

Discover how redundant and nonredundant methods can help you achieve high availability of control systems.

REACH MAXIMUM PRODUCTIVITY

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➤➤ Many engineers think of redundancy as the only method for achieving higher availability. However, redundancy increases the number of components, which increases the number of potential component failures. Therefore, redundancy, if improperly applied, can *decrease* system availability. So, should engineers consider alternate methods?

Availability is the probability that a system is successfully operating. Many people use the term high availability to encompass productivity, including reliability and maintainability. Reliability is the likelihood that a device will perform its intended function during a specific time, often called the mission time.

But even the most robust and reliable system may not be the most available. To be available, a system must be easy to troubleshoot, modify and repair during the mission time — in other words, maintainable.

How Maintainability Impacts Availability

Qualified maintenance personnel are important to maintainability, and so are physical characteristics. You should be able to remove, replace or add modules or components to the system without interrupting the mission and with no rewiring or reprogramming. Control technology features that have improved maintainability include:

- Adding or removing modules under power.
- Adding I/O online.
- Online edits and partial downloads.
- Soft switching of processor's producer/consumer communication.
- Internal diagnostics to detect failures.
- Diagnostics of field circuit problems.
- Configurable fault response: hold last state or turn off.
- HART and other fieldbus technology with sensor and actuator diagnostics.

➤➤ Predictive Maintenance Can Help

The goal of a Condition-based Maintenance (CbM) program is to increase reliability and availability of your machinery, while minimizing downtime, labor and repair costs. You can perform CbM by scheduling downtime, labor and materials based on machinery health. The results can be dramatic, and the documented cost savings can be significant.

A CbM program has many benefits, including overall equipment effectiveness (OEE); reduced mean time to repair (MTTR); increase Return on Net Assets (RONA); reduced unplanned downtime and planned downtime duration; and lower inventory costs.

Three types of condition monitoring services are:

- **Vibration Analysis** measures change in vibration intensity on mechanical equipment when machine condition begins to degrade.
- **Oil Analysis** detects contamination or degradation of oil which indicates machine wear.
- **Infrared Thermography** detects variations of apparent temperatures in electrical, mechanical, infrastructure and process equipment.

Vibration analysis is probably the best-known CbM tool. It detects equipment vibration levels affected by factors such as misalignments, unbalance, looseness, eccentricity, defective bearings, resonance, electrical problems and aerodynamic/hydraulic forces. The goal is to identify changes in the condition of a machine that will indicate a potential failure.

Rockwell Automation Condition Monitoring Services provide tailored solutions to help you implement your CbM program. A vibration analyst can come to your facility and provide both data collection and analysis of your equipment, or Rockwell Automation can teach you how to collect data and perform analysis.

For more information, visit www.rockwellautomation.com/go/tjcm.

- Self-learning or inherent machine diagnostics.
 - Adding sensors, I/O and tags online without interruption.
- HART and other fieldbus devices communicate with more intelligent

sensors, instruments and actuators, and provide their own level of device diagnostics. This diagnostic functionality, along with additional process data that these devices provide, are married to software that benefits users

with up-front alarms, calibration and model information for easier replacement and inventory management.

Other innovations, such as state-based control and self-learning diagnostic routines, have raised the controller's ability to detect, announce and describe problems within machinery.

Redundancy, Fault Tolerance

Redundancy or fault tolerance might be needed for critical applications. Redundancy means duplication or triplication of equipment that's needed to operate without disruption if primary equipment fails during the mission. Fault tolerance is the system's ability to tolerate faults and continue properly operating.

Redundant components needed for high availability include:

- **Uninterrupted Power Supply (UPS).** It's important to provide continuous power. Bad power can cause unexpected behavior to running microprocessor-based equipment. Therefore, the control system only is as reliable as the power provided to it. The key is to attach the output power of the UPS to the primary controller, which filters surges and minimizes system recovery when power is re-established.
- **Redundant Power Supplies.**
- **Redundant Components.** Chassis, processors, I/O modules, sensors and actuators, PCs/human-machine interface (HMI), networks, media, servers, databases.

Redundant Field Devices

To determine if redundant I/O modules are needed for achieving higher availability, consider sensors and end devices. The reliability and diagnostics from sensors and actuators is a magnitude less than that of the logic solver. Engineers often imple-



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ment redundancy on the input side by monitoring the same process variable with two sensors wired to two I/O modules.

The Importance of Design

Many times, you can achieve an acceptable level of availability through design, which includes the controller, HMI and information system. The designer must be willing to accept the fact that anything can fail, and design the facility around this notion.

The equipment or plant can be designed to continue running if a machine were to fail. This often has been referred to as modular distributed design, and involves the following areas:

- Distributed control architectures.
- Distributed control design with independent line, zones, etc.
- Distributed HMI.
- Distributed databases.

In continuous and batch processing operations, following the S88 model helps achieve availability by allowing recipes and procedures to be ported to various equipment, lines and plants. Human interface into a process or operation is crucial.

If data is critical, then provisions should secure it from data loss, such as when a single server goes down. One of the most economical methods is to keep some of the more recent data stored in the controllers. Use redundant or fault-tolerant communications if a network is determined to be a weak link. This could include Ethernet rings, with or without redundant media. Networks can be configured with redundant paths using switches or routers.

More Than Redundant Components

Although redundancy is the traditional method for achieving high availability,

the way to achieve high availability requires more than just thinking about redundant components. A system with no redundant components can still be very available. □

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