With aging plant infrastructures, tighter regulations, data security issues and numerous other challenges to address, process engineers want to get the most from their IT-based plant assets. To do this, many have included virtualization in their automation migration plans. Virtualization is transforming the IT landscape rapidly and changing the way you use hardware resources.

The return on investment (ROI) is nearly immediate because virtualization helps you build an infrastructure that leverages manufacturing resources better and delivers high availability.

What is Virtualization?
Virtualization is a software technology that decouples the physical hardware of a computer from its operating system (OS) and software applications, creating a pure software instance of the former physical computer. This commonly is referred to as a Virtual Machine (VM) (see illustration on page 20).

A VM behaves exactly like a physical computer — it contains its own “virtual” CPU, RAM hard disk and network interface card, and runs as an isolated guest OS installation within a host OS. The terms “host” and “guest” are used to help distinguish the software that runs on the actual machine (host) from the software that runs on the VM (guest).

Virtualization works by inserting a layer of software called a “hypervisor” directly on the computer hardware or on a host OS. A hypervisor allows multiple OSs, or “guests,” to run concurrently on a host computer (the actual machine on which the virtualization takes place).

Conceptually, a hypervisor is one level higher than a supervisory program. It presents to the guest OS a virtual operating platform and manages the execution of the guest OSs.

Virtualization software allows VMs to access the physical hardware resources of the computer on which they reside. Having the ability to run multiple VMs on one physical computer allows optimization of server and workstation physical assets, as most server-based computers are significantly underutilized.

Organizations typically run one application per server to avoid the risk of one application’s vulnerabilities affecting the availability of another application on the same server. As a result, typical x86 server deployments achieve an average utilization of only 10-15% of total capacity. Virtualization allows applications to share computers physical resources, which enables manufacturers to reassess how many computers are needed.

Virtualization in Action
However, the benefits of virtualization go far beyond computer consolidation. Many manufacturers use virtualization to extend their software’s longevity. Consider the case of Genentech, a biotech company based in South San Francisco, California. Genentech specializes in using
human genetic information to develop and manufacture medicines to treat patients with serious or life-threatening medical conditions.

The company estimated that the costs to upgrade one of its Windows 95 PC-based human-machine interface (HMI) to a Windows Server 2003-based system would be about $40,000.

Final figures topped $100,000 because of costs associated with validating the system for use in a regulated industry. Assuming that OSs are updated about every five years, costs quickly become a limiting factor in keeping an installed base of manufacturing computers up-to-date.

Additional factors contribute to the cost of upgrades. “Computer hardware changes even more frequently than operating systems,” says Anthony Baker, system engineer at Rockwell Automation. “Each change incurs engineering expenses and possibly production downtime.”

So instead of investing in the costly hardware and software upgrades, Genentech implemented virtualization.

According to Dallas West, Cell Culture Automation Group leader at Genentech, one of the most lasting effects of virtualization is that it allows legacy operating systems, such as Windows 95, Windows NT, etc., to be run successfully on computers manufactured today. This extends HMI product life cycles from five to seven years to 10-15 years and possibly longer.
“Having the ability to extend the useful life of a computer system allows a manufacturer to create a planned, predictable upgrade cycle commensurate with its business objectives,” West says. “No longer is a business forced to upgrade its systems because a software vendor has come out with a new version. Upgrading systems can once again be driven by adding top-line business value by choosing to upgrade when new features become available that will provide an acceptable return on investment.”

Why Virtualization is a Big Deal
Virtualized assets also help increase productivity. By not having to maintain physical hardware, administrators can carry a heavier workload.

A recent study by analyst IDC found that administrators manage an average of 30 servers. After virtualization, they can manage 60-90 servers — a significant increase in capacity. They also are able to spend more time architecting their infrastructure for higher levels of productivity.

“Gone are the days of ‘server sprawl,’ where a new server is needed for each new application or tool and each ends up running at only 8-10% utilization,” Baker says.

Virtualization allows companies to create a scalable infrastructure, where new VMs can be added without the need to buy new hardware and other physical devices continuously. When manufacturers start to consolidate, they can buy and allocate the appropriate amount of resources for each VM, which reduces system maintenance and energy consumption costs.
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Another feature of virtualization is that the system doesn’t know it’s “virtualized.” This allows administrators to take hardware offline while the system is up and running.

“Since the VMs are not attached to a physical computer, the VMs can be migrated between servers while the system is still running,” notes Baker.

During a planned outage, administrators can shift their workloads so the server can be taken down with no impact to the system. When the planned outage is complete, the server can be placed back into service with no interruption to the running software.

Overall, advantages of a VM include:
- Software longevity and computer hardware independence.
- Hardware fault tolerance.
- Rapid disaster recovery.

Virtual machines can be run on any virtualization-enabled physical server, creating a pool of computer resources that helps ensure that the highest-priority applications always will have the necessary resources without wasting money on excess hardware needed only for peak times.
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If you’re thinking about virtualization for your manufacturing facility, consider the following advice:

1. Being able to run legacy software indefinitely doesn’t mean you should. If you find a software bug in an old system, don’t count on its being fixed. You’ll also want to consider the security implications of running legacy software. Virtualization should be used as a tool to extend the life cycle of a computer system moderately to allow an upgrade to take place in a planned and predictable manner when a suitable business driver emerges.

2. Not all network protocols are virtualized easily. The use of standard Ethernet is most widely supported by the various virtualization vendors.

3. Non-x86-based systems (such as SPARC, DEC-Alpha, etc.) can’t be virtualized to run on x86-based machines, such as Intel and advanced micro devices (AMD).

4. Third-party vendor support for virtualized systems has been limited. There is an added risk of running virtualized software in a production environment that has not been tested thoroughly and endorsed by a respective third-party vendor.

For more information on how to get started, can contact the authors, Dallas West, dwest@gene.com and Anthony Baker, abaker@ra.rockwell.com.

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**Benefits for Manufacturers**

Virtualization has been providing a positive ROI in the IT industry for the past five years. It has matured to the point at which it now offers many benefits that can help process manufacturers achieve high availability while minimizing asset usage.

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