PMO

PREVENTIVE MAINTENANCE OPTIMIZATION

Arrelic Insights

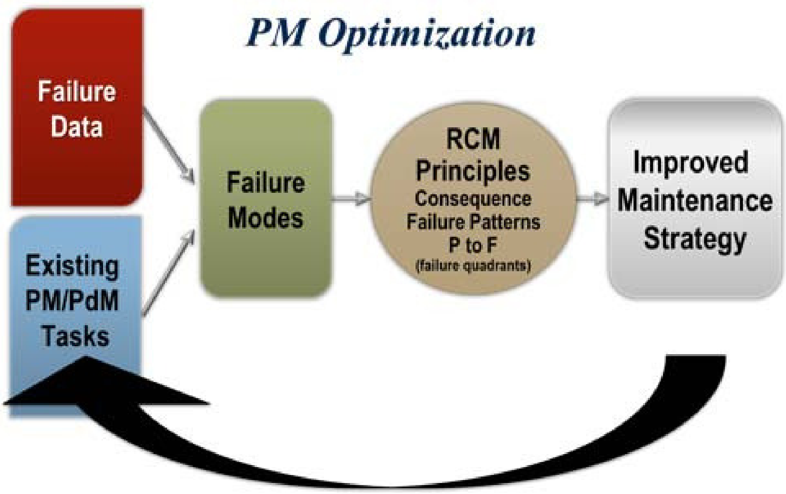
What is it?

PM Optimization (PMO) is a structured process which uses the principles of RCM and aims to preserve and restore the equipment condition. It is a process to improve the effectiveness and efficiency of the PM process. PMO focuses on identification of the failure modes and helps us to develop PM tasks to manage the failure. It addresses the needs of the reliability engineer to identify and manage equipment reliability risks that could adversely affect plant or business operations.
PM optimization uses reliability principles to try to find the most value-added maintenance strategy for a particular asset PM. Optimization involves people that know those assets so well that they eventually implement improvements and create an environment for that to happen. So why do we require it? The answer lies in the benefits that can be derived from it. It's always the biggest gain in an organization to have availability, increasing the equipment running hours. The biggest game is, is on the production side. So if you can find that key asset that needs to run better and apply PM optimization principles, make it run better, reduce the downtime by 50 % or have some significant impact on its ability to run. You will be contributing value added to the organization's bottom line, and so those are the kinds of things that we, as professionals, really need to be focused on.

It starts by collecting the failure data and the existing PMS that we can easily get from the CMMS for a particular asset and then by defining the failure modes from those two datasets that we've got. So the real question is, how does this asset fail to perform? We start by breaking the asset into its components and failure modes that we would see that are likely to occur and subsequently an effective FMECA (Failure Mode and Effect Analysis) helps in re-structuring the PM schedules.

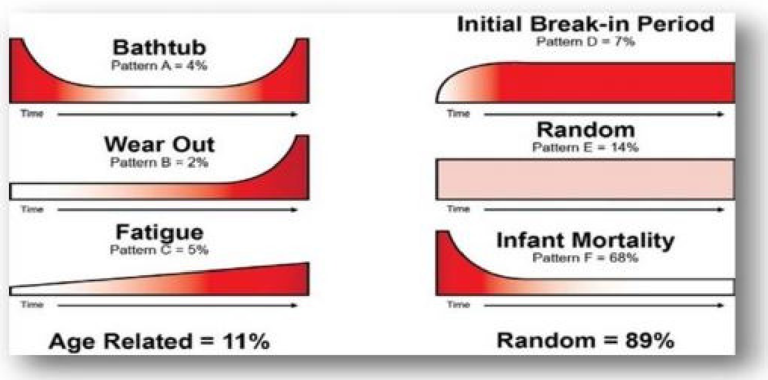
The two pieces of information, first, the failure data shows us gaps where it's not and the second, the PM strategy is not completely helping us to manage all the failures. So is there something that we could do better in the PM strategy to manage those failures and then to in the PM dataset itself?

The answer lies in the failure modes and then once we have that list of failure modes, RCM principles, teach us about things like the consequence of failure and the failure.



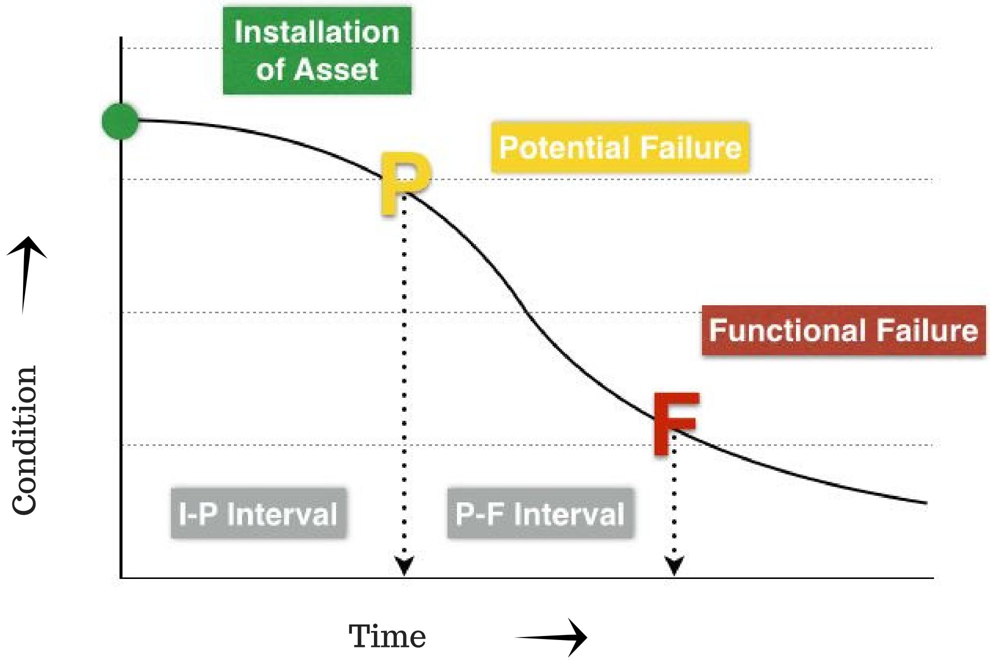
PM optimization schematic diagram

The six failure curves that we get out of our condition monitoring (CM) which are described by the age related failures and random failures are essential but only provide limited information regarding equipment failure life-cycle.



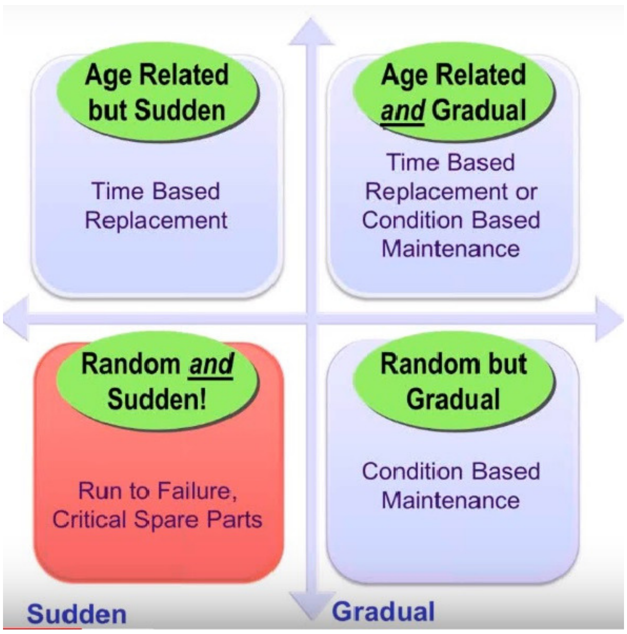
Typical Failure Curves observed for assets

We need more information on how to actually optimize our maintenance schedule keeping in mind the life-cycle of the equipment. Thus, we need to understand the concept of P-F curve to understand the maintenance requirements of the asset. The curve gives us the two points of potential and functional failures.



P-F curve

Let us take an example here to understand this. If you take the tire in a car, it not only has as an age-related failure but also the fact that once it starts to fail due to wear, there's a pretty long curve between when the initial signs of wear start, and the point where I should be concerned about that's showing. No act on my part in these time interval actually makes it to get to the point of failure due to that wear. So I have a long window. I could probably drive my car for in the way I drive it for six months or more probably, if I want to be foolish between when it starts to show signs of wear and when it would actually fail to perform the function and so that time is going to be really important in terms of our PM strategy and how we would approach PMS. So if we take those two facts and put them together, we get a quadrant box.



This quadrant box tells us the maintenance requirements of the assets as per their failure probability and occurrence. These two things together can give us the required PM strategy. We can put the failure modes of the tire into this quadrant box and determine what the best strategy would be for addressing that. So, when you're talking about random and sudden failures, you are probably going to end up running that component to failure. A good example would be a flat tire. Basically, when you get a flat tire that you hit a nail on the side of the road, it's a random and sudden failure mode, and our strategy is exactly that. We have a critical spare that we carry with us in our trunk all the time, because we know that you can't inspect for that and can't change the tire to prevent that. But, when we start to think about failure modes that are still random, but they have a much longer curve to be able to observe the deterioration happening. An example of this would be a slow leaking tireI.t's random when you would get one, but you have a gradual deterioration curve on it to where you have lots of time to respond to that slow leaking tire. In that case, these random and gradual curves are ideal places to be using condition based maintenance. If you have a time based strategy to replace and completely eliminate slowly leaking tires,it would probably not be an effective strategy. It's a random failure mode that has a gradual P-F curve on it. So we use inspections and condition based tools here. Moving on to age related but sudden failure modes

We will take up another example about a car's battery here. Once the battery gets to a certain age, there's a sudden deterioration that begins to happen on it. From our previous experiences, we know that we need to change the battery the first time it cranks slow. We now know that the curve is coming pretty quickly. So if it was a very important component, if the consequence of failure was high, we would have to just change it based on what we know it's life expectancy would be. Now, when we get to the age-related but gradual failures, we have a choice between time based replacement or condition based maintenance as our strategy, and we can do that based on cost and say which is going to be the most economic strategy and of course, many times condition based is going to be more cost effective than time based, but not always, so we can look at the cost equation and make a determination on the best way to manage that failure.

All of these strategies are affected by the consequence of the failure. From our experiences we know how much the downtime of a particular asset can cost us, and thus we know how much money we should spend to actually alleviate that problem. We will look at the Quadrant and say, what can I do if it's random and sudden plus, if it's high consequence, I should better either have a critical spare ready to go or I've got to have a backup system in place to kick in when that first one kicks out, so I reduce the probability that random and sudden failure mode will impact my operations. So, we can take the consequence of failure, and determine what the best strategy is. This analysis gives the best strategy for helping us to address our failures and the reason we need to do that is in a lot of cases, we have non-value-added PM strategies. So, if the consequence is very low for a particular failure, we might be spending way too much money trying to avoid a consequence that doesn't matter much in our organization, so consequence helps us to understand how much we should be concerned and to understand the amount of risk that we will be taking up. Thus the asset that has a high probability and a high consequence of failure, the risk associated with it is very high.

Similarly, the asset that has a low probability of occurring and low consequences of failure the risk associated is really low. Thus, the above analysis helps us to understand how much we should spend, focus, standardize and really plan to avoid that particular consequence of failure. This strategy when combined with the P-F curve and the failure pattern helps us in optimizing our maintenance procedures.

About Arrelic

Arrelic is a fast-growing deep-tech firm aiming to bring the next level of IoT based sensor technology to transform the mode of manufacturing operation and maintenance practice of various industries with extensive expertise in Reliability Engineering, Predictive Maintenance, Industrial Internet of Things (IIoT) Sensors, Machine Learning and Artificial Intelligence. We provide a single ecosystem for catering all industry needs from Consulting to IoT and Analytics as well as providing Training and Development courses for different stakeholders. We aim to help manufacturing industries to improve their overall plant productivity, reliability and minimize total production cost by 25-30% by eliminating machine downtime, lightening management decisions by analyzing the machine data with right mind and expertise; for a worry-free operation.

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