Maintenance, a Forgotten Part of the Strategic Plan

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Resumen
En el artículo se expone los motivos por los cuales la gestión de mantenimiento ha sido relegada a una unidad operativa en lugar de ser tomada en cuenta como herramienta estratégica de la gestión organizacional. Se trabaja con relación a revisión de literatura y a la situación del empresariado peruano. Finalmente se exponen algunos criterios estadísticos que pueden ser relevantes al momento de planificar el mantenimiento.

Palabras clave
Mantenimiento, MTTR, MTTF, MDT, MTBF, Poisson, Lambda

Abstract:

This article exposes the reasons behind the relegation of maintenance management as an operative unit instead of a strategic tool in the organizational management. It works with literature review and the peruvian business context. Finally, it shows some statistical criteria relevant to the maintenance planning.

Key words
Maintenance, MTTR, MTTF, MDT, MTBF, Poisson, Lambda

There is a saying when you work in Maintenance: "When everything goes well, maintenance is not required, but when everything goes wrong is maintenance fault". This phrase pretty much summarizes what is actually working in one of the most ungrateful department of a company. When the factory machinery crumbles because of lack of maintenance is very probable that delivery dates for big sales can be surpassed, but if you want to stop the machine in order to prevent this, it is time wasted for production and sales, therefore, it is always your fault. This area was traditionally seen as only an operational arm of a company. However, recently is becoming more important and recognized in the upper management (Pitt, Goyal, & Sapri, 2006). However, why does this department is forgotten? Why its management and development is not part of the strategic plan if the impact to the profits can be very high? According to Rastegari&Salonen (2015), it is because of lack of knowledge of the benefits, tools and insights. Also, according to Gilabert, Fernandez, Arnaiz&Konde (2015) is because of the lack of adequate information about the maintenance process. De Felice, Petrillo & Autorino (2014) sustain that it is because of the lack of match between manufacturing and maintenance goals.

During the industrial revolution, the first steam machines were invented and with them, the first maintenance troubles. In that times, machines were simple and very specific and so was maintenance. When a machine broke, it was only repaired. Later, by the second generation, automated processes began and more and more companies looked for methods to decrease the time machines were out of order and maximize the time the machinery was working (Compañia Levantina de Reductores, 2017). With this, the first two intuitive indicators were build: (i) MDT[1] and (ii) MTTF[2] (Cavalieri, Garetti, & Pinto, 2008). With the use of some statistics, they evolved into a very useful indicator for managers to know the availability of their machinery. Some time on, and this indicator became a method to understand the behavior of the spare parts in order to be prepared to change them in a sudden failure, and more important to act just before they should fail. With the Poisson distribution, it is very simple to determine this. But this is a theory and randomness do happen in real life so, even if this is a very accurate indicator, the probabilistic approach should be taken into consideration (Sherwin, 2002).

Here is when everything goes complicated. Precisely when statistics enter in the equation. It is very well known that most people have an aversion to mathematics, even among business majors, in which mathematics is a very useful tool for financial calculations (Joyner, 2011). In this context is where we have to analyze what happens in real life with the machinery and its maintenance, and for this, we have to understand the Poisson distribution.

The Poisson distribution uses the lambda parameter for its calculation. This parameter is the inverse of the MTTF, so it can be understood that it is simply the amount of failures per unit of time. In addition, its standard deviation is also the lambda parameter, which leads to the normalization analysis that in a large population, P(x, lambda) = N(x, lambda, lambda). (Balakrishnan & Basu, 1996). Now, let's analyze the randomness of the events. Furthermore, we will use only the normal distribution for the MTBM[3] due to the central limit theorem.

The most difficult thing to understand that most people encounter when they face any distribution is the behavior of the mean and confidence intervals. Usually, people misunderstands central measurements (Univerisity Of Texas, 2016). In Poisson distribution, as in other symmetrical distributions such as the Normal distribution, the probability to be at the mean or less is just 50%. Translated to the analysis of the MTTF, you just have 50% chances to prevent the failure if you program a maintenance at your MTTF.

In this order, it is very important to determine the desired probability to face the preventive maintenance. With this probability set, it is matter of just doing an inverse normal distribution and set your time between maintenances. But, as a matter of fact, in real life is not as easy as shown because increasing the probability to prevent the failure increases substantially the cost of the maintenance due to the exponential ratio of the Z value. For this to be clearly understood is good an example. Let's assume that we have a motor and its MTTF is 15 months with a standard deviation of 1.5 months. Remember that, as said before, if we set to do the preventive maintenance in 15 months,

[1] Mean downtime

[2] Mean time to failure

[3] Mean time between maintenance

we just have 50% chances to actually prevent it and not to repair it once it fails. Now, let's increase this probability to 85%. With the normal distribution with N(0.15, 15, 1.5) parameters we input this to a probabilistic calculator. A quick question that might come is why does it appear 0.15 instead of 0.85 if we are trying to increase our chances. The answer is simple, remember that we are trying to reduce the time between our maintenances and the Poisson distributions gives the probability to fail in a certain amount of time. If we put an 85% chance, the time will also increase. With the calculation complete, we proceed to the results.

The mean time between maintenance now is 13.5 months, with only 85% chances. If we scale it up to 95%, the results are even more difficult to prove them to the upper management because it will say to do management at only 12.5 months. Analyzing this times, a common conclusion would be that we would lose 2.5 months of motor production with still good spare parts. In addition, this will be even more empowered because, there is a 5% chance that even doing the preventive maintenance at 12.5 months it will fail before that. So, summarizing, we set the preventive maintenance at a time where the motor is still running and producing money to the company, and we want to buy some expensive spare parts, stop the producing line and change them, just because we want to prevent something that might work even longer than 15 months. Remember that there is a 5% chance that the motor will be still be working at 17.5 months.

By the untrained manager, this is just an outrageous expense of money and worst, the machines are still failing. In addition, this is true, because randomness is a thing in probabilities. The fact that you all your calculations to prevent all failures in order to do preventive maintenance in a time where the productive line will not be producing, without affecting the normal operations and trying to optimize the resources of the company having a spare parts just in time policy will shatter whenever this small probability decides to step in and prove the randomness of the real life. All this said before is the key issue to understand why does maintenance is always forgotten and, usually, not part of the strategic plan. The previous analysis proves in a certain way that maintenance will always cost money. If you reduce your mean time between maintenances too much, the cost of spare parts will increase. But, if you increase it, it is more likely you will face a lot of failures, which would lead to expense in over time, time loss, opportunity cost and also in more spare parts. This is because once something fails, as this parts does not work alone, all the related pieces suffer also from the damage taken, and might be necessary to be changed too.

As it is very important to have the numbers right, it is also important to have the house in order too. Usually in Peruvian enterprises, the maintenance manager is a mechanical engineer with a lot of experience in the field, design and repair[4]. This is good because it helps to create a good work atmosphere but it is very probable that this excellent Mechanical Engineer does not have the managerial experience and lacks the right competences for keeping the house in order.This is needed to have the right decision in which part of the Cost-Reliability curve set the objective of the area and try to make it stay inside the neighborhood of the set point. In addition, this is why it should be a key area of the strategic plan. It is vital to the company to be able to determine the valley of the curve in order to have a financial and an operational plan.

As any other department in a company, its final goal is, among others, to impact positively in the bottom line, providing tools for the production area to plan better and finally, make profits (Haroun & Duffuaa, 2009). The teamwork required for this is great, because the amount of data to collect is big, and sometimes it is difficult to make people be interested in a data-mining project. However, the importance of having a good maintenance policy is huge. The best maintenance area in the world is the one that is seen as not necessary because everything goes well. As said in the first paragraph of the essay, there is a saying when you work in Maintenance: "When everything goes well, maintenance is not required, but when

[4] Note: A study to prove this statement does not exist or hasn't been found by the author. However, this is the findong after careful review of several position requirements and job descriptions as Maintenance Manager in different peruvian job exchange sites

everything goes wrong is maintenance fault". As a conclusion, maintenance area is usually not taken part of the strategic plan and forgotten because of mainly two things. The first one is the difficultness to understand the behavior of random events in a way that will affect the machinery of the company. This is because the lack of interest and avoidance to anything that has a relation with mathematics of the people. In addition, this is where the second key element comes in, which is the lack of leadership or competences of the maintenance manager, which is explained because of their excellent technical background. The company loses a good technician in order to gain a poor manager. This is necessary because even if people run away from probabilistic calculations, the manager has to be strong enough to prove their point and set an adequate maintainability level, which can be controlled and measured as a key process indicator.

Finally, the general manager of every company must know that having maintenance in as a key process support are will minimize the amount of wasted time in repairs which will lead to maximizing the available time to produce any good the company needs. It will also prevent any kind of surprise in a close lead-time deliver to a customer. In every single way that can be looked in, a good maintenance, area will always be part of the success of a company, but a bad one will make it very difficult to production and sales to be able to deliver in time the orders to the customers, deteriorating the company's name and reputation. The real impact of not investing in maintenance is huge but is usually covered by uneducated analysis of this. To end this essay, just one phrase: The best maintenance area is the one seen as not necessary.

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