System Design for Sustainability
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Week - 08
Lecture - 01
Sustainable Product-Service System Design - Methods and Tools

Hello everyone, so, in today's lecture what we are going to discuss is about. So, we already finish the strategic analysis for the MSDS method.

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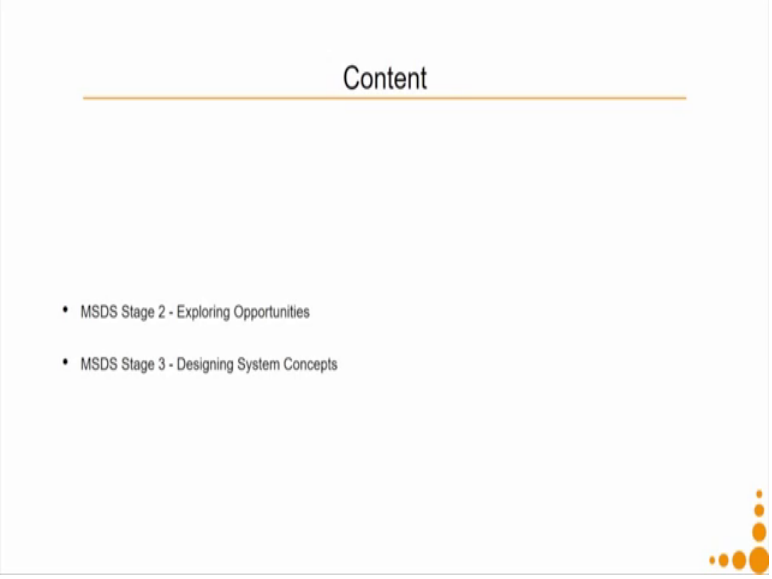

Now, we are going to talk about how do we explore opportunities and design system concepts.

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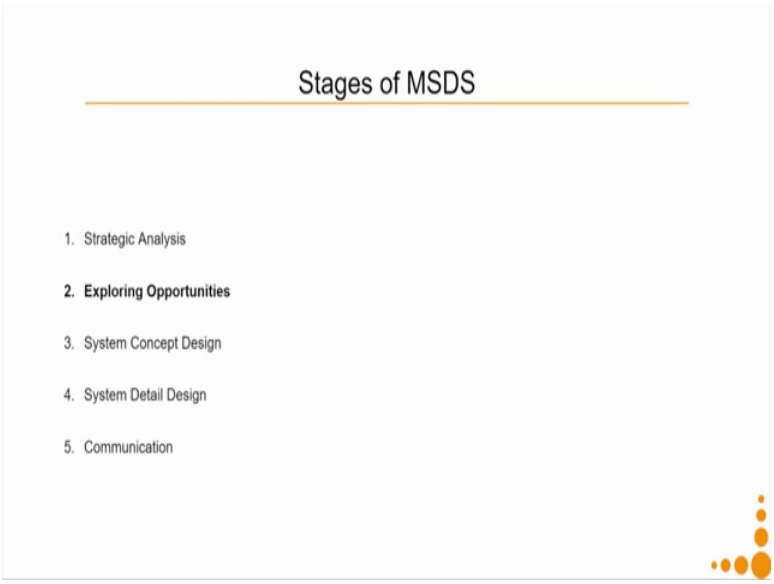

So, as we had discussed just a quick recap the stages of MSDS are first you do a strategic analysis, then you try to explore opportunities, then you do system concept design, then you detail that particular system.

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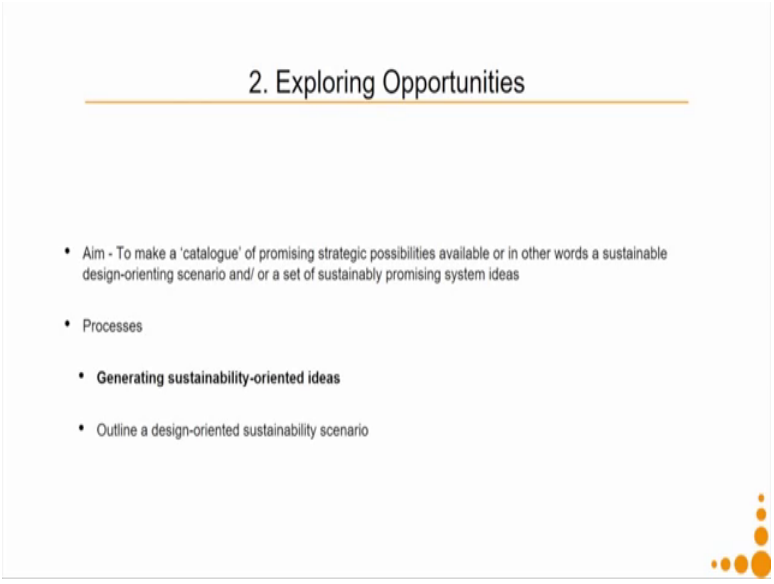

And finally, you communicate the sustainability improvements and how it is suppose to be used the proper solution. Two exploring opportunities, the aim of this particular stage is to make a catalogue of promising strategic possibilities available or in other words, a

sustainable design orienting scenario and or a set of sustainability promising system ideas, so, very importantly we are going to propose system ideas over here.

So, the system ideas can compose of ideas for how do I implement the PSS what kind of PSS it is suppose to be, what are the service components that are going to be part of this, we do not try to focus on the product design.

Of course, to implement the PSS we might require certain changes in the product design as well, but the aim of this particular project, because we are talking about sustainable PSS our aim is to explore, opportunities for system and service design related issues. And we will also identify what are the product related issues, which need to be solved at the end of the MSDS process, we can make those improvements into the product and place into the market as a sustainable PSS solution.

So, the processes for doing this are firstly, we generate sustainability orientating ideas, that is to be always remembered at the back of your head, that I want to generate sustainability oriented ideas, then outline a design oriented in sustainability scenario like how through the design or how through the conduction of that particular PSS I am getting a sustainability.

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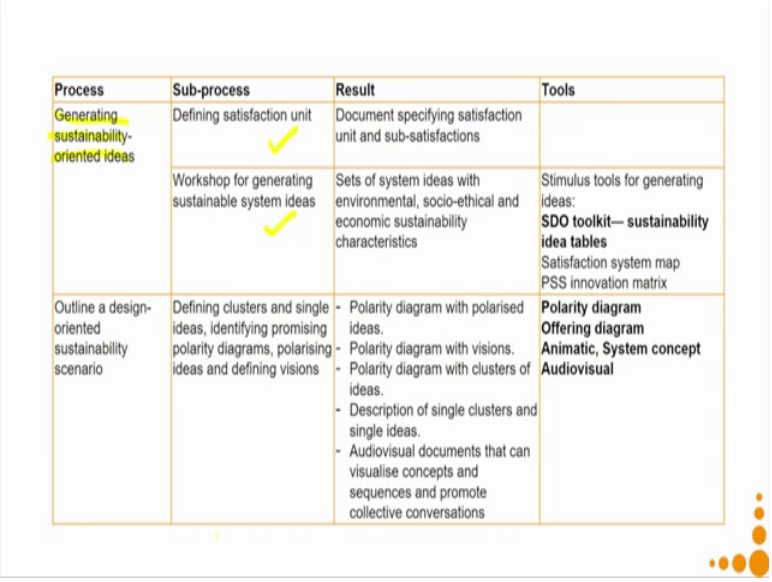

Process	Sub-process	Result	Tools
Generating sustainability-oriented ideas	Defining satisfaction unit	Document specifying satisfaction unit and sub-satisfactions	
	Workshop for generating sustainable system ideas	Sets of system ideas with environmental, socio-ethical and economic sustainability characteristics	Stimulus tools for generating ideas: **SDO toolkit— sustainability idea tables** Satisfaction system map PSS innovation matrix
Outline a design-oriented sustainability scenario	Defining clusters and single ideas, identifying promising polarity diagrams, polarising ideas and defining visions	- Polarity diagram with polarised ideas. - Polarity diagram with visions. - Polarity diagram with clusters of ideas. - Description of single clusters and single ideas. - Audiovisual documents that can visualise concepts and sequences and promote collective conversations	**Polarity diagram** **Offering diagram** **Animatic, System concept** **Audiovisual**

So, let us look at the processes and sub processes that, we are suppose to follow for this particular stage. So, let us look at the processes and the sub processes involved in exploring opportunities.

So, our first process involved is called as generating sustainability oriented ideas, what we do in this particular process is two sub processes, first we define the satisfaction unit and then we conduct a workshop for generating sustainable system ideas.

So, why do we start with definition of the satisfaction unit, because after doing the strategic analysis after knowing what my design intervention context is who are my competitors I would have refine that particular phase in an I am sure, what my intervention context definition is going to be.

So, I will start with defining the satisfaction unit. So, say in the context of fresh the water purifying map purifying manufacturing company.

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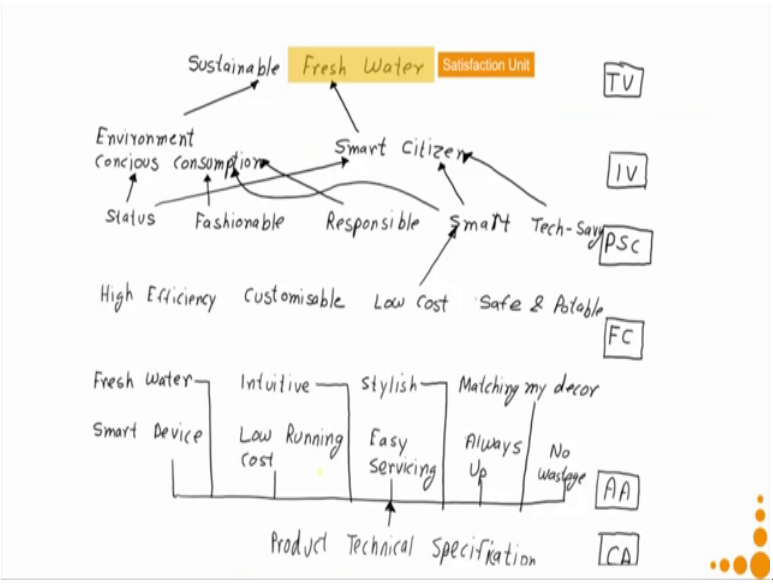

My satisfaction unit can be defined as fresh water providing fresh water, that is what a consumer wants that did a non wanted water purifier they want fresh water.

So, my definition of the satisfaction unit is fresh water, I also write a document specifying satisfaction unit and the sub satisfactions. There after we will start with work shop for generating sustainable system ideas.

So, we define the sustainable water, because we have created this particular chart, we will be also having some of the sub satisfactions, if you also remember the offering diagram we created some sub satisfactions, some actions which in the core functionality the basic functionalities and so, one.

There after we get into generating the sustainability oriented ideas, why does it suggest that, let us do it in a work shop mode, because if all the stakeholders are involved say for example, there are certain stakeholders, who are engineers and specialize in developing the technology used for these water purifiers, there might be others who are from the marketing department of the company there might be some service engineers.

Involved and you can also involve some customers, what will I get through this particular workshop is get the ideas from many different stakeholders the designer also contributes towards idea generation. So, we will use the SDO toolkit for creating the ideas, we call this as SDO toolkit sustainability idea table.

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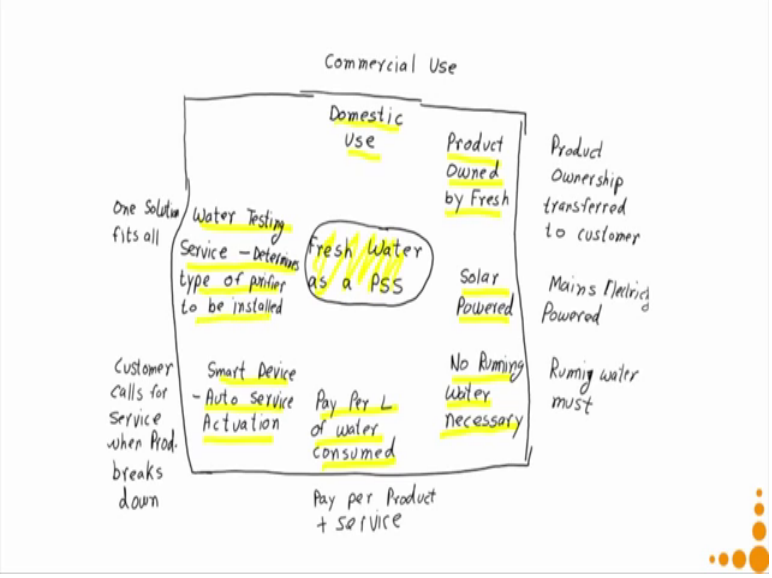

So, we will look into the SDO toolkit before going into the SDO toolkit, let us do a refresher of what we thought was important for this fresh water as a PSS.

So, we had define that the market of market definition for this will be domestic use, product own by fresh, solar powered, no running water necessary you may have running water pay per litter of water consumed smart device so, auto service activation water

testing service which determines the type of purifier to be installed at that particular location. So, this was how we started rate market definition of fresh water as a PSS.

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So, now, let us use the SDO toolkit and go into details of how do I explore opportunities.

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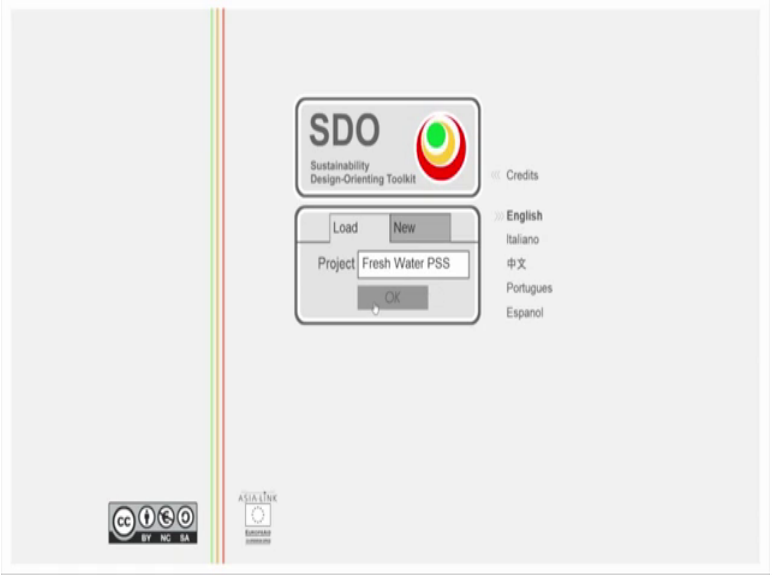

So, as you might remember from our previous lecture, this is the SDO toolkit, I will have to put the name of the file and say load.

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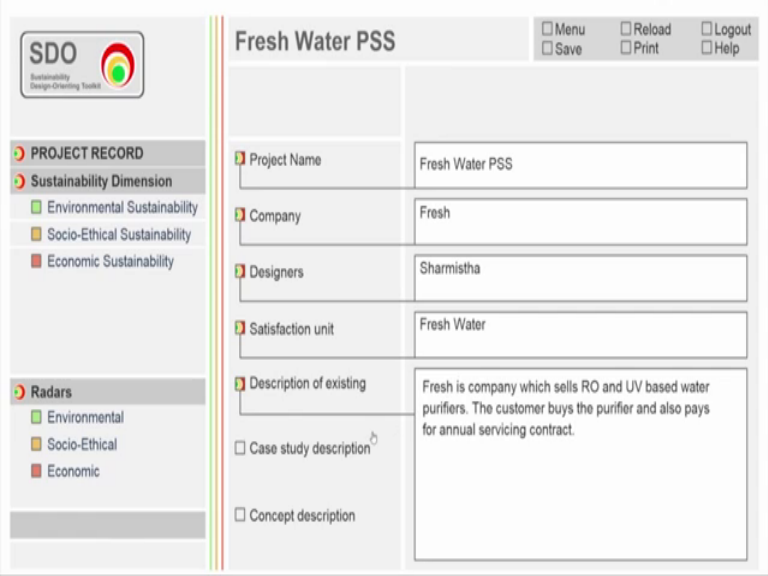

So, now, I have my fresh water PSS ready with me, so, I will start filling up this particular document. So, project name as fresh water PSS my company name is fresh, I can write the name of the designer, then my satisfaction unit is to be mentioned. So, let us say fresh water is the satisfaction unit.

Now, I have to describe the existing system. So, my existing system can be defined as fresh is a company which may sells RO and UV based water purifiers, the customer buys, the purifier and also pays for annual servicing contract. So, this is the existing model for doing business.

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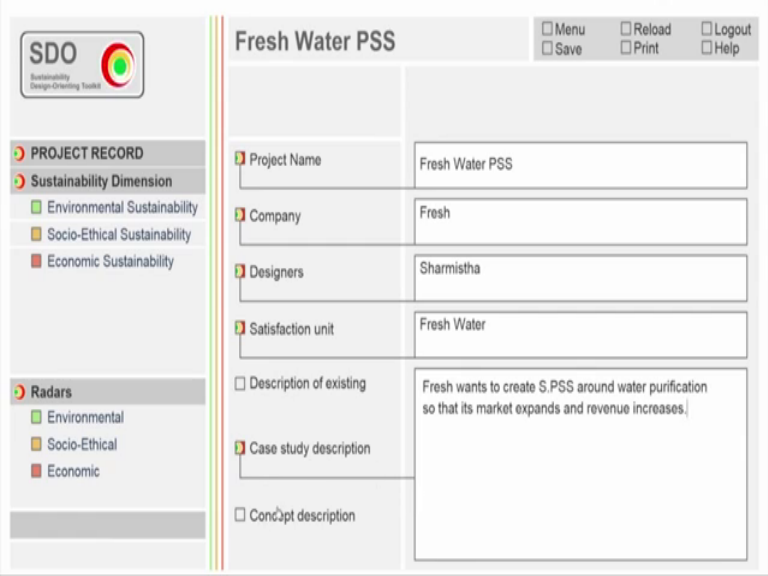

Now, let us go to the case study case study description. So, say my case study description is fresh wants to create a sustainable PSS around water purification. So, that its market expands and revenue increases.

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Then let us come to the description of the concept, when I am trying to describe my concept, this particular chart will come out very helpful. So, I will this was the market definition diagram that I created. Now, I am going to write down as a description. So, my

concept description over here is fresh wants to create a domestic use, SPSS around fresh water, fresh will own the purifier.

And also be responsible for the maintenance and running cost of the product, the customer pays per unit of water used I can write more descriptions, which will comply to the entire market definition say for example, I can write that fresh will also train its service engineers.

So, the service engineers can educate people on water purification optimal usage of water purification and so, on. The system will also consist of a smart device which will auto detect, whether the device is about to break down or there is a change in water quality and will auto intimate the company to send a service engineer. So, that the devices always up.

So, once my concept description is ready you should say that, so this whole this is a flash base software. So, if you do not save it you lose the data so, remember to save it. So, now, let us go to the environmental sustainability. So, our first job was analyse and set priorities.

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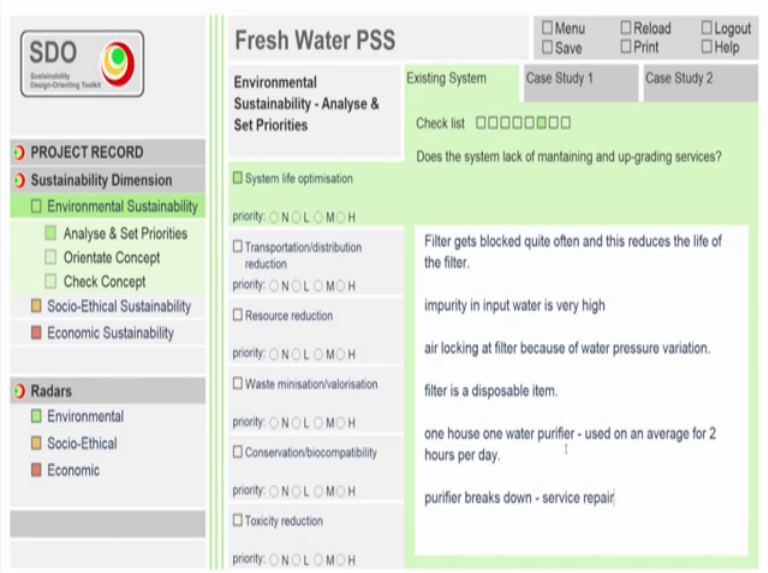

So, if you remember we came to this particular toolkit, when we are trying to understand doing the strategic analysis, it was the fifth step fifth process in the strategic analysis step when we were suppose to do an analysis of the current scenarios sustainability.

We have certain criteria on which we can analyse the system the criteria is given to you, by this particular software. And we also had our forth step was identify cases of excellence in that particular area. So, I can also populate my case 1, case study 1 and case study 2 here.

So, let us go and have a look at the existing system. So, my criteria is so, you can say it is selected in green. So, system life optimization I am on check list one, the question says are infrastructure with short life span used in the system. So, you are suppose to answer the questions over here.

So, I can say that the filter gets blocked quite often and this reduces the life of the filter, I can also write the reasons why it is happening. So, so when you are writing this particular about the existing system, you can write about the product failures, you can write about the service failures and you can write about the entire systems failures.

Because there might be times, when because the product fails the system fails, there might be other times when the service fails and the system fails. So, filter gets blocked, because say impurity in input water is very high.

Say air locking happens at the filter, because of water pressure variation. As well as I write all these pointers, either you can do this simultaneously or you can do it step by step.

So, I can complete the entire analysis then, I can go to the orient the concept or I can do it simultaneously. Let us do it simultaneously, because as designers, when we are looking at problems at the same time, we are also thinking of solutions. So, let us say I know that the filter is getting blocked.

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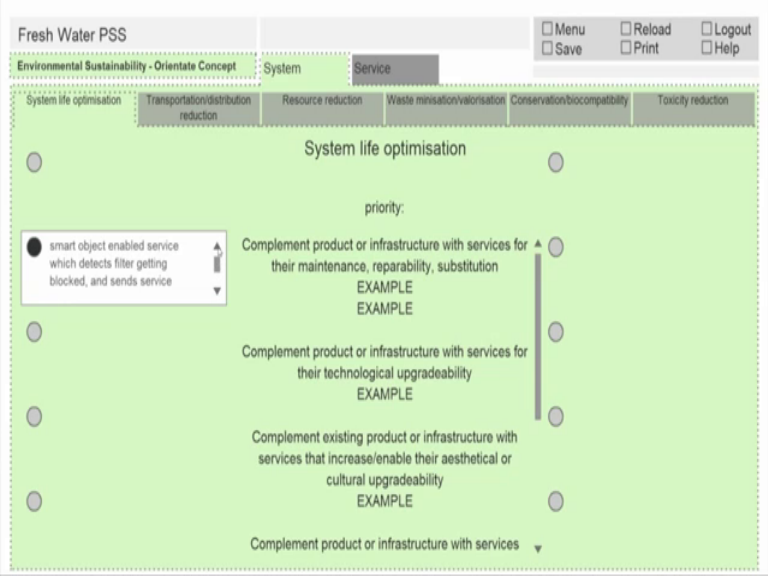

So, I go to the orient the concept, here you see system is selected system life optimization is selected, there are different kinds of questions over here. So, on system life optimization the first question says complement product or infrastructure with services for there maintenance reparability substitution.

Can we think of something in this regard say for example, as I was talking about in the in a market definition having a smart object. So, say a smart object enabled service, which detects filter getting locked and sends service engineer to clear the filter.

That can be one way of dealing with it, where I brought in a system into place that the smart system enables the service from happening. Now, you can also see here, I have a column for service which has another set of questions it is also matter of the service.

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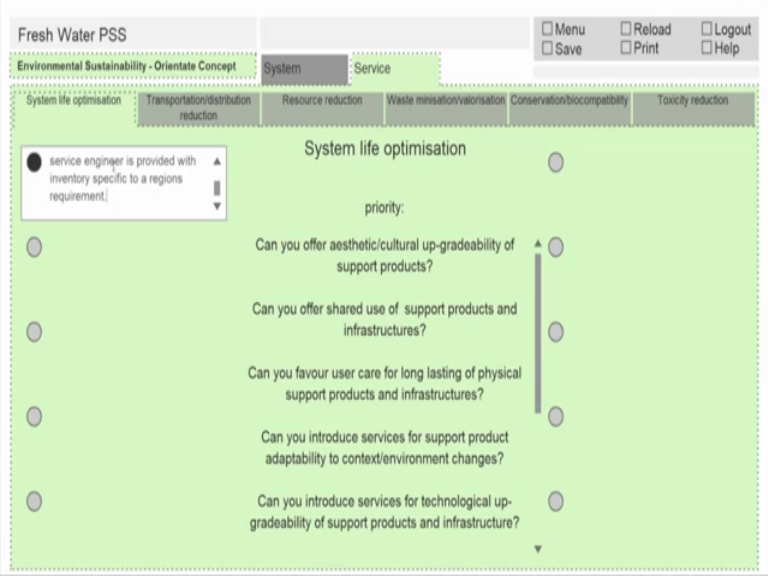

So, the service personnel is informed of servicing needs, in advance I can also say service engineer is provided with inventory specific to a regions requirement.

See for example, this particular company had been into business of water purifier since a long time, in different cities because of the same problem of water quality difference, certain parts will be breaking down more often than in other cities where the water quality problem is very different in nature, because the company already has a database.

So, the inventory management can be controlled with this particular database. So, in that particular area I always keep on sending those inventory items, which are required for that particular serving. Now, let us come back to the system again ok, which says compliment product or infrastructure with services.

So, you can see this is a scrollable list and not necessarily, you will have to write an idea over here, you might also have many more ideas, then what space at gives you right, now it has ten spaces for writing ideas, you might have more ideas than that.

So, you can keep on writing your ideas below this, these are all ideas they do not form the whole system. So, now we are exploring opportunities, in the next step when we are suppose to do system design then we will be clustering these ideas to make system design solutions.

So, say for example, next one complement product or infrastructure with services for their technological upgradability say for example, I realize that people might want to have cold water during summer and warm water during winter.

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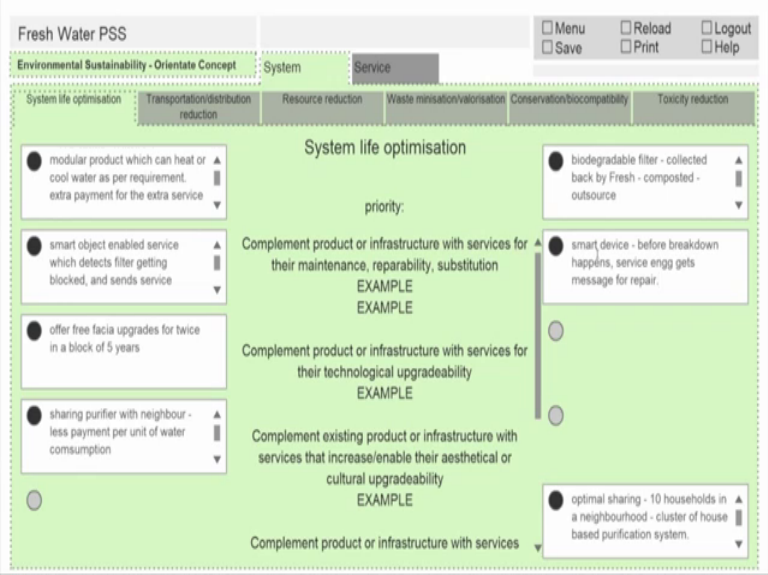

So, can my product come with an attachment, which depending on consumers preference can have this is modular. So, not necessarily you have to get that service, but in case you wanted hot water and cold water depending on the season you can have the attachments.

So, that you do not have to use another source to do that particular activity for yourself. So, you have charge heir for that particular module.

And say me as a consumer I do not want that particular product right now, but may be after 1 year or 2 years of whenever I wanted I can get it attached. So, in the system I am having a system up gradation method. So, I can have that so, now I you can see I am having a modular product design. So, I am writing a; so, modular product which can heat or cool water as per requirement extra payment for the extra service per unit of consumption.

So, now I have a product related idea, I can enhance my product using this particular way, and in which my system enhances. Say complementing existing product or infrastructure with services that increase enable, there aesthetical or cultural upgradability, what can be do.

Say for example, I have an idea that offer free facia upgrades, for twice in a block of 5 years.

So, the outer covering of the product outer covering of the purifier, it can be upgraded free of cost. So, say me as a consumer I redo my kitchen decor and I want a different facia for my water purifier.

So, the company will offer you this free of cost for twice in a block of 5 years. If you want to do that for more often, you will have to pay for it. But this complements the existing product or infrastructure, we services that increase or enable there aesthetic or cultural upgradability.

Offer service delivery platform for product sharing reuse, or second hand selling. Say for example, I can offer a product I, because my whole unit is about paper unit of water that you consume.

Can I have system in which if I am ready to share the water purifier with my neighbour, I am not owning the water purifier, but in this particular case for company fresh with one water purifier, they can give to taps to two houses which are very near to each other.

So, fresh has an advantage that, there product cost is reducing, there service cost is reducing cost for them is reducing. So, by adopting such kind of a strategy that is I am sharing my purifying unit with my neighbour. I can get service at a lower cost, if that is a possibility again it is a win man situation, lower material, lower service impact.

So, let us write sharing purifier with neighbour and so, I have less payment per unit of water consumption.

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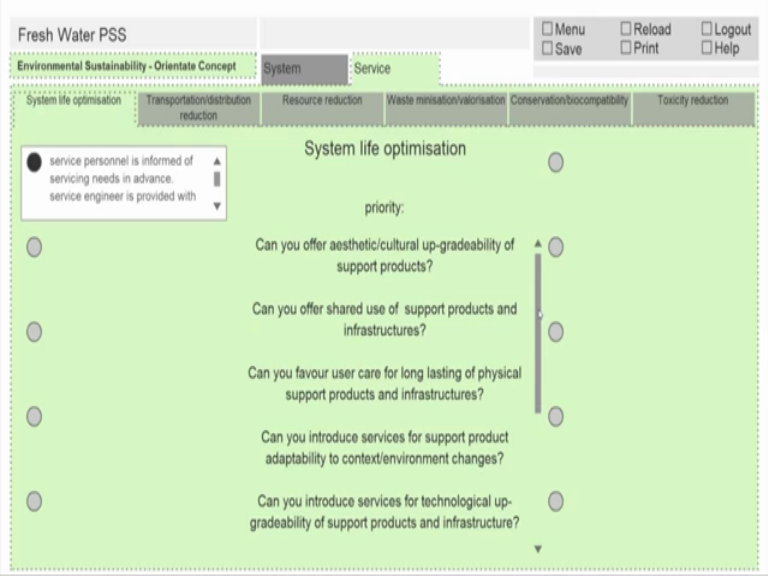

Let us go to the service. So, what does it include in its service component are see can you offered shared use of support products and infrastructures. So, it is if you want to repeat both of them. So, when I am talking about a system, a system is usually composed of a product as well as a service component.

Hence you will see many a times so, when you write the system the service component is more or less implied, but it is always good that you repeated. So, there in this particular context the service part of it is highlighted more and more like how important the service component is so, that you can get it.

Again save it, you click the menu to get this menu back and we can go to analyse and set priorities again. So, I was on my check list one which one are infrastructure with short life span used in the system.

So, I was trying to answer them and then I try to solve each and every problem. Now, coming to the next question are disposable products packaging or support products used. So, the bock for answering remains the same. So, say the filter is a disposable item.

Now as soon as I write the filter is disposable item I might have certain ideas. So, I will go to the orient the concept and I can write in the system life optimization, that what if the filter could be collected by the company. And then it could be bio degraded into composed. So, I make a filter which is bio degradable.

For example so, I use bio degradable filter collected back by fresh composted, then what happens to the composed. Now, consider a country of size of India, it is sound very interesting when I say bio degradable filter fresh will collected composted.

Even for a cities scale the composed volume might be very high. So, may be every city, when it has service provider for fresh, they also how this composting unit, which can compose the filters.

But then what happens to the compose next. So, now, you can realize the importance of this aspect of thinking in terms of systems. So, as soon as you said bio degradable filter it was a product intervention, then you say the now we have to think off this system, thinking of it needs to be collected back by fresh.

Then what happens at fresh ok, it is to be composed at, then what happens to the compose. Now, you start thinking of it in such a big country. So, maybe I outsource this whole activity.

So, what it is giving me over here is if I am outsourcing, then I am not thinking any more about the composting, what happens to the compose next what I have to think is what kind of service partner I am going to involve.

So, that this composting can happen properly and the service provider has to also tell you what happens to the compose next, which forms does it get how does it get, to those funds ok. Let us go back to orient to analyse and sub priorities. So, the third question says do parts of the system 10 to be technologically obsolete or to be culturally or aesthetically obsolete.

Again I answer this question come up with some ideas, is the system individually used, when it could be shared in some of it parts here it with each of these questions here breath of ideation will increase.

So, see I know right now that one house one water purifier and, used on an average for 2 hours per day. So, if I see this particular value I already know, that I have 24 hours. So, which means I have 22 hours more left to be used, if one house is using it for 2 hours, then I can at least on a safer side I can involved, 10 houses to use the same purifying unit so, ok.

That regards another idea to me which says whenever, when you have like, you had this question of a service delivery platform for product sharing we use second hand selling. So, I have an idea for that optimal sharing 10 households, in a neighbourhood, which implies that I can have cluster of house based purification system.

What at service level it means so, may be my marketing agent now, does not try to market the product to individual houses, but it means marketing to societies, or housing complexes.

And only then I can have like 10 houses cluster together to buy one purifier, it also has product design related implications, when we do the detailing of the system design, we will have to also identify how can I have a machine, which can work 24 by 7, also I will have to consider other aspects, you do not fill up water at 2 o clock at night.

So, my effective number of hours is from say 6 in the morning, till 11 in the at night. So, how do I detail those system those aspects will become parts of detailing. And when we get into that face of the design, we will reduce the numbers of hours to be you will reduce the number of households which can be use design the product accordingly.

Does the system lack of maintaining and upgrading services. So, I know that in my current system only when the purifier breaks down. So, I know in my current system only when the purifier breaks down, there is a service engineer who is called.

And the service engineer does the repair job, which might be so, today my machine breaks down, I might call in the evening and say when can you come the service engineer will say I can come tomorrow afternoon.

Say for this whole period of time will becomes around 24 hours, your machine is not working if the service engineer comes and identifies that a particular part has broken down, which here she does not have an inventory off, then your machine might be lying and use for a longer period of time. So, that is a existing systems system life optimization problem.

So, if your machine which is paid per unit, paid per litter of water, if you does not work for 24 hours or 48 hours, fresh is going to make lose money. So, now, I will again go into

the orient the concept part and I will think off system ideas, as well as service related ideas.

So, I have system idea over here, that smart device before break down happens service engineer, get is message for repair.

So, this is how we will keep on continuing, once I have answered all these questions. So, the last one it is as try here you can put an all other considerations. So, there might be aspects which are part of system life optimisation, but sorry in the others there are there might be aspects which are there, but not covered in this questions.

So, in others you can write down all of those points after writing these points, you know in your current system life, what is it what is the priority? Say by looking at the pointers, we have pointed out till now.

Now, the if the filter is such a disposable item here, it will be also good if you write how often does the filter break down. So, the filter needs replacement every 2 months.

Is a certain amount of cost it requires a replacement every 24 months is a different kinds kind of cost. So, if you write down those details as well, then you will be very easily able to give up priority, whether this aspect has no priority, low priority, medium priority, or high priority.

You need to also discuss it with you stake holders, the promoters and agree upon system life agree upon a priority for system life optimization.

Once I am done with system life optimization, I will go to the next one, which is transportation or distribution reduction. Again the same system follows is there any excessive transportation of goods. So, I answer each of those questions, I go to orient the concept and here, you can see transportation or distribution reduction I click there, I again have questions.

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Like use digital infrastructure example internet for transferring or assessing information, there might be again certain idea overlap, but it is always good that, you put the idea over here.

So, smart devices which was part of system life optimization can also come over here, because you are transferring or assessing information about the health of your device using the smart devices, which in these transferring information to you by say using Wi-Fi network of the house or mobile network or so, on.

So, after filling up this entire block for transportation and distribution, we will assign a priority to this. After transportation it comes resource reduction, then say waste minimization and valorisation, I give a medium level of priority conservation of bio compatibility, say there is no priority toxicity reduction has a low priority from project to project and from promoter to promoter.

This optimization priority levels will vary, then I go into orient the concept. This is a ideation board, once you have done this ideation board which we are taking so, we are in this particular stage, generating sustainability oriented ideas.

Once you have generated lots of ideas, then we will go into system design and system detailing. Once I am done with system design and system detailing what I do is check the concept. So, in check the concept again you get the similar kind of a box.

So, I am on system life optimization, I have a check list are infrastructure, where short life span used in the system. So, this is now of my new design system. So, I will write down all the details of my new design and say, how infrastructure were short life span has been eliminated or has been reduced.

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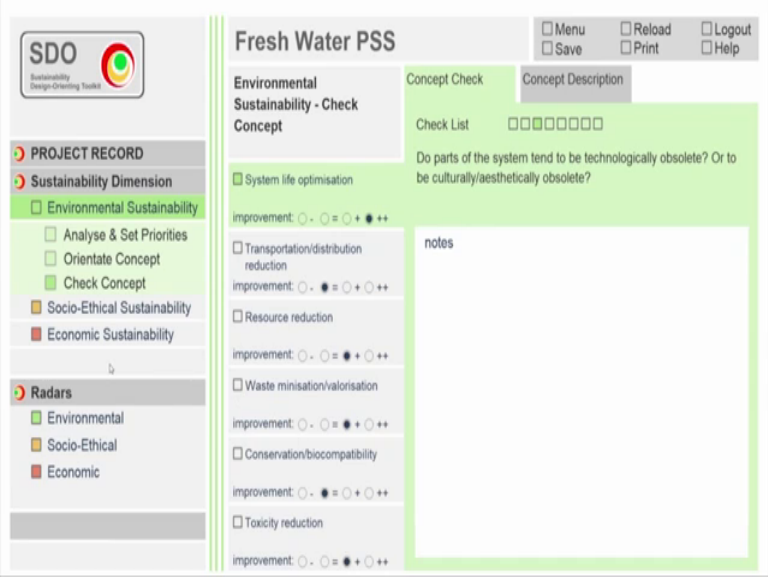

And so, on I am follow all these questions and write down my notes over this place, after on the basis of notes I do a qualitative judgement, of whether my I have no improvement the situation is similar to what it was before the design intervention, that is like the current the new design and the existing one, both of them have the same level of improve same, they are at the same level there is no improvement.

Or you can have incremental improvement incremental improvement is small improvement, or you can have a radical improvement, which is like a huge amount of improvement which has happen, you do the same thing with your other aspects.

So, let us right now, that say for transportation there has been no improvement for resource reduction I got incremental improvement, for waste minimization and valorisation I got little improvement for this one, because for conservation and bio compatibility I said that there is no requirement. So, I did not do much over there. So, I have no improvement and toxicities it is reduction I have little improvement. So, after doing this we go into the radar for the environmental.

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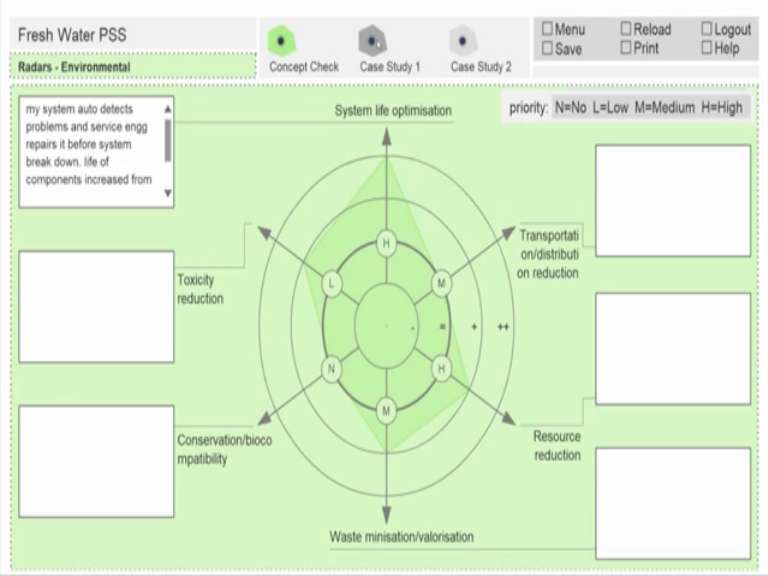

I click the concept check. So, here you can see this is showing this has the high priority, system life optimization I had assigned high priority.

And in high priority I have got a radical improvement, which is good. So, now, I will write in this box how did I get that improvement because as I told you can print these so, in our communication face this becomes a very interesting toolkit to use. So, I can just print this page and put it into my communication page. So, how did I do system life optimization say for example, my system or to detects problems and service engineer repairs it, before system breakdown.

And this brought in so, the life of components increased, from an average of 1 year to 3 years. So, now I can say that this was a high level of improvement that I had brought in, because of this particular aspect and might have many more aspects which brought in system life optimization.

Although where this is very qualitative judgement, that my improvement has been radical, but you need to supported with adequate numbers and proves that, because of this I would say that have got a radical improvement.

So, on the toxicity reduction, where I had low priority, I have a incremental improvement, on conservation and bio compatibility, where I had given no priority to that I have no improvements.

It is like at the same phase as it was before this redesign activity, on waste minimization medium and incremental impact, what I see here is an resource reduction I had given a high priority, but my improvement has only been on incremental improvement so, may be you can again try to do something, so, that you can get higher improvement or otherwise.

You at least know that how that improvement you have got in, if I would have inputted the data for the case one and case study two I could have click these, as well and top it would have shown what is the radar diagram for case study one and case study two as well.

And then I can compare that my concept versus to other concepts of excellence, how does it perform? So, I did this activity for the environmental sustainability, you have to repeat the same with socio ethical sustainability and economic sustainability.

Let us get into right now on the socio ethical sustainability aspect and see what are the criteria over there.

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So, in socio ethical sustainability analysis my first criteria is improve employment and working condition. So, are there any problems with the health and safety, are there any problems of discrimination in the work place. Are there any problems with work load and for in adequate wages and others.

Then I next criteria is improve equity and justice in relation to stakeholders, other stakeholders criticizing the supply system is the client of final user criticizing the supply system. Are there any unjust relations between the partnerships?

Are there any unjust relations with suppliers sub contractors and sub suppliers. Next criteria is enable responsible and sustainable consumption, then favour or integrate weaker and marginalized strata.

For each and every project the definition of weaker and marginalized strata might differ say for example, if I design a product if I design a machinery an agricultural machinery, which is the dimensions of the machine has been designed in a manner that women cannot use that machine.

So, in that case because of my design, I am marginalizing the women farmers they cannot use it. So, in that case I say they are the marginalized people or the other weaker people or say for example, in a particular context I know that child labour will be encourage. So, they become the weaker and the marginalized strata. So, say I design a machinery which requires lot of strength and old people do not have so, much of strength may be.

So, in that case I am marginalizing that. So, first you identifying who is being the weaker and the marginalized in the given context, then you try to answer the questions, improve social cohesion. So, social cohesion can be between genders between intra cultural groups between intra generations.

So, first you have to identify where the exclusion lies, does the exclusion lie in gender or cultural intra cultural aspects are intra generational aspects, or any other form and then you try to improve cohesion between wherever the exclusion lies. Is the system creating or favouring any forms of discrimination, which might be sexual discrimination, religious discrimination, cultural discrimination on the basis of gender, on the basis of age and so, on.

Then the last one is empower or valorise local resources. So, does the current reference system impoverish local cultural values and identities remember, we are in the socio ethical dimension, I can also talk about empowerment or valorisation of local resources

in terms of environment, in terms of economics also, but since I am in the socio ethical sustainability domain.

I am talking about impoverization on the basis of local cultural values and identities, dose the current system offer any offer only one solution, or few variations for all regions and cultures. So, different regions might required different kinds of solutions, different cultures might required different kinds of solutions, but do I provide them with only one kind of a solution.

Which is creating some kind of impoverishment, does the current system have a negative impact on social well being of the local community, say for example, the industry, which is going to make the product for fresh is it polluting industry. Which is going to have any impact on the well being of the people, is the current system impoverishing local economies is the system observing local non renewable resources.

So, now, I am also see my last criterias it is also covering the economic aspects and the resource aspect, because if the non renewable resources of the region are consume, the local people will also suffer.

If the economy of the local region suffers, people are going to suffer and others. Again the same thing I do it for the existing system my case study one, case study of excellence one and two, I do the orient the concept it is always better before you start into doing this whole process, you go through all the questions.

Once you have gone through the questions, while you are doing the analysis also many ideas will trigger.

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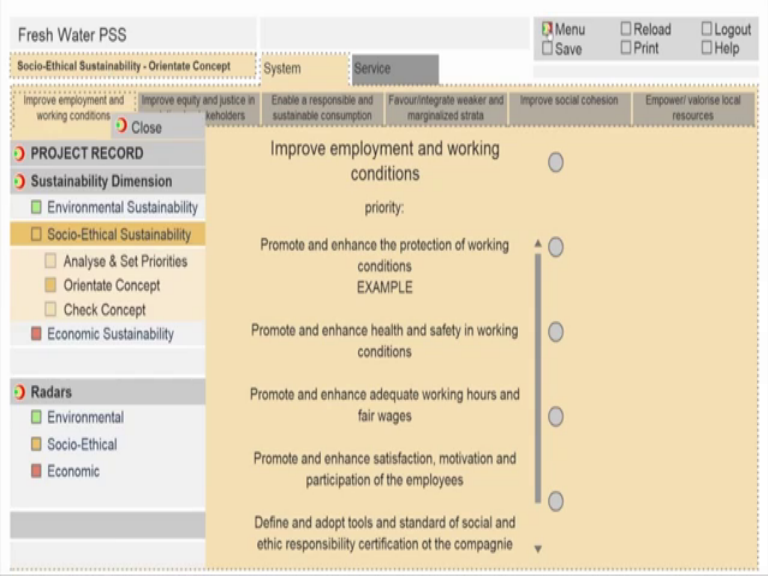

So, here other question promote and enhance, the protection of working conditions. Let us go to economic sustainability.

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Now, so the first criteria in economic sustainability is market position and competitiveness, do you have a weak market position in the current system. So, if you have a weak market position, then you have to have ideas system level service level.

So, that you can go counteract that are they are possibilities to improve your market position, that you do not use at the movement do you see current and future threads for your market position. The next criteria is profitability or added value for the company.

So, this particular aspect when help you to ideate on aspects, which gives added value to the product or the product service system and to the company.

You are not only thinking about your own company, but you are also thinking about all other partners. So, is the profitability of the current system low for your company and other external partners, then comes added value for you customers, because when I talk about economics its part of the company the partners of the company who are providing the result as well as the consumers who are going to consume it.

Then comes long term business development and the risk involved partnerships, or cooperations possibility is dangers involved and so on, then macroeconomic effect. So, say for example, it is not about your own companies product and product and services which make can make you successful or unsuccessful.

It is also about the macroeconomic level say for example, if the local government says I am going to offer very good quality water to each and every citizen. So, nobody needs to install a water purification system at home.

So, that is a macroeconomic level intervention, which might have been done by the local government, as a result of which fresh no longer can provide its services in that particular city. So, I need to identify are there problems in a macroeconomic level example disclosure of participants in economy monopolistic structures rebound effects and so, on and anything else that you can think of in this.

Again in the orient the concept, you have similar structure.

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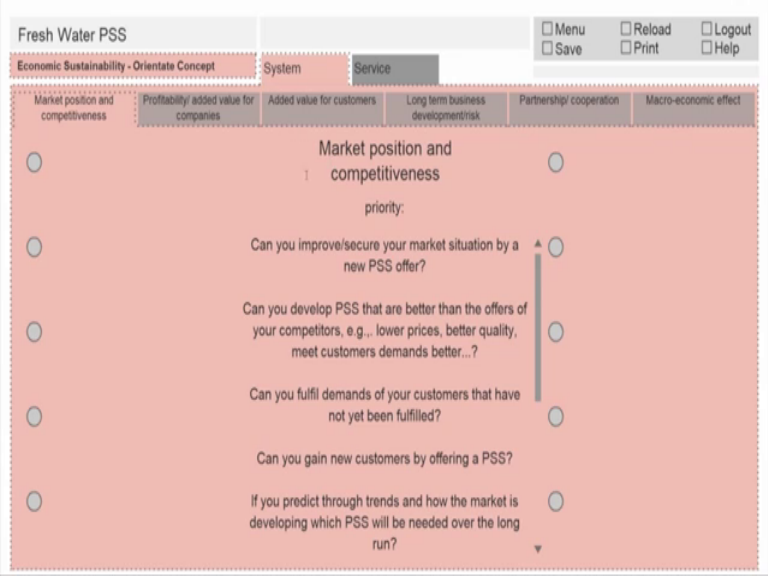

You have your questions across all these different points and you have come up with ideas.

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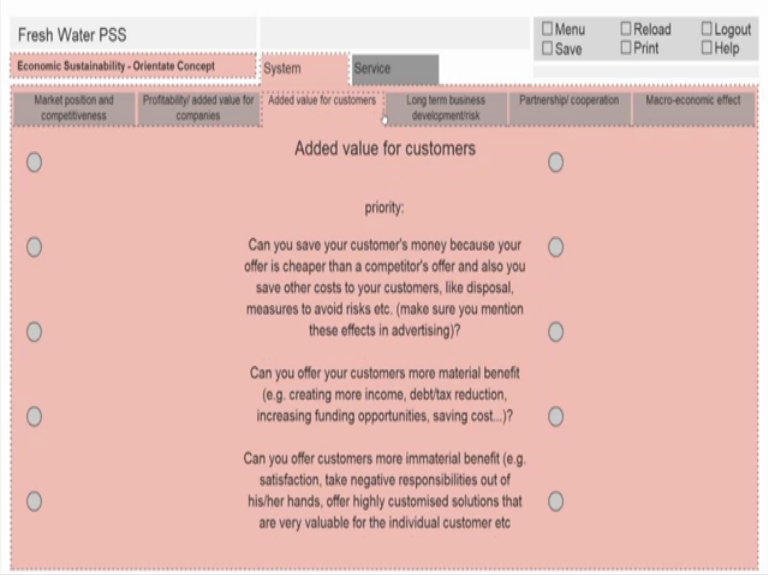

And finally, you can get the radar diagrams. So, let us save it and move back to the presentation. So, we are done with the work shop, for generating sustainable system ideas by using the SDO toolkit.

Now, our concern is satisfaction system map. So, we will discuss about how to create the satisfaction system map, you because now I have a huge pool of ideas in on my idea table, I can start grouping them and gain getting more and more ideas.

As I get more and more ideas, because I go into the satisfaction system map and I start working on the PSS innovation map, I can again go and put those ideas back into my SDO toolkit. So, in the next lecture, we will be discussing about the satisfaction system map and how do we go ahead with it.

Thank you.