Manufacturing System Technology - II
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Module – 11

Hello and welcome to this Manufacturing Systems Technology Part two - Module 11. We were talking about process FMEA and in context of that we were taking about the problem of wax lining and door interiors between the inner and the outer member where there were potential causes of failures associated with rusting of the painting body or painted body or even rusting of the components like window regulator etcetera, which are put inner and you know inside the inner member of the door. And there were various reasons or the causes due to which the failure would come these would kind of identified and the severity of the problem as well as the occurrence of the difference causes of failures were sort of identified again and ranked in accordance.

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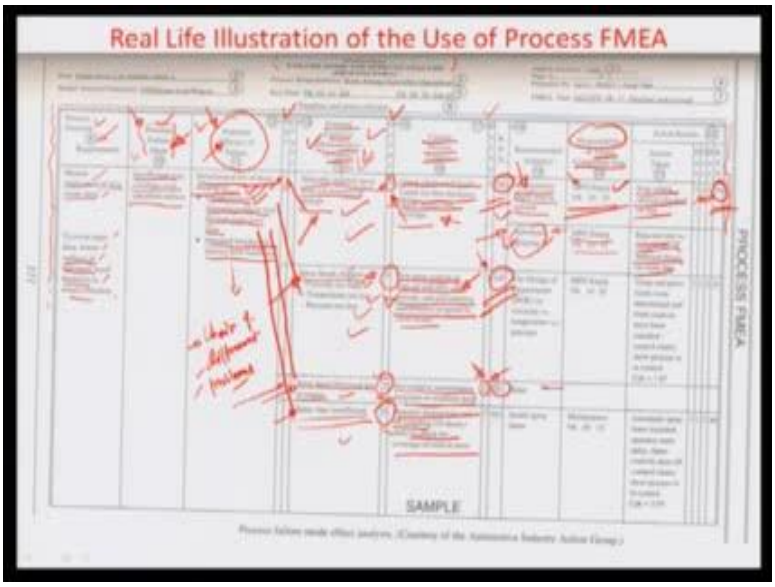

So, we want to now look at the detectability. So, let us come back to this particular check sheet that we were talking about in this context where if you may remember we mention about the potential causes or failure mechanisms - the column 14 of this particular check sheet, and then again rated the occurrence of this particular you know different mechanisms which would cause the failure to happen. And then we talk about the detectability that is how easy or difficult it is to detect and rank accordingly. So, we look

at the current processes controls which are available. So, one of these for example, the manually inserted spray head not inserted far enough as I detailed last time it has a visual check each hour one per shift per film thickness depth meter and coverage. So, the operator here has been instructed to probably stop the line and check. Or maybe even you know you know another case there is a supervisor of that particular zone which has been asked to do this visual check each hour where he after out of whatever number of vehicles are produced in one hour, one of the vehicles, he takes and randomly picks it up and obviously, he varies his time etcetera, on the principle of statistical randomness whatever he wants to introduce in the observation.

And then, he checks for the film thickness, the wax film thickness and also the thickness here is depth in meter, of course and also the coverage area of the wax within the inner and outer door. So, here he finds out that by doing this kind of a manual inspection you know may be about 50 percent of the times he is able to make it out whether the defect is sneaking out of the system, so obviously, it is one per shift and in that time of let us say 2.5 minutes or maybe even like 2 minutes you have both 30 vehicles rolling out in each hour and he is only checking on one. So, based on that still he finds out that you know there is only a 50 percent probability of a detection of this manual inserted spray had not inserted far enough by doing the visual check.

The other potential cause was spray head cloud. So, he finds out what is you know the let us look at what are the current processes controls for preventing that from happening. So, it basically tests the spray pattern at startup and after idles period. And obviously, there has to be a preventive maintenance program to clean the heads from time to time. So, the company has put in place some kind of spray board, where you know it sprays by putting the nozzle or inserting the nozzle on the center of that board and sees if the spray patterns matches the intended pattern that is supposed to come you know in a fully operational nozzle with zero clogging, so that is also again once in a while that he does this check. And then; obviously, this is aligned more towards either the startup period where the first vehicle has to be sprayed; and also after let say any ideal time in between let say the production line stop for some time for lunch or some other purpose, so during that time again he does the test spray pattern checking again. And there he is able to only detect these with 30 percent luck. So, he has rated this particular detectability to be 3 out of 10 - the process engineer.

Now you talk about the next cause of failure which is spray head reformed due to impact and obviously, the only way to do it is preventive maintenance program maintain the head from time to time and there is almost a twenty percent chance of detection of this kind of A. You know failure board or mechanisms of failure which is causing which is going to cause the deteriorated life the door because of the rusting problem etcetera. So, he identifies these two have a rank of two. So, the detect ability is two here. And then finally, the spray time insufficient were the occurrence was about 80 percent of the times the operator instructions are given at that particular point and lot sampling of 10 doors per shift is carried on. So, basically let us say in a production level of about 200 or 250 cars, you were checking about 10 cars. And you are checking for coverage of critical areas in a very accurate bases, but pulling out the cars either into a bay or something and that helps you to prevent you know this defect particular defect of wax coverage in proper up to the extent of 70 percent that means, the detect ability increases because of such a operator instruction from time to time and lots sampling from time to time.

So, therefore, you have now rated all the detect ability of the various process control which are used for identifying you know or which are used for identifying the various mechanisms of failures related to either manually inserted head not going far enough or related to either sprays head, spray heads getting clocked etcetera, because of viscosity temperature of pressure issues. Or again you know related to the spray head reform because of the impact and false practice carried out by the operators on the line or etcetera insufficient. And this whole list of four causes have been identified in terms of their occurrences and rated, and also the processes control associated with them have been identified for the detect ability that with that particular control on is it possible to detect it with the higher percentage or a lower percentage.

So obviously, the RPN has to be calculated by a product of the entire severity occurrence of the detection; and in this particular case the severity for this defect of the overall set up defects which are there in the automotive paint shop is about 70 percent. So, seven has been rated as a severity here as you can see. Severity does not change for any of these causes because these causes are actually leading to the failure mode which is being considered. And so, therefore, you treat that a seven uniformly although. And you make the product of the severity in a column 12, the occurrence in column 14, 15 and detect ability in the column 17 and multiply them to find RPN or a risk priority number of 280

for the first mode of failure which is manually inserted spray head not inserted far enough. 105 for the next head of or next mode of failure which is the spray head clocked because of which these deteriorated life of door comes because of incomplete coverage of waxes within the door inner outer wax within the door inner and outer. And then finally, the RPN of 28 for the spray head deformed cases due to the impact on the operator 392 for these spray time is insufficient.

So obviously, you have now identify which is the mode of failure which is causing the highest RPN in this particular case probably as you can realize 392 case which is illustrated here, and the 280 are the two most impactful modes because of which the potential failure would happen. So, we will have to do something to prevent them on a very urgent priority and then obviously, you can keep you know the remaining ones. In this particular case in fact you can do are comparison for three because you have quite a high RPN value in three you can see 280s for the first cause that is manually you know inserted spray head 105 is for the second cause that is spray head clogged and 28 for the third cause which is minor and the fourth cause is insufficient is 392.

So, we can identify the first cause, the second cause, and the fourth cause and may be just leave this untouched because it has a low RPN. So, we need not really address it obviously, when you do it for the second iteration after doing some kind of corrections or you know identified measures to counteract the potential causes, you will have to again probably pick it up, but at this time we are leaving it. So, the 28 you know RPN is left over which is corresponding to the spray head deformed due to impact it does not happen very severely or it does not happen many times you know, so you can leave it impact and then we only talk about three different aspects or modes causing this failure of incomplete coverage one aspects is related to the manually inserted spray head not inserted far enough for which the processes control has been a visual check and probably a each hour once in a shift you know for the film thickness depth etcetera.

Then you have the second causes the spray head clocked because the viscosity temperature of pressure issue and there also you have to have a process control of a testing of a spray pattern and in some preventive breakdown maintenance programs which are there. And the third cause is the spray time insufficient which is in fact very high 392 and RPN, and you know here you are having a process control of operator instructions regularly or lots sampling of ten doors a shift to check whether the sufficient

time is being spend by the operator one particularly per vehicle etcetera, and here you are getting the highest RPN. So, you have identified these three different causes and you tried to take a counter measure at this particular step. So, let us look at what are the counter measures to eliminate these causes. So, here for example, the processes engineer points out that if we add a positive depths stop to the sprayer then there may be chance of you know the full proofing of this manually inserted spray head not inserted far enough.

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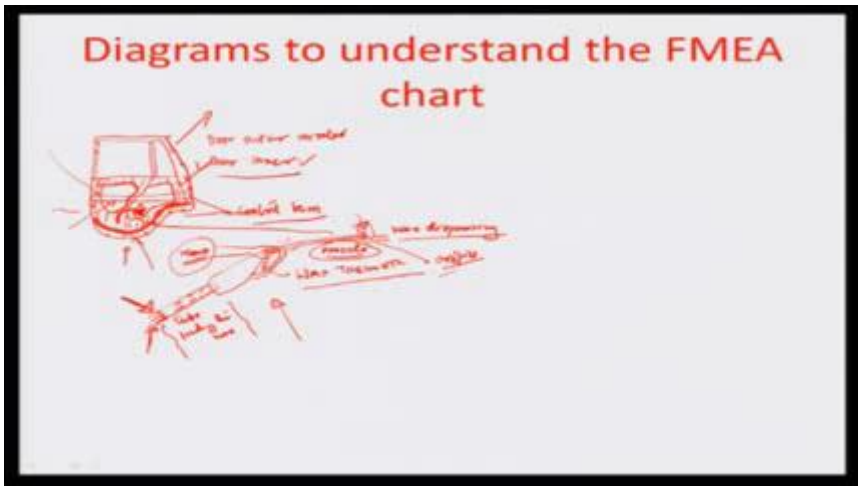

For example, let us say if the nozzle in this particular case as you are seeing as a tip. So, this is the wax dispensing tip of the nozzle, and this tip is supposed to go into this particular region here and it is going all the way into this region in this direction. Finally, even the nozzle comes to this particular point it should start the dispensing. So, if we can make a limit switch there which can be pressed to ensure that the wax is coming out, so basically the nozzle has gone into this inner door and it is going to hit some particular region, where there is a limit switch which gets you know actuated because you know obviously, the construction of the door is such that the if you at look at this is the inner member and this is the outer member they together hem right, so there is some kind of bending of the profile. So, there is hemming at the bottom here and, so, there are fewer gaps here in this lower end.

So, if the nozzle is going all the way down into that less gap zone then may be some limit switch or a positive depths stop can be actuated which starts the flow of the wax. Otherwise, the wax will not come out of the nozzle then it may be a full proofing or a as if Japanese you know call this ((Refer Time: 12:34)) which can be placed, so that

whenever the nozzle is going into these smaller gap in the hemming region of the inner and outer door, the actuation of the limit switch because of a striking of the nozzle with respect to the inner or outer members is going to start the wax disposal here. And before it has gone into that depth top region, you know there is no emanation of the wax which comes out. So, this could be a full proofing that can be done which they have recommended and they have given a completion date in a target in a responsibility. So, here the assembly engineering, the manufacturing engineering comes into picture and some fictitious date has been given here for the manufacturing engineering.

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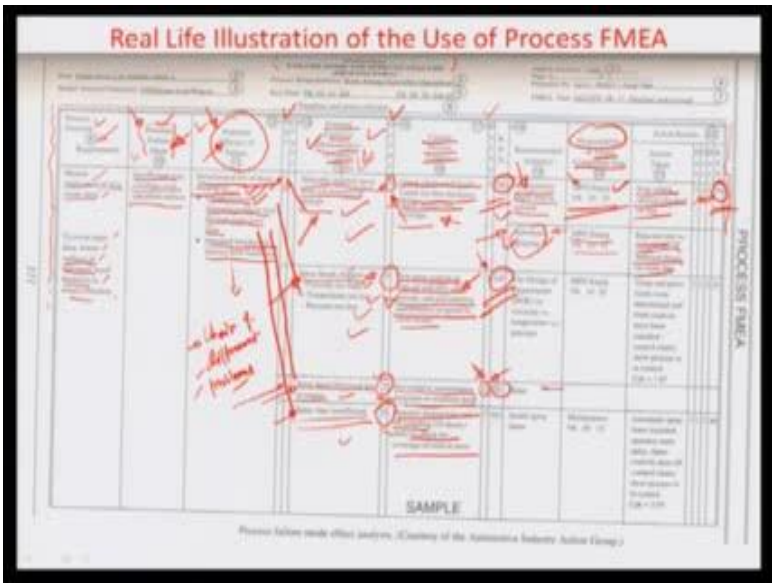

So obviously, there are two functions attained here one is obviously the depth stop, which gives or which ensures that the dispensing would happen or the limit switch would be pressed. And the other one obviously, is that you know it is starting to automatically spray once that particular depth has been reached. So, we can say that this a depth stop providing automatic spraying of the wax. So, the idea is now that this door profile as I showed you here is quite complex you can see the door profile to be in this particular manner here. So, wherever there is this hemming region where there is a change of the gap between the inner and the outer member because of which there is a spray actuation on the moment the nozzle reaches that particular zone, it ensures that the wax has disposed off; otherwise the wax will not disposed off. So, unless and until the operator goes to that particular region the disposal of the wax will not be there. And it can be detected using the processes control of a visual check of one per shift that has been done

and it is one kind of a automation based on which this would solve the problem of manually inserted spray head not inserted far enough.

So, the manufacturing engineer, you know added this is stop and the sprayer was checked on line. And the only problem was that you know once there is a automatic spraying method which I illustrated earlier was implemented by the manufacturing engineering. They find that it is a rejected due to the complexity of the different door on the same line so obviously, the gaps etcetera, between the inner and the outer member of a muck multi model production system may be different because there are many other different you know assembly door assemblies which are been marked. So, therefore, the second solution of an automatic spray as the depth has come was eliminated and only the fact that adding a positive depth stop to the sprayer that is you know it is like a full proofing then it will starts the spraying that was sort of added due to the system and it worked out the very well.

So, now, they have done a severity detection and occurrence ratio here and you see the severity is same because the defect does not get change or this overall severity does not get change, but the because of this counter measure which has been taken of the depth stop the occurrence has reduced from 80 percent to about 20 percent. And obviously, the detect ability is still the same because we have not controlled the process current process control which is the visual check and that happens to be five in these particular case. So, the overall RPN value comes out be 70. So obviously, the 280 RPN as been reduced to 70 because of the less occurrence of this defect going to this automation that has been provided. So, in this particular way you have reduced the RPN value by taking a certain counter measure in a counteraction. So, we are going to look into all the other failure modes which are there and different counter measures in the subsequent module, the interest of time will probably close this module right here, and go ahead with the other modes of failures in the same analysis and how the RPN can be changed in the later on module.

Thank you so much.