Ergonomics in Automotive Design
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Module - 10
Lecture - 12
Automotive craftsmanship

Welcome to the course Ergonomics in Automotive Design. We are going to discuss module 10: Automotive craftsmanship. Under this module, we will cover different headings such as the definition and importance of craftsmanship, attributes of craftsmanship, and assessing craftsmanship. Before discussing what craftsmanship is, we should try to understand why craftsmanship is important?

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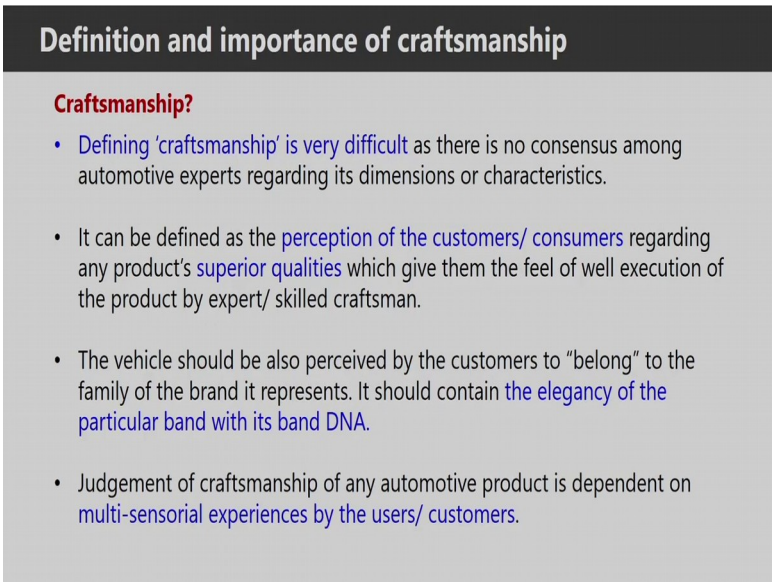

In today's scenario in the automotive industry, there is huge competition and automotive technology is almost saturated and there is also saturation in the automotive manufacturing process. How a company can compete with others and how can they prove their product to be better than others?

In this scenario, it is very important to highlight the craftsmanship and how actually can the craftsmanship enhance the sales value of a particular vehicle or automobile company's product? So, if better craftsmanship can be provided, there is greater chance for selling of that product. This is the reason why ergonomist and designers, engineers

are very much interested in this technical area, that how the craftsmanship of the vehicles or automobile products can be enhanced.

What is craftsmanship? Defining craftsmanship is very difficult as there is no consensus among automotive experts regarding its dimension and characteristics. It can be defined as the perception of the customers or consumers regarding any automotive products superior qualities, which give them the feel of well execution of the product by expert or skilled craftsman. Also, the vehicle should perceived by the customer to belong to the family of the brand it represents. It should contain the elegancy of the particular brand with its brand DNA.

Craftsmanship is very important for the sale of the vehicle. The judgment of craftsmanship of any automotive product is dependent on multi-sensorial experience by the users and customers. This multi-sensorial experience mean, how using various five sense organ the customers or consumer or the user of the vehicle perceive the quality of the craftsmanship of the vehicle?

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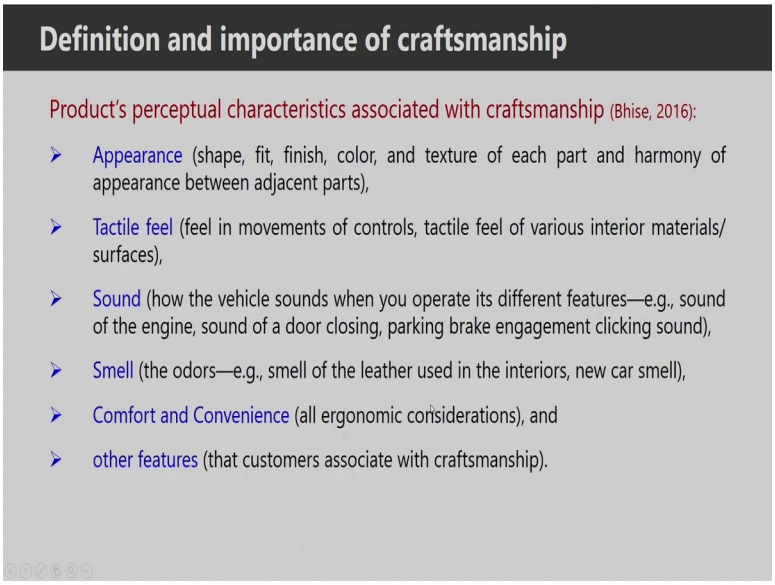

The products perceptual characteristics associated with craftsmanship are listed in this particular slide. What are those qualities of the vehicle which leading to better perception of craftsmanship? First, one appearance; so, it dealing with shape, fit, finish, color and texture of each of the part and harmony of appearance between adjacent parts, it is also dealing with the tactile feel. Well, consumers are reaching to a vehicle and looking and

touching or getting some tactile feel by touch or by moving their hand over the vehicle surfaces, how controls are in tactile feel of various interior materials surfaces, how smooth are they are, how is the texture? Those aspects are coming under tactile feel perception.

How is the vehicle sounds? When a user operates different features, for example, engine sound, door closing sound, parking brake engagement, and clicking sound. All these are important in defining the craftsmanship, the smell of the vehicle the odors, smell of the leather used in the interior, new car smell, comfort and convenience. All ergonomic considerations which are associated craftsmanship is the drivers comfort and convenience and other features that the customer associate with the craftsmanship.

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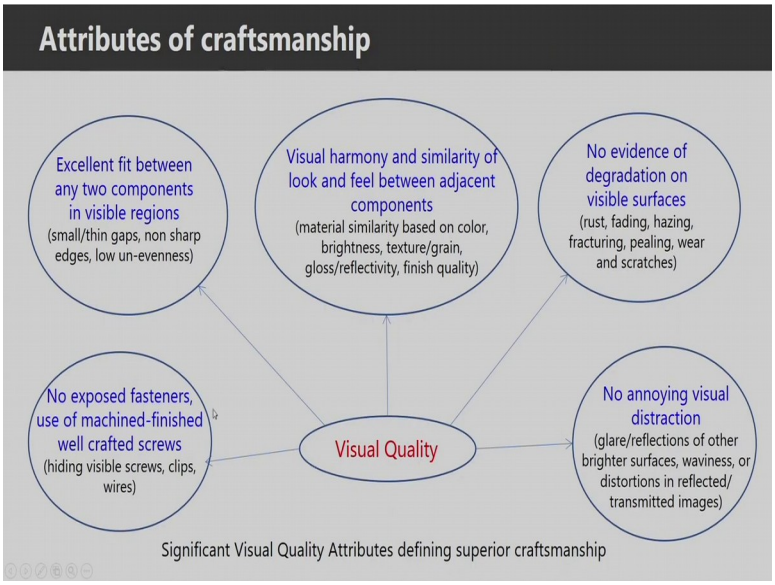

We will discuss individually about these various factors and how visual quality is associated with superior craftsmanship. There should not be exposed fasteners and there should be use of machine-finished well-crafted screws. To achieve these things, what we need to do? For hiding visible screws, they should be covered properly, there should not be any clips wires visible from the outside. There should be excellent fit between any two components invisible regions.

For that purpose, the gap should be very small and thin, non-sharp edges, low unevenness. Then there should be visual harmony and similarity of look and feel between adjacent components. It can be achieved by using similar material based on

color, brightness, texture grain, gloss or reflectivity, finish quality. Another aspect of visual quality is the there should not be evidence of degradation on visible surfaces, there should not be rust, fading of color, hazing, factures, peeling, wear and scratches on the vehicle surface either interior or exterior; no annoying visual destruction.

There should not be glare reflection of other brighter surfaces, waviness or distortion in reflected or transmitted images. So, these are the various aspects related to the visual quality of the vehicle or automotive products. Also, in all these aspects, designers or engineers have to give proper consideration so that the user or customer perceive that vehicle is well executed or well crafted.

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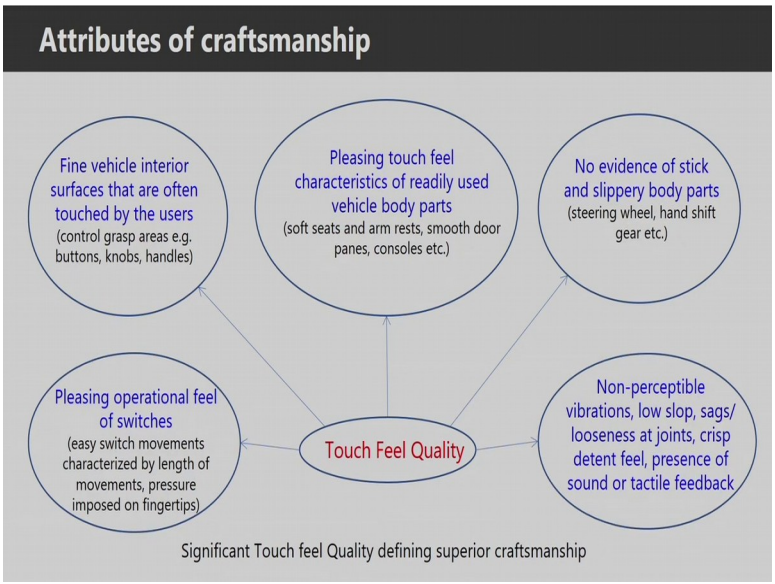

Significant touch and feel quality define superior craftsmanship. How better touch and feel quality can be provided? For that purpose, pleasing operation feel of switches should be there, easy switch movements characterized by the length of movements, less pressure imposed on fingertips, fine vehicle interior surfaces that are often touched by the users. That should be smooth, even, control grasp areas, easy button and knobs handles, designed properly to give better touch feel.

For pleasing touch feel characteristics of readily used vehicle body parts, you can use soft seats and armrests, smooth door panels, consoles etcetera there should not be evidence of stick slippery body parts like the steering wheel and shift gear. These components should be designed properly; non-perceptible vibrations, low slop, sags,

looseness at joints, crisp detent feel, presence of sound or tactile feedback. So, these are the various strategy to be followed to give better touch feel quality.

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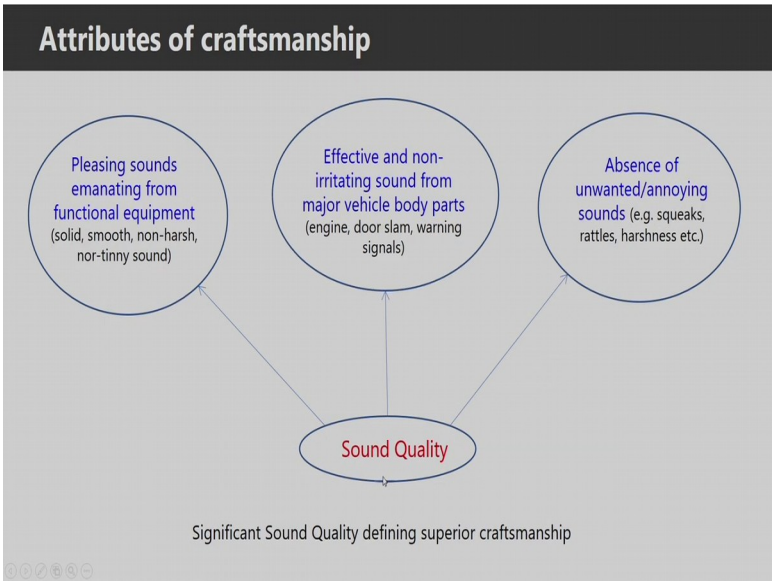

Another important aspect associated with the craftsmanship is the sound quality. What type of sound that the user will perceive while they are operating that vehicle either opening or closing or going inside? The pleasing sound should be solid, and smooth. The sound should not be harsh or tinny sound. Effective and non-irritating sound from major vehicle body parts like engine, door slam, warning signals.

From these components, whatever sound is coming that should be pleasing and not irritating, absence of unwanted or annoying sounds. So, designers have to take proper design consideration so, that from that vehicle there should not be any annoying sounds or unwanted sound like a rattles, harshness. So, this aspect should be considered properly to avoid any unwanted sounds.

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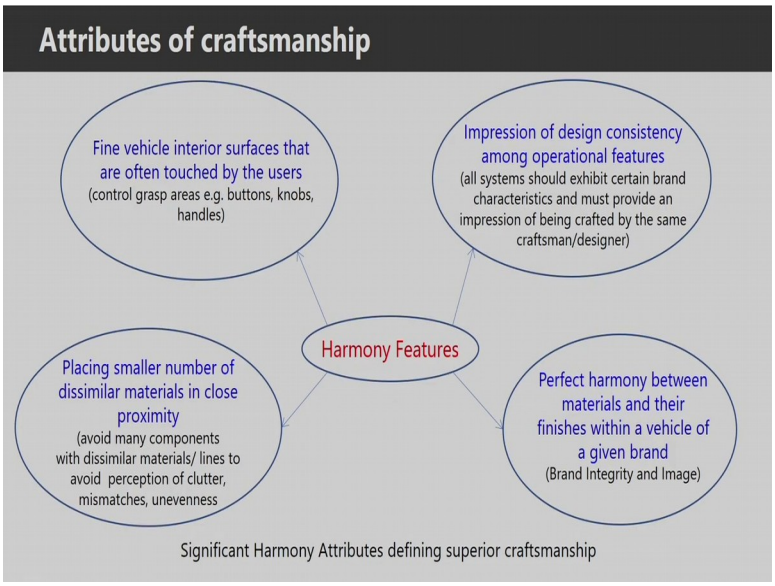

The next important aspect is harmony features. So, how the designers can maintain the overall harmony among various components and sub-components of the vehicle? For that purpose, placing small number of dissimilar materials in close proximity should be avoided. Avoid many components with dissimilar materials, lines to avoid perception of clatter mismatches and unevenness.

Vehicle interior should be fine, the surface should be smooth and often touched by the user for that purpose control grasp areas, button, knobs, the handle should be in harmony and there should be some similarity in design and design languages. The impression of design consistency among operational features; all systems should exhibit certain brand characteristics and must provide an impression of being crafted by same craftsman or designer. Perfect harmony should be there between materials and their finish within the vehicle of given brand. Brand integrity and image is very important to achieve this.

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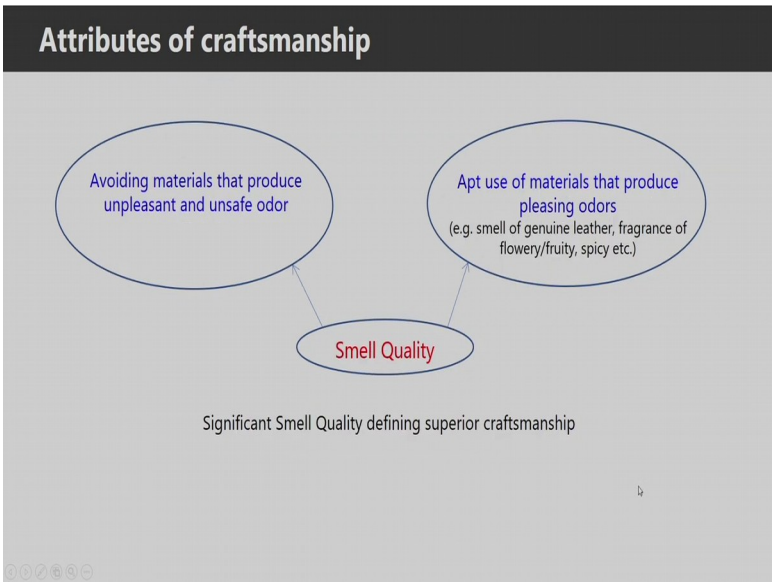

Also, the smell quality is directly associated with the perception of the craftsmanship of the automotive product. We have to try to avoid materials that produce unpleasant and unsafe odor. Because while the drivers or any user or customer going to buy a new car or looking at the car there should not be any an unpleasant smell from that vehicle. On the other hand the smell coming out from the vehicle or vehicle component it should be very pleasant.

So, the appropriate use of materials that produce pleasing odors should be considered during design the designing of the vehicle. For example, a smell of the genuine leather fragrance of flowery, fruity, spicy, inside component can be used.

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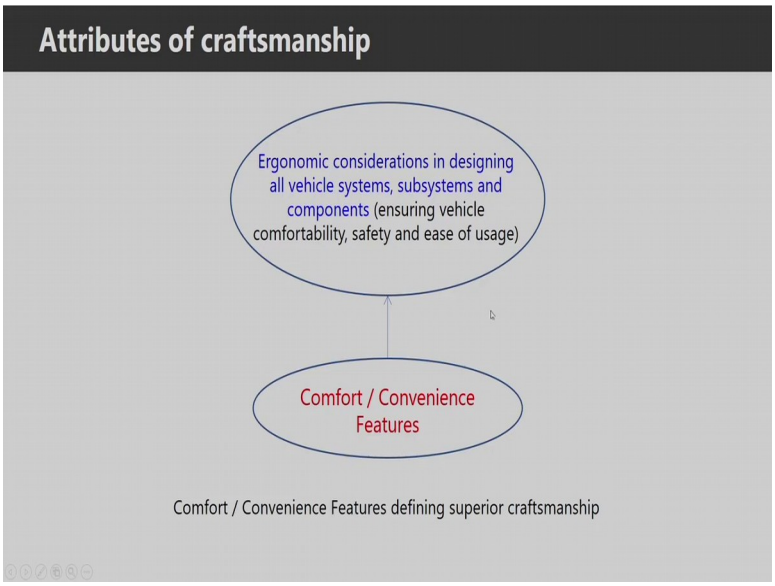

The next important aspect associated with the craftsmanship is the comfort and convenience features and this is also related to various ergonomic aspects of the design. So, ergonomic consideration in designing, all vehicle systems, sub-systems individual components is required to ensure vehicle comfortability, safety, and ease of use. Now we are going to discuss available literature related to automotive craftsmanship.

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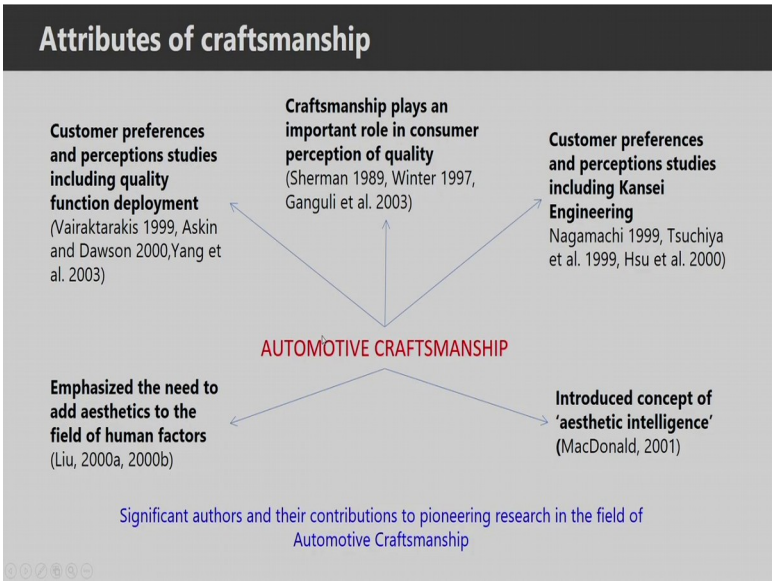

Following the literature review, it was observed that there are numerous literature available related to this field, and many researchers is working on various aspects of

automotive craftsmanship. Vairaktarakis (1999) Askin and Dawson (2000), Yang et al. (2003) worked on customer performances and perception studies including quality function deployment.

Similarly, Sherman (1989), Winter (1997) and Ganguli et al. (2003) worked on research pertaining to craftsmanship which is playing important role in consumers perception of quality. Nagamachi (1999), Tsuchiya et al. (1999), Hsu et al. (2000) researched on customer preferences and perception studies including Kansei engineering. Liu (2000) in their two publications reported on the emphasis on the need to add aesthetics to the field of human factors.

These literature were related to craftsmanship qualities of the product and automotive products. McDonald (2001) in their research reported dealing with the introduced concept of aesthetic intelligence. So, in this way, if we look at the literature, many works of literature actually available which are about various aspects of craftsmanship.

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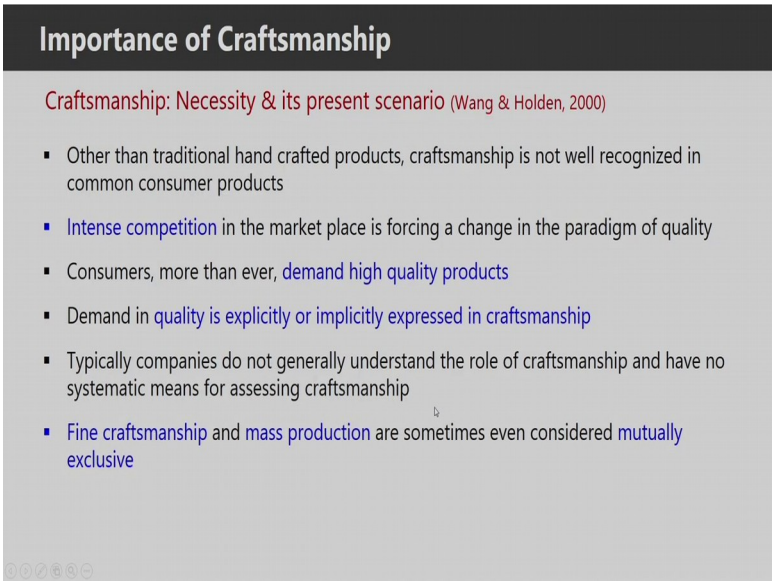

Why craftsmanship is important? So, in continuation of our earlier discussion that craftsmanship is very important other than traditional handcrafted products, craftsmanship is not well recognized in common consumer products. So, that is why it is not studied in detail intense competition in the market place is forcing a change in the paradigm of quality. So, there is also need for quality improvement. While there is enormous competition among the companies for their product and as I mentioned earlier

there is almost saturation in the production process as well as the manufacturing technology.

If we want to bring newness, innovativeness in the product, then, apart from the design aspect, we also have to think how we can improve the craftsmanship quality of the particular product. Demand in quality is explicitly or implicitly expressed in craftsmanship. Typically, companies do not generally understand the role of craftsmanship and have no systematic means for assessing craftsmanship. So, this is the need of the hour, that all the companies and product designers or engineers they have to think how craftsmanship qualities can be accessed and accordingly various measures of process can be followed to improve the craftsmanship.

Fine craftsmanship and mass production are sometimes even considered mutually exclusive. So, while any company or production house is going for mass production and obviously, there is deterioration in the craftsmanship. So, every product should be executed with the proper attention, and every component of the product should be designed with atmosphere. So, obliviously when there is mass production then this type of taking care for craftsmanship is many times not possible. Therefore, we mentioned that this fine craftsmanship and mass production is mutually exclusive.

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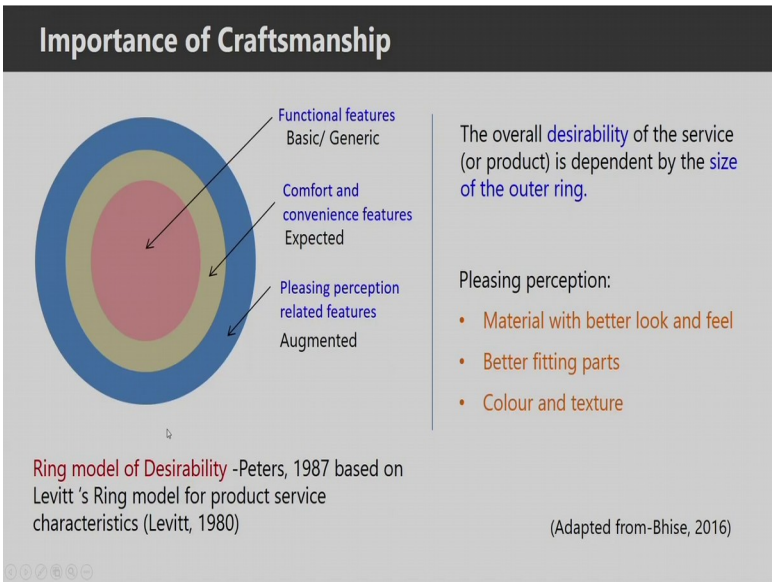

In continuation of discussion of the importance of craftsmanship, we are now going to discuss the ring model of desirability. So, the Ring model of desirability initially

proposed by Levitt Ring in 1980s and Peters in 1987. So, based on this Ring model we can study how automotive craftsmanship improving the desirability of automotive product purchase or preference for particular automotive product or automobile. So, for this purpose now Levitt Ring mentioned that for every product or services there is some basic or generic requirement which is presented as the core of that Ring model.

There is expected factors or expected service qualities. So, those are surrounding the overall generic services or product qualities. Then, there is the third component which is called augmented portion that is the outer ring. So, these are the various components while you are discussing the desirability for a particular product. So, obliviously there should be core or generic aspects, but to improve the desirability we need to add expected features moreover not only expected feature we also need to add augmented feature so that the desirability for that particular product can be enhanced. The overall desirability of the service or product is dependent by the size of the outer ring.

How much bigger the size of the outer ring should be? i.e., actually denoting how much will be the desirability for the particular product and this is also true for the automotive industry. As much as we add the augmented features, the desirability for that automotive product will be increased. Now, if you take particularly for the example of automobile then the core of the Ring model we can mention as the functional features. So, what are those functional features? Say for example, if it is a 4-wheeler. So, 4 people will be able to sit there then there should be it will be easily operated. So, this is coming under the core features, and this is the basic or generic.

Afterwards, we need to add other features like comfort and conveniences. So, as much as comfort and conveniences features we will be able to add then gradually the desirability for the product will be enhanced, then the third aspect that is pleasing one perception related features. As much as pleasing and perception related features we will add then the desirability for that product will be enhanced. So, this pleasing perception related features for automobile include material with better look and feel, better fitting parts there is minimum gap between two adjacent parts then colour and texture of the various components of the automotive product.

If this pleasing perception is in the outer ring, the size of the outer ring can be enhanced mean as much as we will be able to add the pleasing perception qualities, pleasing

perception factors in that automotive product, then, automatically there will be an overall increase in the desirability.

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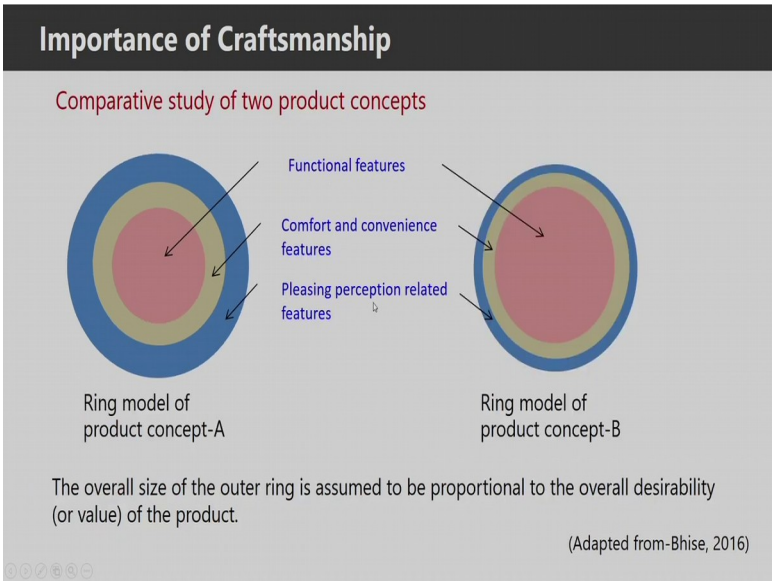

Now, if we take two examples of Ring model for product A and product B. These are the two concept product model. If you look at this two-ring model, you can see the core portion, i.e., denoting the functional features of the automotive products, that is more in case of product concept B in comparison to A. If the next portion that is a comfort and convenience features that is actually relatively more in case of product A.

However, it is relatively less in the case of product B. In the third portion, the third ring which is surrounding the first two rings that is the pleasing and perception related features. If we compare the size between this product concept A and product concept B in size is bigger in case of product A. Now, looking at this two Ring models we have to understand in which case the desirability of the particular product to the customers will be more.

As we mentioned earlier, the desirability actually proportional or guided by the size of the; obviously, the inner ring that is a functional feature, comfort and convenience feature those are required, but it is more influenced by the external thing that is the pleasing and perception related features. That is why the overall size of the outer ring is assumed to be proportional to the overall desirability or value of the product.

The external this outer ring that is the pleasing and perception related features is guiding the product purchase intention through the desirability. The designers or engineers designing automotive products should consider the functional features. At the same time they have to think how they can improve the pleasing and perception related features in that automotive products to enhance its sale and customer purchase intention.

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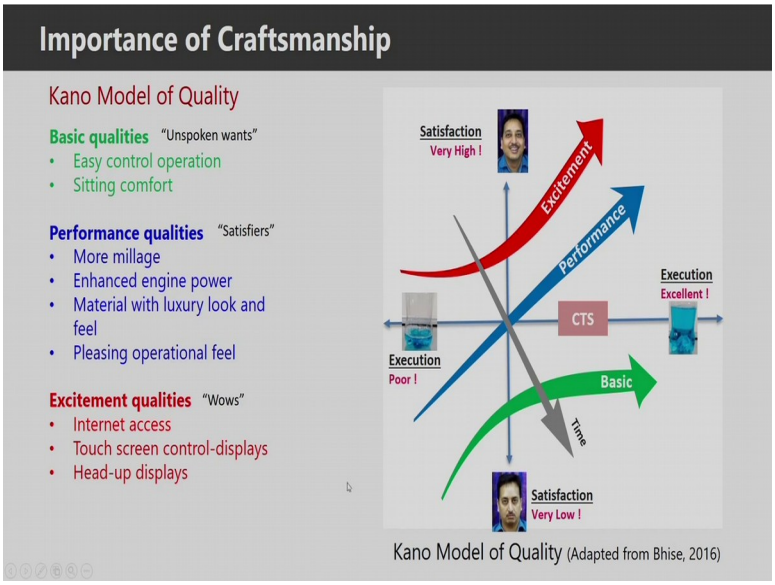

Apart from that ring model, there is also Kano model of quality which also indicates how craftsmanship is important in automotive industry. Now, if you look at this schematic diagram, then you can see there are some basic features. First, look at this middle line, this is called critical threshold for satisfaction. So, gradually from the down to up the level of satisfaction is gradually increasing and this particular this horizontal line this is the critical threshold for satisfaction.

So, at least this level to be reached to be satisfied, below this level I mean if you go downwards the satisfaction is less. So, if it is below the critical threshold level, then the satisfaction is low. Only people will be satisfied will get critical level should be reached if it can cross this middle line and can go upward. Now, in terms of the product features or automotive features, there are various basic characteristics or basic features of the automotive product like if you see this green colour one, the basic qualities which are been said as unspoken ones those are easy control operation sitting comfort.

These are the characteristics of the automotive products coming under the basic qualities and these are unspoken needs or unspoken wants. Although the customers or consumers are not mentioning about this requirement, it must be in that automotive product. But, these features cannot cross the critical threshold level for satisfaction. However, if these basic qualities are not present in expected amount, it will lead to dissatisfaction.

It get the capability to leading to dissatisfaction in its absence, but it never can cross the critical threshold limit for evoking satisfaction. Then another set of characteristics which are mentioned as the performance characteristics or satisfier. These features always have the capability to cross this level that is the critical threshold for satisfaction. Which are those features? These features include more mileage, enhanced engine power, material with luxury look and feel, then pleasing operational feel. So, these features if we can add in the automotive products then it will lead to satisfaction.

Because with these features, the capability to cross that threshold level going upward. The third category of features if we can include in that product which is mentioned as the excitement qualities or wow factor always there is the possibility of enhancing the satisfaction. Because all these features are present or which as the capability to enhance the satisfaction and their presence is above the critical threshold level. So, if we as much as we will able to add this type of features then the satisfaction will be more.

The excitement qualities or wow factors include internet access, touch screen control, head-up display. This type of new features or advanced features if we can add in that automotive product; obviously, there is a possibility for enhancing customer satisfaction. And so, this side it is showing the execution if the execution is poor and this side if execution is excellent, if execution is moving towards the excellent all these different features have the influence on the satisfaction.

What happens with the time all these qualities, either excitement qualities or performance qualities, gradually move downwards? It means, the excitement quality in present scenario, in future will be converted to performance qualities and which are the performance qualities in today's scenario with the time it will be converted to basic qualities or basic need or unspoken wants in near future. So, automotive designers or engineers always have to think how new features, new excitement qualities can be added in the automotive product to enhance its craftsmanship quality.

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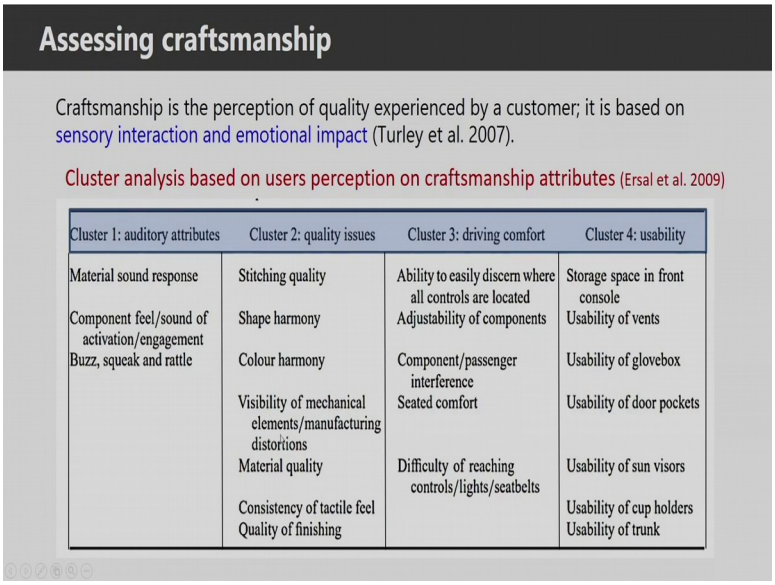

Now, we are going to discuss how craftsmanship can be assessed? What are the various process for assessing craftsmanship? Now, we will discussing the research work from Turley et al. (2007). They discussed that craftsmanship is the perception of quality experienced by the customer, it is based on the sensory interaction and emotional impact. So, automotive craftsmanship the sensory interaction and emotional impact; in our earlier slides, we discussed that this automotive craftsmanship actually multi-sensorial experience.

Following cluster analysis based on the user's perception on craftsmanship attributes, they categorized the craftsmanship attributes into four groups; cluster 1 related to auditory attributes, cluster 2 related to quality issues, cluster 3 related to driving comfort and the last one cluster 4 related to usability. Under cluster 1, they kept these factors like material sound response; component feels or sound activation, sound of activation or engagement, then buzz or squeak different types of sounds buzz, squeak rattle.

Under quality issues, various quality aspect are there like stitching quality, shape harmony, colour harmony, visibility of mechanical elements, manufacturing, distortions, material quality. So, these comes under cluster 2 which is quality issues. Also, under the driving comfort, cluster 3 including ability to easily discern where all controls are located. It will be very easy to identify the control location, adjustability of the components or aparting the components various control operation should be easy. The

component or the passenger interface should be properly designed to enhance the comfort.

The seated comfort a difficulty of reaching controls, lights, and seatbelts those to be avoided to improve the driving comfort. In cluster 4 various usability aspects of various components like vents, glove box, door pockets, sun visor. So, usability aspects of this various vehicle design component should be grouped under this usability cluster.

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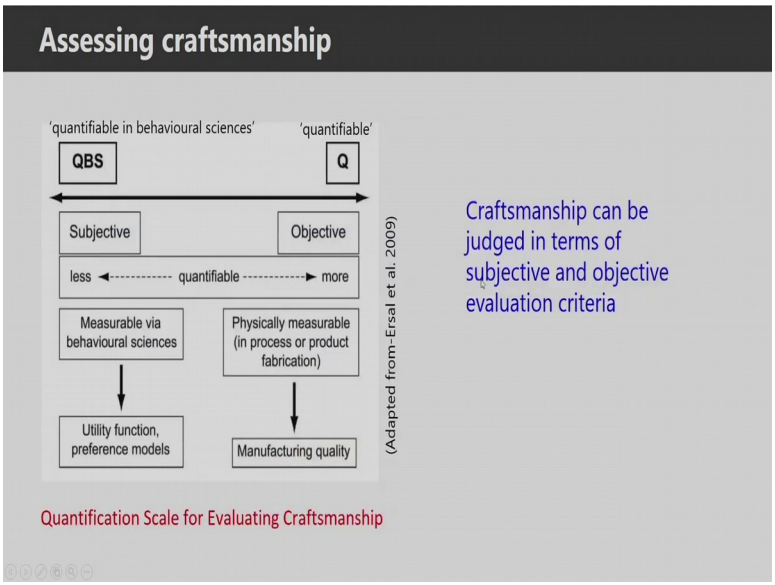

Now, out of these various aspects of craftsmanship, there are two types of evolution process; one is subjective, another is objective. Objective factors which can maybe in various aspects which can be evaluated objectively those are generally quantifiably denoted with the Q, and these are more quantifiable whereas, there are also subjective aspects of the craftsmanship, which is in turns of quantification that is less quantifiable. That is difficult to quantify, but, there is the process, or there are the techniques using those techniques we can also evaluate the subjective aspects of the craftsmanship.

So, for that purpose, we can take the help of behavioral sciences and its various methods in terms of questionnaire study in getting the response of the consumers or customers. So, craftsmanship can be judge in terms of both subjective as well as objective evaluation criteria. Now, in terms of subjective evaluation measurable via behavioral sciences so, these include utility functions, reference models. On the other hand objective measurement techniques we can go for physically measurable aspect like in process or

product fabrication, manufacturing quality. These are easy to quantify and objectively you know we can measure or quantify that expect that how much well-executed.

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The list provides perceived attributes and intended objectives to be achieved. So, which are the perceived attributes related to automotive craftsmanship? So, they listed down and also mentioned the direction then whether the particular perceived attributes to be enhanced or reduced to make the product better. Take this example, the first one, able to easily discern where all controls are located. It means how easily the driver or the passenger can be able to identify the location of the various controls a group of control. So, this easiness or this ability to identify easily identify should be maximized.

Similarly, the material sound response it should be minimized, in this way various perception related aspects of craftsmanship is studied by them. There are another set of variables; these are the list of product characteristics intended, and also here it is presented the intended objectives to be achieved whether those will be maximized or optimized or minimized. So, first one the consistency of buttons, knob, activation field within grouping. So, while you are grouping various controls in a particular group, then there should be consistency in terms of the buttons knob activation. Then number of different geometrics for buttons and knobs; these are vehicle components and this is easy to measure objectively the number of gaps, how many gaps are there?

The number of gaps or; obviously, our target will be a direction will be to minimize the number of gaps, this is the size of the gaps that should also be minimized. In this way various aspects related to vehicle or vehicle design parameters have been listed here and also direction for their improvement has also been provided by them so, that the automotive craftsmanship can be enhanced. So, these aspects can be studied in objective manner whereas these are the issues which can be as these are perceived by the customers. So, this can be assessed subjectively.

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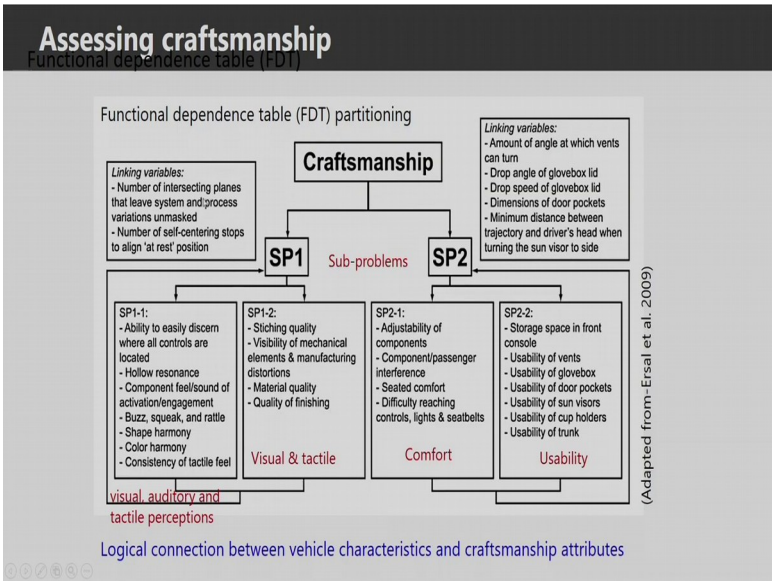

They also developed the functional dependence table partitioning viz. type of subproblem 1-1 subproblem 1-2. So, initially the craftsmanship are related subproblem they categorized into two groups; one is the subproblem 1 and subproblem 2; under that each subproblem 1 again divided into two groups and subproblem 2 divided into two groups. So, the first group of the subproblem following the functional dependence table in the first group they listed these variables which are related to resolving auditory and tactile perception.

Whereas, the second group is dealing with the visual and tactile related perceptions like stitching quality, visibility of mechanical elements and manufacturing disorders material quality of finishing. Under the subproblem 2 there are subproblem 1 and subproblem 2. So, the first group is dealing with the comfort-related aspect; so, comfort and convenience inside that vehicle. So, adjustment of the components: component of

passenger interface, seated comfort, difficulty of reaching. These are the various aspects which are leading to comfort assessment. And, the fourth group this is related to usability aspects of the various components usability of vents glove box door pocket. So, these are the fourth group.

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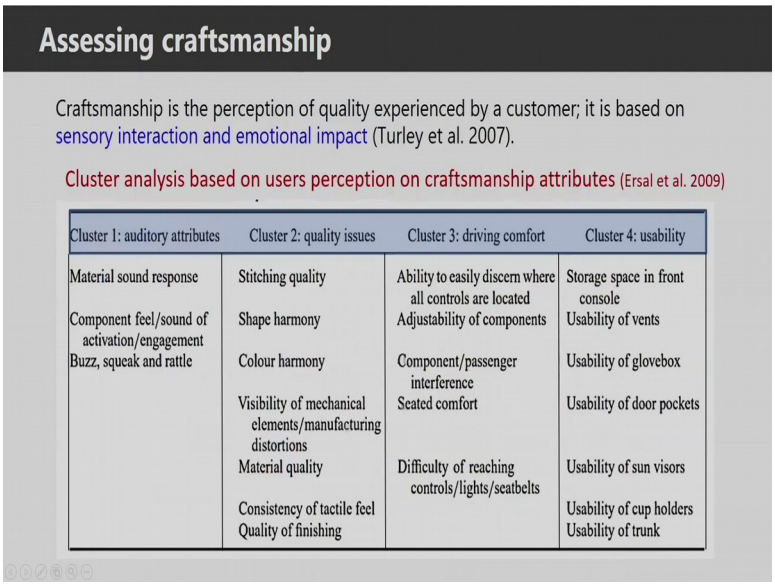

See this one which they achieved by cluster analysis. At the same time, if you look at this particular diagram, they also come up with this four groups of attributes following functional dependence table there is used similarity. These four partitions under the functional dependence table are actually related to the cluster analysis. So, first one was the auditory attributes, second was quality issues, third one is the driving and comfort, and fourth one is the usability.

Similarly, here also you can see, the first one is related to visual auditory, second one visual-tactile, the third one is the comfort, and fourth one is the usability. Although the techniques are different one is the cluster analysis and the functional dependence, in both the cases there is similarity in terms of the grouping of variables. Now, there is logical connection between the vehicle characteristics and craftsmanship attributes. So, these various craftsmanship attributes can be enhanced towards positive direction so, that either it will be enhanced or it will be minimized say, for example, difficulty in reaching control lights and seat belts.

These will be minimized, on the other hand, say stitching quality, this will be evaluated subjectively and stitching quality should be improved. So, without affecting the linking variables like as listed here, similarly linking variables which are related to this variables if you do not alter the linking variables, without altering the linking variables only by changing or by only by enhancing the craftsmanship quality, we can improve the overall craftsmanship of the automotive product.

Various linking variables which are associated with this two group of variables related to craftsmanship include the number of intersecting planes that lead system and process variations unmasked the number of self-centering stops to align at a rest position. Similarly, these two groups related to comfort and the comfort features and usability features which are related to craftsmanship those are linked with various automotive features like amount of angle at which vents can turn. Drop angle of the glove box lid, drop speed of the glove box lids. So, in this way different design variables of the vehicle are associated with this comfort and usability features.

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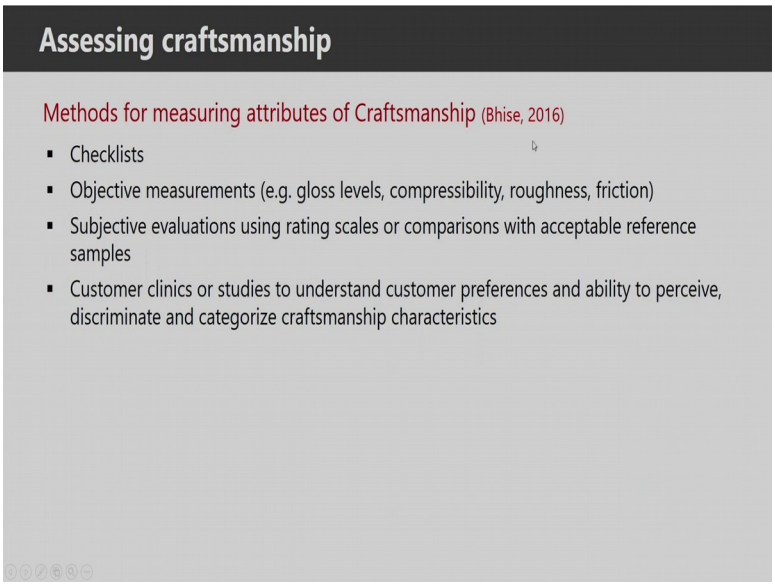

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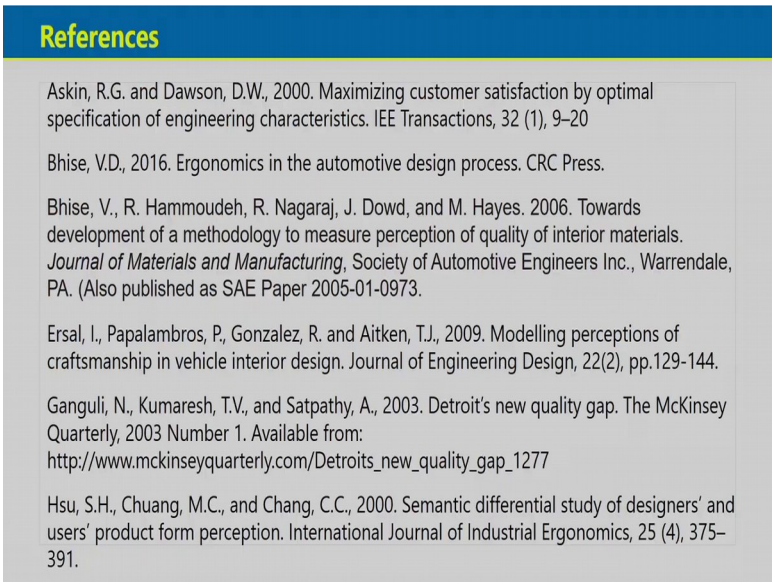

Now, Bhise (2016) in his book, i.e., the Ergonomics in the automotive design process, explained how we can assess various craftsmanship. So, in that book, he has mentioned that we could use various checklist for assessing the craftsmanship; objective measurement process like gloss level, compressibility, roughness, friction; measure in objective terms using various equipment.

Similarly, subjective evaluation using various types of rating skills like our scale, semantic differential scales. Different types of scales can be used and compared to understand how the craftsmanship of that product can be assessed and accordingly we can take action to improve the craftsmanship qualities. Then, customer clinics or studies to understand customer preferences and ability to perceive discriminate and categorize craftsmanship characteristics.

Apart from this objective and subjective measures checklist, we can also go for customer clinics like design clinics, where the customers will give feedback or they will relate to various aspects of the craftsmanship features and collecting their feedback, collecting their responses then designers and engineers can work upon those automotive features improve the craftsmanship.

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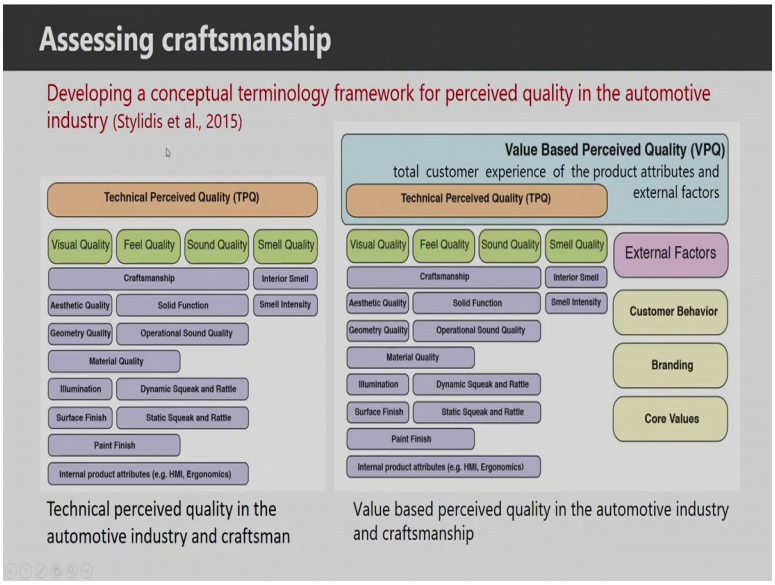

Stylidis et al. (2015) in their research paper on developing a conceptual terminology framework for perceived quality in the automotive industry, grouped the various terminology under the technical perceived qualities and value-based perceived qualities. So, if you look at the technical perceived quality in the automotive industry and its related craftsmanship, then, the technical perceived quality is actually including visual quality, feel quality, sound quality, and smell quality.

Various terminology coming under this umbrella deals with visual quality feel and sound, similarly smell quality related to interior smell, smell intensity, aesthetic quality, solid function, geometry quality, material quality illumination. So, these are the various terminology which is associated with technical perceived quality through craftsmanship. So, apart from the technical perceived qualities, the value-based perceived quantity is dealing with total customer experience of the product attributes and external factors.

So, not only the product features but also there are various external factors which is using to the overall customer's experience related to craftsmanship. So, these external factors include consumers behavior, the branding what type of product is its brand heritage and core values associated with that product. So, these are also other factors which are related to craftsmanship and these factors guide the perception of the craftsmanship quality of the automotive product.

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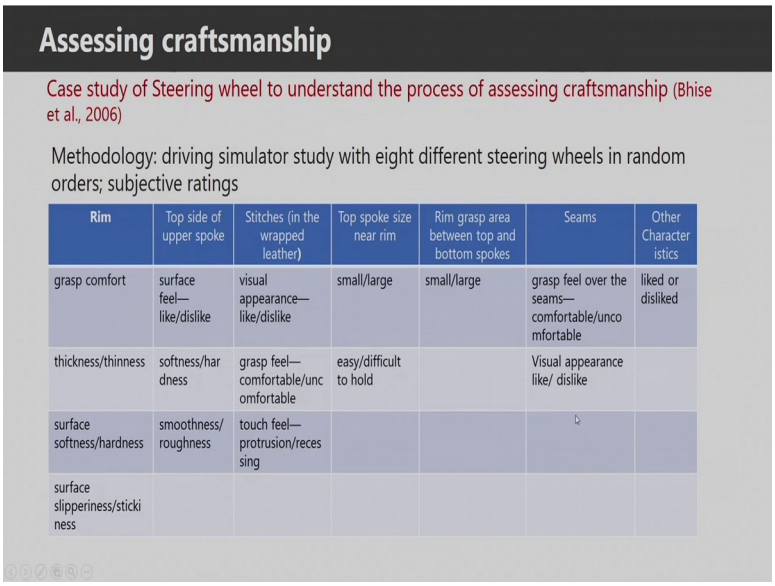

Bhise et al. (2006) showed the example of steering wheel case study, and showed how craftsmanship qualities for a particular product or component can be assessed. So, as a methodology, they used driving simulator and ask the drivers to sit in the driving simulator and to assess eight different steering wheels which are presented randomly. And, based on the evaluation criteria for various steering wheel components like rim, top side of the upper spoke stitches top spoke size near rim, rim grasp, seams, other characteristics.

On these various aspects of the steering wheel, they asked the user stew rate for the eight different steering wheels which are presented randomly. Now, for the rim are assessed in terms of grasp comforts, thickness or thinness, surface softness, hardness, surface slipperiness, and stickiness. So, in this way various aspects of the rim are evaluated. Similarly, for example, top spoke size near rim are evaluated in terms of small or large in size easy or difficult to hold in this way various components of the rim as I mentioned here in this table at the top line of the table. So, various aspects of the steering wheel are evaluated subjectively.

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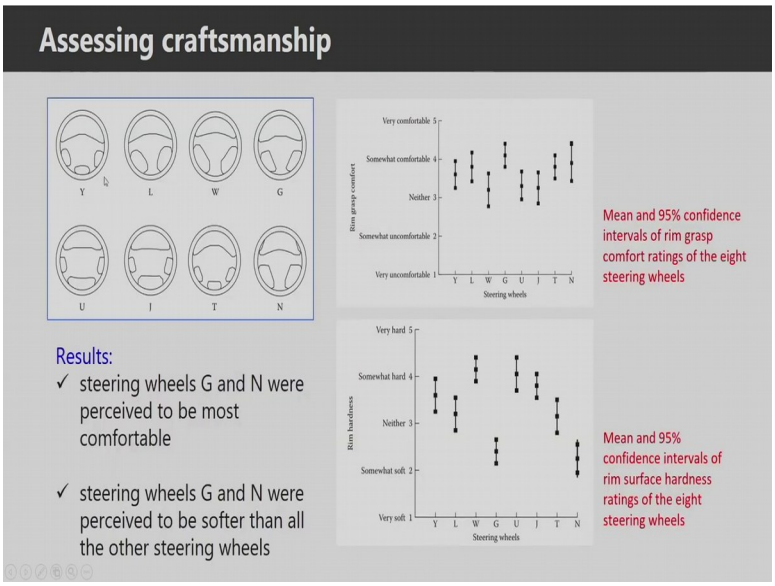

So, here you can see, these are the eight steering wheel designs which are presented to the drivers in the simulator, and while they are operating that one then their subjective response were collected, based on the subjective response, it was found that steering wheel G and N was the two steering wheel designs at best in terms of craftsmanship qualities. So, steering wheel G and N are perceived to be most comfortable, at the same time these two steering wheels also perceived to be the software than all other steering wheels.

So, here you can see from the graph, the mean, and 95 percent confidence intervals of the rim grasp comfort rating of different steering wheels have been presented. So, from that you can see in case of G, mean value, and 95 percent confidence interval; similarly this is for the N this is the mean value, and this is the 95 percent confidence interval are the highest in terms of rim grasp comfort while subjects are asked to rate for starting from 1 it on the rating scale starting from 1 that is very uncomfortable to 0.5 that is very comfortable.

On a five-point rating scale, subjects were asked to rate for the rim grasp comfort and based on that it was observed that in case of G steering wheel G and in case of steering wheel N. So, this rim grasp comfort was the maximum. Similarly, in this graph it is presented mean and 95 percent confidence interval of rim surface hardness ratings of the eight difference steering wheels and here also it was found that in case of G and case of

N the hardness was minimum. So, in this way following subjective rating by the users or by the customers we can assess the various component of the vehicles to understand the craftsmanship quality.

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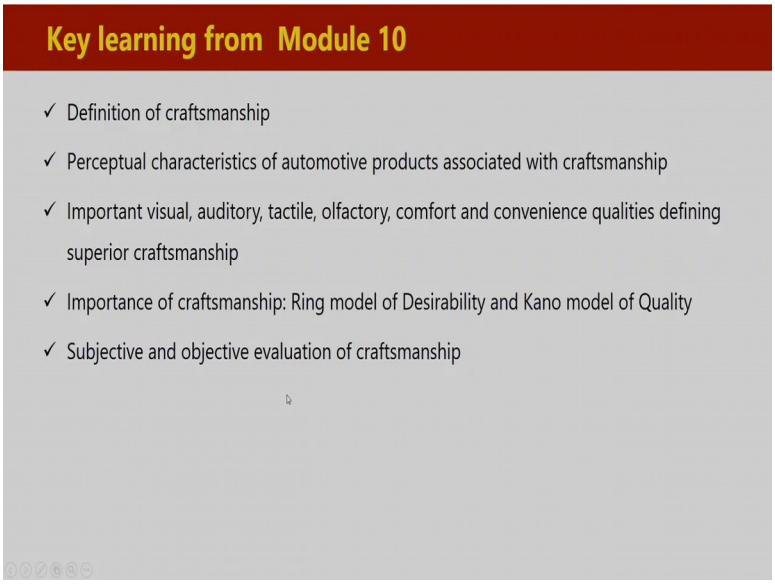

Following these various aspects of craftsmanship, we are coming to conclusion to what we learn from this module. So, we discussed definition of the craftsmanship, what are the various factors which are dealing with the vehicle craftsmanship, then perceptual characteristics of automotive products associated with craftsmanship. Perceptual characteristics as I mentioned there are various visual auditory tactile different types of sensory input which we received while we are evaluating the craftsmanship or perceiving the craftsmanship of that vehicle. Out of this various sensory input which we receive then which are the various crucial visual auditory tactile olfactory comfort and convenience qualities for defining superior craftsmanship.

Out of the visual various visual aspect, the auditory aspect which is very much important in terms of defining superior craftsmanship, then we also discussed the importance of craftsmanship where we discussed the Ring model of desirability and Kano model of quality. At the end we discussed the subjective and objective evaluation process for evaluating craftsmanship of automotive products. Now, these are the list of various references which have been used for preparing very different slides.

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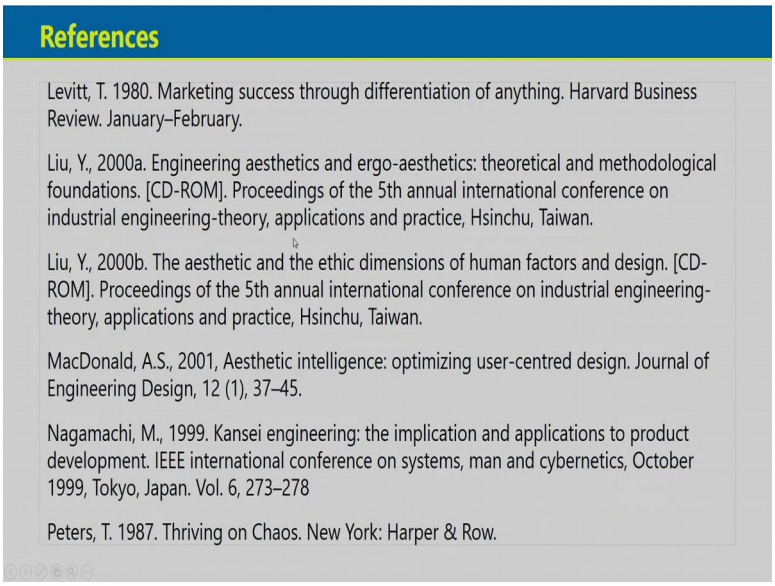

So, you can go through all these references for understanding this topic in more details.

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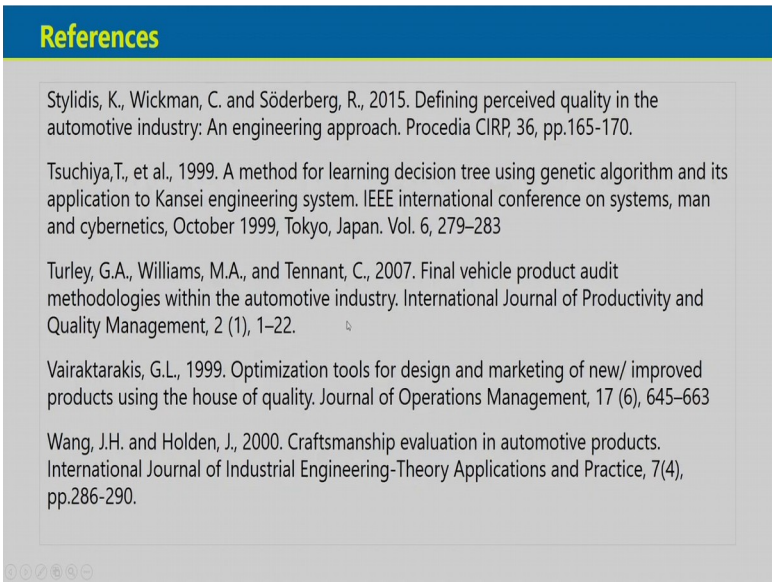

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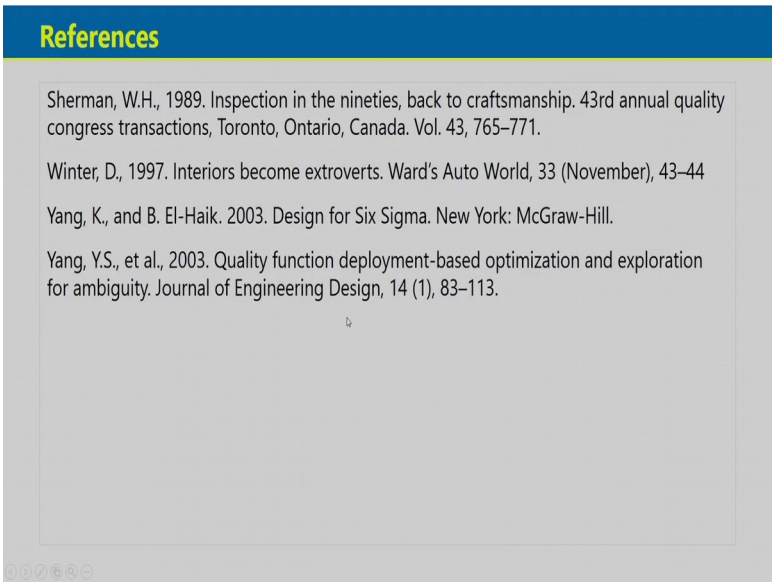

Thank you.