

System Design for Sustainability
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Week - 08

Lecture - 24

Sustainable Product-Service System Design - Methods and Tools (Part F)

Hello everyone. So, in today's lecture, we are going to discuss about rest of the how to do exploration of opportunities and then we will go into Designing system concepts.

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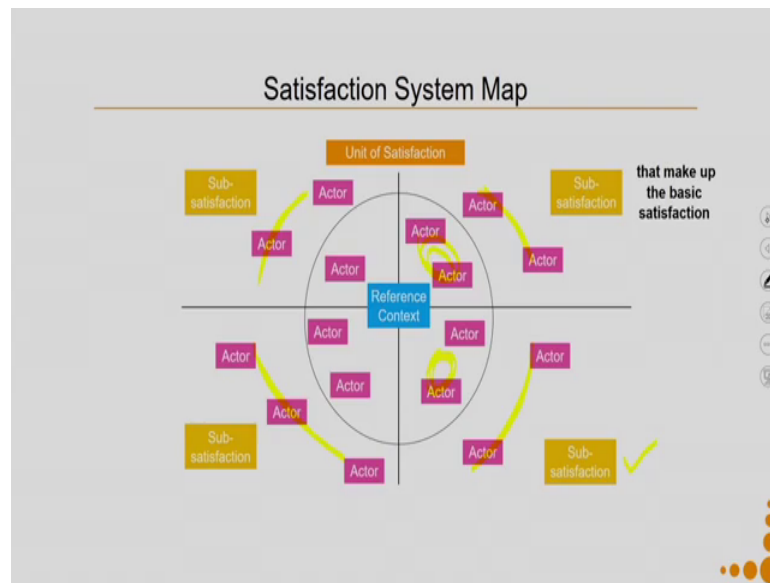
Process	Sub-process	Result	Tools
Generating sustainability-oriented ideas	Defining satisfaction unit	Document specifying satisfaction unit and sub-satisfactions	
	Workshop for generating sustainable system ideas	Sets of system ideas with environmental, socio-ethical and economic sustainability characteristics	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	<ul style="list-style-type: none"> - 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 	<ul style="list-style-type: none"> - Polarity diagram. - Offering diagram - Animatic, System concept - Audiovisual

So, in our last lecture we had already covered how to work on the SDO tool kit; the IVR tables.

So, today we will start from how to make the satisfaction system map. Again, for making the satisfaction system map, you can do it in the form of a work shop with all the stack holders. In case it is not possible to do it, you can also do it alone. But using the SDO tool kit gathering the data for the same, it is better if it is done in a group.

So, let us look at the Satisfaction map.

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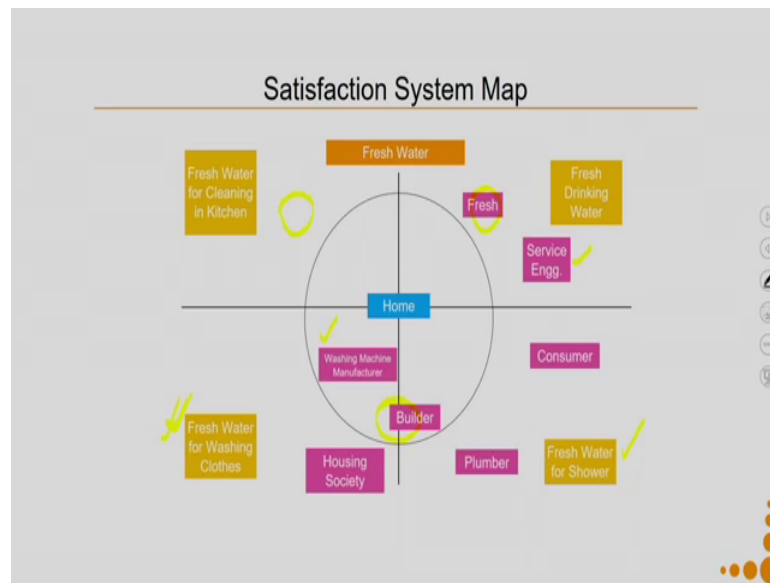


So, it consists of the unit of Satisfaction and then we try to expand it into units of Sub-satisfaction. So, I have my reference context, I have my sub-satisfactions. So, in this particular context, you can see that there are 4 sub-satisfactions. Do not get confused with this diagram, it is not about a quadrant; but you might have 5-6 even 2 or 3 and so on.

So, you try to divide the unit of satisfaction into sub-satisfactions. Then, so these sub-satisfactions will make up the in a basic satisfaction. Then, you have the Reference Context, then you place a circle inside it. So, in this particular context, in this part of the circle I will put all those actors which are specifically present for the sub-satisfaction over here. In this quadrant I will put or in this section I will put all those actors which are specifically for this particular sub-satisfaction and so on.

But over here, I will put all over here I will put all actors who are common to this particular system map. So, I put all my actors, inside the circle all the actors which are specific to that particular sub-satisfaction and outside all actors who can play role in any of these sub-satisfactions; who are common to the sub-satisfactions.

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So, let us see how do we draw it in the context of a fresh. So, my unit of satisfaction over there was fresh water, so I place it at there. The reference context was Home. We are designing it for domestic use. Now, till now I was thinking of fresh drinking water because all are water purifiers are meant for giving us fresh drinking water. But what about taking a shower or washing your clothes or cleaning say, utensils or vegetables or fruits in the kitchen; they also require clean water. Of course, they might not require water of the quality as drinking water.

So, as soon as I try to make the sub-satisfaction, I can further expand my products reach. So, I have this purifier which can produce me one quality of water which is meant for drinking purposes and may be another quality of water which is suitable for cleaning in kitchen for washing clothes and for taking a shower. So, say for example, if there are consumers who live in places where the water is highly polluted with certain kind of salts or chemicals, and they would also like to opt for an option in which they can clean their clean themselves that is take a shower or do other kitchen activities with this fresh water.

So, I divided them into this sub sections. Now, let us see who are the actors in the context of these holes satisfaction system map, Fresh is the company who is the provider; so, is a common actor. So, I place fresh outside the circle. Then, comes my service engineers. Service engineers will be also common actors. So, I place them also outside. So, it does not matter over here whether I place fresh over here or I place fresh over here.

When you are reading this particular map, you will read it in a manner that a fresh is outside, if service engineers are outside; then they belong to the entire system map. My consumers are also a common actor for the entire satisfaction system, then my plumber whatever I do I would require plumbers to do certain kind of plumbing changes in my house. The plumbers might be separate entities or they might also be linked to the fresh with some kind of a contract and so on.

The say for example, I want this so because from a idea table I am coming to this step as the next step. So, I already had an idea which was about why not the water purification system be owned by the entire housing society and the connections comes to individual households.

So, in case we want to go ahead with that particular idea, I would also need to bring in the Housing Societies. Say for example, I have an idea that because I am talking about fresh water for washing clothes; can I have some kind of a collaboration with washing machine manufacturers in a manner that I know I am going to provide higher quality water now in this case; can I optimize the usage of water or can my washing machine manufacture design a machine in whose case, the gray water can be utilized for some other purposes and so on.

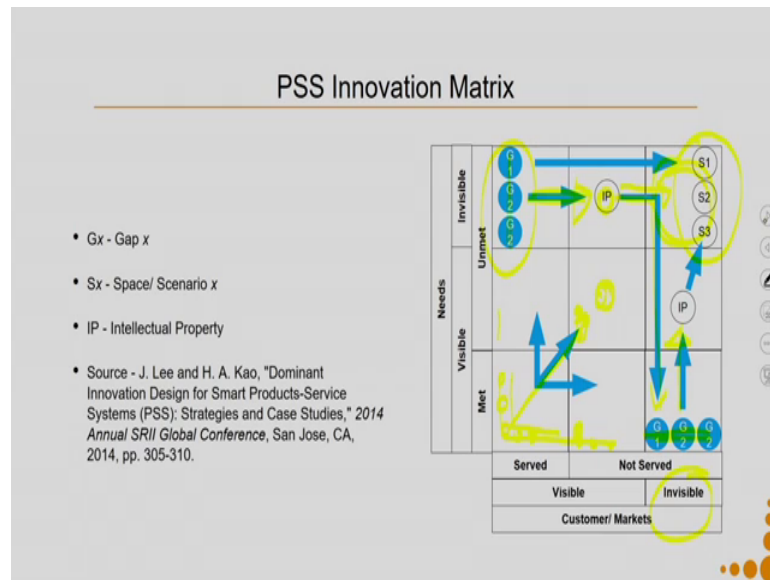
In case, we have certain kind of an idea, then we can say that washing machine manufacturer can also be an actor, but that actor is inside the circle because that is specific to my fresh water for washing clothes region. Not necessarily you have to have them, it is in case you want to have them and you have an idea; how would will you incorporate that.

Now, let say builders as soon as we see say that it is going to be owned by housing societies. I can also think that it is going to be part of the agenda of a builder to build houses which have these kinds of systems inbuilt. So, then you do not need to do a separate plumbing getting in your water connections and so on.

So, in that particular case also I can say that the builder is involved. Why I have put it in crossing these two quadrants? Because I feel that in my kind of concept design that I am working, the builder will be useful for fresh water for shower and fresh water for washing machine because in that case lot of plumbing activity needs to be done. Say if it is done in the building as an inbuilt feature, it might be a better option.

After I have made the Satisfaction system map; the next step for doing this idea generation sustainability oriented idea generation is creating a PSS innovation matrix. So, let us see how a PSS innovation matrix looks like.

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So, a PSS innovation matrix, it consists of gaps, spaces scenarios and intellectual property rights which are required to fill those gaps.

So, first you try to less down the needs and the customer markets because we have already done our strategic analysis and we have we have already in on the way of generating ideas. We know of all the needs, we know of all the customer markets. Then, I divide those needs and customer markets into visible needs, invisible needs, visible customer markets and invisible customer markets. So, what does it mean? So, all those customer markets which are already visible to everybody that this is a potential market and invisible which nobody has seen at yes, yet as a market. Similarly, for the needs there will be visible needs and there will be invisible needs.

Now, we for the categorize them; not necessarily all visible needs are met. So, there will be some of the visible needs will be met and other visible needs are unmet and of course, invisible needs are unmet. Similarly, in the market also there will be a visible market which may be served and might not severe already. So, I divide the visible market already into two categories; Served and Un-served, not served and invisible is of course, not served.

So, once I have done this, next step is divided it up into these blocks where I can place ok. So, in this particular block, I will place all those solutions all those needs and all those customer or market segments which are visible and served. Here, I have visible, but not served; but somehow the needs are met by some other sources.

Say for example, I need clean water for taking a shower; people know that particular need. I know that we need clean water for cleaning our utensils and cleaning our fruits and vegetables, we need we know that, we know that there is a customer segment which exists over there. What is. So, water purifiers are not solving that problem, but there are certain solutions in which you have on tap attachments. So, you put that on tap attachment and it gives you certain degree of purified water instantaneously as you switch on the tap. So, that market was visible; that market was visible that area is met the need is met.

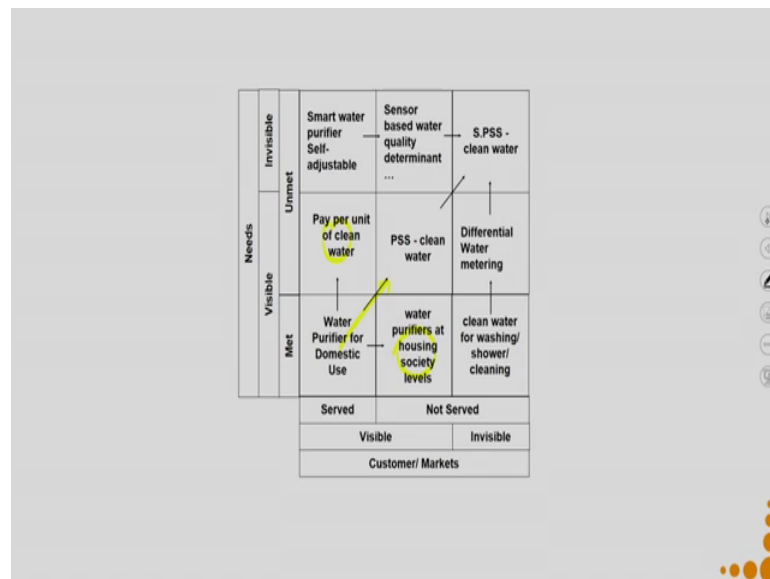
But say for example, I know for showering also I want a solution, but there is existing there is no solution available. So, I know that the market is visible, the need is also visible, but what I have it in the category of unmet. I know I need clean water for washing my clothes; again it is, but there is nothing which is available for that particular purpose. So, it is an unmet need.

So, when you have existing solutions. So, I have some existing solutions over here. I can move to this particular category. So, say I know that there are these instant water purifiers available for which can be put on the tap of a kitchen. I can easily progress it into making some solution over here which can be fitting for my shower. We have gaps in this particular region and in this particular region because the customer market is still invisible, the needs are still invisible. When I develop a technology; so, IP is the intellectual property, I design the technology. So, this can go over here and say I design more technology, this can go here and I can get certain scenarios of usages, new scenarios of usages.

So, for PSS innovation to happen, if we our solution can lie somewhere over here, it is an innovative solution. So, we try. So, we first try to identify invisible needs. We try to identify invisible customer markets; then when we have identified those gaps, we try to develop some kind of a technology. These can be technology these can also be some kind of new service related strategies and as a result I can build up new scenarios of usage.

Let us see in the context of Fresh, what it might mean?

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So, I have my entire chart ready again. So, I know water purifier for domestic uses visible market, it is a served market. The needs are met, the needs are visible and they are met. There is a need that so right now I can pay for buying the water purifier. There is a visible need that let us pay per unit of clean water rather than paying for a water purifier that need is visible, but that is unmet in the current solution.

Similarly, water purifiers at housing society level that customer as or the customer or the market is a visible market, but it is not served market. So, now, this gives us an interesting opportunity that since I have a visibility over here and I have a visibility over here and they are unmet. So, I can easily progress. So, I can develop a PSS around clean water solution that is pretty clear over here.

Now, if I want to go towards a sustainable PSS clean water which is completely an invisible need as well as the market is invisible for that particular activity. Say what do I need in order to make it sustainable; I would think that I need some smart water purifier. How it should be smart? So, it auto detects the water quality at a given point of time and the input water quality and changes water quality in accordingly. It determines ok, I want to use the water for a certain purpose say for bathing, for washing clothes, for washing utensils and I can set those parameters that I want to use it for this purpose and it automatically changes the level to which it will purify water.

So, smart water purifier in those senses or say for example, if the machine is about to break down because I am talking about a PSS, if the machine is about to break down it automatically calls in a service engineer. So, that the machine does not break down and the service keeps on running or self adjustable water purifier. So, I define what is smart water purifier and self adjustable means. How can we fulfill it? So, I have to develop certain technology which base like sensor based water quality determinants and so on. And then, how it automatically changes the level to which water purification is to be achieved. So, those are the technological developments I would require to do in order to reach there.

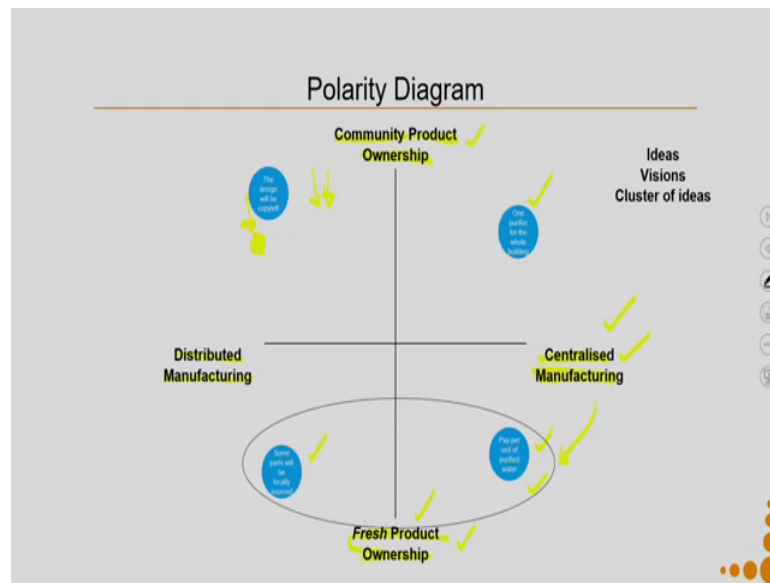
Now, the invisible market over here is clean water for washing shower or cleaning. Now, when I want to introduce that you can have clean water for all these purposes and I will clean it to an optimal degree for each of the purpose, I also need a differential water metering system. So, if I am cleaning the water to degree x , I charge you per unit cost so much of money. If I am cleaning it for say showering, I will charge you for so much of units.

So, when I can design such kind of a differential water meter metering system, I can move towards a SPSS for clean water. So, when you start making this PSS innovation market; so, this is just one example of making it. Because right now you are in the exploding opportunities phase. You will design many of these innovation matrices for different ideas that you have generated in your sustainability idea in a table, and see what do you want to do and it will also help you in further developing your idea.

Once, we are done with generating sustainability oriented ideas our next step is to outline a design oriented sustainability scenario. What does it mean? Define clusters and single ideas, identifying promising polarity diagrams, polarizing ideas and defining visions this is one of the very important steps. So, and polarity diagrams form a very important part of this particular activity. As you can see this MSDS method is very very elaborate, there are too many steps, there are too many methodologies.

It might be possible that you do not have enough time to do all the step, but I would always suggest that never skip this polarity diagram step. Why? Let us see how a polarity diagram looks like.

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So, a polarity diagram is a diagram on a quadrant. How do you form your quadrants? Because now, you have different sorts of idea, you have also done some kind of clustering which tells you certain kind of directions.

Say for example, one of my directions is I can do centralized manufacturing. So, what is centralized manufacturing? So, fresh owns 1 factory in India or maybe 2 factories in India depending on the volume of production and capacity. So, and all the products, all the parts, all the components everything is produced over there and then, shipped to all over the country. It can also have distributed manufacturing.

So, like Fresh does not own the manufacturing setup. So, an extreme case of distributed will be when I release all my designs to the customers and customers can 3-D print as per their requirement. So, then I am having perfect distributed manufacturing, because Fresh has no control over manufacturing. They have given their design to all its customers; anybody who is interested in having that kind of a product. So, these are the 2 ways.

So, for us it is always natural to think about centralized manufacturing, but centralized manufacturing has its own set of problems. You also have to maintain a lot of inventory; whereas, centralized whereas, distributed manufacturing it is on demand manufacturing, its distributed all over the country, anywhere there is a 3-D printer or anywhere in your vicinity where there is a 3-D printer, you can print it and as per requirement.

See then, I have another idea which is a Community Product Ownership. So, when I say the product is owned by the housing society or the product is owned by Fresh. So, Fresh owns the product and not the housing society and another case is Fresh is agreed that I will give you all the services and maintenance at a certain cost, but the ownership will be transported to community to the community that is the housing society.

Now, let us see when I made this polarity diagram; how it helps me in further expanding all the ideas that I have had and trying to give it greater sustainability orientation. So, see if I have an idea which is like one purifier for the whole building. Now this one purifier for the whole building when I place it in the community product ownership and distributed manufacturing quadrant; what it implies that the community will own the product? Of course, the project will also not be manufactured by Fresh.

A large part of the product will be manufactured of in a distributed manner. I did not place it somewhere over here. Here, it would have meant that it was completely distributed and not at all centralized when I place it somewhere over the location where it is right now. I am saying that at least some components will be centralized manufacturing, other components will be distributed.

Say for example, the filters or the RO purifier unit; they might be better that if they are made through a centralized manufacturing system. So, I am making a conscious decision over here. When I place it over here I will also have to create a separate document which says when I place it over here, what are the advantages; sustainability advantages and sustainability disadvantages.

Why it is polarity diagram is one of the most important things is because for each and every decision you keep on arguing that what are the sustainabilities and what are the unsustainabilities involved. As we have been discussing throughout our course there is no solution which is absolutely sustainable. So, you will be easily able to identify unsustainabilities in the system. Say for example, if I put this system over here or I put it over here; as soon as I put it over here at the edge, I will start saying the different components of the water purifier and I will realize that some parts can they cannot be 3-D printed, they need to go through centralized manufacturing.

So, then I will very nicely places over here. I might also realize that for doing certain aspects, I will need certain kind of trainings. Say when I say one purifier for the whole

building community ownership distributed manufacturing. So, which means a design will be released by Fresh to everybody. So, even I have such kind of a design scenario, I have to also think how Fresh is going to make money. So, my document will contain all those ideas how these problems will be served.

Now, say I put this one purifier for the whole building in this particular region. So, it means the product is owned by the community. So, Fresh does not own the product; community owns the product: fresh is the service provider and it will be manufactured by Fresh. This is an easier case to plan for how Fresh is going to make money out of the whole business.

Now, see I have another idea vessels paper unit of purified water in which the Fresh product ownership is the context, I do a centralized manufacturing. So, I will have all the unsustainability impacts which are caused due to centralized manufacturing. So, I might try to figure out ok, in the factory place itself how Fresh can bring in different sustainability parameters say: save water and save electricity and so on. Not necessarily you have to do it in your project itself, but they can go as recommendations.

So, in this polarity diagram what all you can place is your ideas, your visions. So, when I said that one purifier for the whole building that was kind of a vision statement as well. So, your vision scares are also your idea. So, have to service idea, system ideas, visions, and also cluster of ideas can be placed.

So, say for example, I have another one in which it says although I have paper unit of purified water, I am saying some parts will be locally sourced. Can I put this thing into a particular cluster of ideas? So, although they were disjoint ideas at the beginning, but I can think of coming up within new way of offering the PSS in which I combine these 2 ideas. So, some parts will be locally sourced, other parts will be centrally manufactured.

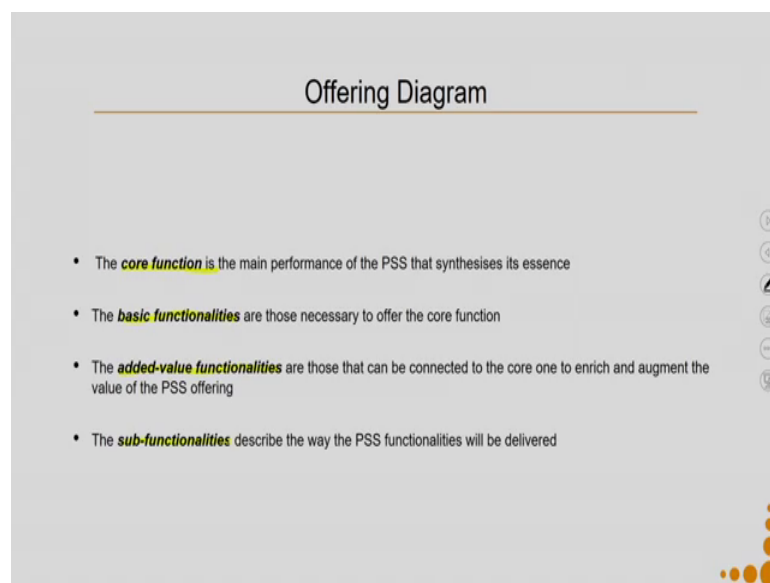
So, this is one example of a polarity diagram for all the ideas generated, you can identify many many different types of polarities. So, you pick up one of these pointers. So, when I was saying that Fresh product ownership, Fresh will retain its product ownership. So, I have to consciously think about what is the opposite.

So, this is one of the opposite. There can be many other opposites say; I say community product ownership, I can also say individual product ownership. As soon as I compare

individual product ownership versus product fresh product ownership, the whole polarity diagram will again change. So, you can have multiple polarity diagrams and it helps you to further dissect the sustainability and unsustainability and come up with better sustainable solutions.

Next one in this particular category is called as Offering Diagram. So, once you have done your polarity diagram, you are more or less very very clear about what can be a possible offering for the customers. There will be a couple of offerings.

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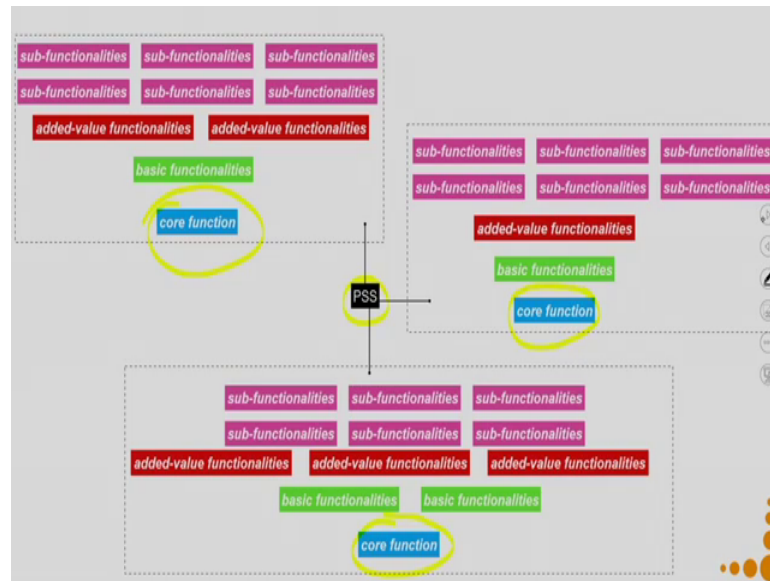


So, what does an offering diagram imply? So, an offering diagram consists of 4 types of functionalities. The core functionality is the main performance of the PSS that synthesizes its essence.

The basic functionalities are those which are necessary to offer these core functions. Added value functionalities are those that can be connected to the core one to enrich and augment the value of the PSS offering. The sub-functionalities describe the way the PSS functionalities will be delivered.

So, let us see, how do we draw an Offering Diagram?

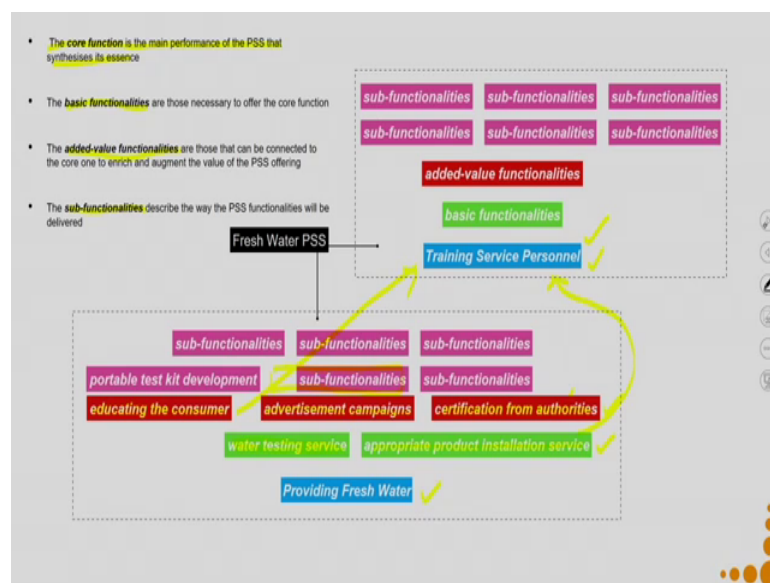
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So, say for example, you have your PSS, you will write down what PSS you are talking about; then, you will identify the core functionalities. So, say in this diagram, I have 3 core functionalities. Then, I will identify the basic functionalities. You might have 2 basic functionality or more per core functionality. Then, I will add the added value functionalities and finally the sub-functionalities.

So, let us see it within the light of Fresh Water PSS.

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So, Fresh Water PSS was our PSS definition. So, again let us go to the definition, core function is the main performance of the PSS that synthesizes its essence. So, what is the fresh water PSS core function? Providing fresh water of course and training service personnel. Because these are the two most important components of fresh water PSS; otherwise it will not function. So, core function they are the main performances.

Basic functionalities are those necessary to offer the core function. So, in order to offer this providing freshwater, one has to have some kind of water testing service and on the basis of that you will set up the water purifier. So, a basic functionality, then you have to have appropriate product installation service that will also help you in providing the freshwater. Now, let us come to added value functionalities. So, added value functionalities are those that can be connected to the core one to enrich and augment the value of the PSS offering.

You can manage without added values also, but added values is something which actually enriches and augments it and it sets you apart from your competitors. So, say for example, educating the consumer you can do without that. But if you have a population of educated consumers who are consuming with knowledge your product and know why they are consuming it; how they are consuming it, education can convince them for their consumption pattern. And the fact that they are behaving in a responsible manner that they are saving their money, they are doing something good for the earth and so on.

So, that becomes an added value functionality. So, by educating the consumer, you are further augmenting your core functionality which was providing fresh water. Advertisement Campaigns because you have to establish how you are different from others. So, your advertisement campaigns do the same thing, we add that in a value. Then, you also need certification from authorities, because your consumer will want to know how and on what basis you can say when you provide certifications, then it gives an authentication for what you are saying is true. So, certification from authorities can also be an added value functionalities.

The last one is the sub-functionalities. These describe the way the PSS functionalities will be delivered. So, each of these functionalities, the core functionality, the basic functionality, the added value functionality; how they will be delivered is part of sub-functionalities. So, sub-functionalities describe the way PSS will be delivered. Say for

example, I say for doing this water testing, I will develop a portable test kit which can be taken from one house to another house and a test can be done. How will I do this appropriate product installation service? So, for which I will say ok, I will train my service personnel because I thought that this particular aspect is can we become one of the sub-functionalities in this.

But it is so important training service personnel that for me putting it over here as just a sub functionality would reduce its meaning. Hence, I decided that rather than putting it over here as a sub functionality training service personnel of course, I will write here over here as training service personnel as one of the particular sub-functionalities. But I will have another core functionality over here for training service personnel which I will elaborate further with all the basic functionalities, added value functionalities and sub-functionalities.

Then, to get certification for authorities you have to design your product accordingly in accordance with the rules of the certification. Then, you have to apply for those certification with proper legal bodies in the help and so on. So, they are the sub-functionalities. For advertisement campaign, again you have to identify appropriate advertisers for you, identify proper campaign elements and execute them. So, they are the sub-functionalities. For educating the consumer you have to; so, how do I educate my consumers. I have to understand the proper channels.

So, is my advertisement campaign going to be the only one or am I going to train my service professionals in a manner that they are capable of educating the consumers. So, you can add as many sub-functionalities as required. Hence, we will follow the same journey for our training service; personnel identified basic functionalities, added value functionalities, sub-functionalities and we create our offering diagram.

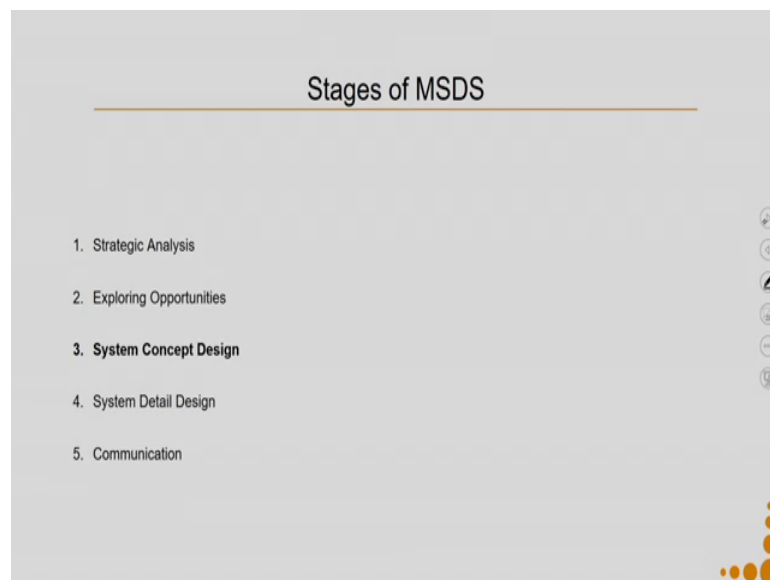
So, we might because we are exploring opportunities at this point of time, we might have couple of offering diagrams. Then, we can show these offering diagrams to our stakeholders in the promoter or anybody who is involved in that promoter group and ask them which offering diagram seems to be more suitable for your context and take a decision.

You can also make some kind of animation or system concept audio visual by enacting those activities. So, what this audiovisual document can do is visualize concepts and

sequences and promote collective conversations. So, when you can when you are presenting your ideas to your prospective clients, an audio visual way of presenting your idea presenting your sequences can be a very interesting way of getting your ideas through.

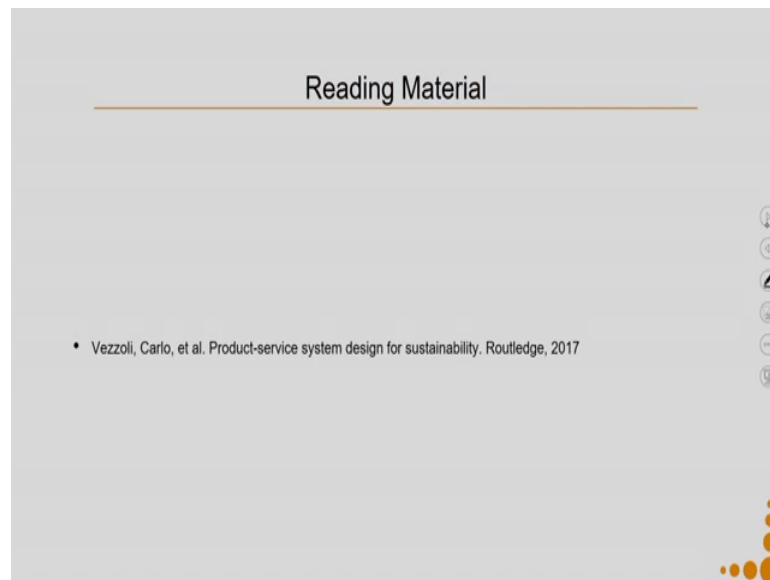
Since, there is no specific format for doing that. So, I am not presenting that. Also this one is good tool for presenting your ideas to someone. So, in case you do not have much time to deal with this, you can also avoid doing it, but most of the time we need to go and keep on presenting our clients. So, you have you can also do make a simple power point presentation to achieve it.

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Next comes system concept design. So till now, we were doing exploration of opportunities. So, what we generated was lots of opportunities, lots of polarity diagrams, lots of offering diagrams. Now, we will at this particular phase system concept design phase, we will select the most prospective directions and start with the entire concepts, entire systems design.

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So, the Reading Material for the course remains the same. We will discuss on to how to do system design concept. So, we will design system concept design and system detail design together. Many a times what you see while you are doing the system concept design the steps of doing system concept design and system detailed design they are almost similar.

So, if you already have selected one major direction from your offering diagram, you can do both the steps together. In case your client is still unhappy or say says that ok, these two or three offering diagrams I am interested in seeing, how the system concept will work better, then in that case you work on the system concept design for all the three and present it and then, whatever one is selected due to the detailed design for that.

Thank you.