Application Note

Where to Use Trendmaster® Pro

Asset Classification Categories

All equipment assets are not created equal. Some – such as large, un-spared process compressors – have the entire plant process stream flowing through them, and represent enormous lost production costs when they don't run. Others, such as the hundreds of small pumps, motors, blowers, fans, fixed equipment and other assets that populate a typical plant, are spared or have a minor impact on plant output when they fail, but represent appreciable collective maintenance costs and can benefit from some form of condition monitoring. Still other assets simply don't merit much more than a "tighten the bolts, change the oil" approach without any routine condition monitoring. And finally, there is that class of assets that falls somewhere in the middle – benefiting from continuous monitoring, requiring more than intermittent manually gathered data, but not able to justify the expense of monitoring system architectures typically applied only to the most critical equipment assets.

The following table summarizes the four broad asset categories most frequently used by customers when considering the type of condition monitoring to apply.

Category	Description	Economics	Recommended Monitoring Technology	
Tier 1 "Critical"	Equipment assets that have large or total impact on plant output; equipment that represents significant repair costs; equipment that has significant safety ramifications if failure occurs. Failures can occur very suddenly and may not always give advance warning.	Failures are very expensive – often millions of dollars per day or event, due to lost production, environmental impact, or health and safety impact. Typical examples include large horsepower, large energy density machines with very large replacement and maintenance costs. Financial justification for monitoring these assets comprises lost production avoidance, reduced maintenance costs, and protection of life and environment.	Method	Continuous, non-scanning (3500, 3300, 1701, etc.)
			Type	Protection and Condition Monitoring
Tier 2 "Essential"	Equipment assets that have lesser impact on plant output; equipment with moderate repair costs; equipment that can have health- and safety-related implications if failure occurs. Failures can occur relatively quickly (minutes or hours), but usually with some advance warning.	Similar to economics of critical equipment assets, but of smaller magnitude. Typical examples include medium horsepower machines with moderate replacement and maintenance costs. Financial justification for monitoring these assets comprises the same factors as critical equipment, but usually of smaller magnitude.	Method	Continuous, scanning (Trendmaster® Pro)
			Type	Condition Monitoring only (no protection*)
Tier 3 "General Purpose"	Equipment assets with little or no direct impact on plant output; equipment that represents limited repair costs; equipment that has minor safety ramifications if failure occurs. Failures generally occur with weeks or months of advance warning.	These typically include smaller assets, with small individual replacement and repair costs, and little or no costs related to lost production. However, due to the large number of such assets in many plants, they collectively comprise a large percentage of the annual maintenance costs and the financial justification for condition monitoring relies primarily on reducing maintenance costs.	Method	Manual Data Collection (Snapshot™ family of portable instruments)
			Type	Condition Monitoring only (no protection)
Tier 4	Equipment that is generally not related to the process in any fashion; may be related to facility infrastructure (water, HVAC, etc.)	Similar to Tier 3, but even less important equipment assets with small individual replacement and repair costs, and no costs related to lost production. The ramifications and costs of failure do not exceed the costs to monitor (or have excessive payback periods), and a run-to-failure or planned maintenance (rather than predictive maintenance) approach is deemed the most cost-effective.	Method	None
			Type	None

* A relatively small number of Tier 2 assets may benefit from basic machinery protection as well. Bently Nevada provides our 1900 series monitors for use in such circumstances. These small, stand-alone devices provide basic continuous machinery protection capabilities and are appropriate for machines where only one, or a few, measurement points can adequately address the asset's protection requirements. 1900 series monitors include an option for direct interface to a Trendmaster® Pro system.

While these categories incur different names by different customers, and may have slightly differing attributes, a classification system with 4 tiers is the most common. Also, the decision regarding the particular category to which an asset should be assigned will vary from customer to customer. However, variation usually occurs in the middle categories rather than at the extreme ends. The assets that are critical are generally readily apparent to operations, maintenance, and plant management alike. Likewise, the assets that are simply too unimportant to merit any kind of condition monitoring program are often readily apparent. It is the continuum of assets between these two extremes that can be most difficult to categorize, and will often require a methodical analysis process that considers the economics of each machine and its service.

Trendmaster® Pro – Targeting Tier 2 "Essential" Equipment Assets

Historically, equipment in Tiers 2-3 has been addressed by a manual data collection program utilizing a portable instrument to take periodic readings and measurements. However, over the past 10-15 years, those machines that fall into the Tier 2 category of Table 1 have been an increasing source of concern to customers, who are not always able to meet their objectives using a manual data collection strategy.

Industry Needs

Customers in a variety of industries have articulated the need for a better method of monitoring Tier 2 equipment assets. Comments such as the following are common:

> "Failure on these equipment assets seems to be related to process conditions, but by gathering data only once a month or so, it is impossible to establish any kind of meaningful correlation or cause/effect understanding. I may be able to identify the parts that are failing, but can't always stop them from failing by getting to root cause."

> "I catch some failures, but others spring up faster than my data collection interval can cover, and I can't afford to collect data more frequently by hand."

> "I'd like to collect data, but the places I need to make measurements on these equipment assets are too hazardous or inaccessible."

> "The facility is remote and/or un-staffed. It is too expensive to send someone in just to manually collect data."

> "These assets don't warrant the same type of system as my critical assets, but I don't feel like I have any alternative if I want continuous monitoring."

> "I take portable readings, but I'm not happy with the variation I get with hand-held transducers from one day to the next. I think permanently mounted transducers would provide better results."

> "My labor costs are rising and my staff is shrinking. I need to automate portions of my condition monitoring program because I can't afford to use people solely to collect data – I need them to focus on fixing identified problems and improving reliability."

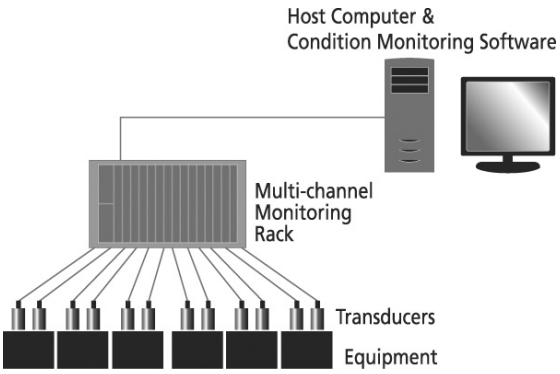
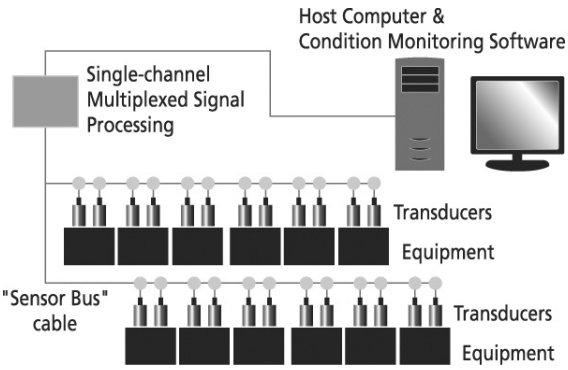
> "I want to address more than just rotating machinery with my condition monitoring program – I have to maintain fixed equipment in my plant that includes electrical as well as process equipment. I would like a system that could cost effectively bring all my machinery and fixed equipment asset information together into a common tool."

These types of industry needs first prompted Bently Nevada to develop the Trendmaster ® 2000 system back in 1989. Aimed at the category of assets we've designated Tier 2, the Trendmaster idea was simple:

1. Permanently mount low-cost transducers on the equipment and find innovative mounting methods that are easy and inexpensive, yet reliable.
2. String these transducers together using a special network, allowing multiple transducers to share the same multi-drop cabling.
3. Instead of individual monitor channels dedicated to each transducer, "share" a single monitor across all transducers in the system using a multiplexing (switching) scheme that polls the transducers on the network, one at a time.
4. Provide low-cost options for intrinsically safe operation of the transducers and cabling, allowing their use in hazardous areas.

Figure 1 shows the contrast between a conventional continuous monitoring system (such as Bently Nevada's 3500 Series) and the Trendmaster system's scanning approach.

Figure 1

	
CONVENTIONAL (NON-SCANNING) CONTINUOUS MONITORING SYSTEM	**TRENDMASTER® PRO (SCANNING) QUASI-CONTINUOUS MONITORING SYSTEM**
Dedicated channels in a rack-based system are uniquely assigned to each input transducer to perform signal processing and monitoring from all transducers simultaneously.	A single signal processor is multiplexed among multiple transducers to take measurements in series. Measurements from one transducer are taken, then the system goes to the next transducer and repeats the process.
When installed in hazardous areas, each transducer requires its own intrinsic safety device (e.g., zener diode barrier) – one device per transducer.	When installed in hazardous areas, a single intrinsic safety device can be used for all transducers on a network, (since only a single transducer is powered up at a time) – one device per sensor bus.
Wiring costs are higher because each transducer requires individual field wiring all the way back to the monitor rack.	Wiring costs are lower because a single sensor bus can be used for many transducers.
Data for all channels is collected continuously at very high speeds (multiple times per shaft revolution).	Data is collected intermittently (about once every 10 minutes for a moderately sized system).
Transducers are shared among a single monitor; therefore, they require a device that gives them each a unique address when the monitor is polling the transducers on a bus.	Transducers are not shared among a single monitor; therefore, they do not require a unique address.

Trendmaster – Finding the Balance

Trendmaster Pro represents a less expensive solution for permanent monitoring by using its innovative sensor bus and quasi-continuous scanning architecture.

Some might be tempted to conclude that Trendmaster is just as appropriate for high-speed, critical, multi-case machine trains (Tier 1) as it is for "essential" machinery (Tier 2). However, the failure mechanisms of Tier 1 machines can occur very rapidly and require a system that is protecting the machine with every single shaft revolution. Furthermore, diagnostics on these machines are often more complex than those of smaller "essential" machines with only a few bearings and simpler rotor dynamics. For this reason, Bently Nevada continues to advocate, and customers continue to prefer, our continuous machinery protection systems (such as the 3500 series) for Tier 1 assets. When coupled with 3500's built-in TDI communications processor for high-speed, parallel data capture from all transducers simultaneously, such an architecture provides the data acquisition speed needed for diagnostics on these machines, and provides a level of alarming and shutdown protection commensurate with the critical nature of these machines.

Summary

We advocate that the Trendmaster system can be applied on any class of asset (Tier 2-4) except “critical” (Tier 1). However, the economics of the situation will generally dictate that “essential” (Tier 2) is the most appropriate category for Trendmaster applications.

In the petrochemical industries, Tier 2 frequently includes pumps and motors, particularly those that can have bearing or seal failures that progress relatively rapidly and can result in not just broken machines, but possibly fires or the release of hazardous substances. Additional machines often included in Tier 2 include cooling tower fans, heat exchanger fin fans, blowers, small single-stage steam turbines, fixed equipment, and others.

There has been widespread deployment of Trendmaster systems in the cement industry, in pharmaceutical plants, in the mining industry, in power generation facilities for “balance of plant” assets – and anywhere else that online mechanical health monitoring of important assets is warranted.

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