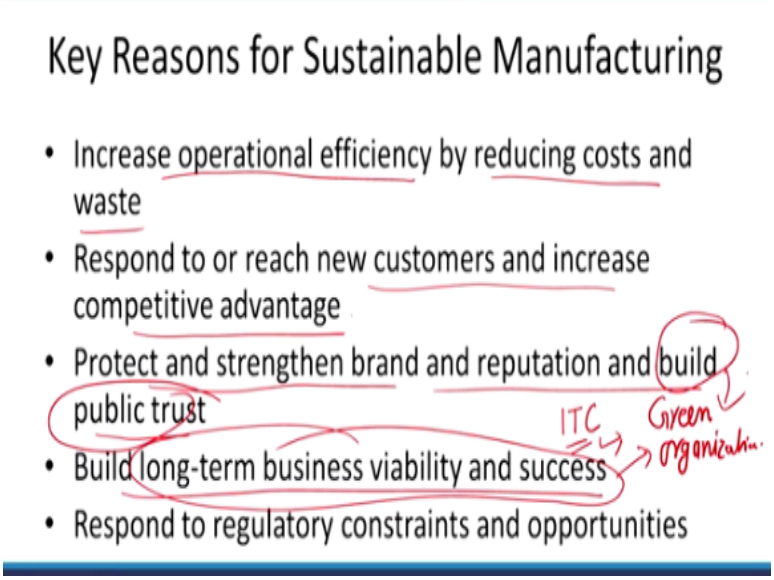

So, when we are reducing the waste so obviously, whether it is waste related to traditional manufacturing or waste related to green manufacturing, it is going to help us in improving our operational efficiency and whatever type of waste you reduce, whether you are reducing the consumption of additional energy uses, whether you are reducing the consumption of extra material, whether you are reducing the consumption of extra fuel, all these things will help you in reducing the cost and waste.

And these things will help us to respond to or reach new customers and increase our competitive advantage nowadays, customers are also becoming very aware, they want to have a products which are made through green processes, so therefore concepts like green marketing, green consumer behaviour, green supply chain are also becoming popular, so therefore if your manufacturing process is also green, it is also sustainable, you will have a better competitive advantage.

It will protect and strengthen brand and reputation and build public trust, as I already explained that green manufacturing will lead to green marketing and you will have a better public image because of your environmental friendly approaches, build long term business viability and success; you all know in India, there is a company known as ITC; Indian Tobacco company. Now, we all know this company that they are the largest manufacturer of tobacco related products.

But since last around one decade, they are never using full name of their organisation, you only read about ITC, ITC, ITC, nowhere you will read Indian tobacco company, why; they are in the process of changing the image, perception of people about their organisation and they are now want to be known as a green organisation, everywhere, they are promoting themselves as a green organisation, not as an organisation making tobacco products.

So, it is very important that you will have a long lasting public trust, you will have a long-term business viability and success, when you are known as a sustainable organisation and it will respond to that is another legal aspect of this whole issue that you will be able to respond to the regulatory requirements of the place of your work so, these are the important reason that you should have sustainable manufacturing.

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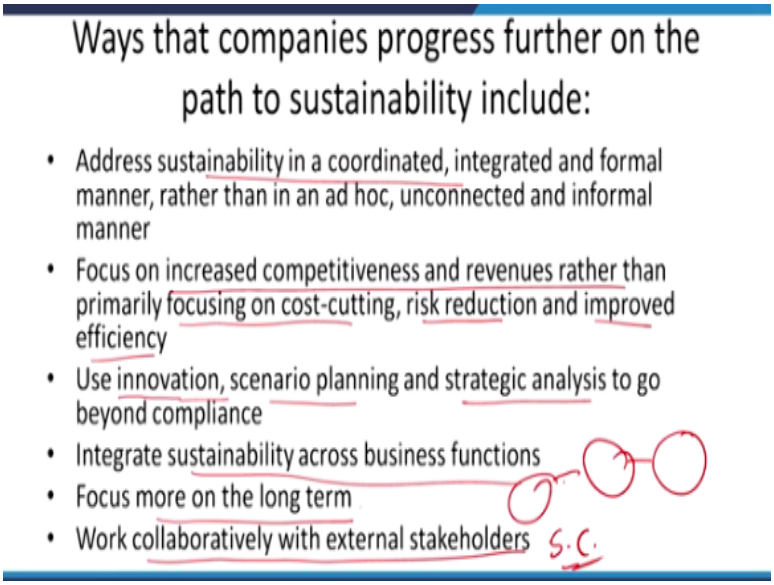

Ways that companies progress further on the path of sustainability, so how these companies are moving on the path of sustainability so, they address sustainability in a very coordinated integrated manner, thus only operation people can help you in achieving the sustainability not possible so, you have to act in a coordinated manner where you also need to include your suppliers on one side, your distributors on the other side, then only this concept of sustainability is possible.

Focus on increased competitiveness and revenues rather than primarily focusing on cost cutting risk reduction and improved efficiency, you need to see that how this green manufacturing will add more competitiveness to my organisation, so when you are seeing that because I am into the green manufacturing, I am able to target, I am able to address the requirement of new customer segments also, my revenue will increase, my competitiveness will increase that is rather a better proof than just focusing on the cost-cutting that is the traditional approach of manufacturing.

Now, this will also be possible to implement by using innovation, scenario planning and strategic analysis and you just not limit yourself to full fill some kind of legal requirements, you do not need to go beyond those things because every organisation in your industry, every organisation in your country may all have to full fill the legal obligations but you need to go beyond those legal obligations.

So, with legal obligations you will be entitled to work but you will not be having the competitiveness, if you are only into that compliance part, then integrates sustainability across business functions, whether it is marketing, whether it is supply chain, whether it is investments, so everywhere you have to have rather people have started talking of green HR also so, in all business functions, you need to integrate this concept of sustainability.

Focus more on the long-term, you need to focus more on the long-term activities, those activities which are sustainability is actually meaning when you can live for the longer divisions, so sustainability issues cannot be addressed for the short term period, it is a long-term activity and therefore, the discussions of sustainability are very, very important in the course of Toyota production system.

Because the core of Toyota production system is philosophy and in that philosophy also we discussed the that we need to have a long-term vision for the organisation and we can sacrifice many short-term gains for the long-term vision of the organisation, same thing is in the case of sustainability that we need to have a long-term objective, long-term vision for the organisation then only this sustainability is implementable.

Then, work collaboratively with external stakeholders, as already discussed that we need to extend the concept of sustainability to other departments, other areas of organisation and those other areas include supply chain also and when we are talking of supply chain so, the sustainability is not limited to me but it has to extend to other partners also and therefore, tier 1, tier 2; tier 1 suppliers of OEM also play a very important role.

There are cases we have done some exercises, where we saw that OEM's are highly sustainable, the tier one suppliers are again having good kind of awareness about the sustainability but as you move away from OEM's, as you come to tier 2 or tier 3 suppliers, they are almost unsustainable, they follow no regulatory norm, they follow no environmental norms, they follow no ethics and there are lot of issue with respect to different types of sustainability as you move away from OEM's.

So, therefore it is very important that we need to include all our external stakeholders then only our entire business, our entire supply chain can become a sustainable supply chain, it is not only the sustainable manufacturing but it has to extended to the sustainable supply chain and that is the ultimate objective of discussions of sustainable manufacturing which can give you sustainable advantage in a coordinated manner.

So, we stop in this session here only and we will continue with some of the important terminologies to be used in sustainable manufacturing in our next session, thank you very much.