Manufacturing System Technology - II
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Lecture - 10

Hello and welcome to this manufacturing systems technology part 2 module 10. We were talking about FMEA and the last module and we theoretically introduce the concept of FMEA. So, we want do actually now start looking at a practical FMEA problem and how the analysis has been carried out in one of the automotive manufactures in their paint shop.

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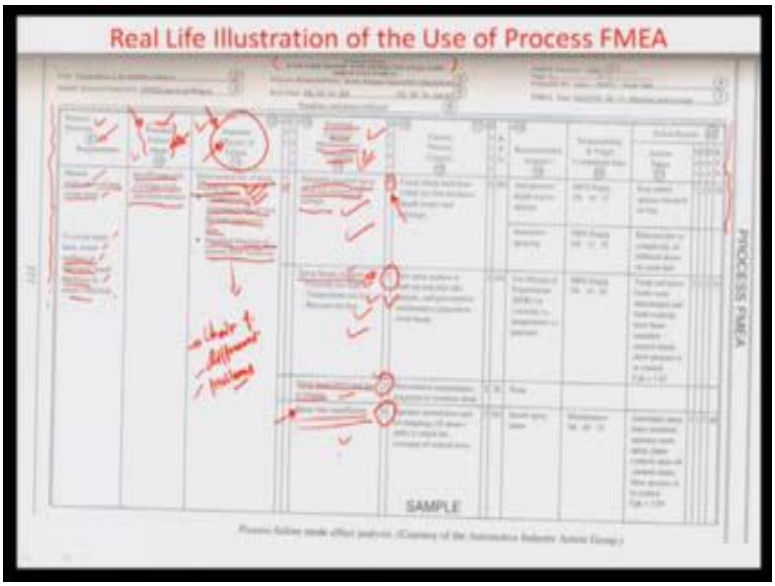

So, let us now understand. So, what I am going to do here is to sort of look at this particular FMEA sheet which you can see here in this particular slide, and we are going to understand this by some diagrammatic representation which I am going to draw in the next slide which is here diagrams to understand the FMEA chart at you know because there would be issues related to the process, you know you should have some understanding of what really the process about. So, I will do that and back and forth swipe between slide one and slide two to make you understand the various steps associated with the risk identification, and how elimination has been done or what counter measures have been suggested.

So, let us look at this process FMEA a very closely, we are talking here about a potential failure mode effect analysis process, and the process function that is in this particular

slide here which is corresponding to column 9. This is obviously of a much higher size sheet which has other columns as well, but we are just making sure, we are just in concerned with only this part of the sheet which talks about the FMEA process actually. So, the requirement here is the manual application of vacs inside doors. And the process function really is to cover the inner door, lower surfaces at minimum vacs thickness to retard the corrosion, so those of you who not involved with an automotive assembly.

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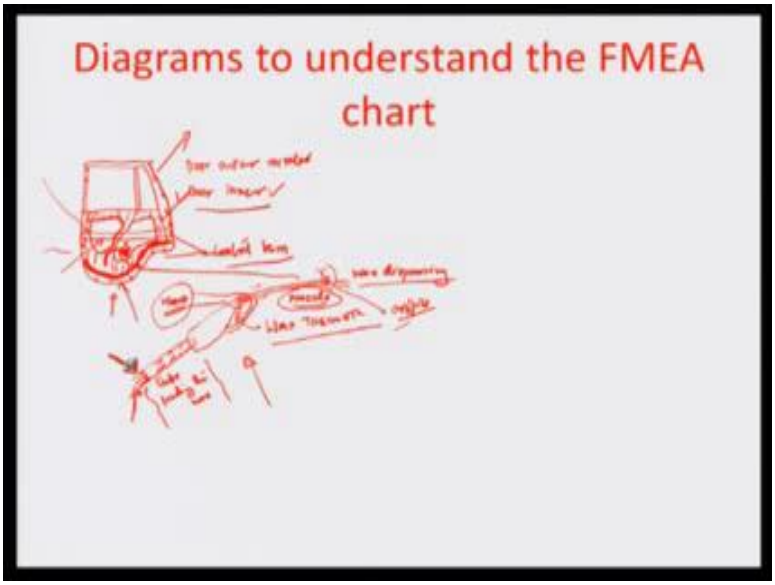

I would just like to illustrate what really it means. So, let us we talking about door in this particular manner. So, typically on a door you have the outline of the door given in this particular schematic cartoon and from the inside it looks like this. So, door typically is comprised of two different aspects; one is the door outer, and the door inner. And obviously, the door inner is this side, the one which is being shown top of here where you can see the inner member having this perforation or holes and it is really a certain amount of thickness. So, the outer is on one particular side of the door and the inner in on another new hamming the inner and outer with respect to each other with spot welding or whatever processes. And these cavities are created within the inner of the door to ensure that you have access to placing the various, you know other sub assemblies with in this door like let say the, let say the window regulator or let us say the guide channel called the sash for the window to be able to go up and down. So, all these things are done through this inner side and the mounting is given by the access provided on the inner side of the door.

So obviously, the purpose of the door inner is two folds; one is to actually create you

know some kind of a bracketed component, which can hold the various interior requirements of the car assembly like the trim board you know or may be the window regulator handle or in case of an auto window, the power switch so on so forth. And the outer member; obviously, is the outer member which formulates a part of the body of the car, the outer body of the car and typically they are may or may not be a third member in between sometimes, there is a placement of a third member in between here which is used for the purpose of strengths you know. So, therefore, there is one member on the outer outside which we are not able to see it is on the rear side of this, so that is the door outer member.

And then there is the inside member which we just talked about the perforated member, and this is somewhere in the center you can call it a central beam or you know it is something which is provided providing the strength to the door in some cases in case of accidents etcetera, and typically the way that the assemble happens is a welled assembly where the outer and the inner in the central members or all put in a jack and the hamming is done on the edges here. So, there are spots related to doing the hamming you know all this different regions, you know where this three sheets would be meeting together and you can have welded spots in almost all these different areas as you can see here in the door. So, it is a very, very complex unit and; obviously, the purpose as you can understand here in the FMEA is the application of wax inside the door and to cover the inner door lower surfaces at minimum wax thickness to retire the coregent.

So, the purpose here is; obviously, when you have made the door outer side and the door inside, you are able to somehow go inside these gaps into the space between the door inside and outside, and are able to apply wax in this particular areas or in this particular regions to ensure that if supposing there is some kind of a flash, what is flash, and obviously, the door opens and closes many times and it is accessed, it is quite accessible to the flashes of the water etcetera which comes out during the routine operations of the vehicle. So, or even during let say rainy season there is a problem that there is going to be a case where the automotive goes in a submerged manner in a part of this door is already submerged in water you know this kind of a level.

So, you have to ensure that even though there is a hamming between the inner and outer members, there is going to be some kind of a waxing in the inner member which would prevent such a thing from happening. So, the idea is that if this is the thickness where this is the outer, this is the inner, you have to go from the inside and in between the two

you have to give the wax coating somewhere in the middle. So, you basically as I again told you please understand this very carefully, this is the outer member as can seen by the sorry the inner member as can be seen by the shaded region, and you are going into the cavity of the inner member and going into that space which is formulated between the outer member and the inner member and trying to do the wax coating very, very clearly I would like to define this here.

So, you are talking about such a waxing process which is typically done after the painting of the body car body is done typically at the end of the paint shop, that this wax is somehow done in the system. So, that you can keep it free of rest any other problems. So, the problem that has been identified or the potential failure mode that has been identified which. In fact, creates rash ting of the components; it is a very big problem is that the wax coverage on a specified surface is not appropriate or is insufficient. So obviously, you can see that you know it is very complex for an operator to sort of go inside all the way into this region unless really, he has gegh or a gun which can deliver the wax, but there is always a problem that the wax may not be able to sufficiently come and coat the inner surface of this particular door. So, that there is you know a prevention of the water from entering inside the hamming etcetera which are there.

So, it is very difficult location and obviously it is something which also as a very high chance of going undetected, because obviously in the assembly when the car has gone into the assembly or even, let us say even at the paint shop stage when the waxing etcetera has been done unless you are able to see and seeing is also not very accessible here, you can see a problem where the you know you can think of it the whether the wax is covered or its totally covering all the way to whatever you known region it should get into with the manual, visual kind of an inspection it becomes very, very difficult to see whether inside this door outer inner the wax is getting covered in the whole inner surfaces smoothly or not. So, it is definitely a defect which has a very difficult detectability and obviously it is severe, because it creates rust in the inner and outer members of the door and that is a very you know you can say that the severity of this problem is quite high and the occurrence also it has been found is quite reasonably high. And you know you can say that the potential effect of this failure. So, once this wax coverage is insufficient, the effects of this failure could be the deteriorated life of the door which can lead to an unsatisfactory appearance due to rust through paint over time, so obviously, there is going to be a sticking of the water with in the door inner and outer

and its going start rusting the inner side inside of the door.

So, there is an unsatisfactory appearing appearance, because of this rusting through the paint over that a over the time, and then obviously the impaired function of the interior door hardware, you have window regulators, you have sashes, you have whether streps which are there on the door for this particular purpose. So, that there is no sticking of water once the door is jammed to the main body of the car there is obviously sufficient packing of rubber between the door and the body of the car, so that the water may not go inside the car. But the idea here is that there this can be get impaired the functionality of such system like regulators etcetera, because of the continuous flashing of water and going inside may slowly get rusted, and because of with the functionality may slowly get you know reduced over time, and it can create a customer dissatisfaction you know a customer negative point for the customer.

And so obviously, the rating of the vehicle etcetera can go down, because of this in fact there can be a warranty issue a major critical fact factor in the automotive with customer as to again and again go and get things repaired inside the door, and it may lead to chain of other things in the process for example, it may lead to the opening and closing of the trim boards again and again it may lead to the mounting and taking out of things like regulators again and again, and it is not a very comfortable situation.

So, therefore, it is actually creating a chain of different problems, just because of the simple problem of the wax insufficiently covering the gap between the inside, and the outside through the, you know of the door in this particular situation. So, the severity of such defect has been rated as seven, because obviously there is a chain of different problems, which is associated with such a defect.

And then let us now look at the potential causes or the mechanisms of the failure which has been identified here. So, was the effect of the failure has been identified and the failure mode has been identified. So, one thing that I am very sure is that we are only working on one failure mode here, where as the overall check sheet may have more than 30 different failure modes, and 30 different potential effects of the failure in the same manner in a columnar manner, you will have to address the different modes and organize the different RPN values which are there.

Now when you are doing this you know the potential causes of the mechanism of the failure you closely study on the paint shop line, and see what are the different responsible

reasons for why this wax coverage may not happen. So, one of them is that the manually inserted spray head is not inserted enough; obviously, when you are talking about doors of assembly, and you see here how difficult it is for the operator to actually take a wax nozzles, which may be otherwise you know something like this with a probably a nozzle gun. And then you know you have some kind of a pipe line which is used by the operator who probably holds the, you know gun in this particular manner and inserts the gun into this gap right here.

So, you have a grip of the person as you can see over the nuzzle. So, this is how a gun really looks like a wax gun really looks like you have a feeder tube, where the waxes melted and flown at a certain temperature. And then there is a the hold point for the gun you can see this you know operator holding this gun at this particular place initiate the wax trigger which pull, you know the pressurized wax from the tubing and the feeding and all the way to this nozzle. So, this is the wax nuzzle and the dispensing happens at the end of this particular nuzzle as the operator move. So, you have to consider the difficulty level, which is there that this nuzzle actually nets to get inserted into this small space here and the nuzzle has to again be turned from this side to this side. So, this is the complete coverage on this particular region you know happens actually, because of that. So, it is a very, very difficult preposition.

So, that is one part of it that is manually insert this spray head and during that you feel that, you know these spray head is not inserted enough far enough, because probably it is not the nuzzle the you know nuzzle able to not cover the whole area which is needed to be coded by this particular nuzzle, the other process failure which causes this failure mode to come up can be spray heads closed you see. Now the wax feeded into the system can also get, you know lower I mean it can also solidify, because temperature goes down and there is no heating arrangement as such which you can see here towards the tip of this nuzzle; once the nuzzle the actually has the heated up molten wax, and the wax is dispensed there is a tendency that this particular region this orifice here can be clocked, because you know the it does not have any heating mechanism.

So, because of the carved nuzzle again even if the reach of the nuzzle is to all the area the dispensing may not be proper, because it has been clocked. So, viscosity too high may be one of the reasons temperature too low is another and then pressure to low is another. So, these are reasons why the spray heads would get clocked and that may be a potential cause for the failure which is the deterred life of the door leading to

unsatisfactory appearance due to rust to paint over time etcetera, and then obviously, this spray head deformed due to impact is another. So, sometimes what the operator do that in case the door is not operate opening or even the door is probably you known may be because of some reason, where it needs hammering for the door to be set back in place or some jet to be set back in place instead of you know the availability of a humor, because of the availability of humor around the operator, he uses the nuzzle head as a humor sometimes, and that can create a problem the orifice getting smaller, and again this insufficient dispensing of the wax from the tip of the particular wax nuzzle.

And then obviously, spray time insufficient is another that you don not give it enough time the operator, it is an assembly line of cars which is moving, and obviously, the waxing is also to be done at that particular rate. So, the tack time of a line is something like about two minutes or two and half minutes. So, you have to do all operations associated with that particular station including the wax application, and that may not be given enough priority by the operator, because obviously, it is inside the area and it may go undetected, but again it create severe problems or severe impacts on the overall qualities. So, these are some of the potential failure mechanisms which are identified here and based on that the occurrence of these failure mechanisms contributing to the final failure is being rated here. So, the case of manually inserted spray head not inserted for enough. So, that the whole area can be coated occurs more.

So, that is probably one of the more potential reasons, and you know 0 to 10 scale the concerned engineer at that particular process level is rated the occurrence to be at 8. So, therefore, in most 80 percent of the cases the reason why this failure of the deteriorated life of the door occurs is, because the spray head is not able to go as far into between the door inner and outer. And that is why it is a high level of occurrence similarly is what 50 percent of the times, you know it is basically the spray head clocked, because of the viscosity of the wax being too high or the temperature too low or pressure too low, you know the pressures and temperature.

Obviously, again let us look back into this wax dispensing system is related to this end of the spectrum. So obviously, the wax has to be melted to a certain level. So, that you know you have it, you have viscosity low enough. So, that follow ability can increase etcetera also it has to be done at a certain temperature condition, and may be because of non compliance of those temperature condition, and viscosity conditions the wax which is coming into the nuzzle may not be to the level, you know may not be melted to the

level that it is suppose to be and it starts nuzzle. So, there is about 50 percent occurrence. So, the engineer rates that to be about and then obviously you know spray head deformed due to impact is quite less in may be two of the case or 20 percent of the cases, the operator may have accidentally rammed the nuzzle again something to do some hammering action, which may have resulted in this particular case the hammering action may be have resulted in this particular car case hammering may be just related to the door getting jammed, and you have to open the door in order to do this application.

So, there he may have used this process, because it is coming from the last step of the paint step, last paint step where there is a possibility of sticking of the door with the body. So, he uses this nuzzle and that creates damage on the nuzzle, but that is very rare. And then again the spray time insufficient, because of a change operator is also high it is about rated eighty percent. So, you have rated the severity, you have rated the occurrence I am going to probably close on this module in the interest time, but in the next module I am going to take up how you will rate the detectability of this problems. And then we will see what positive counter measures can be implemented, and then again do the RPM analyses to see is the failure mode effect analysis good or bad.

Thank you so much.