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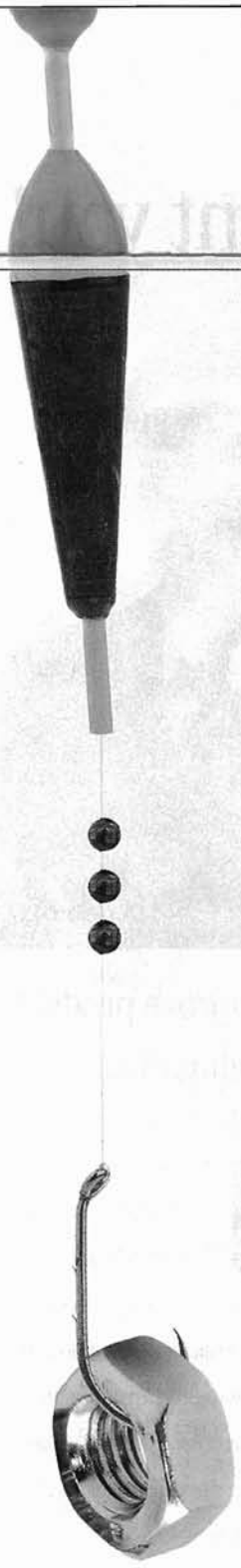

IT'S A STRATEGY FOR MAXIMIZING AUTOMATED MACHINERY AVAILABILITY WHILE CUTTING OVERHEAD EXPENSE

Do you feel that every equipment maintenance article you read is pushing you to spend more money on overhead and more time pampering machines instead of running them? If so, here's your lucky break. Go FISHing. Functional interface stress hardening (FISH) is a methodology developed that is proven normally to eliminate:

- 50% of mechanical downtime
- 80% of hydraulic systems downtime and expense
- 92% of electronics, microprocessor and computer equipment downtime in most manufacturing facilities.

Equipment life and availability go up, while drastically cutting maintenance pampering and overhead expense. If your machines take unscheduled breaks and unannounced days off (malfunctions and downtime), that's not lean. That's losing.

Are lean machines required for lean success? Absolutely? Usually? No? Is it the people and the process that count? The correct answer depends on your product and the type of machines, computers, process controls, machine tools and telecom equipment required to order, process, pack, ship and invoice for your product or service. Ask yourself these two questions:

- Which computers, machine tools, motion controls or other equipment would affect my lean operation or my ability to deliver if they were taken out of service today for the next week?
- How much work would my operation deliver or process today if the power went out, leaving me without machines?

Most facilities have automated during the past 20 years to 30 years to a point that leaves them completely dependant on machines. You often hear about employee appreciation, employee training, employee development and building a productive employee environment but, we often overlook that our computers and automated machine tools have become our most valuable employees.

We pay far more per hour for these semi-intelligent mechanical employees than for any human (the boss included). So, what are we doing to provide these digital marvels with a productive work environment? The answer lies within your FISHing expertise.

Why FISH?

FISH is based on a fact of nature – things most frequently wear out, malfunction or fail at an interface. Think about it:

- Tree limbs break off at the joint where they interface to the tree.
- Sidewalks usually crack and crumble along the edges.
- Doctors replace more knee and hip joints than bones because the body wears at the joint, an interface.
- Car suspension parts, machine gears and the like wear out at the point or surface of interface.
- Desks and chairs get worn or damaged where you interfaced with them.

If you can find ways to protect the joint or interface from the root-cause stress, wear or damage can be eliminated or greatly reduced.

FISHing in the factory

These days, the design community is giving a lot of attention to design for Six Sigma, design for reliability, robust engineering and reliability engineering. Normally, the focus is on making individual components or modules (circuit boards, gears, crank-shafts, etc.) more reliable or robust. Failure mode effects analysis and highly accelerated life testing help discover ways to make the module more robust.

FISH

Designers spend much time and money calculating the reliability (failure rate) of individual modules as well as the reliability and failure rate of the entire system. Many times, they are greatly disappointed when the final system is built and fielded because real-world reliability just doesn't stack up to their predictions. That's the price one pays for ignoring this fact of nature. Designers plug all their nice modules together, into a system, and discover that, in the real world, equipment often fails because of physical or environmental interface stress.

In the plant, focusing on functional interfaces for opportunities to stress harden will bring returns in reduced amounts of malfunctions, scrap, equipment failures, unscheduled downtime and related production losses. Stress hardening equipment and components to protect them from root-cause stress can result in increased equipment uptime, accuracy, repeatability, yield, availability and productive profits, as well as reduced maintenance frustration and overhead.

The goal is to discover the root-cause stresses and find ways to harden against them.

How to FISH

Discover the root-cause stresses and find ways to harden against them. By way of example, consider a hot July afternoon spent trying to revive a CNC lathe that has been shut down after high scrap rate characterized by extremely rough rather than smooth ID cuts. It might take a couple of hours of unscheduled downtime before you identify, replace and re-tune a bad board. As soon as you open the axis drive panel, you realize what had caused the problem – it's too hot in the cabinet.

So, you replace the board. The machine is fixed and the operator begins using it again, but with the cabinet door opened and a shop personnel fan blowing in it to keep the drives cooler, as operators often do in summer months. Now, you've got both a safety hazard and shorter machine life because of the dirt blowing into the electronics. But, hey, it works.

Rather than carrying on with this way of reviving machines, go FISHing. You pull an "electronic cabinet cooler" catalog from your shelf and find the right model to add to that CNC lathe axis drive cabinet. But, wait. Heat is only one stressor that causes equipment malfunction, scrap, and sometimes failure. Other circuit card root-cause stressors include: Heat, vibration, dirt, oxidation or corrosion, voltage transients and current surges. For hydraulic systems, the list includes: Heat, dirt, water, acids and varnish.

Harden or protect against all these and what would happen to failure rate? What would happen to uptime? Do you see or fee a paradigm shift? This should convert a maintenance engineer from a fire fighter to being a "Smokey the Bear," a fire prevention bear, a reliability engineer.

This scenario actually happened. John Deere's Dubuque plant had three of those CNC lathes. Air-conditioning them stopped the summertime scrap, malfunctions and failures. The next summer, a sister plant called. Their operation was entirely dependent on 25 such lathes. The summer heat had them

absolutely crippled. So, the same solution was applied. The lathes became as reliable in summer as in winter. Deere applied a lot of air-conditioners during the next few years.

But, thinking in terms of FISHing, the company then realized that, in most cases, increased air flow past electronics in a well-sealed cabinet is a better solution than an air-conditioner. The reason is that air conditioners introduce contaminated make-up air, they require additional power and they must be maintained.

The next stress hardening discovery came when six Lucas boring machines with GE-550 NC controls frequently malfunctioned or failed because of oxidation and factory fume buildup on circuit board pins and other friction connectors. The techs were told, "Don't remove and replace a bad circuit board without first giving it the magical stare." Technicians have the power, if they stare at both sides of a board, to have fixed it in about 70% of the cases. Just put it back into the machine and see how well it works. Of course technicians realize it wasn't the "magical stare" but the reseating of the board that rubbed off oxidation, residue or corrosion and reestablished good connections.

Here we are again, at the interface between the board and the machine, seeing more than occasional problems. The introduction of the military's JTP (joint test protocol) 02-EC-001-P8 states "Corrosion of electrical connectors is one of the leading causes of malfunctions in military electrical systems." (See www.armycorrosion.com.)

After year or two of experimenting with different oxidation inhibitors and contact cleaners, a couple of solutions were found that would both clean the oxidation off and prevent (harden) it from coming back again. The more widely you apply these, the more impressed you become. It noticeably eliminates problems and reduces unscheduled downtime. You also can use oxidation conditioner sponge modules inside well-sealed cabinets to treat screw-terminal strips, friction connections and other hardware. This is one $47 piece of FISHing gear that can easily catch more than $47,000 in increased uptime.

Going down the list of stressors listed above, we learned how to keep control cabinets dirt free, how to harden them against voltage transients and current surges. We learned that removing contaminants from hydraulic oil was better than changing the oil.

Now, many companies have applied FISHing methods on more than 1,000 automated control systems and machine tools to gain "like new" reliability and availability from 15 year to 30 year old machines and to maximize uptime and equipment life for new machines as well. Companies that go FISHing for reliability, normally minimize mechanical downtime and hydraulic downtime as well as computer and electronic controls downtime as was indicated at the beginning of this article.

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