GE
Intelligent Platforms

High Availability for Non-Traditional Discrete and Process Applications

Ensuring Continuous Operations With Increased Controller Reliability

Introduction

Maximizing system uptime is imperative for many businesses, as it drives productivity and profitability, in addition to customer satisfaction and company reputation. The risk of downtime is a significant concern that negatively impacts operational resources and the bottom line. According to ARC Advisory Group, plant downtime costs average about $12,500 per hour—of course, it will be less at some plants and much more at others.

With the significant threat that system interruptions pose to business performance and profitability, businesses are increasingly seeking to gain a competitive advantage by re-engineering their solutions—driving the need to deliver higher levels of availability. The emphasis on continuous operations of mission-critical systems has become more widespread, and uptime is increasingly measured in dollars, euros and yen—not solely in time and convenience.

The principle behind a high availability control system is to double the individual system components and pass over control from the "active" controller to the "backup" controller at the moment of failure—minimizing system downtime by delivering continuous control. It provides increased reliability and performance compared to a single controller, which has no backup if an interruption occurs.

As one might expect, the use of high availability solutions is common in process industries that face very high potential downtime costs such as power and energy, water, and pharmaceuticals. However, high availability solutions can also benefit discrete manufacturers with high-speed, complex operations, where the economic impact of even a short period of downtime or momentary interruptions can have huge financial, operational, and reputational costs.

This paper demonstrates the financial upside of investing in high availability technology and takes a closer look at the latest features and benefits of such solutions for continuous, efficient operations—expelling previously associated perceptions related to high cost, increased complexity, performance tradeoff, and difficult support issues.

Industry trends

The weaker economy in recent years has increased the need for manufacturing businesses to optimize operations. The extreme focus on reducing costs while increasing efficiency has led many companies to significantly restructure their organizations, resulting in plant closings and consolidations, and fewer personnel in key support areas such as maintenance, which typically helps resolve system interruptions and downtime events.

Businesses that have heavily relied on external maintenance support to address downtime issues are also grappling with slower or minimal support services than in the past, as their service providers have also had to reduce their staff or consolidate with other sources to reduce costs. As a result, more businesses are without an efficient and timely way to address system failure events—significantly increasing risk and potential costs.

For example, a typical controller may take one hour to repair, but if the machine isn't maintained in plant, downtime could easily become 8 to 16 hours. As manufacturers reduce their maintenance workforce and rely on external repair companies, this longer timeframe is becoming the norm. Therefore, a key machine down for eight hours at an average cost of $12,500 per hour would cost a company $100,000 for a single incident.

Understanding downtime tolerance

Depending on the industry, the business impact of downtime can vary significantly, based on factors such as business size and others. For instance, companies that have the ability to revert to manual processing can continue to function when their systems are unavailable, although usually at an appreciably lower level of activity. In contrast, some companies cannot conduct any business during system downtime or have to destroy all of the work in progress.

A high availability system provides 99.999% uptime compared to 99.9% for a single controller. As shown in Figure 1, the additional .099% can be the difference between 5 minutes of downtime compared to 9 hours of downtime annually, which can translate to tens of thousands of dollars to millions, depending on the industry and type of operation. To determine the need for a high availability solution, businesses need to consider the financial,

Discrete and process manufacturers can turn to high availability control systems for increased reliability, continuous operations, and business agility, as the negative effects of downtime can be costly—hindering a company's ability to gain a competitive edge.

reputational, and operational risks of the downtime differential and the maximum amount of downtime they can tolerate.

Availability Percentage	Approximate Downtime Per Year
95%	18 days
99%	4 days
99.9%	9 hours
99.99%	1 hour
99.999%	5 minutes

Figure 1. (Source: Oracle)

Return on investment of a high availability system

To estimate the timeframe for a positive return on investment, businesses must understand the true cost of downtime, which accounts for a number of categories, including scrap, band-aid time estimates, troubleshooting costs, shipping for new parts, maintenance, lost productivity, and more. The cascade effects that a failure on the assembly line can have to other lines that it feeds can quickly escalate downtime costs.

For example, let's say a high-speed assembly line loses $50,000 annually in production due to downtime. A typical high availability investment is about $15,000 in incremental hardware costs for a second CPU, power supply, backplane, sync link and I/O LAN. Therefore, the return on investment for a high availability solution would be less than four months. If the annual downtime costs are greater, the return on investment would have an even quicker payback period—easily justifying the upfront investment.

Annual Machine Downtime Cost	Estimated High Availability Return on Investment
$50,000	3.6 months
$25,000	7.2 months
$15,000	1 year
$10,000	1.8 years
$5,000	3 years

Figure 2. If annual downtime costs are equal or higher than the cost of investing in a high availability system, a return on investment can be achieved in one year or less.

In the past, the perceived high cost of investing in a high availability system may have prohibited manufacturers from considering such a solution. However, as shown in Figure 2, a high availability solution can deliver a rapid return on investment and potentially save significantly when compared to downtime costs.

The advanced features of high availability systems

In addition to increasing system availability, high availability solutions leverage the latest technologies for faster, better, and more flexible performance than in the past. There are advanced redundant controller solutions from companies such as GE Intelligent Platforms that enable seamless switchover control, even with large amounts of data—rejecting any perceived notions of performance tradeoff.

More memory, faster transfer rates, and bumpless switchover

To maximize system performance, discrete and process manufacturers need a high availability system that can synchronize large volumes of data and meet high-speed machine cycle times. These capabilities are critical to ensure bumpless controller switchover in the event of failure, whereby the machine does not pause during controller switchover, which can result in product defects.

For example, GE Intelligent Platforms' PACSystems* high availability solutions can transfer up to 2 Mbytes of data over a fiber optic deterministic network at speeds of up to 2.12 Gbits/second. The CPUs are synchronized so that both are updated at the same time and results in a true bumpless switchover. The controllers have dedicated, redundant links to one another and operate synchronously with virtually no overhead added to the control application—transferring all of the application's variables, status and I/O data on every scan with speed and transparency.

Furthermore, the fiber optic synchronizing link can span 300 meters between redundant PLCs, providing three critical benefits:

- Enables use in high-noise environments without concern for network interference
- Facilitates a high degree of physical separation between controllers in case of fire or physical damage from an accident, as the critical control system is capable of remaining operational
- Delivers real-time data synchronization, even at a distance of 300 meters

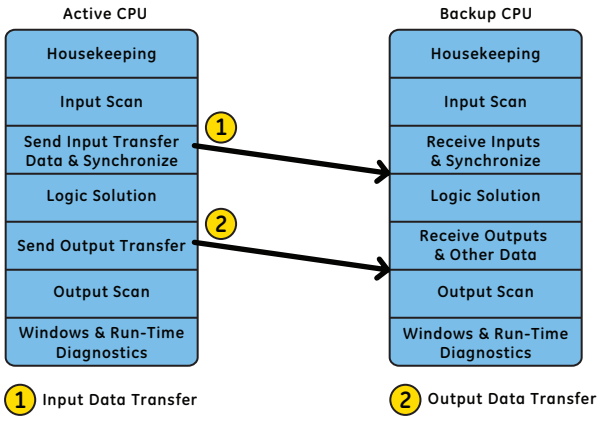

Figure 3. Data is synchronized between the active and backup CPUs at both the input transfer point and the output transfer point, and can be transmitted on either redundancy link. If one link fails, the transfer switches to the other without loss of synchronization.

Simple system configuration

To optimize control, businesses need a high availability system that does not require complex preparations to synchronize data between applications and external systems. For example, the ability to debug and monitor a system online using simple, intuitive tools; modify transfer list entries without interruption; or easily set up a hardware configuration with the correct parameter setting for the redundancy scheme can save significant time, engineering efforts, and costs.

A solution such as PACSystems operates as a completely integrated system, simplifying redundancy at all levels, a key advantage for businesses. For example, it includes Proficy* Machine Edition software, which enables object oriented programming and eases configuration, monitoring, and maintenance. There's also a built-in redundant IP that floats between the active and backup Ethernet controllers, providing transparent switchover at the HMI/SCADA level—simplifying development and integration efforts, and eliminating the need for duplicate databases.

Scalable redundancy

The more flexible the system, the more likely a business can protect its current and future investments and maximize production—adding real value and ease of use. A high availability system should enable seamless integration with existing and future systems and devices. For example, a flexible distributed I/O system can lower wiring costs and reduce machine complexity, key advantages for any business that implements redundant control technology in its operations.

The PACSystems RX3i ENIU remote I/O supports redundant Ethernet LANs and a wide variety of network modules. It can expand to include additional LANs and pick up other signals from field devices using popular field buses, and all modules, including discrete and analog I/O and intelligent cards, support hot swap.

In addition, PACSystems has two different applications running in the controllers, which allow users to add or modify logic while the machine is running; if the change isn't acceptable, it can instantly go back to the original application without shutting down the machine.

Is high availability right for your business?

Below are some questions to help you consider whether a high availability system may be an ideal solution for your business.

- How many times per year on average does your system go down?
- What is your average Mean Time To Repair (MTTR) for the machine/process?
- What is the cost of lost production per hour on the machine/process?
- What is the annual cost of downtime on the machine (# of times per year a machine is down x MTTR x cost of downtime per hour)?
- Is the machine a feeder to other lines that are impacted when the feeder is down? If so, what is the cost impact to the downstream machines when the upstream system is down?
- How often do you shut down the machine to make control changes, and what is the cost of lost productivity during the changes?
- Do you have in-house maintenance support for machine troubleshooting, or is it external from the plant?

Conclusion

System interruptions pose a significant threat on business performance and profitability, with many negative effects, including lost productivity, profitability, customer satisfaction, and reputation. Even a short period of downtime can be very costly, a risk that companies cannot afford in today's highly competitive environment.

With fewer support resources and an increasing business need to ensure continuous operations, high availability solutions provide discrete and process manufacturers with a cost-efficient, reliable way to improve operational resilience—maximizing system uptime and enabling less dependence on maintenance support or troubleshooting staff.

As this paper explains, high availability systems can provide a quick return on investment while helping companies leverage the latest technologies for enhanced performance and ease of use. These solutions address the critical capabilities that businesses need for maximized uptime and a sustainable competitive edge.

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