Life Cycle Assessment
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Lecture – 19
History of LCA

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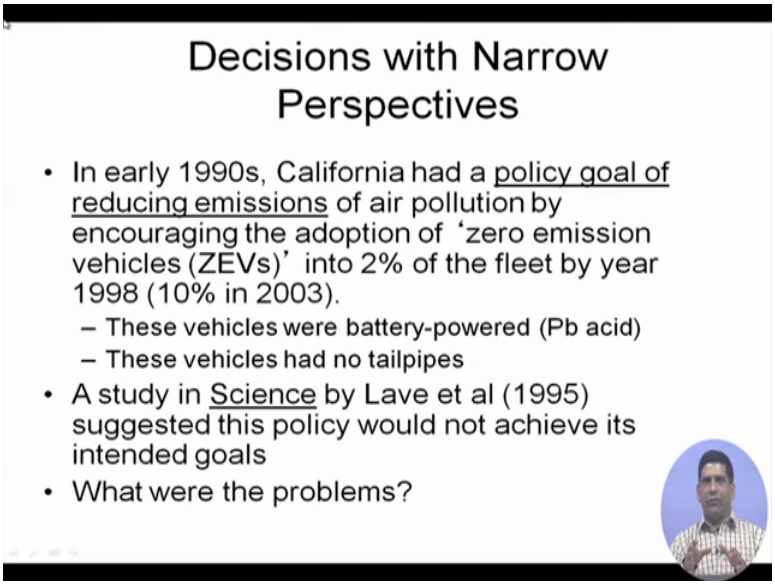

Let us continue discussion on we are talking about what are the benefits and draw backs benefits and drawbacks of LCA exercise. So, let us here we will look at an example this is an example from California which was in 1990s. 1990s LC was although the concept of LCA in terms of just the concept was also in very much infancy like it was just started. So, there was no there was no ISO there was you will you may find some studies here and there, but not the detailed LCA study. So, 1990s, but California they had a policy goal of reducing emissions of air pollution what they did they encouraged adaptation of 0 emission vehicle.

So, they wanted to have the 0 emission vehicle where essentially they wanted to reduce around 2 percent of the fleet by 1998 it like a in 1990s they started with reducing 0 emission vehicle in to 2 percent of the fleet by the year 1998. So, they wanted to have 2 percent of the cars in California to be 0 emission cars by 1998 which will increase to 10

percent in 2003. So, if you think about it sounds a very good goal is it not say you want to have 0 emission; 0 emission means it will reduce the air pollution great, but if there was since there was no LCA thinking which in many of the decision we make even today we do not take this LCA thinking that is a problem and that is why the concept of this life cycle analysis into the systems approach where you are rather than having like a narrow what we call silence approach we go for a systems approach.

So, here these vehicles this 0 emission vehicles were battery powered now you are using batteries that too lead and acid batteries. So, lead acid batteries were used lead is a big environmental problem which we already know that is why we got rid of lead form lead based paint that was we got lead we are getting rid of lead from gasoline by the petrol and the diesel we are we want to get rid of lead form our electrical and electronic equipments like all these laptops, TVs and all. We do not want to have too much lead in there and why you already saw we had I think in the second week in one of the module we also looked at the health impact of some of these major contaminants although and the lead was one of them. So, and this was using lead acid battery. So now, you have the lead the acid and you are using this lead acid battery powered car. So, you need to charge them, for charging if you are using thermal power. So, again you are using more and more energy.

So, these vehicles although they were claimed to be 0 emission, but in the real terms they are not really 0 emissions you are not doing emissions from the vehicle, but you are doing already doing emissions in the form of manufacturing these lead acid batteries you are doing emissions in terms of all the energy that you are using to charge these batteries to power these batteries. So, there was a study done later on by Laviatol in 1995 that they said that this policy would not achieve its intended goal. So, that they come up with that this policy will not achieve the goal and. So, what were the problems? So, we talked about some of the problems already.

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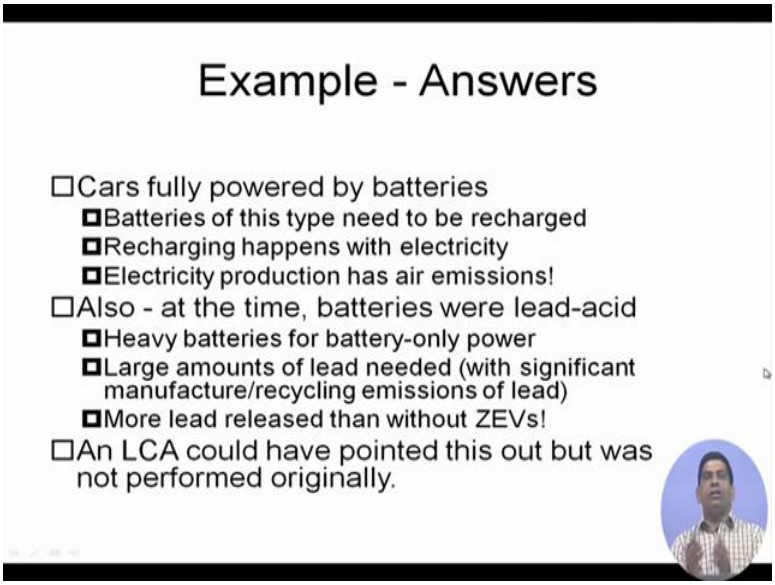

So, if you look at what were the problems the problem was cars were fully powered by batteries now these batteries were using batteries are being used. So, batteries of these types need to be recharged as I said earlier.

Now, for recharging of the battery like you recharge battery you recharge your cell phone your mobile or anything you use you have to recharge laptop I pad all that there you are you are plugging in to your electrical socket now if that electrical socket is that electrical power that you are getting is basically if you are in India most of the places you are getting thermal power. So, if you are getting this thermal power you already saw the water foot print of the thermal power you already kind of have an idea of how much energy in terms of emissions of a thermal power plant.

So, the recharging happens with electricity production has a emission problem so and so what we have done we have rather although the car has 0 emission, but the stuff that going to make the car is has lot of emission already. So, we have what is its very similar to what we are talking about earlier in terms of the problem shifting we have shifted the problem to something else. So, we did not really solve the problem. So, and at the time where we are talking about in early nineties the batteries were lead acid batteries.

So, heavy batteries for battery only power the batteries was huge large amounts of lead was needed now this lead has to be procured make this lead acid battery. So, that will come from the mines form the mines if you think about from the mines it will go to the like a smelting plant where they will get those lead out and then it will go to the manufacturing and all these processes will have lead emissions coming into the environment and other emissions associated with lead smelting and all. So, the large amount of lead is needed with significant manufacture and recycling emissions of lead. So, and the more lead released them then without like a 0 more lead was releasing into the environment as supposed to other cards so the non 0 emission vehicles.

So, this whole exercise although the policy as the policy looks it sounds really great, is it not; you want to go for a 0 emission car, but if you to achieve this 0 emission car; that means, that you are using; that means, are not environmental friendly or if the means actually has higher environmental burden or environmental footprint as supposed to what is the really happening with this normal gasoline power car your purpose is defeated. So, that is what happened in this particular case although the goal was very like novel they wanted to have 0 emission, but they could not achieve it because of although on a first look it looks like yes it was great 0 emissions on the road, but emissions in the form of lead emissions in the form of air pollution from the thermal power plants or a what kind of a energy supply. So, water footprint. So, if you do in. So, what could have prevented this kind of decision?

So, that is why in the word today recently we were few months back we did a life cycle analysis 3 days short term course here and one of very senior professor who just who is actually retired now, but he is around on campus he just came back from California visiting his kid his like a visiting his son he just came back there in California he mentioned that now most of these places in US and other places as part of this payment engineering or the payment design they are asking life cycle analysis data they are asking life cycle analysis done on those as part of their payment design to see that what is the environmental footprint. So, these things are coming many of these world bank refunded project any international funding agency giving funds these days they want this life cycle analysis to be done which is kind of big brother of LCA; sorry, which is big brother of EIA.

So, we have been doing EIA and EIA is mandatory for most of the projects so, but LCA will become also become mandatory from the years to come. So, what the LCA exercise does it helps us to make not make these kind of mistakes where. So, we could have LCA looks at in a more system approach had we done an LCA on this California policy we could have found that. Although, you are having a 0 emission vehicles, but for the 0 emission vehicles you are going to use this lead acid battery the lead acid battery will have this environmental footprint and then you will be using energy to charge this batteries and for that matter you will have this much environmental footprint. So, in totality actually you are not really gaining anything you are you are in terms of the environmental footprint you are going to be on the negative side which was found out later in this particular case. So, that is why for any policy we have to especially for the environmental policy we are we are trying to really have a environmental like a environmental benefit we have to look at things in a more global scale rather than in a sylose scale.

So, an LCA study could have pointed this out, but it was not performed originally because it was not that popular that particular time anyway. So, there was they could not do it. So, with that let us look at what is the history of LCA. So, it was not done in nineteen 1990s in California. So, when it started how the LCA again its always its very interesting anything you learn you should try to have some background like the what when it all started who started this LCA exercise how it has evolved over the years because those things are always interesting to know because it encourages your curiosity it helps you to be more curious about the subject matter.

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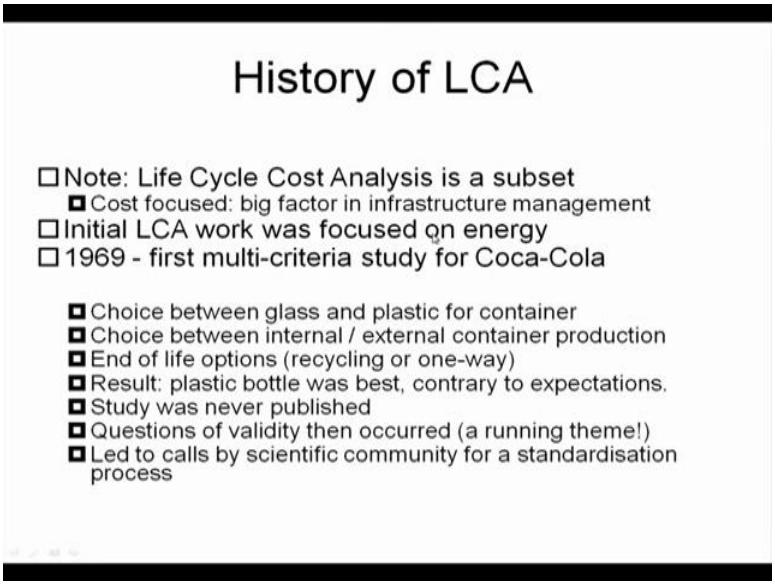

So, life cycle analysis is a is a subset coast is coast is subset of LCA coast focused big factor in infrastructure management in we also do life cycle coast analysis, but initial LCA work was focused in energy and that is what initial LCA work was focused on energy and you believe it or not the first LCA was done much much before even several years before I was born. So, it was done by Coco-Cola.

Although in true sense we really cannot really call them an LCA exercise because it was not an LCA exercise as we know it today they did not use that ISO methodology. So, if somebody is very strict they may say that that was not really an LCA exercise, but for that matter in terms of what that in terms of the first multi criteria study that was done that was in 1969 it was done by Coco-Cola company and why they wanted to do this LCA study they wanted to have a choice between the glass or the plastic bottle, whether we should go for a glass bottle or the plastic bottle for the container. As if you are old enough you may have seen that we used to use even for the smaller volume we still use today we may not use Coco-Cola may not that much, but for Thumbs Up and other things we do see may be Coco-Cola is also there like I do not drink that soda so much. So, I do not really know, but I have to, but I do see small bottles. So, for 200 ml or 250 ml those glass bottles are still available for some of these soft drinks.

So, but earlier we also used to have like a one litre bottle one litre of a glass bottle which you see any more right now, but it used to be earlier and before that even all the bottles used to be that glass bottles. So, these plastic bottles came latter and then we have this aluminium cans now aluminium cans are also used in soda industry in the soft drinks industry. So, Coco-Cola industry in 1969 they wanted to know whether they should go from glass to plastic because they were using glass what is the benefit of glass you can use it again and again you can wash it and use it. But when you wash it of course, you have a energy input you have a detergent input you have to clean it up and then you have to bring it to the bottling plant again to wash it and then bottle it and then send it back again. So, there is additional transportation also involved with that.

So, that is there is a it is in terms of container for the choice between glass and plastics container. So, they wanted to they wanted to actually have a plastic bottle manufacturing within their plant. So, that was their choice whether they can have choice. So, they also at end of life option whether they could go for recycling or it should be a one way use it and throw it 1969 even the plastic recycling was not that not that much like very popular, but they did find that if they go for recycling the plastic bottle was best contrary to expect to expectation why the plastic bottle was best they assume that it would be recycled and, but they were all only looking from the cost from the cost perspective from the economic perspective and from looking at how much it will in the transportation cost because they were glasses heavy. So, if they if it is anything heavy it will require more energy and things to transfer, but this study were never published. So, and it was it was never published. So, we do not really know it was internal exercise by a Coco-Cola company so, but that is that is, but that was kind of first multi criteria analysis very something similar to LCA. So, if you want to say that the first kind of multi criteria study similar to LCA was done in 1969 which was much much earlier.

So, question of validity of course, that occurred that whether it is a valid exercise or not, but that is a, but then kind of that let to because the Coco-Cola came up with this answer which kind of the scientific community were saying that it looks like something wrong here because it kind of goes against what the popular belief is that although the glass to be better than the plastic bottle. So, that led to the call by scientific community to have a standardization procedure for this kind of a test. So, we should have a standard method.

So, we can say that everybody has to go by that standard method then we can compare the comparison will be fair in terms of the different options.

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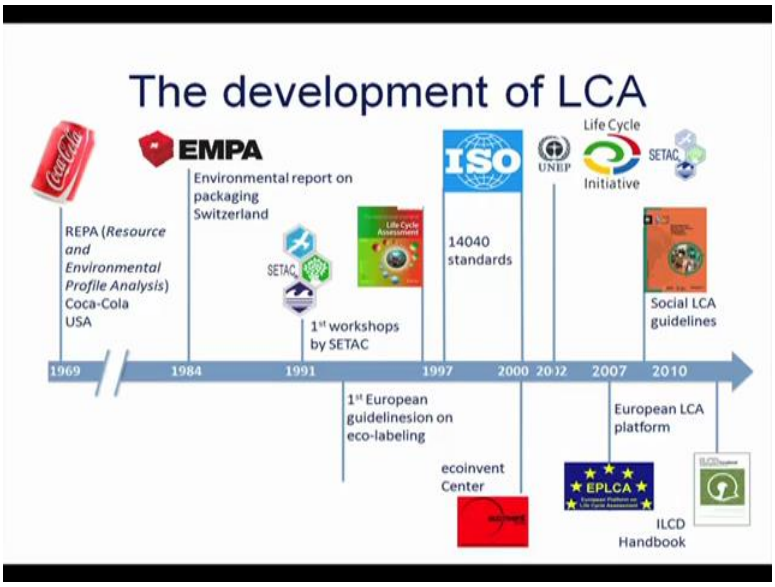

So, if we look how this LCA was developed. So, this is kind of a history of this LCA life cycle analysis thing. So, 1969 that is first we talked about Coco-Cola company the resource and environmental profile analysis that that is what they call it Coco-Cola USA EMPA, this was done is 1969 from 1969 and until 1984 that is almost how much fifteen years there was not much activity on LCA front not much work was done in that fifteen years, but in 1984 in Switzerland this environmental report and packaging. So, that is the environmental report on packaging this packaging organization they come up with environmental report. So, that is came up in 1984 that is where this real in a real sense you can say the LCA that we know as of today is kind of a started in 1984 that is what you see over here, so, this packaging industry in Switzerland. So, that is how this ecoinvent organization is in Switzerland if you remember we talked about earlier.

Then in 1991 SETAC got involved SETAC is the society of environmental toxicology and chemistry, it is a very big organization, it is a international organization basically it is like professional organization it runs lot of courses work shop you may be familiar with SETAC if you are not you just google SETAC and then you will find lot of

information on that SETAC got involved which is a lot of professors are members of SETAC lot of environmental professionals are member of SETAC. So, they got involved and they had a first work shop in 1991 at regarding LCA. So, that is it started coming LCA started popular.

Then around the same time in 92-93 the first European guidelines on eco labelling come eco labelling is when you are labelling a product to be which is a green product. So, which we will talk about that later on that as well we will talk about some of the design for environment and when we when we put a green dot it is not a green dot green dot like a if we if we in India when you, but any food product it is a green dot it is a vegetarian and the red dot is non vegetarian, but that does not mean green means it is a environmental friendly stuff although vegetarian is a environmental friendly than non vegetarian which we saw that form that water foot print.

If you remember that slide from water footprint the vegetarian diets are actually has a lower water footprint. So, that way as the green dot does say that it is environmental friendly, but for just that was just a joke for this in terms of environmental profile where if there is a green label there is an equal label. So, European guideline we do not have a green label in India, right now we have a proposal to have a green label like that in India 2 some countries already have some green label and for that green label you have to do some LCA exercise and so that your product is really green. So, the first European guideline that came on eco labelling came in 92-33; 1997 this life cycle assessment journal came it is the international journal of life cycle assessment and it is a very popular journal now its and its pretty good impact factor its it is not that easy publish in this journal in terms of LCA, but this is there are other paper other journals also publish LCA papers, but this is a one of the this kind of the oldest journal in terms of just dedicated to life cycle analysis.

So, ninety seven it came at the same time between ninety seven 2000 this ISO standards were developed and we will talk about ISO standards very soon in I think next few slides. So, ISO standards came ISO 14040 is the standard for life cycle analysis and I will go through this ISO standard because that is very important spot of the methodology for LCA. So, that is ISO standard came between those 3-4 years and in between in an

year 2000, we have this ecoinvent centre ecoinvent if you remember again it is an organization based in Switzerland and they are basically the biggest database centre in terms of life cycle analysis all those LCI inventory data that we need ecoinvent has it I should not say ecoinvent has it ecoinvent tries to procure that. So, they data from Western European countries right now they are trying to collect data from south Asian countries they are doing some projects in India they are doing some projects in Bangladesh also in Africa. So, they are trying to develop some databases from different sources.

And since they are collecting all these data they do sell those data many times these data is not available for free, but as I said earlier as a Indian academic Indian student you can get this data free access, but just only for academic purposes if you approach, then going to ecoinvent which was a good like a right now ecoinvent we use ecoinvent database quite a bit in doing the LCA exercise. So, 2002 and you will see some of these again and some of the case study when we come back in terms of how we use ecoinvent. So, 2002 UNEP- United Nations Environmental Program; they also got involved as LCA. Now there is a UNEP SETAC life cycle initiative which is part of. So, even this conference that I was mentioning to you that Indian life cycle management conference which happens every year freaky organises that. So, they are UNEP people were there some SETAC people were there this life cycle initiative this was kind of part of the organization team.

So, UNEP life cycle initiative SETAC they all came together rather than having individual effort. So, why do not do why not let us do a team effort and then things gets much better. So, that is how this these things came together and then now this kind of the guiding force behind this life cycle in the globe I would say the UNEP life cycle initiative where some of the European countries are also involved Western European countries SETAC which has presence all over the world. So, this is the guiding principle behind life cycle analysis today they we had European LCA platform came EPLCA in 2007 ILC ILCD hand book which is again European document, like how to do life cycle analysis that is a hand book.

And this hand book is available for free you can download that social LCA guideline

which is how to do social LCA which is not that easy to do, because the social environment changes a lot from place to place environmental emissions do not say- if you have the same process whether you are using that process in India or whether that you are using that process in Australia or in US or say in Western European countries it is the same process; similar input you will have, similar emissions coming out, but in terms of the social whatever things which are socially acceptable in Indian context may not be acceptable in European context.

So, that is in American context and vice versa too. So, that is why social LCA gets little bit complex and its more qualitative than quantitative it is very difficult to put a quantitative numbers. So, that is a; it is a important it is a nice document, but it does get confusing sometimes like how to do this social LCA and still we will not we will cover that little bit in this class, but how to encourage you to kind of look at the document more in detailed if you are interested in that area. So, this is how this LCA exercise is going on right now where we have this different this is how like a development of LCA over a course of last say mostly 3 decades and slightly more 3 and half decades. So, that is because in 1969 one was kind of a standalone work and nothing happened for next 15 years.

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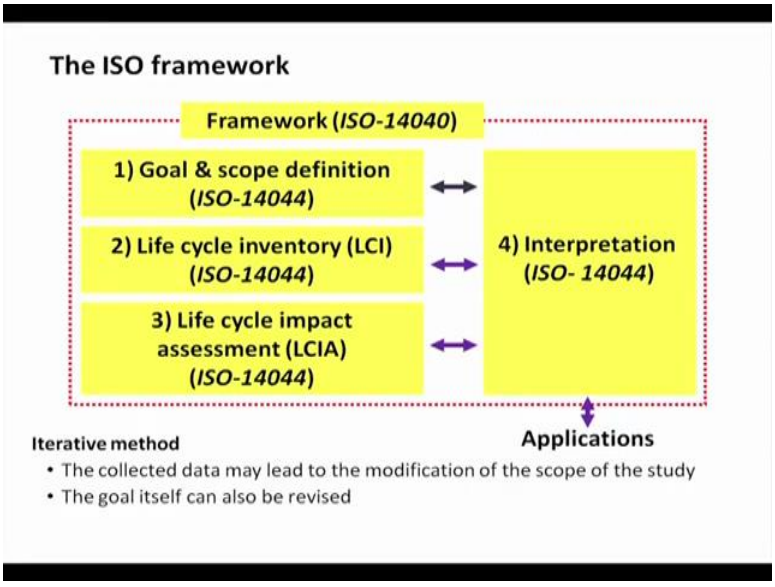

So, this kind of history of LCA, let us look at, after that let us look at this ISO frame work because as I said ISO frame work which came in between 1997 and 2000 when the first version of this ISO frame were came this is this became the guiding principle now of how to do an LCA exercise. Again if you remember for any environmental analysis we have standard method. Remember I told you that for the water wastewater or air samples we use that this standard methods you walk into any environment lab you will have that blue coloured or slightly like a these days I think the newer version has a light green colour cover.

So, you see a standard method book which will be there in any good environmental lab will have it. So, similarly when you go for this ISO sorry, you go for this l c exercise you need to have a method you show that when you do LCA here in India somebody doing LCA over in US or other places if you want to compare the different work they should be done in a like a similar steps. So, this ISO framework tells us what are those similar steps then we kind of talked about that already. So, it should it will not should not take that much of a time, but I will go through this ISO framework and it does get boring a little bit. So, I apologize for that, but I will try to keep it as interesting as possible.

Because any rules guidelines they tend to get little bit of dry it is not that it is a dry stuff. So, things do get boring. So, here in terms of the ISO framework again we have 4 major areas the number one is the goal and the scope definition. So, that is what you need to we already talked about we did that for the bulb. If you remember for the bulb exercise we had a goal we had a scope definition for the bulb if you do not remember go back and watch that video again. So, that is as per ISO 14,044 and ISO document is the older version of ISO documents are not available for free actually you have to have subscription of that.

So, if your library has a subscription to ISO document you should you may be able to get it through your library if its if your library does not have a subscription to ISO document if you google this ISO LCA methodology for ISO like ISO framework for LCA methodology you would get a older version 2006 version is available for free there is a newer version out there now, but 2006 version older version you can I when I was goggling it this morning I could find it. So, it is available on the google so, but like a

newer version you need to actually pay it is around 25 Euros or something like that.

So, there are 4 main components which we already talked about goal and scope definition life cycle inventory we already looked at that life cycle impact assessment we looked at that as well and the interpretation where we went from midpoint indicator to n point indicator to the single score. So, that was in terms of their interpretation you see on this particular chart if you look at carefully there are for these have these arrows pointing both sides. So, what are these means or here also at the bottom when we talk about the application here it means that it is iterative process. So, you learn and then you change. So, you want to have a goal and a scope when you interpret and then you find out that this is not actually you wanted to study you wanted to study something else then you go and change your goal and scope.

When you look at life cycle inventory some of the data is not available some of the data is not available what you will do if the data is not available it is not available. So, rather than using say bad data you may have to kind of tweak your goal and scope tweak your interpretation. Accordingly same thing with the impact assessment, so it is an iterative process the collective data may lead to the modification of the scope. So, once depending on the data that is collected it can be it can lead to the modification and the goal itself also could be revised. So, you can revise the goal based on what the data is available what kind of. So, this there is a flexibility in the system in terms of how you how you interpret that.

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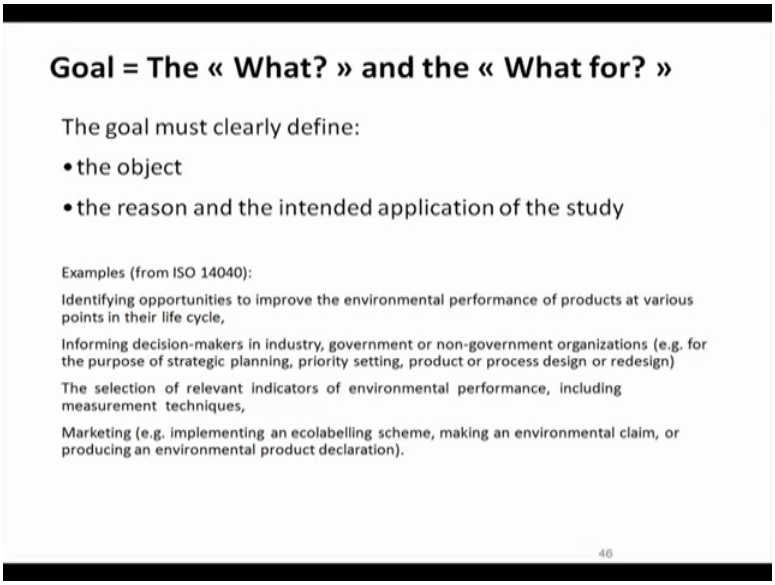

So, goal is what? For now some of the slides; you will see from now these points onwards are essentially coming directly from the ISO document. So, especially the bottom part that you see over here it is essentially a copy and paste from the ISO document. So, the reason for putting it over here is just to give you some examples. So, that is why it is a goal what their goal must clearly define; the goal is for what we are going to do and what for we are going to do. So, it should clearly define the object the what is the object what is the objective of doing this exercise what are the reasons why and who is the intended what is the intended application who is the audience what we will do with this exercise.

For example from this ISO standard 14040; if we want to identify opportunities to improve the environmental performance of products at various point in their life cycle. Now what does that mean say if you have a product for example, if you have a like a mobile phone. So, in that mobile phone you want to use this you want to do an LCA of this mobile phone itself. So, there are different components which is present to this there are different stuff in here. So, you want to find out what are what are the different makes what is the different unit processes associated with that and we talk about unit processes in a little while in probably in next module.

So, there like a for the different unit processes which unit process has higher environmental footprint. So, that is what you want to look at the environmental performance of the product at various points in their life cycle. So, does it uses too much of a battery like many times we see this mobile phones the battery works for a may be one year and after that the battery starts discharging very quickly may be we end up we load them up with too many apps that may be the reason I am not a electronics engineer I do not know what is the reason for that.

But so in terms of whether the battery is efficient or something like can we can we improve this product. So, we look at the whole unit processes associated with making of the cell phone of this mobile phone, Smartphone and then for the individual unit process we look at their environmental footprint. So, the one which shows very high environmental footprint relative for others we focus on that particular process and then we talk to our electronics engineer electrical engineer and say is there a way to reduce the environmental footprint of that. So, that is what the first bullet of the example that you see over is trying to say where you are identifying opportunities to improve the environmental performance of product at various point in their life cycles. So, that is that could be one goal.

The other goal could be that you want talk to the decision makers of the industry or the government or the NGOs for planning priority sitting product or process design or re design similar concepts what you just said you look at your product and you find that the environmental footprint is higher, then you talk to government you try to impress upon government to have a better policy. So, that the companies are encouraged they get some incentive to do it the environmental more better product now. Even you can do selection of relevant indicators for environmental performance like you look at the measurement technique if the measurements those kinds of stuff and also for marketing like if you want to do a if you come up with say for the 2 different.

Again, I kind of use lot of example from the electronic industry because that is everybody carry mobile phone or not like most of us most of the middle class these days have a Smartphone. So, at least that is what say- if you have 2 similar Smartphone with similar performance similar price and all that. So, you can do an environmental LCA

exercise on those 2 models and then you can say that you can compare and then you can say my product is better then the other product and that kind of gives you an incentive in terms of the marketing. So, those things can be done as well.

So, we will continue looking at this ISO standard kind of go more in terms of this ISO framework we just looked at the first part. So, in this next module we will continue looking at the other aspects of this ISO framework. So, as wise as I said it is a method which we use to do LCA and it is a standard method. So, that throughout the world globally people follow the same methodology to this exercise, so that the results could be compared. So, let us wrap this module right now, and then we will go to the next module where we kind of continue with this ISO framework.

Thank you.