System Design for Sustainability
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Week – 09
Lecture – 02
Sustainable Product-Service System Design - Methods and Tools – Summary

Hello everyone. So, over since the pass 7 lectures we are discussing about Sustainable Product - Service System Design - Methods and Tools. So, today when we have already finished about discussing this particular methodology, we discussed all the tools and so on. So, we will do a quick summary to understand the whole concept in one glass.

So, the MSDS - Methodology for System Design for Sustainability, for this the reading material is Product-service system design for sustainability book; it is a freely available book.

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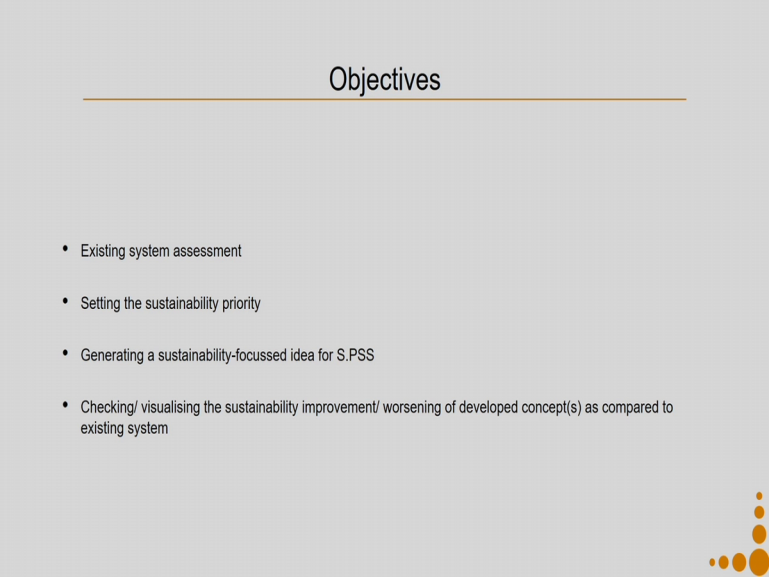

So, what are the objectives of this methodology? So, the objective one is do Existing system assessment. Then, set the sustainability priority even in given context. Then, generate sustainability-focused ideas for Sustainable Product Service Systems and finally, check a visualize the sustainability improvement or worsening of developed concepts as compared to the existing systems.

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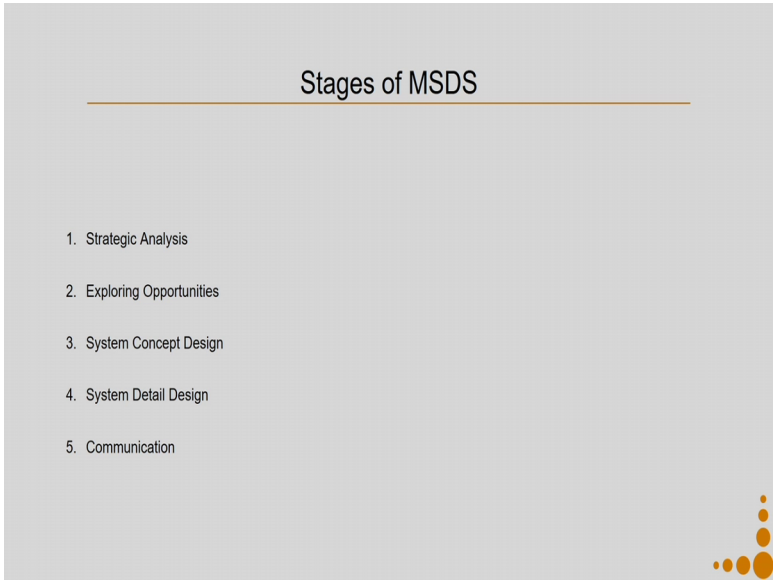

So, what are the stages of MSDS? Stage 1 is Strategic Analysis; stage 2 is when we explore opportunities; then, we do system concept design; then, we do system detail design and finally, we do communication.

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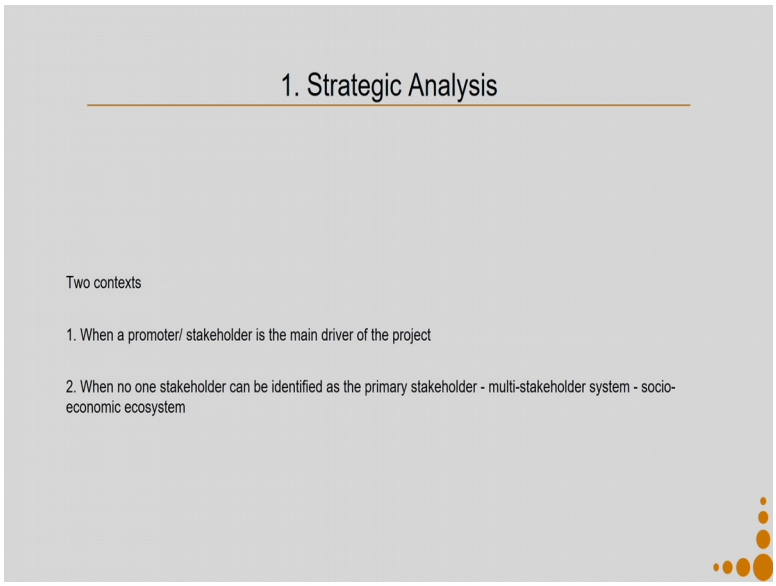

We also studied that Strategic Analysis; so, all the other steps remaining same. In the context of strategic analysis, we can have two context. In contest 1, there is a promoter or stake holder who is a main driver of the project. So, this promoter or stake holder comes

to the designer or comes to you asking that can you help us design a sustainable product service system for our company.

In this particular context of course, the promoter or the stake holders has a clear cut idea that sustainable product service system is a kind of concept or they have already implemented or they at least know about product service system design. It might be also a situation where see for example, the promoter or stake holder approaches to you saying that we have certain kind of difficulty or we want this new design to come up and then, you can also suggest them this SPSS.

How is it different from the second context? In the second context, there is no one stake holder that can be identified as a primary stake holder. So, it is a multi-stakeholder system or as we call it as socio-economic ecosystem; where, in the economic activities of the community is dependent on this social ways of living. So, like the craft sector, the farming sector, the hand loom sector and so on.

So, in the first context a there is at least 1 or group of promoter or stake holders and you can design it for them. Whereas, in this context it is multiple stake holders, nobody knows who is the main; you do not know who is the main, whom to you target and at their economic activities deeply ingrained in there social way of living.

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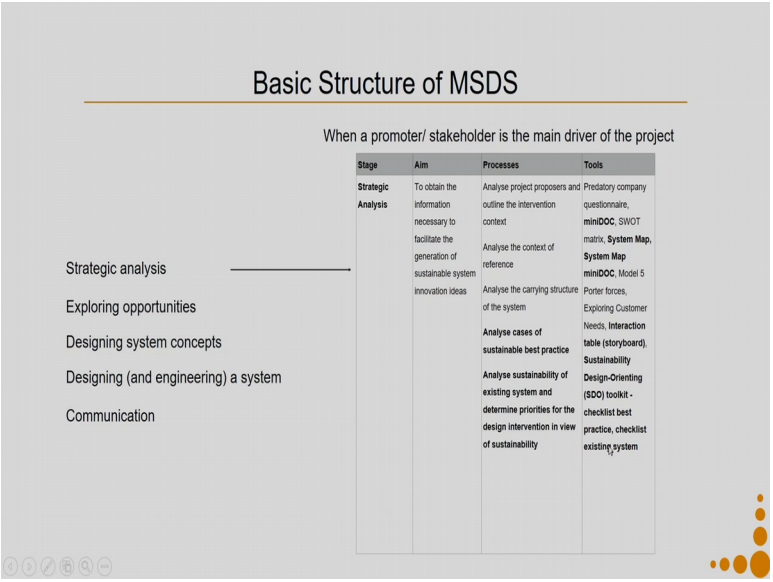

So, the basic structure of the MSDS method with respect to all these stages that we discussed consist of, so first let us take the strategic analysis when promoter or stake holder is the main driver of the project. So, in this case, in order to do the strategic analysis first, our aim is to obtain information necessary to facilitate the generation of sustainable system innovation ideas.

How do we obtain this information? First by analyzing project proposers and outline the intervention context because we know these project proposers and we will interview them, they will identify what are the intervention context.

Then, we will analyze the context of reference so which is like the existing context. So, we will try to understand the existing context and we will try to further define the intervention context. Then, we under try to understand the carrying structure of the system; carrying structure of the system in terms of technological aspects, social aspects, economic aspects and ecological aspects. This particular report helps us to understand that in the given context of reference, what is the carrying structure of the system? What is the boundary conditions?

So, it gives us further idea further idea to refine our intervention context. Then, we also try to identify cases of sustainable best practices. Why we try to do that? So, that we can bench mark our new design and also our existing system against the cases of best sustainable best practices in that particular domain. Many a times there might be no such solutions available; in that case we have no choice, but to keep this particular step.

The next process is analyze sustainability of the existing system and determine priorities for the design intervention in view of sustainability, that completes our strategic analysis. That is we have now obtained the information necessary to facilitate the generation of sustainable system innovations ideas.

Because we know about the project promoters, we know about the context, we know about the carrying structure of the system, we also know about sustainable best practices and we have also benched mark our existing system on the criteria for sustainability and we have determined our design priorities in the context of those dimensions and sub dimensions of sustainability.

We also discussed lots of tools in order to do each of these processes. Let us look at the other strategic analysis.

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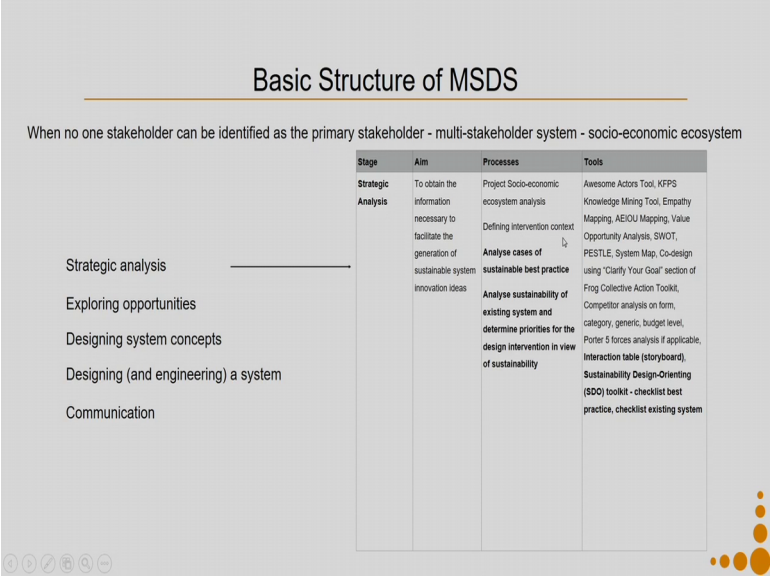

When no one stake holder can be identified as the primary stake holder and it is a multi-stakeholder system – socio-economic ecosystem. So, in this context, again strategic analysis aims to obtain the information necessary to facilitate the generation of sustainable system innovation ideas. But, in order to do this, my process is the first processes to first two process change.

So, my analysis of cases of sustainable best practice and analysis of sustainability of existing system and determine priority for the design intervention in view of sustainability, those two processes remain the same. But the difference that comes in this context from the previous context is, there is no stake holder, no one stake holder, no one main stake holder and the whole business or the whole activity, they come activity happens in a very distributed manner. So, just think of a craft sector just recall the (Refer Time: 08:01) handloom sector example that week took.

So, in that case first test very important for designers that we need to understand what is the eco system. So, first step is project socio-economic eco system analysis. So, how do we do that we have to understand who all are the stake holders; who all are the main stake holders; who are the stake holder which help these main stake holder in achieving the targets?

If then, try to identify what are their major contributions; what are their value systems; what is the gains that they on; what are the pains that they suffering? We also try to understand the existing infrastructure because in many of this context of the socio-economic eco system are big hurdling block is the infrastructure.

So, the best people to gather the information in this case is either local administrators or local visionaries, because they have bird eye view of the whole eco system. So, they can be the good starting point, they introduce you to the actors; the actors because they have being introduce by somebody who is local to their eco system, they have much greater trust on the designers who are coming into the picture.

Again, in this case as you can see the second step is defining intervention context. This is an extremely important step because there are so many stake holders, the intervention context definition does not come from so easily with when it is like one means stake holder the intervention context definition comes way much more easily.

Here, in this case the designer has to put in a lot of effort try to bring in all the stakeholders together, create have lots of focus group discussions and define the intervention contents context with mutual consent from all the stakeholders because, each and every stakeholder has very competing interest in the system.

So, we have to be very very careful at this defining intervention context. We might come up with the most beautiful sustainable product service system solutions, but if it is not acceptable to the stakeholders our whole design will fail.

Hence, defining intervention context in this situation is one of the most crucial event which determines the success and failure of your project to a great extent. Again there are lots of tools to do this particular activity which had been presented to you. Once, we are done with the strategic analysis now, we have the information which is required to facilitate generation of sustainable system innovation ideas.

Always be careful of the fact that we are talking about sustainable. So, we are talking about sustainable system innovation. We are not talking about product design, we are not talking about only service design; what we are talking about is system innovation, system design which will constitute which will be formed with product as well as a service. So, once this is done, our next step is let us try to explore the opportunities.

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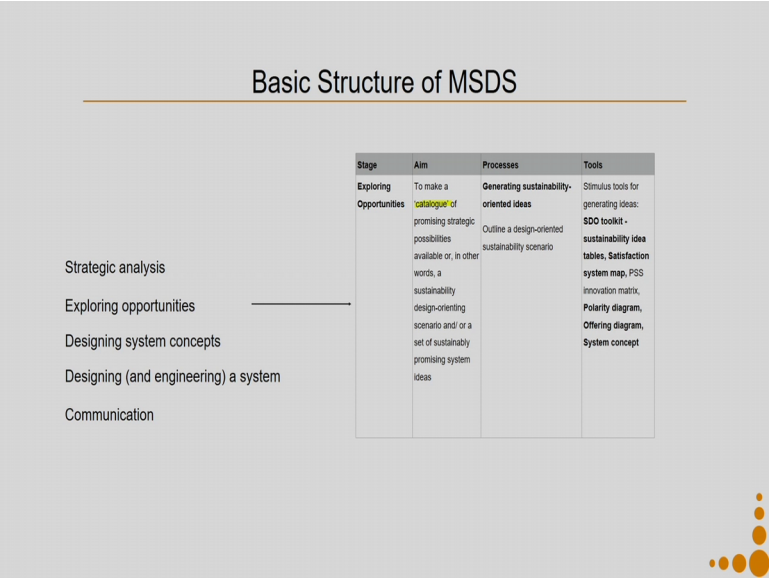

So, how do we explore opportunities? The aim of this particular stage is to make a catalogue of promising strategic possibilities available or in other words, a sustainability design orienting scenario and are or set of sustainability promising system ideas.

How is the exploring opportunity stage different from designing system concepts? So, the difference between an idea and a concept is; so an idea helps to solve a small part of a problem. So, you have a big problem, you cannot have one idea we solved that whole big problem, but you divide the problem into many components.

So, say for example, in our sustainability and design SDO example that we took of fresh water PSS, we were taking each and every component. So, the filter is a component which requires to be changed quite often and it gets clogged because of many different aspects, reducing the life of the whole product, also reducing the efficiency of the product.

So, that was one component of the problem. So, we pick up that one component of the problem and we try to generate promising strategic possibilities on how to deal with it. So, there will be certain aspects which will be related to redesign of the filter. But the filter is getting damaged not because of the filter itself, not because of the product itself. So, here comes a strategic ideation possibility.

So, we try to think of all those system components where we can change and as a result an entire system change happens. So, say for example, organizing regular monthly checkups of the filter or say doing an intervention at the main source of the water. If you put in a certain kind of a purifier which ensures that large dot particles do not enter into the filter.

So, that is the difference between ideas and concepts. So, when idea start, try to solve a part of the problem where we have broken down the big problem into chunks and a concept is something in which we bring together multiple ideas and give one holistic solution. So, in exploring opportunities, our target is to pick up individual problems in this big problem and try to come up with systemic ideas, service ideas as well as product ideas to solve the problem.

Then, come so, in order to achieve this in this particular a stage, our processes involved are generating sustainability oriented ideas. So, we use the SDO tool kit to do that and we finally, outline and design oriented sustainability scenario, once our idea generation is complete.

Once, we have generated all the ideas, we are ready to create something which is related to a scenario; so, which is like the bigger concept. So, I will combine couple of ideas and try to build up certain sustainability design oriented scenarios. I might come up with 3 to 4 different scenarios which have combined many of these ideas together. Once, this step is done; then, we get into designing the system concepts.

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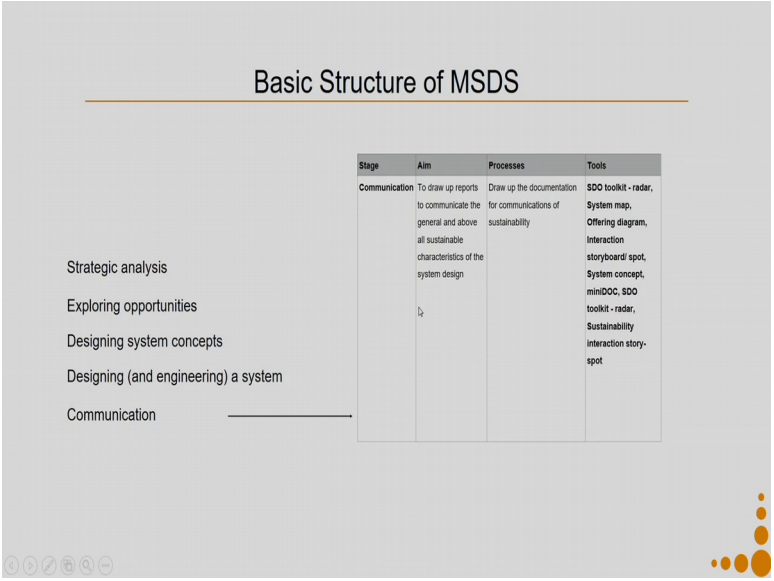

So, the aim over here is to determine one or more system concepts oriented towards sustainability. It is always good that if you can come up with multiple concepts that improves, the each and every concept, you can also draw up ideas from one concept which you might think is a better. But in case you have lack of time, then you can also come up with only one concept just because it there is lack of time.

So, what we do is we select clusters and single ideas which we generated in our previous context, the exploring opportunities; then, we develop our system concepts and then we do an assessment.

So, in this phase where we are designing system concepts; how is it different from the next step which is designing an engineering system. The difference lies in this designing system concepts, what we try to do is we pick up the single ideas or group of ideas from exploring opportunities phase and we cluster them together to form a concept.

Now, for this concept to be produced in the market, you need to further detail it in terms of economics, in terms of social aspects, in terms of the engineering aspects. So, that is what we do in the next stage, designing and engineering the system. So, in designing system concepts, I come up with develop system concepts, I do an assessment of all the concepts that I came up with on the environmental socio ethical and economic assessment.

After doing this assessment, I would be able to select the best concept. I might also see that out of the 3 concepts that I have developed; concept 1 is best, but concept 3 has certain aspects to it which is giving it is a very good strength on the social dimension.

I can also see, can I borrow those aspects from concept 3 and bring it to concept 1 or not. There after we go into the engineering and detailing of the system. So, detailed system design we then again do environmental and socio ethical and economic assessment of this detailed design using our SDO radar diagram.

How much detail it should be? It should be so detailed that anybody who reads your detailed report, which details the interaction, details the system; how it is going to be created; who is going to do what in the system; what is going to be produce; who is going to own the product; who is going to provide the service; how the payment modalities has is going to happen you have to detail them to the level that anybody who takes your report can implement it into the feed.

Finally, the last step of the MSDS method is where you communicate all these aspects, all the sustainability improvements that you have brought in; how you have brought in; how the system has to be implemented; all these needs to be communicated. So, you draw up reports to communicate the general and above all sustainable characteristics of the system design.

The communication part of it depends largely on who your audience is going to be? Say for example, your audience is going to be a funding agency you will pitch it accordingly. If it is going to be a certifying agency, you are going to give them communication documents as per the requirements of the certification organization.

If say you are going to give this as proposal to a company so that they can fund it as per their CSR projects. Then, again it has to be very different kind of communication. So, you want to just you have all the funding, have done a great job and you want to tell the whole world that see I have done a great work and you can replicate more work. Then, again the communication has to be modified accordingly. So, these were the basic structural elements of the in a MSDS methodology. This helps you to create the whole system smart.

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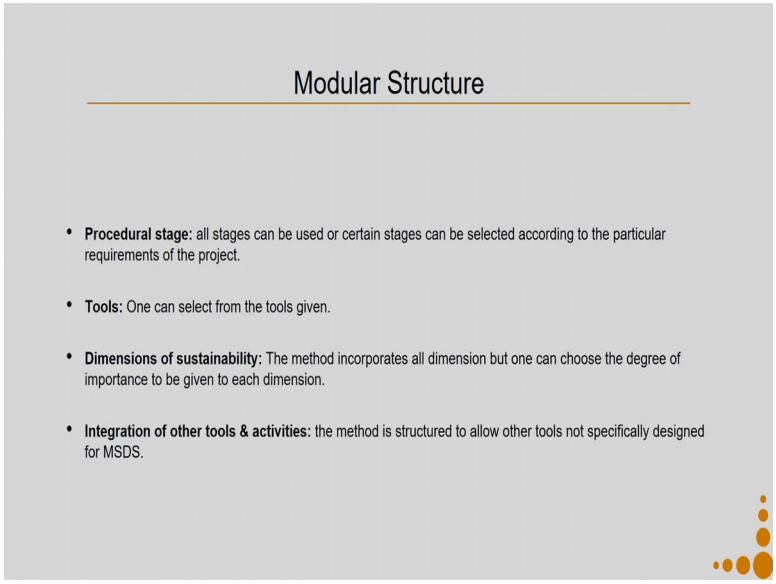

So, the benefit of this structure as I showed you again a summary of all the processes and stages involved let us also see that this is a very modular structure. You are given the freedom to make changes to take certain aspects to not take certain aspects because they all depend on your context. They also depend on the amount of resources time, money and human the resources that you have at a given instance.

So, at the procedural stages; so, you had the strategic analysis, exploring opportunities, designing system concepts, designing and engineering the system and communication; the 5 stages. So, in all the procedural stages, you can use all of them. For all stages, can be used or certain stages can be selected according to the particular requirements of the project.

Say for example, strategic analysis has already been done by your client then of course, you can drop that particular stage. Say at the designing the concept stage only you did the design and the detailing together. Then, in that case many of these steps will merge. There are lots of tools which have been mentioned for each and every processes and sub processes that we are going to use, you can select the given tools, you can also bring in your own tools.

So, say for example, you want to conduct or participate design session and you assume that in this participate design session, if I conduct it in a manner that people start playing

games and when they are playing games, they come up with a definition of the problem context.

So, that is you are bringing in this game design tools or game storming tools, you can bring in body storming tools where in people start enacting what they have supposed to do. So, although those tools are not specifically designed for this particular method; but as per the requirement of the context, you can bring in tools that you think I have more appropriate for the given process.

Also you do not necessarily need to go through all the tools. You can pick up the tools which are most important for you, I will shortly also show you a selection of the most important tools which in my experience, one should not skip one should do it to get better results.

Then, come dimensions of sustainability. We are concerned about all the 3 dimensions as in the SDO tool kit. You have already seen it has environment, economic and social ethical dimension. All the dimensions are there; but the tool gives you the possibility to set different priorities. Even within the say the environmental dimension, there are 6 of dimensions. So, you can set different priority levels to system life optimization; say system life optimization gets high priority in your context, but waste minimization gets low level priority.

So, all those possibilities is offered by this particular tool. Hence, it is also called as modular structure. You can of course, you can bring in other tools and you can also bring in other activities which can become part of this methodology and is happening because of your current context.

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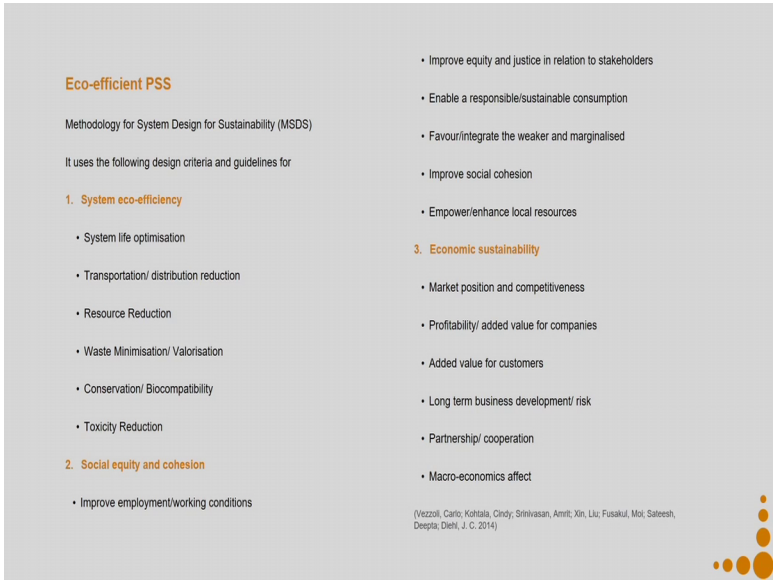

So, as we told that there are 3 dimensions. So, the Eco-efficient PSS, it talks about system eco efficiency which is about system life optimization, transportation or distribution reduction, resource reduction, waste minimization valorization, conservation or biocompatibility and toxicity reduction. So, you can set different priority levels to each of these sub dimensions.

Then, comes Social equity and cohesion, improve the employment of working conditions; you improve the equity and justice in relation to stakeholders; enable a responsible or sustainable consumption; favor or integrate the weaker and marginalized; improve social cohesion; empower enhanced local resources.

The third dimension the economic sustainability. So, you look at market position and can competitiveness; profitability or added value for companies; added value for customers; long term business development or risk; partnership or corporation; macro-economy affects. So, in this particular tool all the 3 dimensions are being considered. Hence, the chances that you come up with a sustainable solution is much higher because you are talking about you are deliberately trying to design at the confluence of all the three dimensions.

So, what are the key tools for this sustainability orientation, which will which in my experience you should always try to incorporate because this is a long methodology. It takes a lot of time; it takes a lot of resources to go through. I would suggest that in case

you, you all of us always have a project timeline. So, it is always good that you put in certain amounts of time. So, say for example, your entire time available for doing a particular project is 12 hours; you allocate couple of hours for strategic analysis.

So, say I allocate out of this 12 hours, 2 hours for strategic analysis; 2 hours for exploring opportunities. I allocate some 8 hours for designing the system and detailing system and the rest for communication if any if it is required, that helps you to keep yourself under check that I do not way run out of time.

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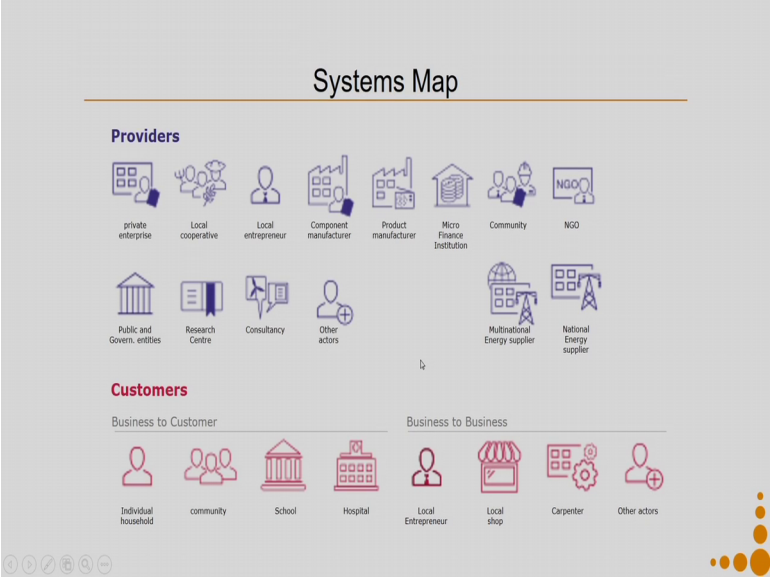

What are the key tools that you should not skip? One of the most important this is having a system design. So, you just cannot skip this tool, you have to do the systems map; you have to make the systems map multiple number of times.

So, systems map, it is made in 2 steps; step 1 is where you list down all your stakeholders who are the providers and all the stakeholders who are customers. So, as we had discussed, we use different kinds of the icons; we use the text below that; we also use different colors. Providers different colors and customers different colors. Customers can be again business to customer or business to business. So, this is the step one of system map, where you identify all the stakeholders and this is the step 2.

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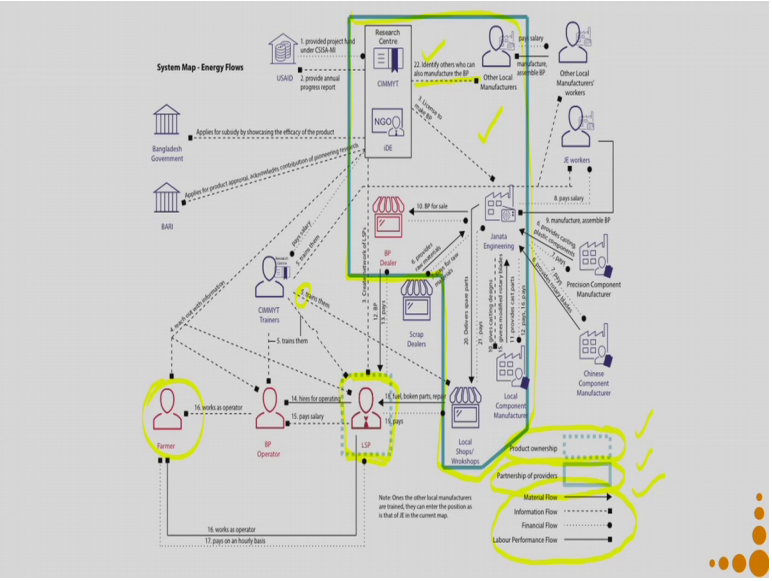

This is called as the energy flow diagram in a system map. Why energy flow? Because it shows all the material flow, it shows the information flow and it shows the financial flow and the labor performance. So, between each and every stakeholder, you buy using these arrows you say what is flowing between them and you write on top of it what is in you describe what is flowing; you can also put down a number.

So, this is step 5. This also gives the reader, an idea where to start from; I will start from 1 and I can go on reading serially because this is a pretty complicated map to read through. You also try to show who are though what is the partnership of providers, what is the product ownership. So, not necessarily so, in this case the product ownership is here and this large box depicts the in a partnership of providers.

So, this one is an example of product oriented PSS. So, as a result the product no longer is owned by the providers, but the product is owned by the customer. But again, in this particular context my end customer is a farmer and this one is also a service provider.

So, depending on your system you will create what is it means for your particular system, you will create one systems map where of the existing scenario; then, you will create another systems map of the new scenario that you created. So, say if you have 3 concepts for sustainability, you will create 3 systems map. Then, you do the detail design, you again create another systems map of your final design.

So, minimum 2 systems map in case you do the existing systems map and then, you do the final systems in a map. It might be also very helpful that the when you do the analysis of the best practice of sustainability cases, the step from strategic analysis; if you can do a systems map for those best case examples, also it will be very good. Because it helps you to identify what are the elements; what are the flows in those systems that you could qualify them as best practices in the context of sustainability.

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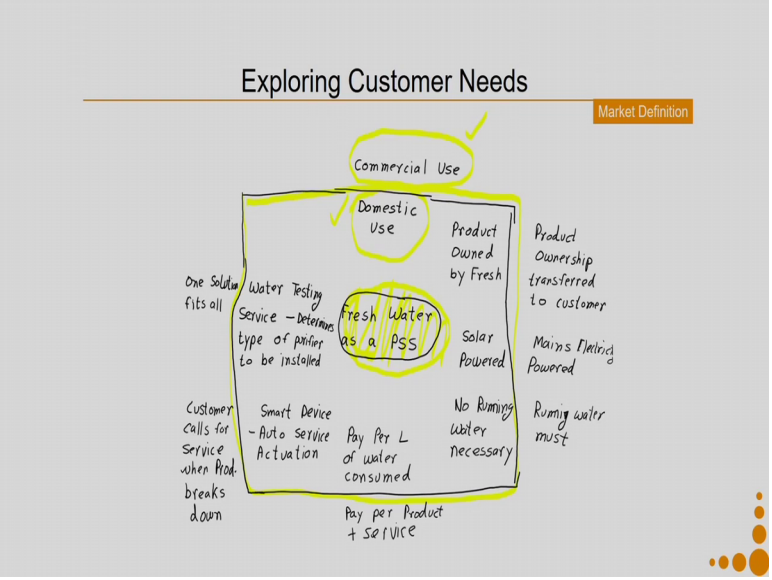

Another very very important tool they should not be skipped in this whole process is exploring customer need. As we had already discussed the very basics for sustainable product service system design is we try to switch our focus from designing products to designing for customer satisfaction.

Hence, we have to understand what is the need of the customer, what is that which satisfies the customer? Hence, this is the another step, a very important step in this whole process which should not be skipped.

So, how do we do this exploration of customer needs? So, there are 2 steps; step 1 is market definition where you put your PSS that you are going to design in the center. Then, you create a boundary all around it, what will be inside your boundary? So, what will be your PSS in the market definition? So, you put that inside and what it will not be, you put outside. It is very important to put what it will not be outside because if gives see a much clearer picture.

So, when I see it is meant for domestic use and it is not meant for commercial use in the subsequent stages, I can also decide say for example, is a small business with 4 to 5 employees equivalent to domestic use, because there is not so much commercial use. So, these meanings have a lot of implication on how are you going to design your system; how are you going to approach your customers and so on.

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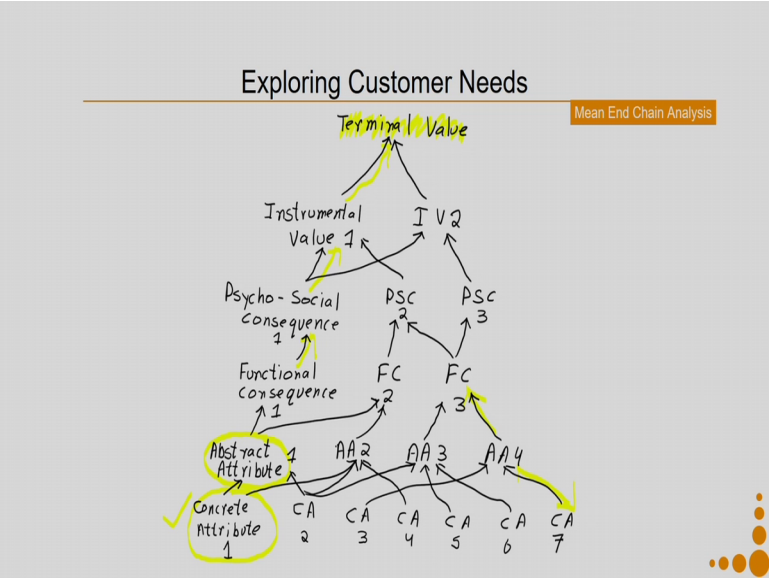

The next step of exploring customer needs is the means end chain analysis. This is also one step which takes considerable amount of time. So, you have to try to understand what are the concrete attributes, abstract attributes, functional consequences, psychosocial consequences, the instrumental value and the terminal value.

So, in this particular map, terminal value is something that you will reach at the end of it. So, which is basically the end goal and value that you are going to give out of your SPSS in order to start this particular means and chain analysis, it is usually helpful if you can start from the abstract attribute level. Why so? Because in the abstract attribute level.

So, like we discussed in the case of fresh water PSS that I want safe drinking water. Safe drinking water is an abstract concept. What do I do from that particular abstract attribute is defined the concrete attributes. So, safe drinking water we can imply no microorganisms in the in a water, no chemical in the water.

So, in order to remove the chemicals say I have to incorporate process a, process b and process c of purification; in order to get rid of all the microorganisms, I will have to use some process d. So, they become part of the concrete attributes.

Hence, we always start or it is always better to start at the abstract attribute level. You can involve all your stakeholders or after inter being your stakeholders, you can yourself sit down and try to do this means and chain analysis and once it is done you can go back to your stakeholders and discuss and make modifications accordingly.

So, from abstractor attributes, we go into identifying what are going to be our concrete attributes; then, from abstract attributes I go to identifying my functional consequences. So, due to each of those abstract attributes what is the functional in a consequence; from there what is a psychosocial consequence. As a result the instrumental value created and terminal value created.

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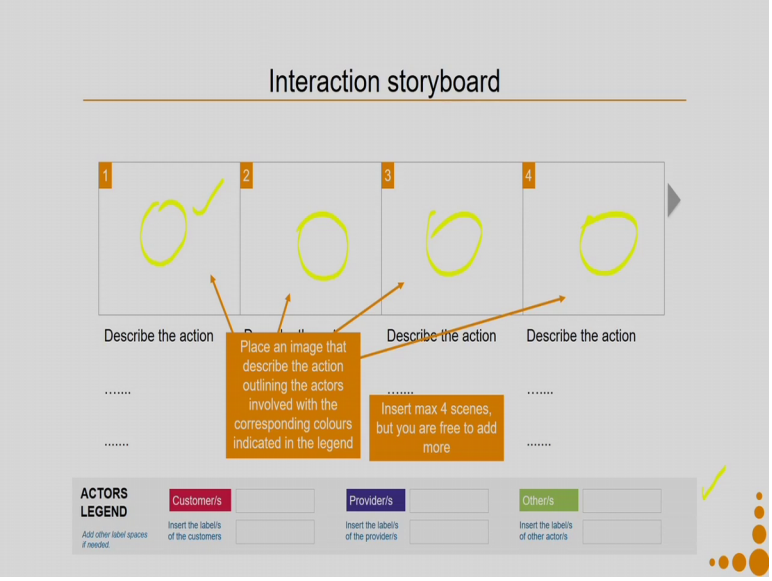

Another important stage is the Interaction Storyboard. What you do in an Interaction Storyboard is you describe an action, you describe another action, you describe another action. So, insert maximum 4 actions you try to say which are the actors involved in this particular action. So, please the image that describe the action outlining the actors involved with the corresponding colors indicated in the legend.

So, we will be using the same kind of legends that we have used in our systems map. What it helps to identify is the kind of interaction which is happening? So, you can create the instructions storyboard for the existing system which shows how the different stakeholders are interacting with each other for a given action.

Not necessarily you have to do it for all the actions because that will be a very huge interaction storyboard. But for the key actions, you can create the interaction storyboard. Again, you will have to make an interaction storyboard when you have come up with your ideas for sustainable orienting design scenarios.

So, in that particular context, you highlight those interactions which are actually bringing in sustainability, because they are the key ones which need to be elaborated and it needs to be highlighted and thought through much nicely. So, again this interaction storyboarding you might have to do minimum 2 times; one for the existing and one for the new and it might also happen as many times as there 4 times.

So, once for the existing scenario; second time for the best case sustainability scenarios that you have identified. Say you have identified 2 or 3, then you will do it for all 2 or 3. So, in that particular context you only try to highlight those interactions which are sustainability orienting in order to save your time. Then, you do it when you have done your opportunity exploration of the opportunities that you have explored. Then, when you have done; when you are done with the design detailing, you show another interaction storyboard. So, this is the maximum case with minimum cases for existing and the final scenario.

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The SDO tool kit is another very very important tool and this is like the heart and soul of the whole process. So, should not be avoided. This toolkit will help you to give priorities through the different dimensions, the environmental social ethical, economic sustainability.

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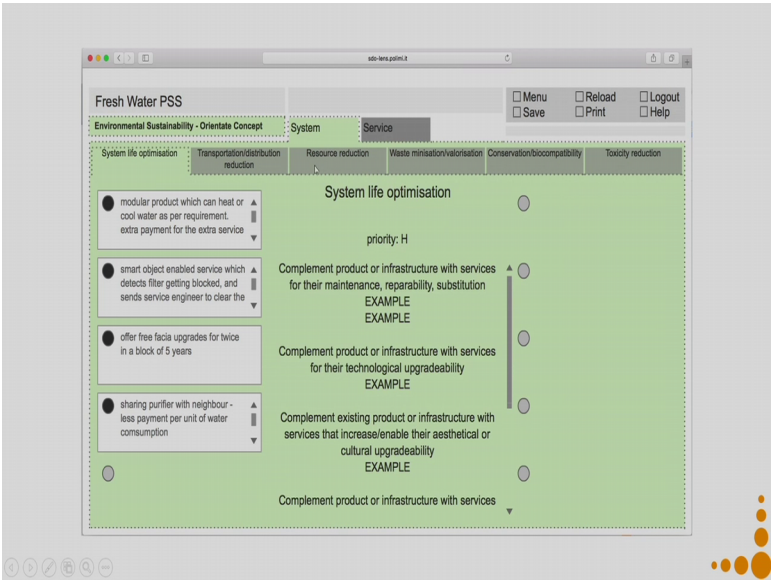

It also helps you to generate ideas. The SDO tool kit helps you to generate ideas, which are oriented towards system design and service design. Why so? Because we are trying

to deviate ourselves from the traditional way of improving product related innovation. What we are interested in; how do I satisfy the customers need?

Of course, when you have to implement it before the products that are required you have to design those products as well; but our major focuses on the system design on the service design which can. So, in the system along with the service you will put in the products so that the customers needs are satisfied.

So, when you are generating ideas be very very careful that when you are on the system tab, you generate ideas which are at the system level and when you are at the service tab, you generate ideas which are at the service level. Say for example, when I say smart object enabled service which detects filter getting blocked and sends service engineer to clear the filter.

So, here you can see that I started with smart object. Smart object is no object it is like an entire ecosystem in itself. Then, I am also saying that it detects the filter is getting blocked and it sends service engineer a message that the service engineer has to come and the service engineer has to attend that particular problem within one days time. So, that is what is meant by a system idea.

So, a part of the problem which was related to my question compliment product or infrastructure with services for their maintenance, repairability and substitution. So, for that I came up with this systems idea that there is a smart object which detects problem, which a notifies a service engineer and the service engineers implement contract says that you have to go and attend to that service problem within one day.

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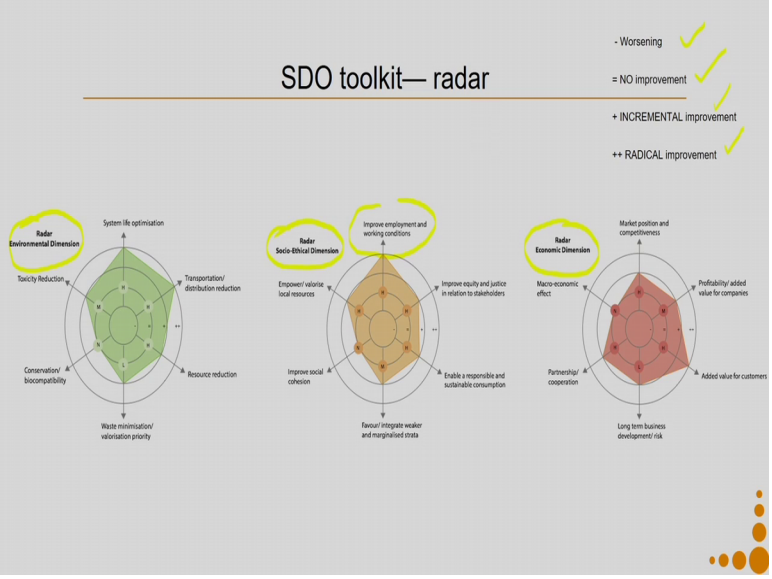

Once this particular in a whole chart is filled, the SDO toolkit also helps you in doing an assessment. It is a qualitative assessment; it is not a quantitative assessment. In order to do a quantitative assessment, you should go and do a lifecycle assessment. The problem of doing a lifecycle assessment in these contexts is many times you might just not have data to do it.

So, as a result strength of this qualitative assessment is also very high it atleast gives you a way much more simpler tool to do an assessment. You can do this assessment yourself, but it is better if you do this assessment with the stake holders involved because when they read through your project report, they might be better able to because we are part of that ecosystem; they are daily dealing with that, they might we also able to bring in a useful inputs to you.

Even this SDO toolkit diagram, this has to be done couple of times. So, the first radar diagram you prepare for the existing in the best cases that you have identified. As per the SDO toolkit you are supposed to identify 2 best cases, if that is possible. So, first radar diagram is prepared. So, I try to identify how good or how bad it is on the each of these parameters.

So, this is what for the environmental dimension; this is for the social ethical dimension; this is for the economy dimension. So, I try to identify how are they worse as compared to my existing scenario or there is no improvement as compared to my existing scenario or there is incremental improvement or there is radical improvement.

If there is an incremental or radical improvement, I can see how can I adopt that particular part of the system into my redesign so that I can also achieve radical improvement in sustainability from the existing scenario. So, that is point 1 when you make your radar diagram. Point 2, you make your radar diagram when you are trying to do an assessment of the concepts that you have designed.

So, say you design 3 concepts; you will do SDO radar diagram for all the 3 concepts that gives you a comparative idea like which of these concepts performs very much better on sustainability parameters and then finally, of course, you will do a radar diagram for your existing sorry for your final design.

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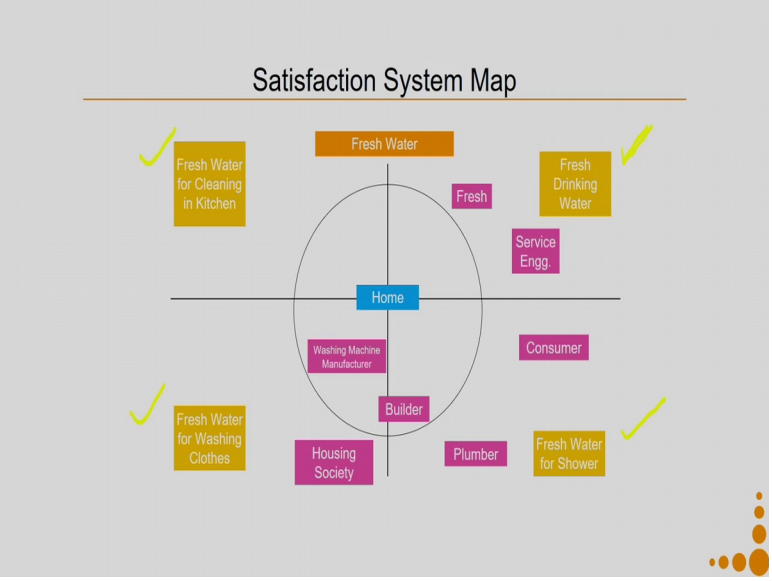

Another important tool this tool can we skipped, but if you bring this tool into your process what it helps you is to expand your in a system design. So, say we started with fresh providing, fresh drinking water; but this by using this tool the system satisfaction system map which tries to identify what all other things I can push my system into with minor modification, gives way much more data utilization of my system. It also reaches me out to very much more larger market segment.

So, as in this example my fresh drinking water, it expanded into fresh water for showers; fresh water for washing clothes; fresh water for cleaning in kitchen. So, this satisfaction system map helps you to in a broaden the scope of your system design and your system can reach to much wider net argot audience. So, if you do that is the advantage you have.

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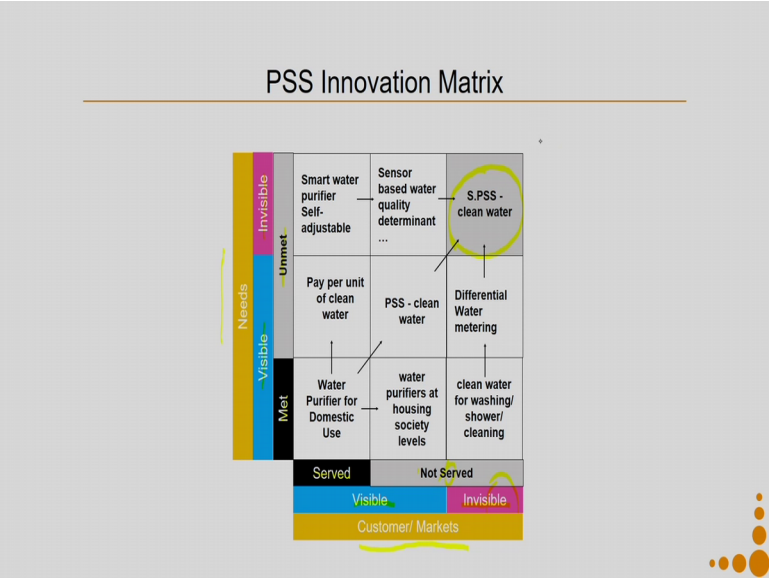

Another tool which can enrich your concepts further; this is not one tool which is like a must have tool, but this tool helps you in enriching your idea further. So, if you have time; so, please go ahead with using this particular tool. What this tool helps the PSS innovation matrix, you try to map what are the customer markets; customers and markets available, what are their needs; what are the visible needs; what are the in sorry what are the visible customer or markets; what are the invisible wants; what other visible needs; what are the invisible needs; of those needs of the visible needs, what are met and what are not met and of the visible customers, who all are served and who all are not served?

When you put this thing into the matrix and your start putting in your idea, your target should be reaching this corner which gives you all huge competitive advantage, why? Because now you are able to target invisible needs; needs which were not visible till now and hence, they were not met and markets which were till now not visible and we are not served. So, you are designing a solution over this space.

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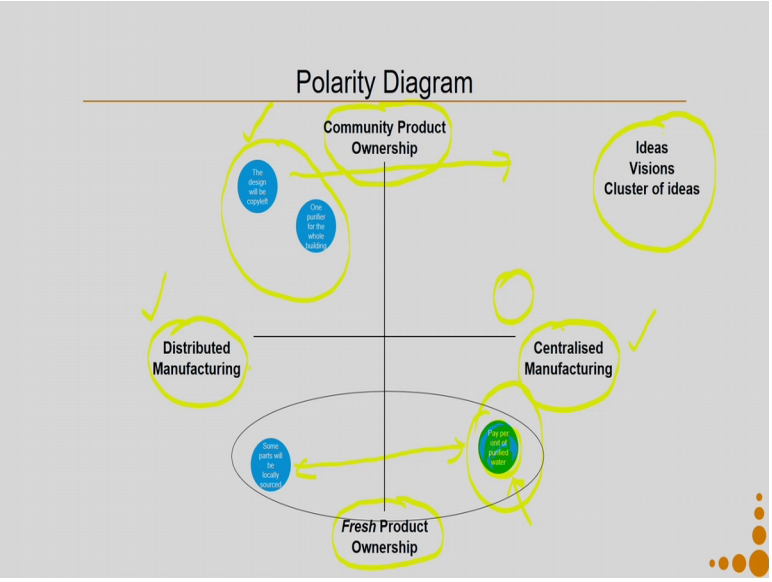

So obviously, your product will perform, your PSS will perform very nicely it will have a competitive advantage and it will also give you is the transition very drastic; are there available technology or available solutions which can be adopted to fit into my solutions? So, this matrix helps you to determine all those aspects.

Then, comes the Polarity diagram. I would always suggest that this is another must have tool. Why so? This tool helps in 2 ways. Firstly, it helps you to put your ideas on a 2 by 2 matrix. So, you can put opposites, distributed manufacturing versus centralized manufacturing; you can put community product ownership versus fresh product ownership.

So, you will have many of these polarity diagrams. It depends on your concept and what all you think is important. So, after you have done your idea generation in the exploring opportunities stage, it is very important to create a polarity diagram, where in on the polarities you put opposing conceptual frameworks. There after you put your ideas, visions or cluster of ideas that you have generated into this polarity diagram.

So, it helps you to see where my ideas are lying; if I see my idea lies here, but I see more opportunity over here, can I bring this idea over here? So, that gives you further gives your creativity for the boost. It also tells you that what are the disadvantages over here; what are the advantages over here?

So, I know that I cannot have distributed manufacturing. I have to go for centralized manufacturing because of cost considerations. But I know sustainability is higher, environmental sustainability is higher if I would have gone for distributed manufacturing. So, how in this particular concept because this is more of a viable concept and I want to go into this concept, how can I bring in situations which can bring greater sustainability in the manufacturing or greater sustainability in transportation or can I combine the best of both words?

So, some in components happen in a distributed manufacture; others happen in a centralized manufacturing fashion. So, the polarity diagram helps you in expanding your ideas and also knowing what are the drawbacks of; what are the sustainability related drawbacks each of those ideas and then, you can try to think of ways in which you can counteract them.

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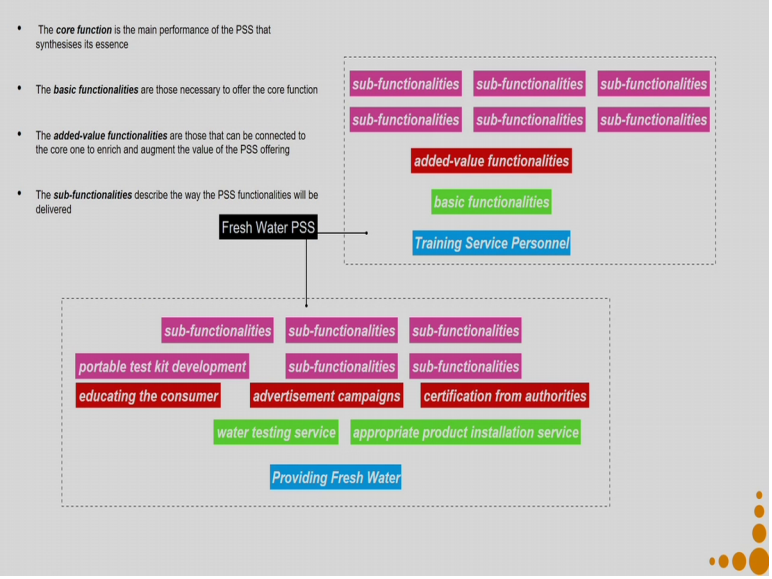

Once the polar; so, the polarity diagrams they can be done while you are trying to design the system concepts as well as when you are trying to do the system detailing. This is where you try to map, what are the core functionalities, the basic functionalities, added value functionalities, sub functionalities; these are always they have to be part of the a detailed system design. So, you cannot avoid this particular step. It is also very important because it gives you what more clearer picture, you are yourself your idea gets more and

more refined. Also this particular step is very less time consuming. So, going ahead with this step is a good idea.

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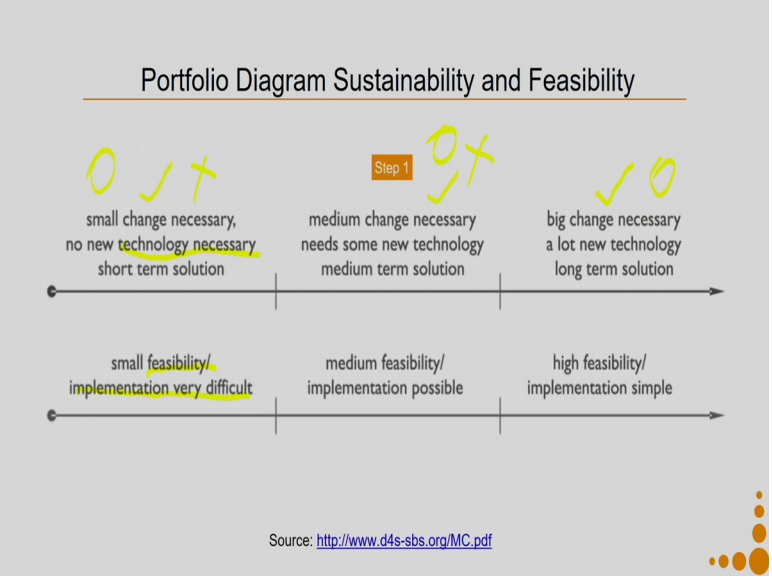

Very important you have to do a Feasibility check. Feasibility check has to be done in terms of technology necessary; also in terms of implementation or feasibility. So, I can have small change necessary or no new technology necessary, I can have medium level; I can have big change necessary. Why it is important not necessarily anything which require big change should be avoided or anything which does not require any change should be embraced. It is not for that we have to know what other resources available at hand; can should we go here or should we go here or should we stay here.

We have to also consider our computation. If like if we are over here and the competition is going to catch up with us within 6 months, then all our effort is not very fruitful. So, hence why not be over here. Then, comes the feasibility or implementation. So, there is small feasibility or implementation is very difficult or there is medium feasibility or implementation as possible and high feasibility of implementation is simple.

These 2 are different aspects. Something which hell requires a big technological change might be feasible, that big techno it might also be like medium feasibility; only in case when this big change is has small feasibility, then we should reconsider whether we really want to go ahead with it or not.

So, this particular diagram helps you to check feasibility in terms of technology as well as in terms of implementation. So, we have to do this.

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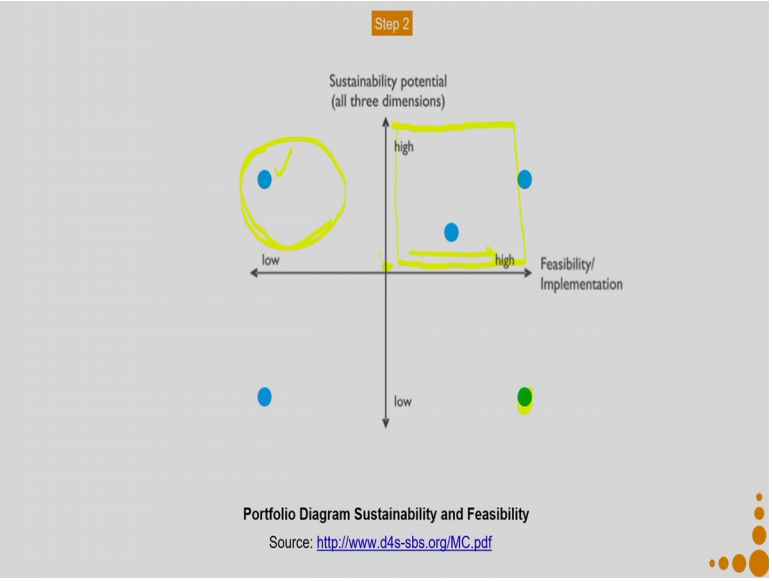

The other way in which you can look at it is, looking at it as a portfolio diagram. So, where you can put sustainability potential because we are talking about, sustainable product service system design.

So, in our previous slides, we compared technological fees technological change requirement and the feasibility or implementation plan level; but it is also very important that we check on to the sustainability potential. Say something has very high degree of feasibility, but on the sustainability potential, it lies somewhere really low. So, it is somewhere over here. Of course, that is not the solution that we want to take because our purpose is to go for sustainable solution.

Hence, we want to targets anything which lies in this zone because the sustainability potential is either good or it is, not much change and I am still I have a feasibility option possible. All these options say for example, in this quadrant where the sustainability is high; but feasibility or implementation is difficult or feasibility is low in that case I might consider is it that if I take this keep this strategy for a long term option; is that a viable option we can, try to think in those courses.

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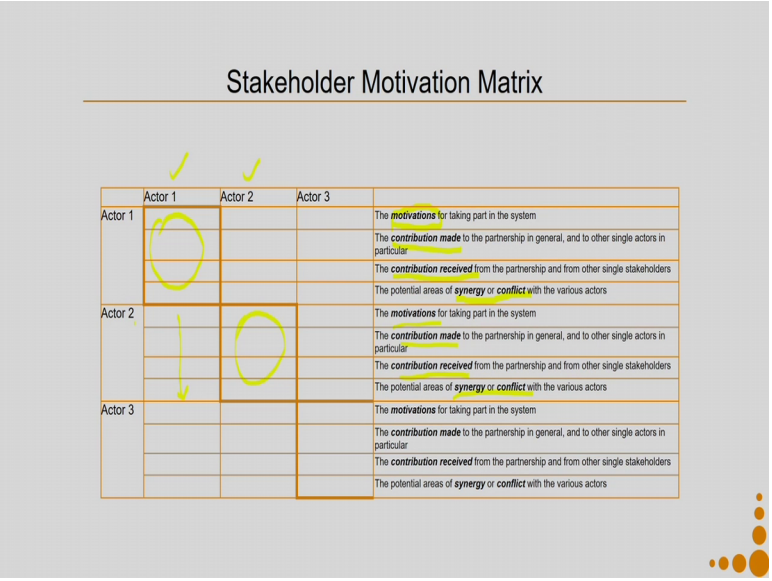

As we started with the definition of products of a system design; so, the sustainability in this sustainable PSS is brought in a manner that it is in the economic interest of the providers to be sustainable. Hence, to get that we need to know what each stakeholders motivation is.

So, this stakeholder motivation matrix, I can create as my end result as may when I am doing my system detail design, I can create this stake holder motivation matrix where I try to identify what is the motivation; why will a particular actor, there will be multiple actors why will an actor want to participate into it. What will be the contributions made by each; what will be the contributions received by them from another other actors and what are the potential areas of synergy or conflict?

So, we will list down all our actors. So, at the confluence I have the what it is meant for actor 1 to do those activities and here in say when I am talking about actor 2 with respect to actor 1. So, here I will put down element switcher of actor once actor 1 versus actor 2 the motivation, the contributions I have made, the contribution received and synergy or conflict. And here, it is for actor 2 for themselves or some of the key in tools so from the MSDS methodology which needs to be incorporated.

In order to be able to complete your project within the given time frame, you can set different timing. So, you can say I will spend 1 hour for doing this particular matrix; 2 hours for another matrix or say 1 month for doing a matrix, 2 months for doing another

matrix. You will be better able to do justice to all of those steps. Each step has their own relative advantages and they have been those tools have been built into it so that you can achieve the best possible sustainability oriented product service system design.

In one of the projects which was related to agricultural machinery design, where we try to apply this entire MSDS methodology; it took us around 4 months of time to complete all the stages of the this methodology. Within this 4 months, we also did the engineering design of the agricultural machinery. So, this particular project also involved around 30 different stakeholders. So, this gives you an approximate idea regarding the scale of people involved, regarding the time involved.

So, say if you take up a student project, when we use this methodology in our student's projects. So, usually a student can finish applying this methodology in semester's time. So, that brings us to the end of this sustainable products of a system design method. So, we will meet next week with another module.

Thank you.