Product Design and Innovation
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Lecture – 10
Importance and Overview of Human Factors_Ergonomics in Product Design

Welcome, today we will start the third module that is importance of ergonomics and human factors in product design and innovation.

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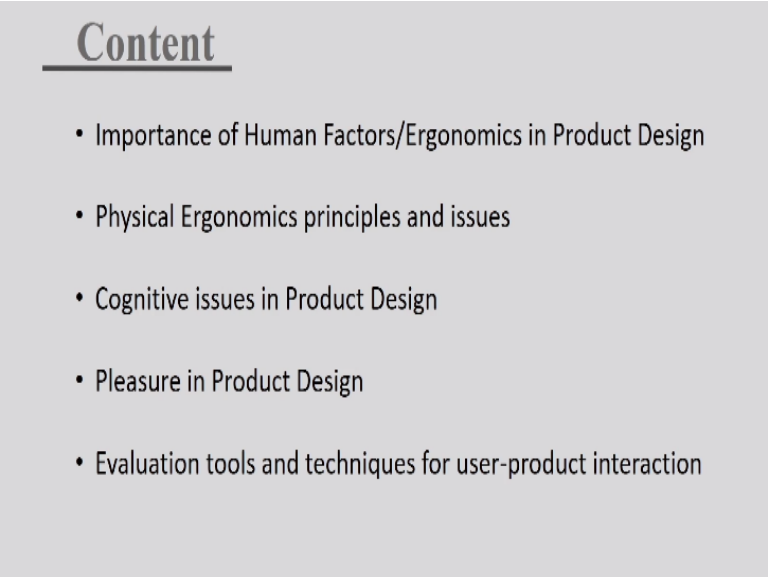

In this module, we will cover the importance of human factors and ergonomics in product design, physical ergonomics principles and issues, cognitive issues in product design, pleasure in product design and last the evaluation tools and techniques for user-product interaction which we will cover in the sixth module and that will be also shared with the subject matter expert Dr. Devaindar.

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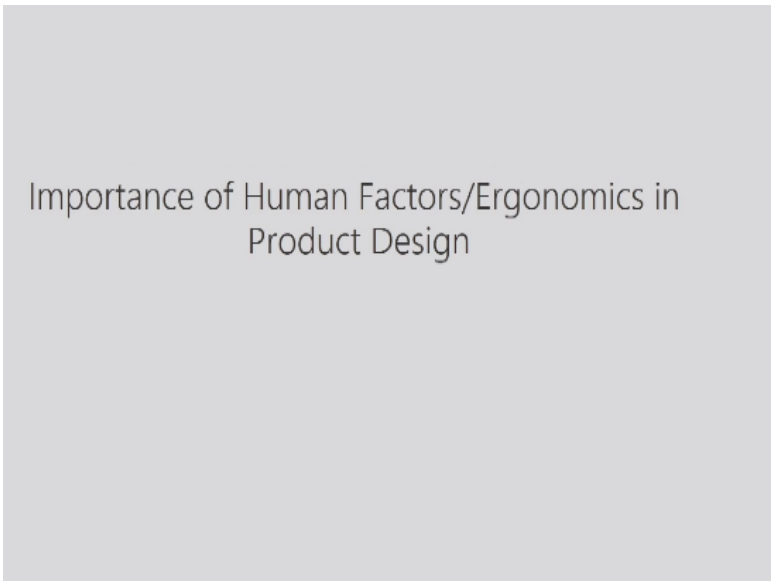

So, let us start the first part that is importance of human factors ergonomics in product design. Under this, we will cover mainly introduction and overview of the discipline.

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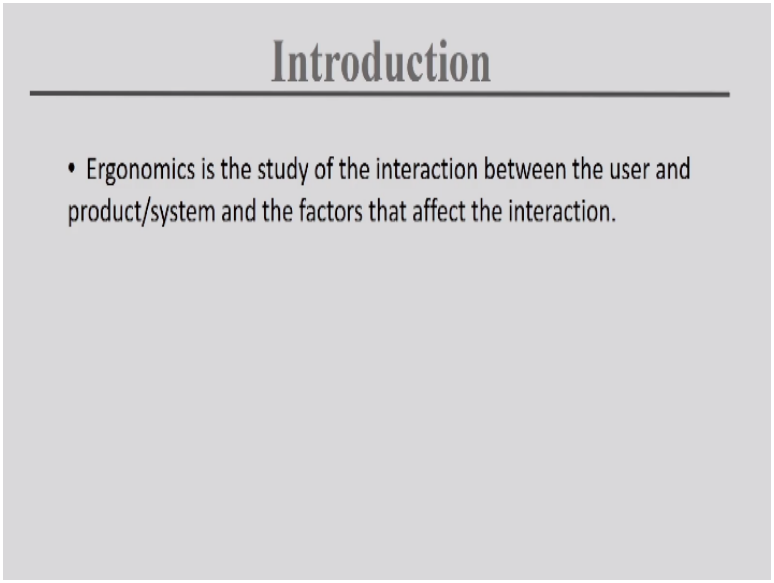

So what is human factors and ergonomics? It is the study of the interaction between the user and product or system and the factors that affect the interaction. Let us elaborate what does it mean?

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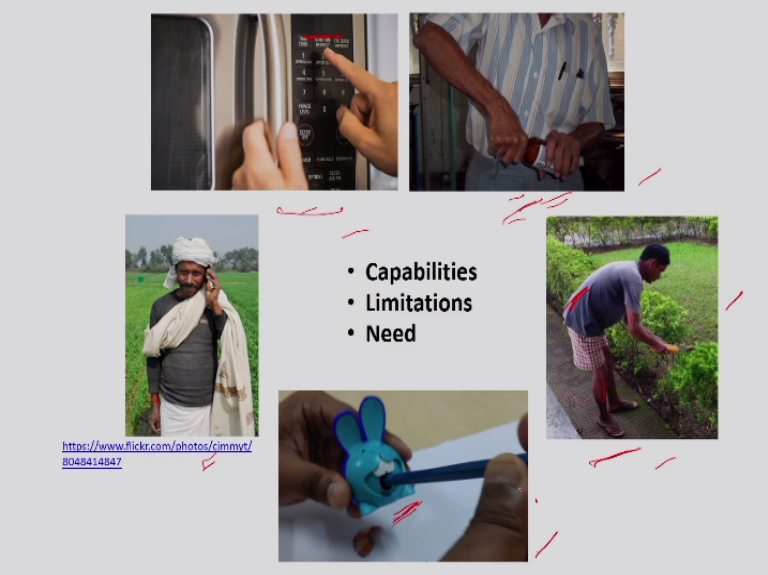

So let us take few examples from our life. So every day we are interacting with so many products to carry out our life, but few products after using we are feeling very satisfied, but other products were not that satisfied. While complaining that it is not good it has some problem like this. So we have taken 4, 5 examples from that only. Then, we will explain how importance of human factors and ergonomics matters in a design of a product.

Now let us start the first picture that is we are seeing here one person is using a smart phone. We know nowadays smart phone is a very important product that we are using everyday every moment. Then also we are observing that few people like elderly people semi literate and illiterate people are sometimes not very comfortable in using a smart phone. They are telling that it is bit more complex than usual phone or landline.

So right, there is some incompatibility in between the product and the user. So next going to the next example, so this example is 1 person is trying to using a microwave so which is a very important product in our kitchen nowadays, but sometimes when you are getting a new product like microwave and we are trying to make any cake or something sometimes we are finding it bit tough to figure out how to make a cake very easily.

For the first time, we are not able to understand sometimes whatever is coming in the display in the microwave like this so what does it actually mean. If in your manual it is written that you

have to cook it in 80 degree, so what is coming here whether it is actually 80 degree or may be below or above that. So what it is coming the information in the product is actually not helping me to sort out that problem.

So next moving to the next problem, we are seeing that 1 elderly person is trying to opening a bottle so this is a very common problem in our everyday life. So we are seeing that sometimes elderly are trying very hard to open any bottle and open any bottle or any faucet or wherever more physical strength is needed. Sometimes we are unable and they need some help from others to solve that thing. So next we went to the next problem that one person is using a hitching scissor to hitch.

So these type of problem here at the end of the day this person is facing pain and discomfort in this area and this lean portion so some problem is there because he is may be maintaining the awkward posture here for the whole day to do this activity so sometime he is facing this type of problem. So in all these 4 cases, we are seeing that may be sometimes the person what is the capability of the person may be this person is elderly person.

What is the capability of the person is not fulfilling the required amount of force, required amount of strength to operate that product or to open that bottle rather. So the capability is not matching with the product which is required to use that product or sometimes there is some limitation of the person may be he has some strength deteriorated due to the age so that is the limitation of the user and he is unable to do.

Here the person is not understanding the information so there in all these 4 cases so the capability of the person is not fulfilling the required thing what is needed by the product. There is an incompatibility. So last but not the least sometimes we are going to a shop to buy few things you are seeing this is an example of sharpener as you can see here so that this is not the usual sharpener what we are using in our everyday life.

When you are going to buy few things if you have few options you have sharpener what usual is and also we have sharpener like this which is very like a toy and very nice to see and very

interesting. So in these cases you will find though in all these cases functionality is same. We like very much these type of thing. Though we know the functionality is same. So there is some factor which is very important and dominating our choice.

So we are preferring such product which is big different like toy like or something is giving us pleasure so that is why we are preferring these type of product compared to usual sharpener. So these are few of the examples what you can discuss further and what can be handled by the use of human factors and ergonomics. In first 4 cases, we can solve those problems and in these cases, we can increase the preference we can modify the preference by using human factors ergonomics in product design.

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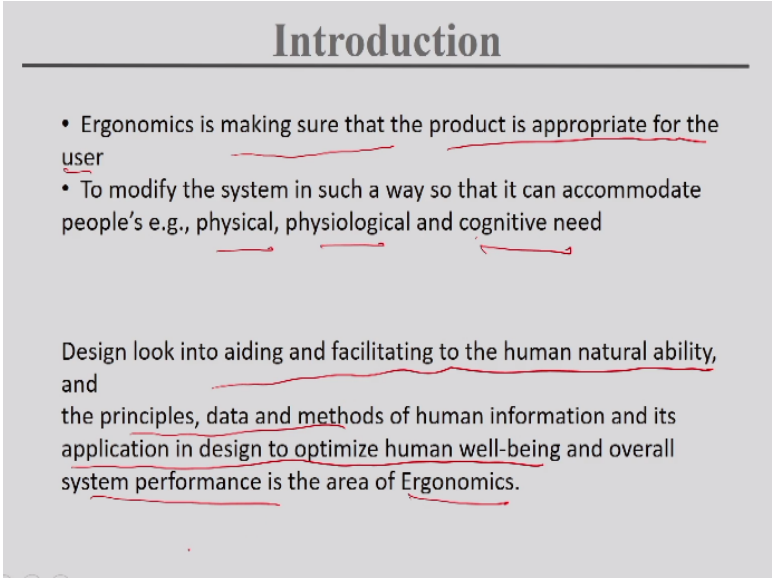

So as we have discussed in the slide that ergonomics is making sure that the product is appropriate for the user. This is very important as for example in case of the elderly the amount of force he can exert the product need to be designed such a way that he can use that product. So it should be appropriate taking care the abilities and limitation of the user. Next is to modify the system in such a way so that it can accommodate people's physical, physiological, and cognitive need.

So physical and physiological need we have discussed just now may be using the hitch scissor the person is working in a garden so in that case he needs some physical strength and

physiological issues are there and cognitive need means the person may be the person when he is using or she is using the microwave he or she needs to interpret the information what it is getting displayed in the product display.

So that is whether that information is actually we can process that information in the way so whether that is compatible. So that can be one cognitive need. Another is the pleasure of the sharpener that is also some pleasure is there and we like it is may be holding this is very nice. We feel that if I hold this it will give some smooth texture so I feel pleasure so that can be another type of cognitive need which we will discuss and that is taken care neither use of human factors ergonomics.

So in all these cases what we have seen that product is there so design look into aiding and facilitating to the human natural ability. So it has definitely all those products what you have seen in the earlier slide. It is aided and facilitating the human ability and what is ergonomics in that design product design is the principles, data, methods of human information, and its application in design to optimize human well being and overall system performance is the area of ergonomics.

So when you are designing a product, you need the human information what is the strength they can exert, how they can interpret the information in a better way, how do they feel pleasure using the product those type of information and to apply the information in a product. Then only we can optimize the human well being and the system performance and that is the idea of ergonomics.

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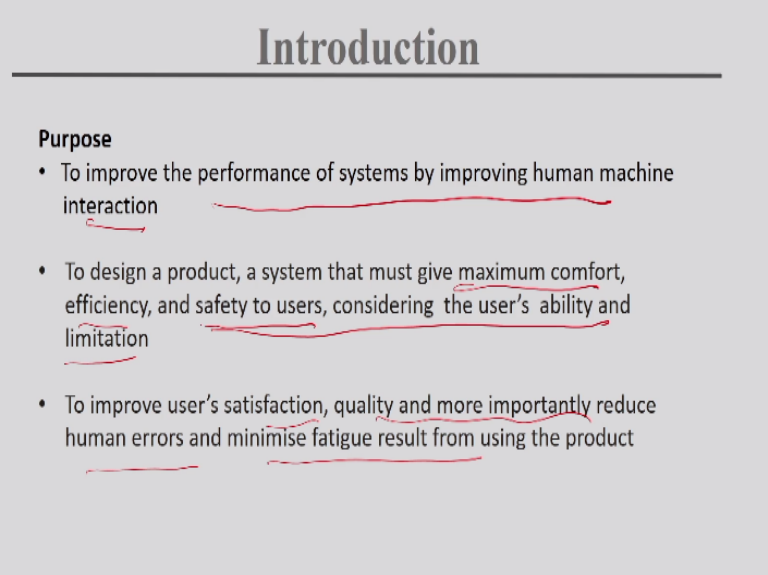

So overall the purpose if you discuss it is that to improve the performance of system by improving human machine interaction for example in the case of microwave if we improve the information it is giving. So if you can interpret it will be easy for me to perform the activity. It is another example we can discuss here when we are using some software or some computer operation, sometimes we are finding during the time of installation there is a message that is error # such and such 101, 202 like this. But, though there is a message there is a feedback.

There is some problem, but still we are unable to figure it what actually mean. So #101, #202 that I do not know what actually means. So there is some information but I am unable to understand. So if some information is there that I can understand may be reinstall or something like this then it can improve the interaction then I can do that activity and it can improve. This type of example is there to improve the performance of system by improving the human machine interaction.

Next is to design a product, a system that must give maximum comfort, efficiency, and safety to user, considering the user's ability and limitation. So few of the things we have already discussed. Now what is safety to users? So if you consider the example of the person who is doing the hitching in garden so if the person is doing this activity everyday as is it is his profession so after few months or few years of work they can develop some problems in their health.

Another thing after doing the same activity like may be 2 hours, 3 hours as due to they have some pain and discomfort in their health it can deteriorate the activity they are doing. There can be lack of concentration and by that, that can be affect the performance they are doing, that quality of aging can be deteriorated. Another thing can be there he has some injury as he is not concentrating properly due to his discomfort, he has developed for long duration of activity.

So maybe he is facing some problems and that can increase the chance of accident or injury it may happen. So that can be 1 example of safety to users. So next is to improve user's satisfaction, quality, and more importantly reduce human errors and minimize fatigue so human errors also another issue that what is possible may be some knob or something is there you are not understanding how to do it, how to operate it so maybe you are pushing it, but you have to pull it.

So something like this so you see another example what we are facing very frequently sometimes in front of a door when you are trying to open a door there is some handle. So you do not know whether you need to pull it or push it. Sometimes you pull so then it is not working, then again we are pushing it. So that is also an error. So design should be such that so my first attempt the people should successfully use it. It can be as simple as this type of door handle and it can be very complex like a space craft design.

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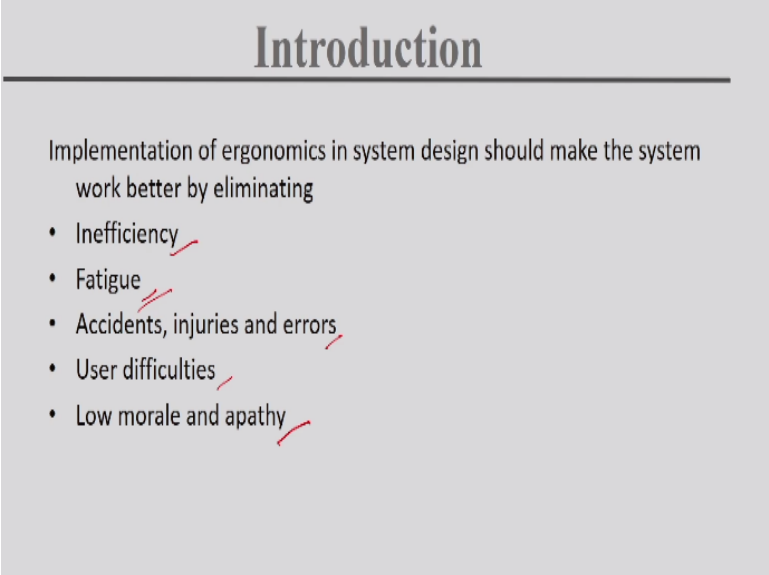

So implementation of ergonomics in system design should make the system work better by eliminating inefficiency, fatigue, accidents, injuries, and errors, user difficulties, and low morale and apathy. So inefficiency can be the input you are giving, output is not that much or more than that. If you want efficient system output should be more than the input, but it is possible whatever you are giving so that is much more than the output you are achieving.

So in that case that can be a suboptimal operation or inefficiency. Fatigue can be if you are using some product it is for a long term use it is very fatigue and for your health physically it also can be mentally. If you need some more memory load, more information processing that also can make your fatigue mentally which we will discuss in the later on discussion. Accidents, injuries and errors we have already discussed.

User difficulties: So that we will very much relate it to the ability and limitation of the person and in design mainly if it is what customized we are trying to cater a range of people. If you are designing a scissors so you want to cater a range of people so that the range of people will be able to use that very efficiently and very successfully in a first attempt or if they are using for a long term, then also they will able to use it efficiently and comfortably.

So taking clear by variation of the people or populations ability and limitation we should cater when you are designing a product we should take care what is the user difficulty and then we

should design the product. If these things will be there in the design, then it can ultimately result in low morale and apathy. Now going to the next ergonomics is a very new subject it is actually emerged during World War II.

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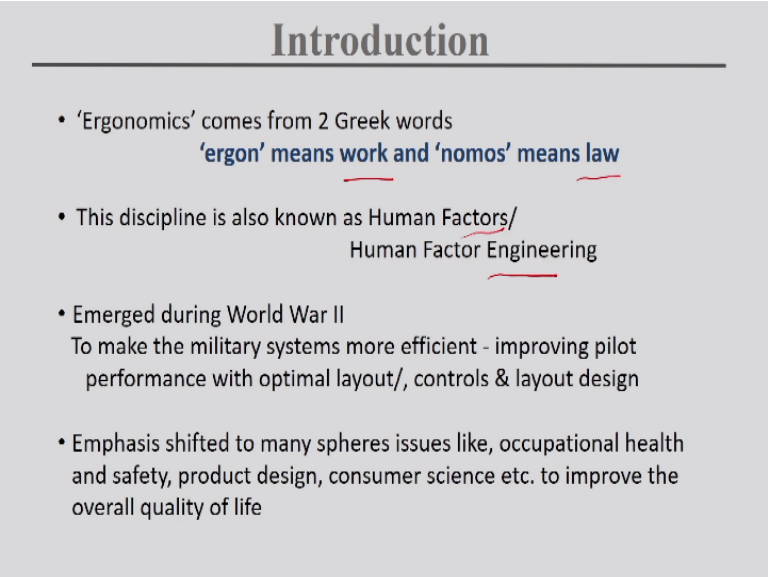

Ergonomics means it comes from a 2 Greek words ergon means work and nomos means law. So, ergonomics is the laws of work and this discipline also sometimes termed as human factors or human factors engineering. So laws of work we can understand 1 human factors. So in these examples we have seen that how the people behave or how the people perform. So we are calling those as human factors because by this we are also understanding the behaviour and performance of the person.

So that is why it is called human factors or human factors engineering. Emerged in World War II it was mainly used in the military system to make it more useful and efficient from the prospective of the person who is using. From the point of view of pilot who is flying that aircraft for their point of view first it has emerged. So it was mainly used to improve the optimal layout control and of the design.

So this in detail we will discuss a later, but now it is more broader and it actually shifted to many spheres, like occupational health and safety, product design, consumer science, etc. Few we have

mentioned here to improve the overall quality of life. Product design and consumer science however all these things we will discuss in the later part.

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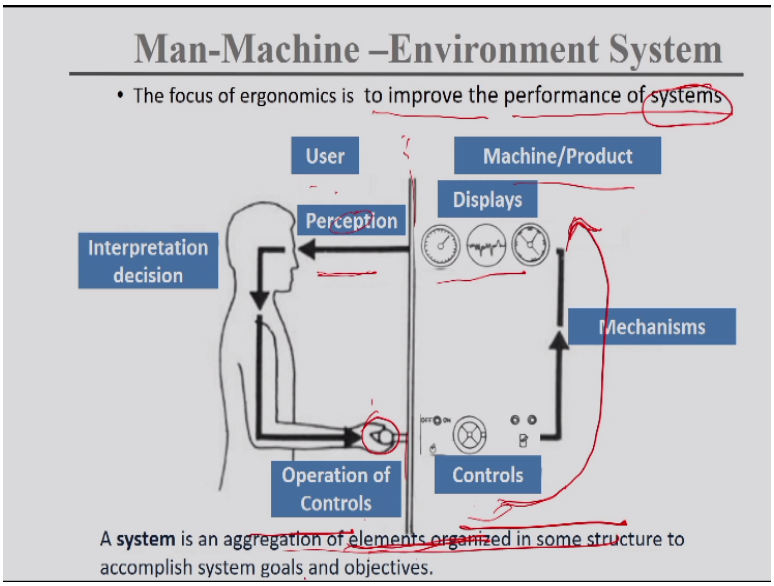

So now going to the next slide where we are talking about the focus of ergonomics is to improve the performance of the system. So now what this system means? When we are interacting with any product you can take any example. Actually when we are using any product we are interacting with something. Say for example this is 1 example of 1 person is driving a car, you can see it here.

So see for this thing when we are interacting this with this may be steering wheel to drive a car or something then we are to use that product and interacting with some product. So the interaction is through steering wheel or some control. So when we are discussing this picture let us assume 1 you are driving a car in a road and you have seen one elderly aged person and across the road. So after seeing that definitely you will think that whatever speed now you are driving the car you need to reduce that speed.

So when you want to reduce that speed that means you are if it is running in 60 kilometer per hour so maybe you will reduce it to 30 so that you can the elderly can be safe, you can safely drive imagine this example and let us discuss this picture. So in this case the person has seen this

elderly and whatever is coming in the display maybe 60 kilometer he is perceiving whether you can drive it in a same way or you need to reduce after seeing the person.

So you are perceiving, that perception is the processing of the information so you understood that 60 km in not a safe thing, safe speed so you need to reduce that. So you have processed that information and after that you want to reduce that from 60 to 30. So after processing the information that is this perception you are manipulating the control. What our control is there you are interacting with that particular control were operating there to reduce the speed.

So whatever you are operating so it is going to the machine side and there is some information from that these whatever manipulations you have done so may be 60 to 30 that control is going here again then you see the display will show 30 that is the machine part it has changed that mechanism is there finally you got in 30 kilometer of speed and you are safely driving. See these whole incidents if you divide there are 2 parts 1 is the user part, this side left hand side of this thing and there is the machine part.

And if we think of the context you are in a some road so that is the environment where your user and product is interacting. So in this case, it can be very crowded with or it can be at office hour at evening 6 o'clock it is very crowded or it can be at night at 1 a.m. so it is less crowd almost there is no car. So that is the change of environment if it is obviously if it is very crowded there will be a huge noise so many passes by will be there cars, auto, everything will be there.

So it will be very combustion and complex for any driver to drive it very safely or if it is very at night or midnight so then it will be different, it will be completely different so it will be there is no noise almost no cars are there very hardly you will find a car so you will have less difficulty to drive if we think from a point of view of environment. So there are 3 issues that is user, product, and where this is happening. So here in that can be the environment.

A system is an aggregation of elements organized in some structure to accomplish system goals and objectives. In this case goal is to reduce the speed and you have achieved that objective and then you have drove the car. So this is called the system. When you are discussing the

ergonomics and human factors we are usually mentioning it as system. So when we will try to understand we will think it as component wise. So it can be from a point of view of user it can be from a point of product or it can be from the point of the view of the context so the environment.

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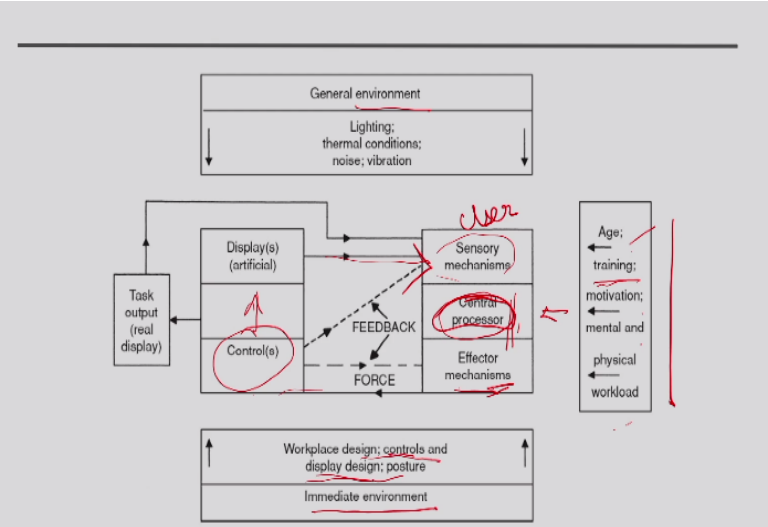

A human-machine model (Adapted from prEN 14386:2002(E).)

Now going to the human machine model we will elaborate this. So from that example of this earlier slide we will explain this that is human machine model. So if you see this is the user so user is sensing some information that is sensory mechanism. Sensory mechanism in this case when we are seeing from the display something information is may be 60 kilometer or it can be also that fuel is less something that information we have seen through our eyes.

So mainly it is as were visual so it can be your eyes or it can be your ears the 5 senses you can use to sense what it is happening sensing the information eye, ear, touch everything. So next is central processing. So central processor is what you are perceiving, what we are seeing? You are interpreting that can be result. So you are processing and what you have to do? If it is 60 kilometers your thinking will have to reduce your processing that information.

So central processor is doing that thing. After that we are doing, but what is the effect is how you are doing that? How you are actually operating and the result of the information that we are getting after processing the information how you are putting that in that actually. So, here in this case as were manipulating the control and reduce it to 30 km so that is the effector mechanism.

Usually it is with our kinesthetic that means your musculoskeletal part you are using may be it is hand driven.

Sometimes it can be verbal you are talking to somebody else effector can be something like this. See next after this thing it is going to the control this is the machine part and it is going after manipulating the control there is some changes in the display is happening and again it is coming to you. So you are sensing again whether you have achieved the intended goal that is 60 to 30 in this case. So this is the main user product interaction it is happening.

Now what are the influencing factors it can be? So, one can be the age. So see if you are a novice driver the novice's driver they are not able to do all the changes in a very crowded road. There can be some factors which can change the way will interact with the product. One can be age, training, motivation, mental and physical workload. So now we will explain 1 by 1. One can be the age. We are very often we are finding so therefore elderly it is big difficult to manipulate the system or manipulate the product very fast as they have reduced reflex due to their age.

So age can be 1 very important factor another is training if you are very novice's rider may be in a very crowded road you will be unable to judge the situation or whatever is going on and you would not be able to manipulate the thing and successfully drive this thing. So training is very important issue when you are using something some product. So if you are very used to in our difficult situation you will able. Next is motivation and mental and physical workload.

So if it is very difficult to do that may be you need much more force to operate that to operate that control and you are not able to exert that much force due to a physical inability so then you would not be able to do use that product very successfully. So these can be few factors which will influence this human product interaction. Next is this design of the controls, display, design, and posture.

So here if you see there is something called immediate environment next is general environment. Immediate environment in where you are doing that interaction so in these case the control and display design of the car is the immediate environment and where you are sitting those things,

what posture you are maintaining so those thing in this particular example if the control and display design is very good and easy then it will be easier for you to operate that so that anyway will increase the efficiency.

And last but not the least is the general environment what we have discussed if the like its noise is much more in the whole environment is or the road is very chaotic so many hassles and buses are there so then it will influence the general environment and that also will affect the human machine interaction.

So when we will discuss we will observe in that context how this product can be effective when it will be used by the user then we will take care how to modify it how to design it in a better way to make it more user center taking care their age, level of training and work load what is the abilities those thing. Now, going to the next slide.

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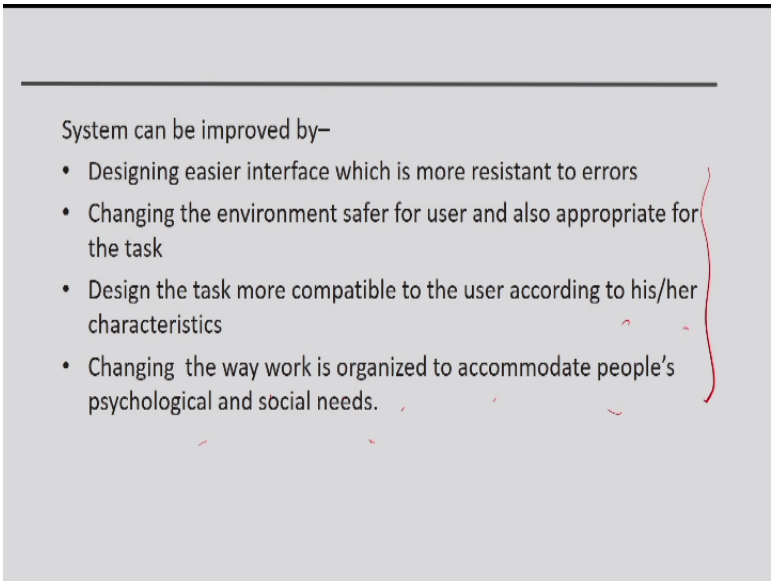

The system can be improved by designing easier interface which is more resistant to errors. Next is changing the environment safer for user and also appropriate for the task what we have discussed. These are the all task more compatible to the user according to his or her characteristics. Changing the way work is organized to accommodate people's psychological and social needs. All these 4 points we have discussed in these earlier slides. So this is now aim of the ergonomics and human factors in product design to improve in all these cases.

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Next so in attention if we discuss the guiding philosophy is to fitting the job to the man not fitting the man to the job. Here in this case the equipment is adapted to the requirement of the person. She has adapted her comfortable posture and then the other accessories and equipment has been designed in such a way so that he or she is the center and in these next cases if you see the worker has adapted himself to do this polishing activity in this thing.

So here the person or the user is not in the center. It is taken the prime importance and the person has fitted himself to do this activity. When we will use the human factors ergonomics principle we will take care it should be like this not like this. So the guiding philosophy is fitting the job to the person not this way.

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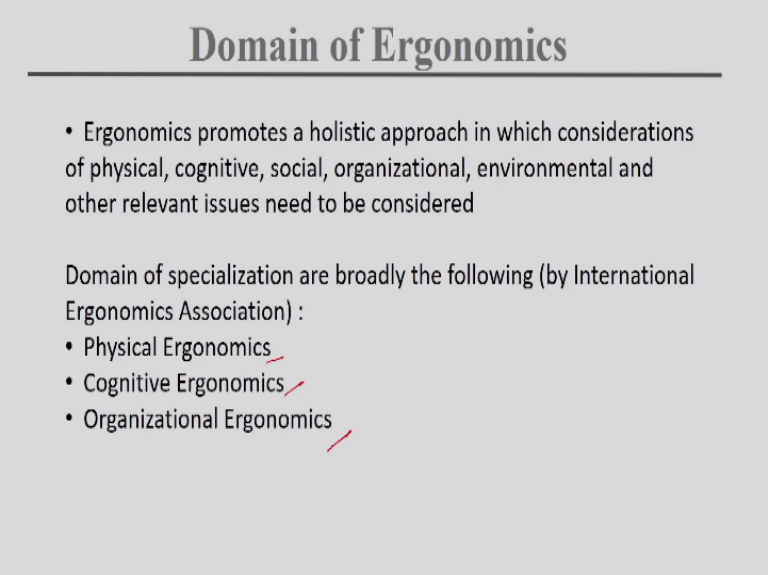

Now discuss the, what are the domains of ergonomics. Ergonomics mainly there are 3 domains and domain of specialization are broadly the following: This is physical ergonomics, cognitive ergonomics, and organizational ergonomics. Now we will discuss what these are?

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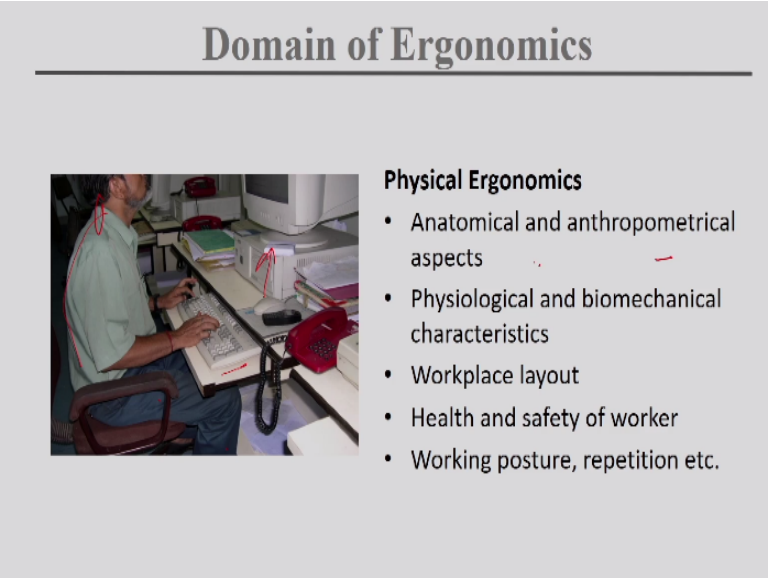

Mainly physical ergonomics is handling with the anatomical and anthropometrical aspects that means a physical fit. So if we can see here the person is using a desktop computer and he has adapted some posture to use his keyboard and there are few products are there like this what he is using a phone, a log book something like this. So in this case, the physical fit of the person with this furniture.

So these are taken care by the physical ergonomics and if you see due to the height of this desktop, his posture is something like this so he has also make a something like this so these are the issues of physical ergonomics that is anatomical and it is only the physical fitness of the dimension, the physical strength, biomechanics all those.

So anatomical and anthropometrical aspects, physiological and biomechanical characteristics, workplace layout, health and safety of the worker and obviously if you adapt a posture everyday so then definitely it will affect the safety or health of the person so health and safety of worker, worker posture or working posture and repetition. Those things are related to physical ergonomics. Now, going to the cognitive ergonomics.

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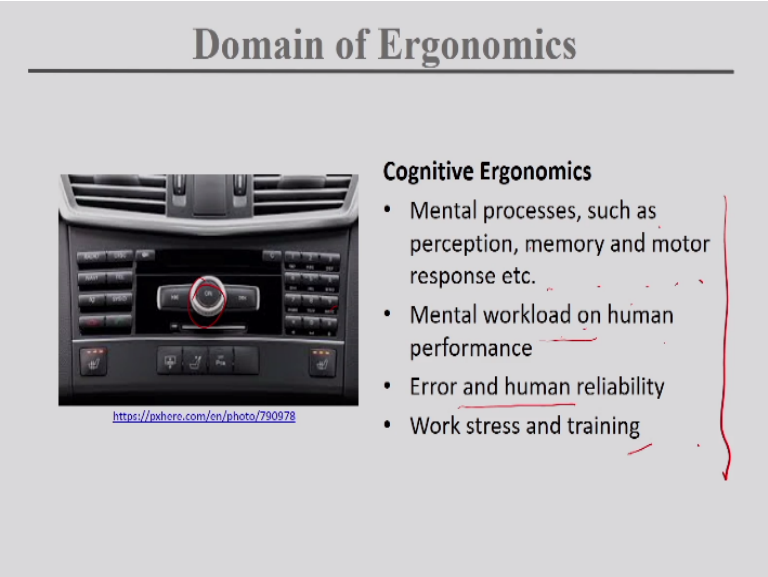

This is one very common example what we have seen every day so car dashboard. It is just an example so it is mainly how you are processing the information. So mental process such as perception, memory, motor response how fast you are acting. See for example after seeing these how fast you can understand that you have to rotate this thing or you have push this thing so those information.

So after seeing this design how fast you can react process the information and react and manipulate that in such a way. That is the correct way successfully. So those are the thing taken care of cognitive ergonomics. This is the mental processes such as perception, memory, motor

response etc. Mental workload on human performance, mental workload means if you are using some system if you are operating some system you need to remember so many information to use that system.

That is a mental workload because a memory load is so much you have to retrieve first what you have learnt or whatever is in your memory then you are using that information and when you are operating that thing and that can be and obviously if you have a huge memory load or you have to retrieve the information obviously your performance will reduce. So that is the mental workload on human performance.

It can affect and if your mental workload and this thing will be much more there is chances of error will be more. So there will be a chance that you will forget few information then if you are not filling all the information then definitely work system will not work. So that can be an error. So this mental workload error and work stress and training. So if in case of work stress and training can be something like this take an example that we are seeing whenever we are getting some products say for let us take an example of mobile phone.

So whenever there are newer version is coming you are expecting if you are getting a new mobile phone you are buying a newer version then if you try to understand whenever you have this in hand you will try to use it in the way what you are doing in your earlier mobile phone that is you are expecting something that you will work like this. So that can be as you are used to your working.

If it is not working the way you are expecting like your mobile phone what you are using so it can big stressful. Then you need to learn how to use this thing, this product it is different. That can be 1 example, what can be the work stress and training this is a 1 example that it can be very important when the person is doing very complex information handling work. So, all these issues are taking care by cognitive ergonomics.

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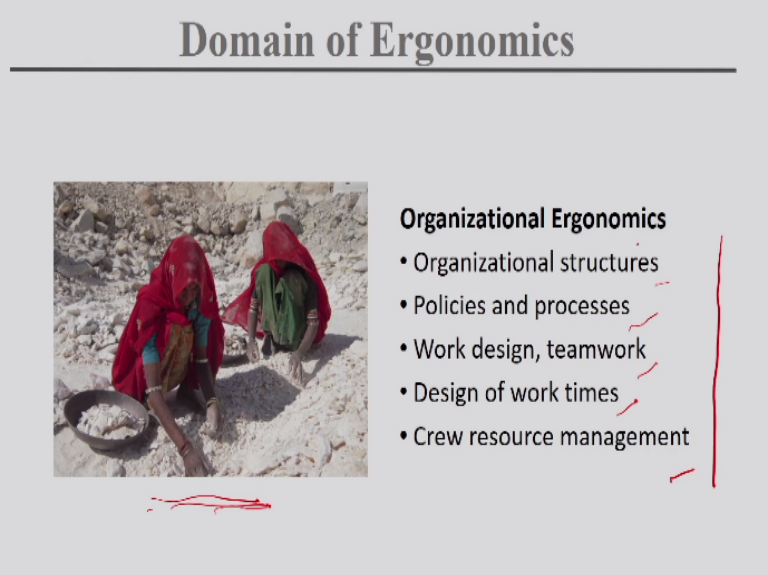

Now, going to the last domain, that is organizational ergonomics. So, organizational ergonomics is mainly dealing with organizational structure, policies and process, work design, team work, design of work times, crew resource management. So just very briefly organizational ergonomics say for example if you consider this picture these ladies are working in a very scorching heat may be 50 or 51 degree centigrade in an open mine like this heap stone what you are seeing here.

So how long the person, the workers can work there. So it is definitely not very healthy atmosphere and healthy condition to work. So may be after 1 hour they should have some pose and rest. They should be kept in a cooler place and they can revive and they can have bit comfortable environment in the rest room and then again they can resume their work for 1 hour then again they can go like this.

So these kind of work time how you will do this manipulation of work time, how many people will work if you are shifting some very heavy load, how many people should recruit to shift that load 2 persons, 3 persons all these thing. So these things and what will be these policies so these things are relevant under this organizational ergonomics, but these ergonomics we will not discuss because it is not in the preview of the design innovation course. So now where to intervene? So if you see any system so real work systems are hierarchical.

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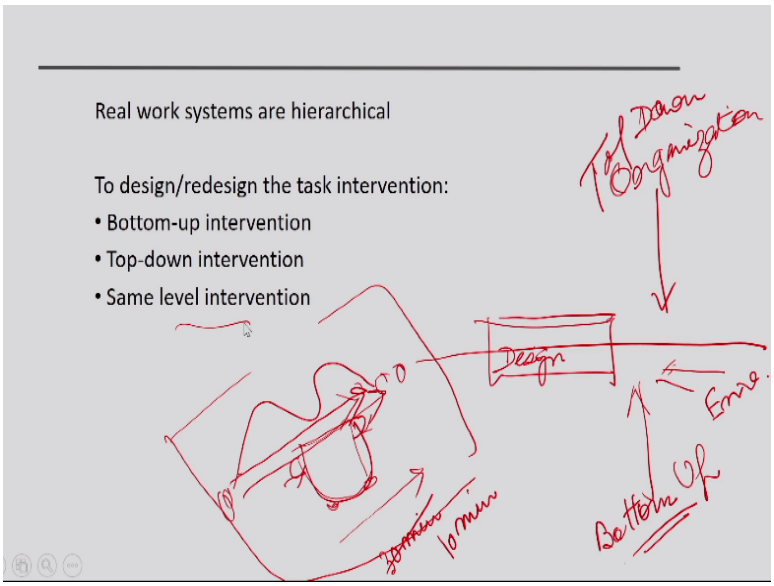

So to design or redesign the environment if you take anyone of these interventional approach or may be 2 that is bottom up, top-down, and same level. Say for example if you are handling some load and in you want to change that or design or redesign that thing. So in this case, if you are handling some load there can be 1 possible. So for example the vessel you are handling is like this and the person is 2 persons they are shifting this thing holding this place.

So what we are seeing very frequently to shift the cooked food from 1 place to another place restaurant something like this. So when we are seeing some product it has been used with 2 persons to shift from 1 place to another place holding here we want to redesign that thing to make it more user center. So how will you intervene? Intervene can be in so many ways. One can be you can do something here and it can be useful to hold these 2 persons to use.

So that these type of product redesign or there can be some tool to use so that the person can use this thing that type of intervention from this bottom up. So when you are doing this type of it is called bottom up. When we are redesigning the tool you are redesigning that product itself or you are giving some aid these things are bottom up. Another can be top down it can be from the organization side that is maybe you can recruit more people or enough people who is doing this activity may be for 30 minute at a stretch. It should be reduced to 10 minutes.

So that can be an organizational also what it is called the top down interventions. So intervention can be in this way also. Next is same level where the environment, for example: to reach from here to here you are traveling this way so if you change in this way may be this will be better. So, that can be another approach what you can do or the environment where they are using.

So there can be enough light so that they can reach from this place to this place safely those things of issues we can think in that same level of intervention. So when you designing some product or redesigning something what approach we will take to intervene that thing? Now going to the next which is very important nowadays for consumer goods industrial design, is the pleasure.

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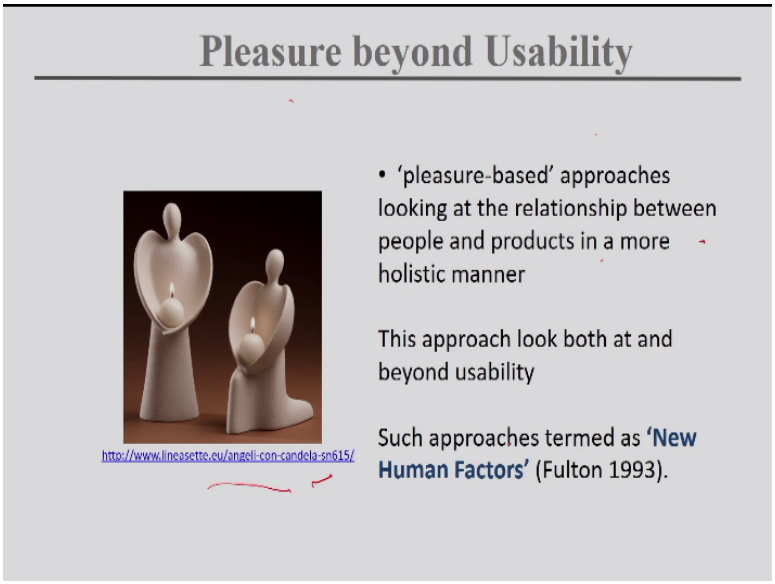

Which is beyond the usability as we can see this is something we can withstand, but it is very different, and it is once you see you will feel oh if I hold this thing it will be very smooth. I can hold it very nicely and if I put this in my drawing room it will be very nice and people will tell it is very nice like this. So you will have some better feeling. So you will have some pleasure. You will now enjoy that so that is the pleasure of the product which is beyond the usability. It is not something simple usability so pleasure beyond usability.

It is fulfilling all the usability criteria top of that it has some pleasure value. So this pleasure based approach is also very important now a days and it is very important factor in case of

inertial design and from a point of view of consumer. So pleasure based approach looking at the relationship between the people and product in a more holistic manner. In this case usually product user is building some relationship with the product.

This we will discuss later. This approach, look both at and beyond that usability and such approaches termed as new human factors. So we will discuss this pleasure value of the product design also.

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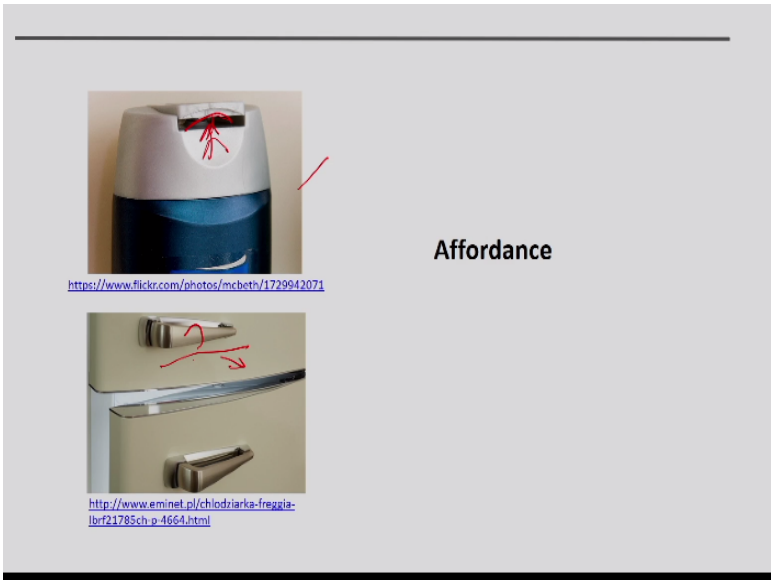

So now we will discuss few examples where all these things what we have discussed this physical, cognitive aspects, pleasure of the product how they have used all those factors and considered this factors in design. So we will just overview few of the design what we are interacting in every day. So we will see, observe, and how they have used these thing in the design. First is the affordance.

So affordance is if you see this product, take this example, this is 1 product after seeing in the first glance you can understand. You have to put your finger here and there is something like this so you have to put face upwards so then you can open this product or for this example from these design of this handle you very well know you have to put your fingers like this and then you have to pull it then only you can open these 2. So this is called affordance.

So even key is there in the product. So this visual key on the product is giving you some information how to use it what is the intended purpose of this design. So that is called affordance.

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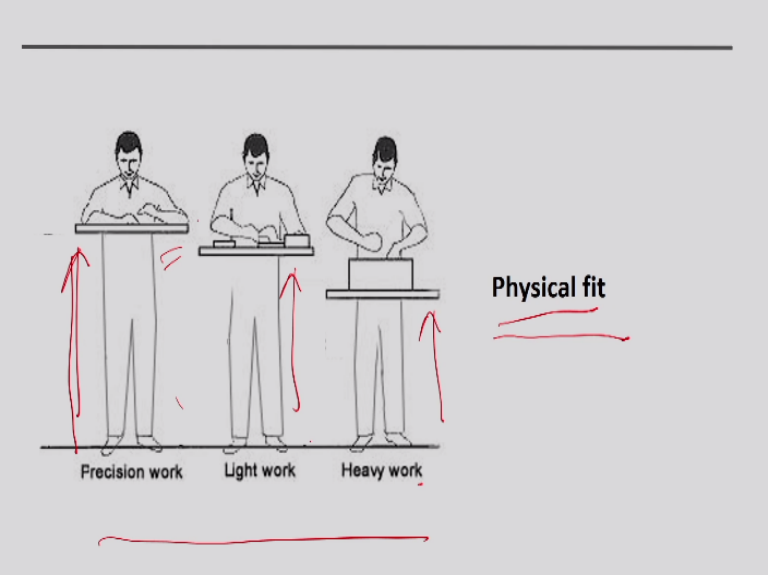

Next thing is the physical fit. When you are discussing about design it is very much context specific as we have discussed in the introduction section we have discussed that depending on the user you are designing that one. Where they will use, depending on that we will design that. So this is called a context. So if you observe this picture so that is something called physical fit when you are discussing the physical ergonomics we are talking about physical fitness of the person or to make the product compatible to the user physically but there is no hard and fast rule.

It depends on the what type of work you will do or what type of lean is there. In this case, this is an example from a kitchen what we are doing in usually in our kitchen we are doing 3 types of activity may be making dough to make some roti or something. Second type of thing is there to cut vegetables in a precise way and something can be washing of utensils. So if you see these things washing of utensils is a bit heavy work. You have to wash; you have to put side.

So these type of heavy work you need more platform height. In case of light work, may be making chapatti or something you do not need that much force or something, it is less. So you can the platform height will be much more than this heavy work and in case of cutting vegetables

in a fine way you need more precision not the force. So in this precision what type of work your platform height will be more than the light work or heavy work.

So depending on these 3 types of activities we are fitting the platform height with the user. So first design is very context specific when you are using this physical fitness think of the context so there is no hardened first rule you have to put in this much inch or this much centimeter depending on the activity they will do you have to make it.

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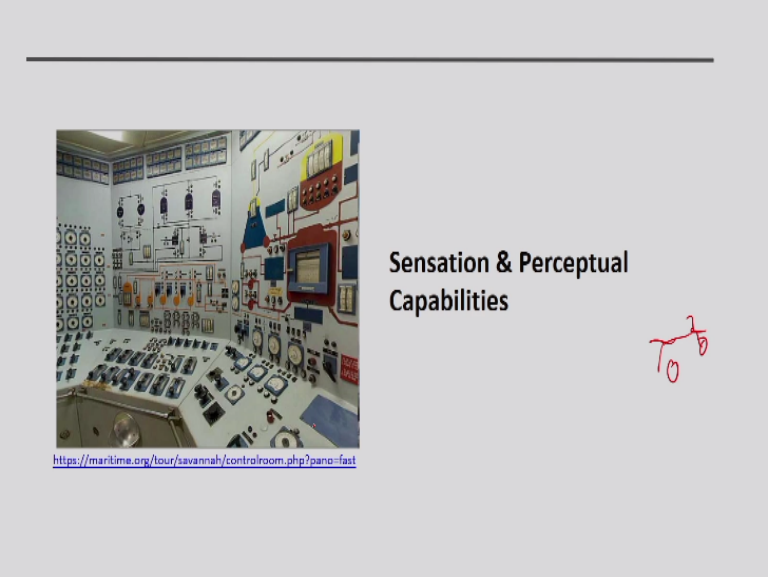

Going to the next example is the sensation and perceptual capability. So what does it mean sensation and perception? Sensation is something these 2 sensation and perceptual is the steps of information processing. So in this case, for example you are seeing a bicycle. When you are seeing a bicycle you are sensing something it is not bicycle it is a product. So after sensing that thing you are sending that information to your brain so then from your brain you are retrieving this is something this image is something what I more get it is a bicycle.

So you are trying to match what you are seeing right now with that information what is in your memory. You have you know this bicycle is something like this so it is something like so bicycle is something like this you are matching that previously learnt image of bicycle and what you are seeing right now. So this is the sensation and you are pursuing. You are arising that senses what

you are getting from the product, you are matching with that and you are pursuing that it is a bicycle.

So that is called sensation and perception. So this sensation and perceptual capability is very important feature when you are doing a good product design, user center product design. For example, here if you see this thing this is an example of control panel which is very complex so in this case this is 1 example of this control panel which is if you see switches and control switch there if you see these type of thing may be how you are sensing these information and how you are perceiving.

For example, these are whether you need to rotate, whether you need to pull it, push it, do this, this way whether you need to rotate it those thing after seeing this thing how you are sensing this and how you are working on that information. So this is very important. This sensation and perceptual capabilities which is under the cognitive ergonomics are sent and which is very important in case of good product design. Now let us take an example.

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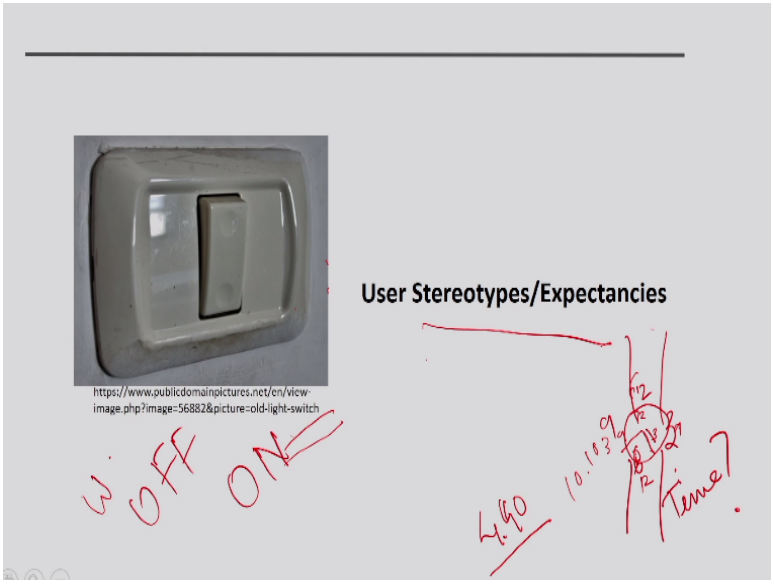

This is called user stereotype or expectancies and which is very important factor in case of designing any product. Let us take an example. So what is the time right now? So mainly after seeing this thing most of the people you will tell that it is around 04:40. So it can be also 10:10 because when you are talking about 04:40 we are putting those thing like this, but when I have

shown you, I have not put this 3, 6, 9, 12 when I am talking about its time is 10:10, I am putting is this way.

Why you are thinking is more like it is 04:40, because you are expecting this will be this 6 will be here, 3 will be here, 12, and 9. So this is you are expecting. So this is called stereotype. So in case of this example, mostly all of you are telling that now it is on, but here nothing is written like on, off something. So this is your expectancy or your stereotype. So using stereotype and expectancies is very much related to the experience of the person what they are usually in practice is there so you will try to match that thing with your product what you are using.

If it is matching so people can use that product in a more efficient way without error, but you have to handle this user stereotype expectancy very cautiously because it is very much dependent on the culture of the person and what is the experience of that particular target population. Say for example for as it is on.

But if you go to any western countries it will be off because they have this switch they are using this is on and this is off. So for example, if you change the country and a population the user stereotype will be very different. So user stereotype is very much dependent on the practice where and the experience of the target population what usually they are having. Next is positioning.

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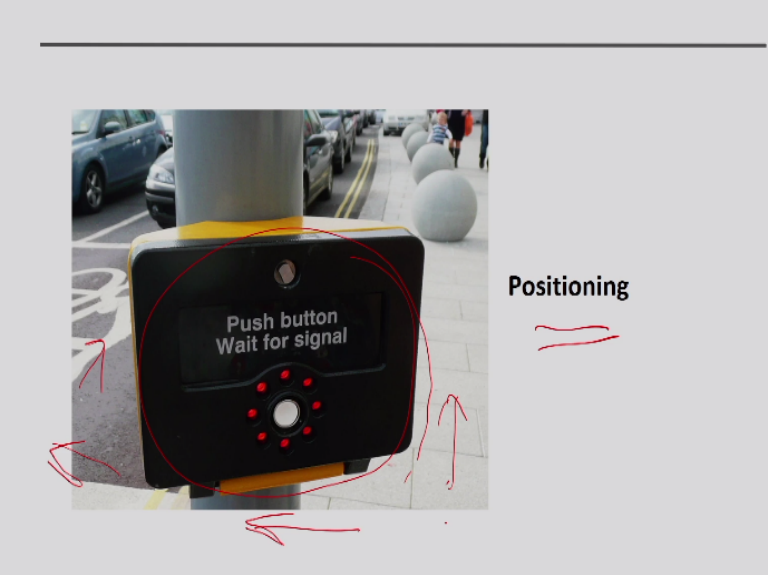

This is one example of positioning of any product; it is a pedestrian traffic signal. If you are seeing this product has been this is the footpath and this is the road. So they have put this signal in a right hand side of the person, as the person might cross from this foot path and use this road to cross. So once we will cross this road then it will be obviously we are seeing the right hand side of the road.

So that is why it has been put in the right hand side the person will be compelled to sit that side and he will cross the road. So that is the importance of positioning of a particular product in such a way so that it is obvious that user will see that thing, observe that thing or what is your intended purpose is you are fulfilling that with the positioning of the product.

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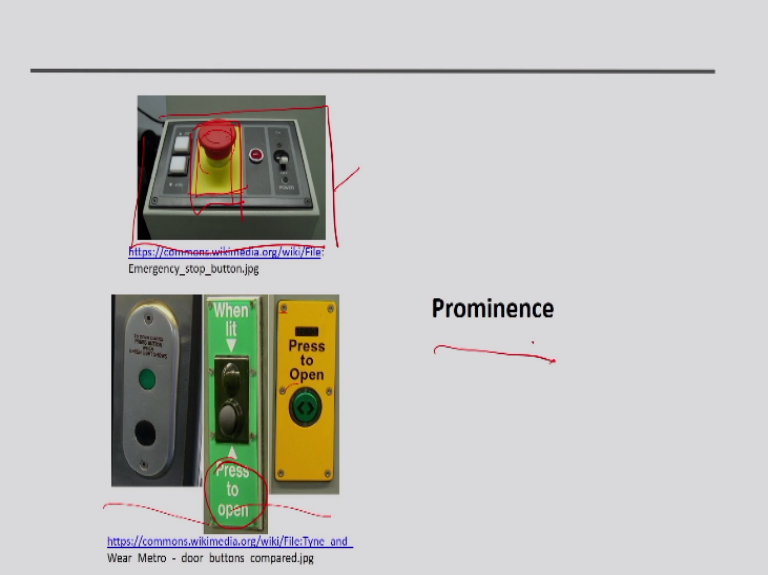

Now going to the next example is the prominence. So it is very common saying everyday so what you want to make it very prominent for the user make it more pronounced make it more exaggerated. For example, it is something stop button, maybe it is an emergency switch something like this, and in emergency you have to press it so first is very universally acceptance so red to stop, then they have made this yellow patch. So it is a high contrast.

So once you see it is making very prominent if you consider this whole control panel this part is exaggerated and very pronounced in case of this panel design or something some information if you want to put give this thing that yellow, green or some way you make it more prominent and pronounced. Another thing that need to be considered, these type of thing may be press to open when lit so these thing also is very important depending on the context.

If you are doing some control may be in airport or somewhere depending on the context in that place it may be possible few passengers do not know language English what you are using may be the language whatever you are written here. So in that case, use some graphics so then irrespective of the literacy on that particular language the person can use that thing. So it is very much context specific like the either factors what we are discussing.

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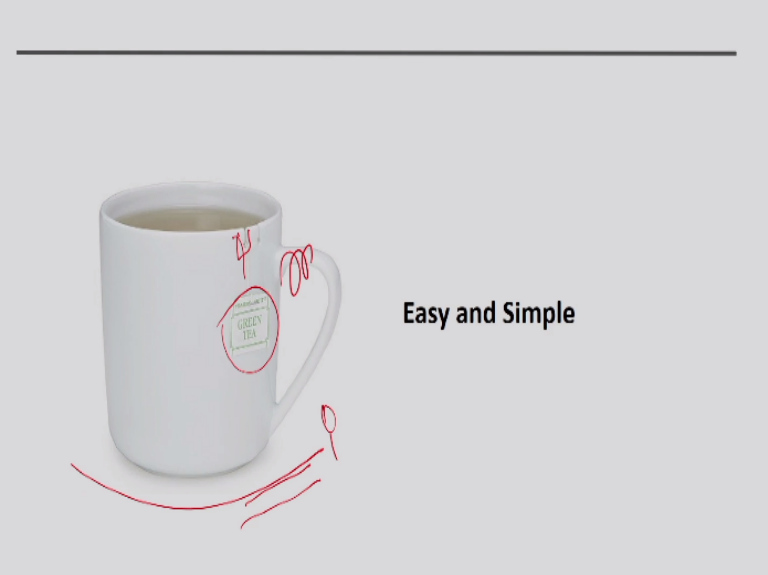

Next is easy and simple. So if you see this product this is a very common product. It is a tea bag it is made a cup of tea with tea bag you are seeing here. So the problem is what you are seeing everyday that is you are having very much problem after dipping the tea where to keep the tea bag so there is sometimes you are having some plate like this, sometimes you are keeping it here only. So, how to solve those problems?

So they have made a slot here and you can keep your tea bag something like this and also if you want to keep it you can pull it and then you can also wrap it. So make your design very ease and simple and without much more complexity of that thing. So to making design is ease and simple is also another very important issue from the point of view of human factors. Now if it is possible

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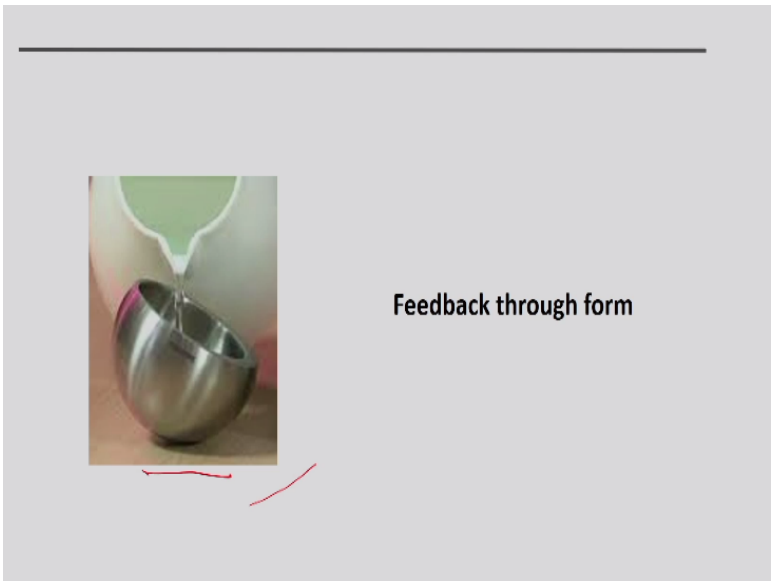

If you see this thing that feedback through form, feedback through form is, if you see this is called balancing bowl. So balancing bowl is such that if you may be it is not 100 gram. Once you put 100 gram it will be stable, it will be balanced. So in this case the product itself is interacting with you so this is feedback through form. So this form is the product it is giving you some message and interpreting.

There is no need to measure whether you have to put 100 gram or not. So feedback through form if it is possible product itself can interact with the user.

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Next is proximity and grouping. This is very common example what we are using in everyday say it is a TV remote so if you see proximity when you are changing any channel you are mainly using 23, 56, like this part. When you are going to the right, left, up, down where you are moving this or for setting or something home these things are not very obvious when we are changing channel or volume or something.

So proximity and grouping is something what type of activity is related may be up, down, right, left, group it in a same grouping in a same part. Or grouping in proximity you group it. For example, this digital thing has been grouped in proximity and this in 1 group. So proximity and grouping is very important. It also depends the type of activity you are doing with this similar type of control and panel you group it in that way.

Another can be the activity you will do may be it is a cycle. First you have to do this thing, then you have to do this thing then also you can putting in that group. So this we will discuss later on in detail, but proximity and grouping is very important in case of control panel design. Next is affordance.

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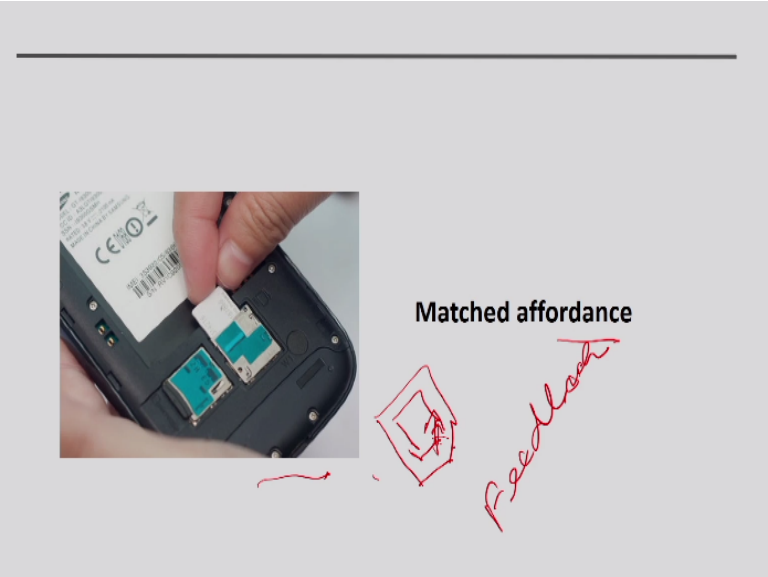

As you have seen what affordance means. In these type of case if you this is a very common example when we are putting those type of sim card so we are seeing if you put it in a opposite way it will not go inside because there is a bold part here so once it will go like this then only it

will fit the slot. So matched affordance is also very important feedback from the point of view of this design product.

And which is giving some information to the person once you are putting it in a different way it will not go inside. So you are giving the information. If you put and it is matched with this thing, then only it will work otherwise it will not work. So your product can give something like this so where the slot has been designed in such a way so you will give some feedback from there. Next is confirmation.

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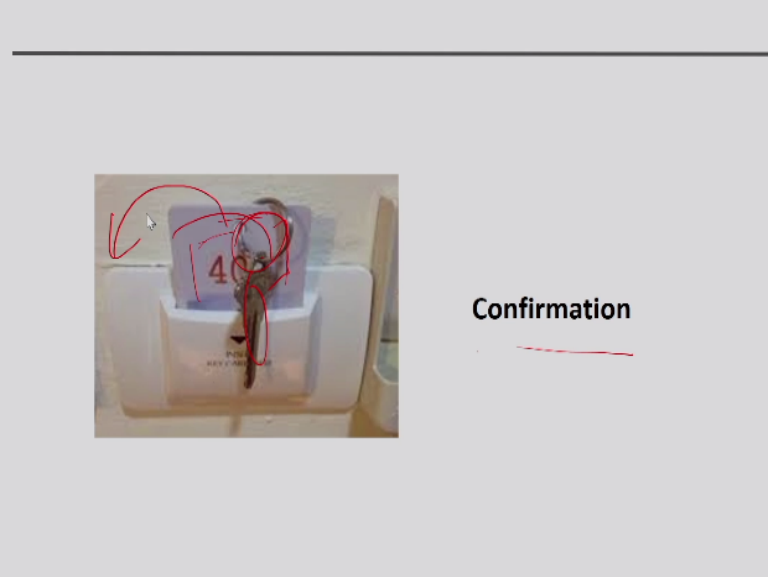

Confirmation is using an example of a hotel room, we all know. So once you are going out from the hotel room we need to take this key, and once you take this key automatically this thing will come out and your power will be off. So this type of confirmation you are compelling the person that so that what you intend that there should not be any unnecessary power usage so unnecessary power should not be there.

Once you are coming out of the room it should be power off in this case we are compelling that somehow you are what is your intended purpose is to making the power off you are clubbing it with this key. So whenever the person will lock this room so definitely this power will be switched off because this will be also coming out. So that is the confirmation. Confirmation we are using where you do not want any activity should happen which is completely unintended.

And you want to prevent that activity. Prevent the misuse something like this. But you should use this confirmation issue in design not very often then it may create the frustration of the user and it may be very tarring for the person. Use this confirmation factor very wisely when you are designing any product.

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Next is interlock which looks similar to the confirmation, if you see nowadays the ATM machine once you will take your ATM card slot is here and only you will take your ATM card out then only you can take your money from this slot. So in this way there is no option that people may forget to keep their card there only by that thing 1 activity is cannot be performed until.

And unless you will perform the other activity so that is interlocked with one another. So until and unless you will not take your ATM card you cannot retrieve this thing. So by that thing you are actually helping the user to minimize the error it may happen. So that is another very important factor. Now going to the next is the aesthetic usability effect.

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If you have see this chair it is a chair obviously but it is very nice looking and very aesthetically very nice. So the idea is that people usually expect that aesthetically pleasing or nice looking product is easy to use so that is called aesthetic usability effect and which is very important in case of product design when it is a consumer product. So this is called aesthetic usability effect. It is also related to the pleasure of the product, what we will discuss in the pleasure in design.

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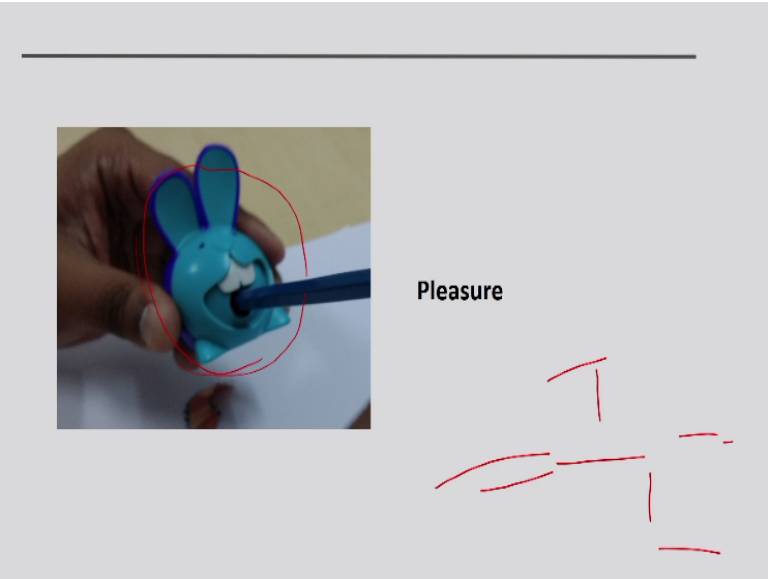

Next is the pleasure. So as you have seen this same product in this sharpener so as the toy like structure, toy-like face is there so that is why people like this thing then it is giving some enjoyment and pleasure to the person so how to use this pleasure factor in your design so that

people will prefer that type of product compared to the other usual which his very obvious and it is bit different. So use this pleasure factor in your design. Next is contour bias.

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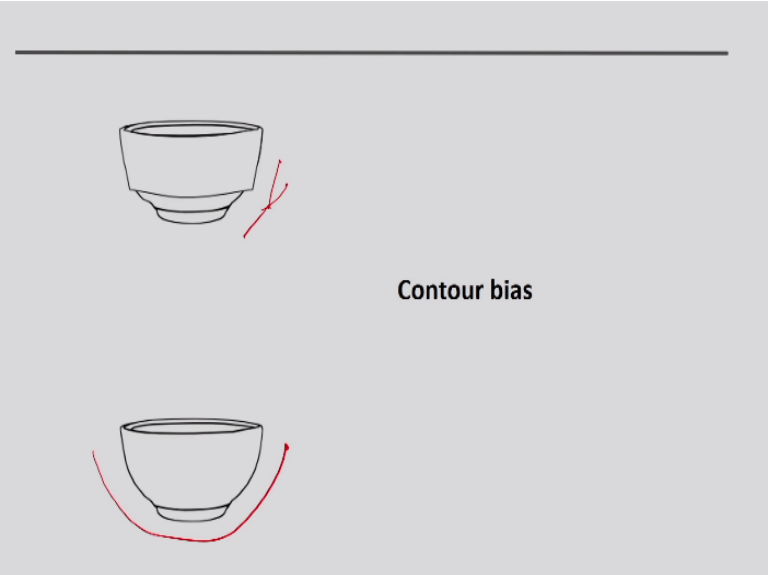

So usually after seeing anything people mostly use this rounded thing not this angular thing. So this is also very important with the cognitive aspect of any product design. So if you want to make people be thoughtful then use this angular thing. So and otherwise if you want to make it very common to people that make it something round. So that is called contour bias which is very important in case of product.

And it is better to use this type of contour bias when your environment is very neutral and you want to put some thought there you use this contour bias.

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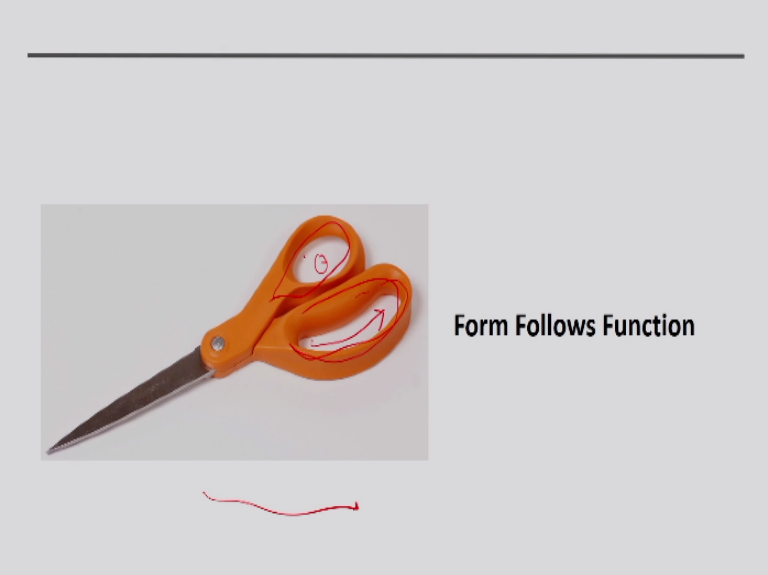

This is very important that is form follows function. If you see this scissor so form follows function is after seeing this hole and the eye of this scissor is not symmetric. After seeing this product, it is very obvious you know that you have to put 3 fingers here or 1 finger that is thumb here not the other way. So this form itself is giving you some formation so the first time user also can handle it very correctly. So this is called form follows function.

This form is giving the how to use this how it will function how to hold it so this is called form follows function which is very much integrated with any product design and first criteria should be form follows function then aesthetic should come later on. Next is mapping.

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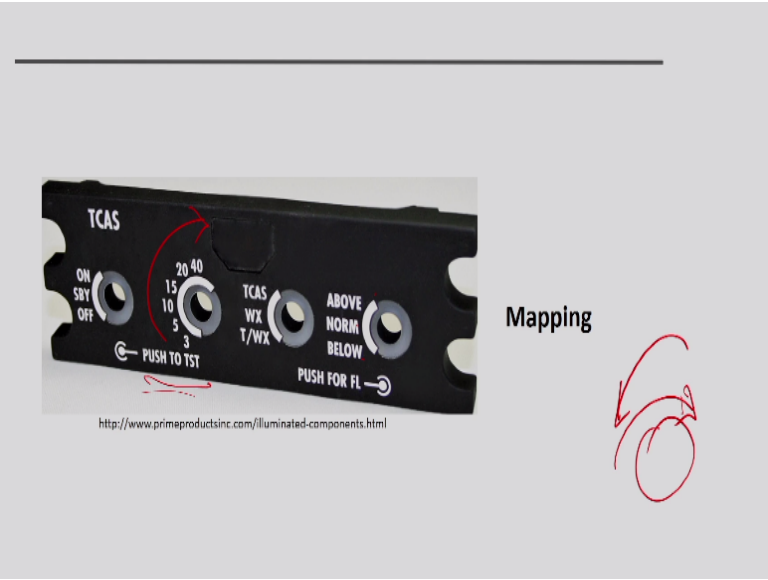

Mapping is something what we have discussed after seeing this thing when we want to it is very obvious. We are giving you some knob like this if I tell you to increase usually you will put this thing in clockwise. If I tell you to put decrease, then you will put it in this way anticlockwise. So that is what you are mentally thinking it should work like this so mapping is if you see this thing so besides increased in this way 3, 5, 10, 15 or below normal above something like this.

So mental mapping is also look similar to stereotype mental mapping is very important to reduce the cognitive load of the person in any product.

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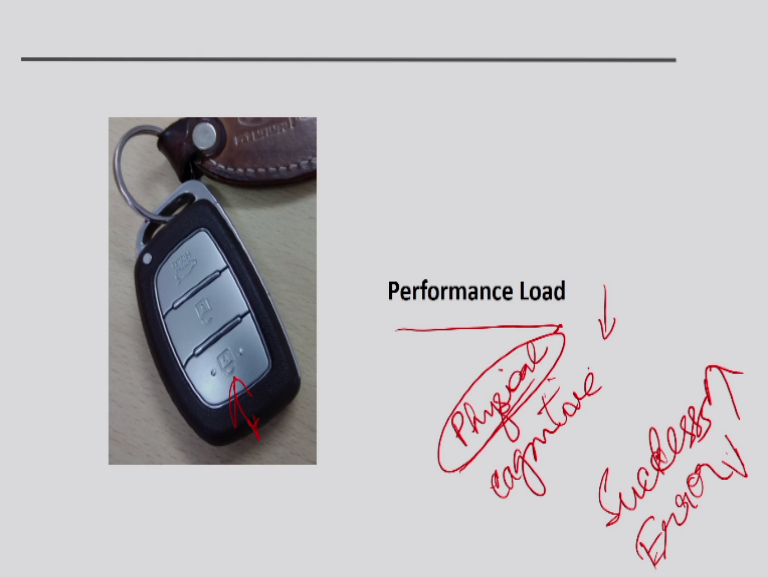

Another factor is very important that is performance load. Performance load can be 2 types, 1 is this physical load another can be cognitive load. Physical load is mainly the how much strength you need to exert to do something activity this is an example of a key of a car. So if you see earlier we need to unlock this car door with key and you have to unlock after exert some force and then you have to unlock. Now it is simple click of this thing this button you can unlock.

So it has reduced this physical load drastically and actually it has reduced the physical performance just with a click so this is called performance load. Once you decrease the performance load the success will be much more. So if your performance load is getting decreased your success will be very high another point is that your error will also be very less because there is a very less chance of error.

So performance load when you are designing any product lessen your performance load both physical cognitive, then you can increase your success and rate of error will also decrease and last but not the least in this example is the in few example you see it is mainly applicable in case of premium product like jewellery, car, or something very cruise like this so there people are more likely to have a high price product. So it is more desirable.

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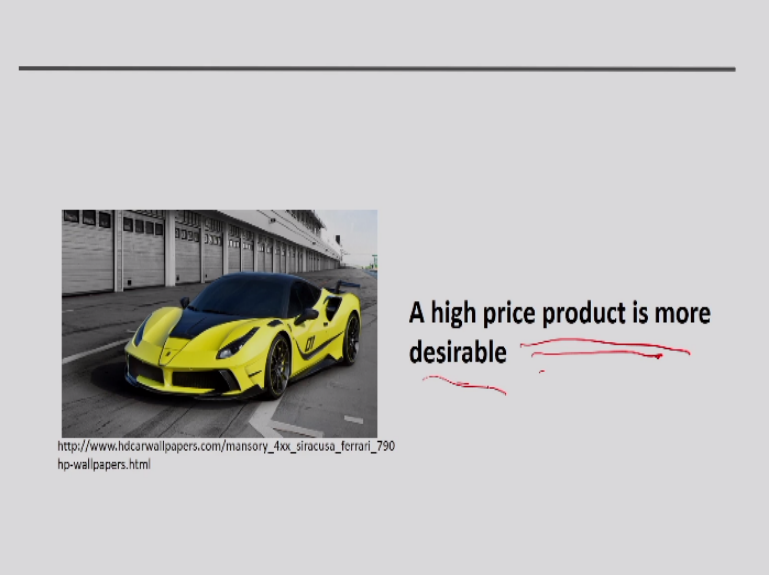

That is called high price product is more desirable that is also called Veblen effect that usually as a user as a person always does it desired but to be in a higher status not to belong in a lower status that is the psychology of the user so this factor is also important when we are designing some premium product it is also important in case of branding and the form.

So it is also important in case of pleasure of the product which is very important which will give the more social status and which is very much related to the design of the product how you are doing. So after all these examples, this was an overview with different product we have seen just to wind up all these examples in hierarchy that.

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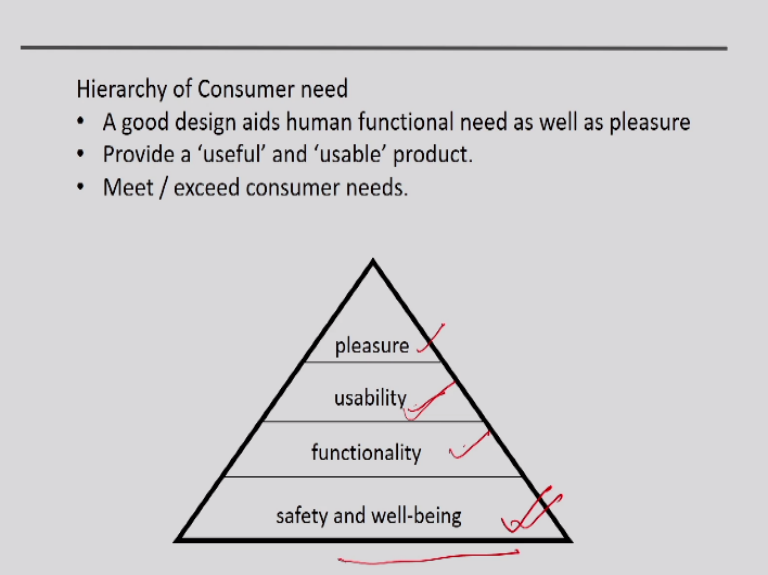

So consumer need is in this way. So hierarchy of the consumer need is first it should be safety and well being. You have to fulfill this thing when we are making any product. Next, it will come the functionality. So it should work. So intended function for example if scissor it should cut that is the functionality. You have to fulfill that. Next is the usability. Usability is how much it is compatible with the person or with the user taking care his abilities and limitation.

So once you have this scissor design should be usable for a user so it is compatible the physically, cognitive, last but not the least is the pleasure value. How it looks? Once I hold whether it will give me that smoothness whether I will feel happy to holding this product that is the pleasure value. So, good design aids human functional, as well as pleasure and provide a useful and usable product and meet or exceed consumer needs in the way pleasure.

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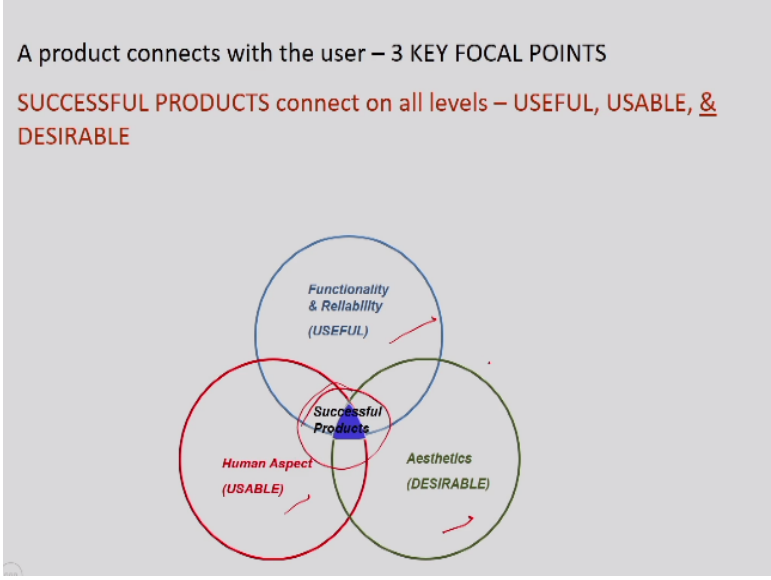

So wrap up this thing mainly a product connects with a through 3 key focal points with the user. One is functionality and reliability. Next is human aspect and aesthetics or desirability and if it fulfills wherever in a product if 3 issues are there then it will be successful product.

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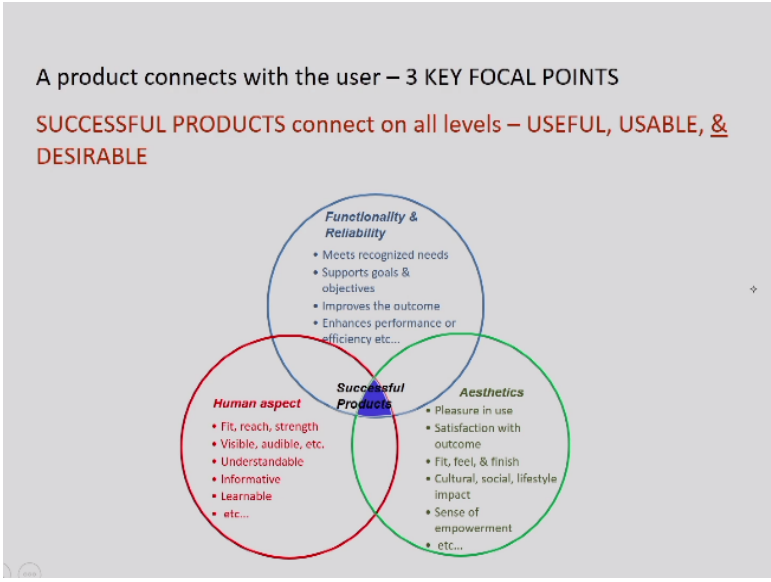

So just be free human aspect will fulfill this fit, reach, strength, visible we have discussed few of the examples and next will be the functionality is that meets, recognize needs it should work in a way intended purpose should fulfill. Next is this aesthetics that is the pleasure satisfaction, fit, feel, finish, cultural need those thing should be fulfilled. These are the 3 key focal points which need to be fulfilled in a product design from a point of view of human factors and ergonomics.

So, successful product connects on all levels useful, usable, and desirable. By this, we have completed our introduction and the overview of role of human factors ergonomics in product design and innovation.