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What to Know Before You Upgrade Your Line

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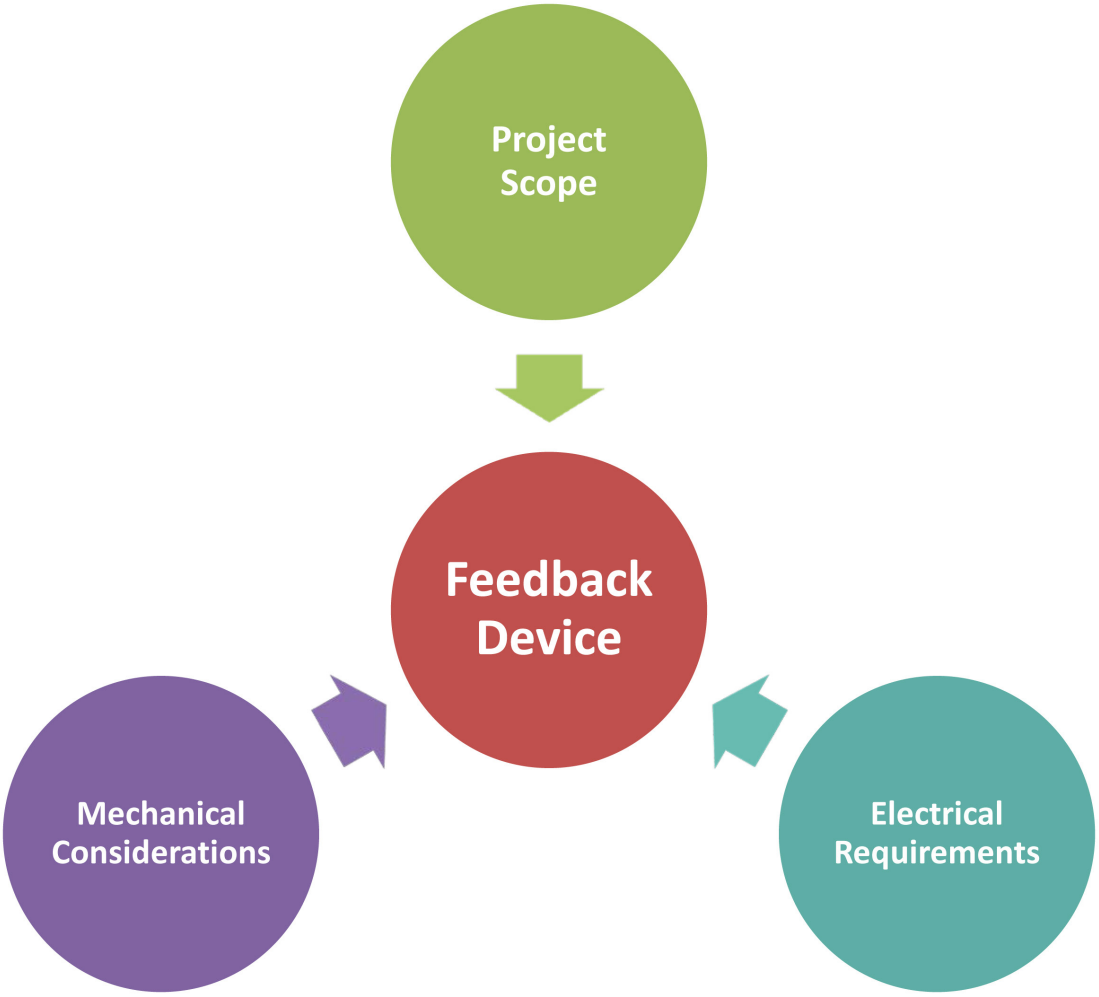

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INDUSTRY WHITE PAPERS

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In these days of swapping out computers and smart phones every year or two, a tour of paper and steel mills around the world will reveal a startling sight for those who are not familiar with these environments – machinery that is not two or three years old but 20 or 30 years old. From the structure to components such as feedback devices, industrial machines are built to last. That can be both a blessing and curse. Avoiding capital expenditure by running a machine as long as possible initially makes good business sense. Past a certain point, however, even a functional machine starts costing money in terms of limited throughput, increased maintenance, high power consumption, and outdated performance. Past a certain point, it's time to upgrade.

The question is how? As the saying goes, “if it’s not broke, don’t fix it.” Introducing the latest technology can offer huge performance enhancements if done properly, however. This includes specifying the right components and integrating them correctly. Depending on the age of the machine, the challenges of upgrading range from outdated controls platforms to incompatible mechanical and electrical interfaces or lack of space for the components. Meanwhile, every minute the system is off-line costs money. How do you get the performance you want with the least possible financial impact? Let's take a look at key points to keep in mind and common pitfalls in the process of specifying and integrating feedback devices for an existing system.

PROJECT-LEVEL CONSIDERATIONS

End-users typically upgrade their systems for one of three primary reasons: The current components are obsolete, the current components are unreliable, or the current components no longer perform at a level that keeps the business competitive in the market. State-of-the-art feedback technology offers an enormous performance upgrade compared to devices of 20 or even five years ago. Fully realizing those benefits requires taking into account a variety of factors, from systems to staffing.

What does your application require?

When it comes to replacing obsolete, underperforming or unreliable components, one of the biggest mistakes is looking for a one-to-one replacement. Although it's natural to want to find a device that's as close as possible to the tried-and-true version, in today's market, that familiar technology may no longer be the best solution. What you should do is take a step back and look at the full range of choices available within the context of the application. The question to ask is not which component is closest to what you already have but which component will best perform the task at hand. Maybe the original design included an optical encoder because it was the only way to get the required resolution at the time. Perhaps it was simply the standard offering for the original OEM. Perhaps the dust and contamination found in your paper mill caused more encoder issues than you'd like, but it was a trade-off you had to make. Times have changed, though. Today's magnetic encoders can deliver higher resolutions than previously available (e.g. 2048 PPR, in the case of Dynapar’s incremental RIM Tach 8500 Nex Gen, or 16 bits, in the case of the AR62 absolute series). Because they're based on magnetic technology with potted electronics, these devices are also robust enough to operate under the harshest environmental conditions without a hitch (see figure 1).

What is the scope of the upgrade?

What is your current feedback solution? Are you upgrading only the feedback devices or are other components such as drives and motors to be replaced also? The scope of upgrade will help define your options. It's also important to consider not just the immediate scope of the upgrade but future activities. And, of course, you must take your budget into consideration.

Figure 1: Magnetic encoders operate effectively even when covered with dust and oil.

What is your timeline?
Most industrial component vendors build their devices to last and support them for many years. Even the most reliable supply partner may have to designate a component as obsolete at some point, however. In most cases, vendors notify customers in advance of when a product will become obsolete. When this happens, one solution is to stockpile inventory to guarantee a supply of spares. Still, even that supply will eventually run out. Forward-looking end-users will take advantage of the notification to begin the upgrade process – that way the work can be performed during planned outages to prevent unscheduled downtime. For example, a paper mill may upgrade only the dryer section during an initial outage then do additional upgrades on other sections of the machine on future outages over a one to two year timeframe. This method allows the components removed to be set aside as additional spares for the devices still awaiting upgrade. Another end user may choose to upgrade the entire machine during an annual outage.

Who will be performing the upgrade?
Modernizing your line can bring major benefits in terms of throughput and accuracy, but only when the components are properly specified and installed. Will your company be working with an experienced integrator or will you execute the project with in-house staff? That will help you determine the degree of support you need from the encoder vendor.

You also need to make sure that your maintenance staff is able to work with whatever technology you choose. When searching for a supplier or integrator, ensure that they offer the training that your staff needs and can provide technical assistance in the event of problems. Here, the budget needs to be considered with the same systems-level perspective as any of the other decisions. Maybe your staff has all the experience they need to tune and maintain a low-end device. Maybe your vendor can help fill in the gaps with training courses and service agreements. If your staff doesn't have the skill set to maintain advanced components, it may make more sense to choose a higher-quality, more reliable component to limit your investment in service. As with other types of engineering decisions, it comes down to weighing the trade-offs. It's important to remember that operating expenses ultimately dwarf capital expenditures, so be sure to look at the big picture, even if another department ultimately has responsibility.

ELECTRICAL CONSIDERATIONS
Although encoders and resolvers provide essential feedback, at the end of the day, they only generate a stream of pulses. It is the hardware and software in the drives and controllers that take that signal and interpret the speed or position data. The feedback device must be able to communicate with the other devices in the system in order to function properly.

What type of signal do your other components require?
The drives and controllers in the system determine the electrical requirements of the feedback device. If you're converting a line-shaft-driven machine to a sectional drive machine, you can take advantage of today's best-in-class digital offerings, but what if you have 30 year old drives that only accept an analog speed reference signal? Now, you need to make sure you're able to deliver an analog feedback signal. That doesn't necessarily mean that you're limited to only analog tachs, however. A better approach would be to use a digital encoder coupled with a frequency-to-voltage converter (F-to-V). That way, you deliver an analog signal in the short term but when you eventually upgrade your drives – and at some point you will – you simply need to remove the F-to-V device and wire the digital signal directly from your encoder to the drive.

The characteristics of your drives and controller will determine the specific type of output driver required by your encoder as well as key operating parameters like voltage, current, etc.

Is interoperability with other machines a concern?
In the industrial environment, a production line might involve multiple highly-synchronized sections, robotics integrated with machines, or multiple machines linked together. In such cases, you need to ensure that the

various devices on the factory floor can communicate. What type of feedback and controls technology do the other machines use? What level of synchronization do they require?

From the standpoint of inventory management, you want to try to use the same encoder on as many axes as feasible. Even if you're only upgrading one machine or module, be sure to take into consideration the requirements of the other machines on the floor in order to be able to take advantage of the commonality of spares.

MECHANICAL CONSIDERATIONS

It's easy to focus on the performance requirements of an application, but even a perfectly suited feedback device will be useless if it's not easily integrated with the machine. Mechanical compatibility is important and must not be overlooked.

How much room do you have for the devices?

When it comes to factory floors, space is money. Machine builders design their systems to pack maximum functionality into the minimum square footage. It's not enough to choose your new components for interoperability with your drives and controls. If you fail to take mechanical considerations into account, you may get an unpleasant surprise when it comes time to install – they won't fit.

What are the mechanical parameters of the system?

It's essential to consider not just overall form factor but interfaces. Will the encoder be attached to a 0.5-in. motor shaft or a 4.5-in. shaft? Do you need to have compatibility with specialized shaft configurations such as keyways, splines, etc.? Depending on the age of the motor and/or bearings, the shaft may have a certain amount of run out. You need to take this into account when specifying your components.

What are your mounting requirements?

Manufacturers offer feedback devices with a variety of mounting configurations such as shafted, hollow shaft, or bearingless (see figure 2). You may find that you have new options available that will better suit your machine and application, so again, look beyond the one-to-one replacement.

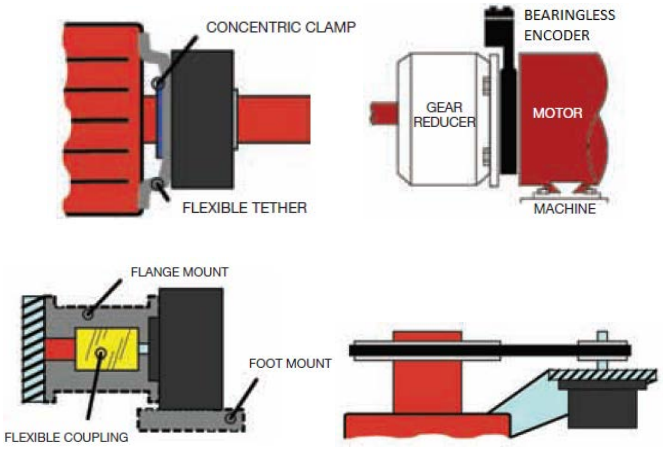

Figure 2: Mounting options in today's feedback devices include hollow-shaft encoders (top left), C-face or bearingless encoders (top right), shafted encoders (bottom left), and shafted encoders with belts (bottom right).

Perhaps most important tip when it comes to upgrades is to work with your vendors and communicate as much as possible. The more information you can provide the vendor about the application, operating conditions, and current equipment, the more efficiently you will arrive at the exact best solution for your need. Take advantage of the knowledge and experience of applications engineers who have worked on hundreds of upgrades. Have them visit your site and watch the machine in operation. Let them help you find the parts you need. Whether you're considering an upgrade because of lack of availability, lack of reliability, or lack of performance, the right feedback technology can provide an immediate benefit and with astoundingly fast return on investment.

*Dynapar offers the world's broadest range of encoders, resolvers and accessories for motion feedback control. For 50 years, the four brands of Dynapar have been providing innovative, customized system solutions for virtually any heavy-duty, industrial, servo, or light-duty application. Innovative products, designed your way, delivered when you need them—that's the Dynapar difference. Click **here** for more information.*

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