Maintenance Prevention is not Preventive Maintenance! Part 9

By Brian Heymans M Ed

1972 MAINTENANCE

I remember buying my first car: a used, light blue, 1972 four-door Toyota Corona Sedan with manual transmission, and all in good working order. Once at home, I read the vehicle's manual cover-to-cover. I discovered rather quickly that the service requirements to keep this big investment running were extensive, and expensive (at least for my budget at the time). I was a trainee accountant living on hope and soon discovered that I would also need to become a maintenance mechanic, as I could not afford to pay the service fees to keep my Toyota running. I resolved to acquire a range of tools necessary to service this car myself. After all, the owner's manual graphically described just what had to be done, so I quickly assembled tools I would need… a timing light, feeler gauges, socket wrenches, an oil filter wrench, an oil pan, grease gun, and a hydraulic jack. I would spend most of a Saturday working on my investment. Not only did I change the oil every 1000 miles, but I also changed the transmission fluid and differential oil, plus greased the suspension, steering mechanism and wheel bearings. I adjusted the timing by adjusting the distributor cap while aiming the timing light on a small groove in the timing chain pulley. I cleaned off the points, added distilled water to the battery, replaced the air filter above the carburetor, and adjusted the valve gaps (while the engine was running with the tappet cover off while hot oil squirted out in small fountains). I adjusted the spark plug gaps (sometimes replaced them), replaced the disk brake pads and brake drum pads… You get the idea.

2013 MAINTENANCE

Fast forward to 2016 and I have a 2013 Toyota RAV 4. The list of maintenance services required to keep this car running dwarfs my Corona's list, and I never handle the maintenance now because I can't. Fortunately, the list is a lot shorter: an oil change every 5000 to 7000 miles accompanied by many inspections and a few other things I could never get to anyway. So much has changed over these past 44 years and car design is no exception. If you were to open the hood of the RAV 4, you would discover, as I did, that most of the gizmos in there are inaccessible and very different. Technology alone has improved the car altogether. Today's automotive technology has made cars safer, more reliable, and more maintenance free because the industry has re-designed many of the components and systems by using a concept known as Maintenance Prevention.

MAINTENANCE PREVENTION

This evolution to a need for less maintenance has developed because of the need to ensure longer equipment life and lower life cycle cost. Maintenance prevention is the deployment of improved technology to reduce or eliminate many forms of maintenance activity by ensuring that the design of the equipment enables standard maintenance practices to be performed faster, cheaper, and more effectively.

Several concepts are inherent to the practice of maintenance prevention, the most important of which is prevention. The cost of downtime is typically underestimated, and many companies see maintenance on equipment as a cost that needs to be reduced. However, the investment in the development of equipment that does not break down is not made. So, when the equipment breaks down, the resources necessary to fix the equipment are unavailable. A prevention mentality is essential in the application of methods to assure equipment run-time.

LIFE CYCLE COST

Most companies do not consider the total life cycle cost of equipment. Life cycle cost includes all design, capital, maintenance, refurbishment, repair, and parts replacement. One could also include the cost of lost production as a result of breakdowns and preventive maintenance. Poorly designed equipment from a maintenance prevention perspective results in higher repair and preventive maintenance costs later. The strategy of maintenance prevention is to reduce all life cycle costs and equipment downtime, plus increase the total operating life of equipment which would result in an improved return on the initial capital investment.

Unfortunately, many other types of industrial equipment have not gone through the radical changes the automobile has. I still see new equipment in factories today poorly designed to reduce or eliminate maintenance activity. Past designs focused on performance and function, not on the long-term life of the equipment. Design has not emphasized operability and maintainability. Reliability has not been seen as a factor in long term performance. Lack of Maintenance Prevention design hampers equipment improvement projects that ease cleaning, lubrication, inspection, adjustments, and reduction of minor stoppages. In addition, a number of factors are prevalent in management thinking that are short term in nature, for example:

• Reliability is not considered as part of the design.

• Management often seeks lowest procurement cost, so prevention elements are not considered.

• Budgeting for and deployment of maintenance practices are poor.

• Little consideration is given to disposal, environmental, and recycling costs.

• There is a lack of cross-functional collaboration during the design phase between design engineers, maintenance personnel, and production personnel.

So, the design or re-design of equipment must result in improving accessibility and ease to perform maintenance activity. This will reduce downtime plus reduce cost. This should apply to new equipment design and refurbishment of old equipment. Design must reduce maintenance activity. This will reduce cost and equipment downtime. Design must eliminate maintenance activity by utilizing new technologies. A new design ethos must be adopted to ensure maintenance reduction and elimination, reduction of the cost of maintenance practices as a direct result of the design features of the equipment, enhancement of the equipment life cycle, and lowering of the life cycle cost.

The difference between my 1972 Toyota Corona and my 2013 RAV 4 is evidenced in the elements mentioned above. It goes without saying the old equipment can be redesigned and updated to contain some maintenance prevention features, but a number of design protocols need to be incorporated into that re-design, and these are the same protocols to be used in the design of new equipment. The process of designing new equipment with these maintenance prevention features in mind starts with the customer or person using the equipment. Clear design features that include greater maintenance accessibility and reduced or eliminated maintenance activity must be a user-defined set of attributes, so finding a mechanism for defining these characteristics is critical. One very useful method to define these characteristics is Quality Function Deployment (QFD). This method is typically used to define the relationship between the qualitative attributes of a product and the production process or features. This method can be adapted to show the relationship between the performance attributes of improved up-time, reduced maintenance downtime, and the costs I referred to above with the design features that come from a "prevention" mentality. Preventing failure is critical within the component design process, but failure does occur as a phenomenon, so creating conditions for the automatic discovery of potential failure is essential using mistake-proofing methods in equipment design. The Japanese call this "jidoka" and as a process or piece of equipment is working, you will want the equipment to be designed to recognize potential failure before it occurs and then provide a warning or stop the operation to prevent catastrophic failure. The ultimate is that it will self-correct to avoid the failure altogether. Once a design is being considered, the next method that can be deployed is Failure Mode and Effects Analysis (FMEA). This method is a risk analysis tool to determine the potential risks of failure of all design features. Its use will help determine the potential elements of any equipment that might fail, and the effects of that failure on cost, production, etc. It is standard practice to use FMEA's in aircraft and automotive component design. Another design tool is the use of Value Analysis / Value Engineering (VAVE). Value analysis, very simply put, is the process of reducing the cost and weight of materials in a component - less materials or parts, less opportunity for breakdown, and less cost. Value engineering is doing the same for the manufacturing processes needed to make that component. How can we simplify or reduce production steps and methods, and so reduce manufacturing cost? The use of examination tools in VAVE will help reduce overall cost of equipment but can also be used to design components for a longer life cycle. This is an exciting area of continuous improvement, one every engineer should relish, whether in designing equipment or in its refurbishment, and certainly in its maintenance. I think about it every time I take my RAV 4 in for service… there is less maintenance work, less cost to me, and I don't do it as frequently. Now it's every six months and I can just wait for it; I don't have to leave it there overnight like I may have had to do 44 years ago.

If your organization wants to improve up-time and Return on Net Assets (RONA), Drive can help. We have a team of proven experts on improving business performance as well as implementing world class maintenance strategies. For a non-obligation introduction meeting, please contact Paul Eakle at paul.eakle@driveinc.com or 865-323-3491.