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## **Virtualized Development & Deployment: Driving Efficiencies and Cost**

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### **KEY WORDS**

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### **ABSTRACT**

Virtualized Information Technology (IT) is found at the intersection of environmentalism and economics. The 1<sup>st</sup> wave of virtualization (server) was focused in the data center and driven by “green” objectives (i.e. reduction in data center space and reduction in power and cooling) and operating efficiencies (i.e. slowing the proliferation of servers and reduction in overall IT operating costs).

The 2<sup>nd</sup> wave of virtualization (desktop) will focus on efficient management and reliability of desktop applications. It will feature thin client technology, a central management and provisioning layer, and a high reliability application server which resides in a managed data center. Application virtualization features built-in redundancy and quick recovery resulting in the isolation of the end-user from technology failures.

Virtualization has much to offer during the software and system engineering lifecycle. Increased flexibility affords both owners and integrators to enjoy lower cost of developing and deploying system solutions. The flexibility takes the form of quick provisioning of the development platform, use of templates (e.g. pre-built virtual machines), re-use of development systems vs. dedicated systems, and archiving of development platforms for later quick reference. Virtualized development platforms are much easier to migrate from the development environment to the production environment. It is reasonable to simulate a full production environment as a virtual system enabling the development team to continue support of the system in parallel to system startup.

## BODY

Virtualized Information Technology (IT) is found at the intersection of environmentalism and economics. Normally when the subject of virtualization in the context of information technology (IT) comes up the reference is to server virtualization. In fact there are at least two distinct types of virtualization; server and desktop. The scope of this paper is to discuss the advantages, disadvantages and other considerations of both types of virtualization technology in support of manufacturing IT.

The 1<sup>st</sup> wave of virtualization (server) is well underway and was focused in the data center and driven by “green” objectives (i.e. reduction in power and cooling via consolidation of hardware) and data center management challenges (i.e. space management in the relative high cost real estate of the data center). One often overlooked benefit that drove adoption of virtualization is flexibility. Flexibility comes in the form of ease of provisioning new servers, moving virtual servers from one physical server to another to achieve load balancing, and archiving servers which can be re-provisioned at a later date if needed.

With any technology come disadvantages which should always be weighed against the advantages to determine overall benefit. The advantages of server virtualization stated above come with the disadvantage of introducing new complexities into the IT environment. The complexity has implications in respect to design, operations, and maintenance. Design complexity is introduced because multiple virtual servers normally share common hardware. The shared hardware includes the typical components within a physical server (i.e. CPUs, network cards, hard drives, etc.) It's not unusual for the physical server host device to incorporate advanced more complex capabilities such as Storage Area Networks (SANs) to accommodate the need for large disk capacities to support multiple hosted virtual machines. An optimum hardware configuration requires a thoughtful design process which incorporates specific requirements imposed by the virtual server technology.

One of the unintended consequences of the ease of provisioning of new servers enabled by virtualization is the proliferation of virtual servers. A governance process for the management of servers should be in place prior to adoption of virtualization in the data center. A weak governance process might have seemed adequate when the provisioning of physical servers were throttled by hardware requisitioning, ordering processes, and physical installation procedures. Unused, underused, and abandoned servers are still an issue regardless of whether they are virtual or physical.

It's common knowledge within the IT industry that virtualization features are evolving at a faster rate than virtualization management tools. Some virtualization vendors are evolving and introducing sophisticated monitoring, load balancing, backup and restore tools, and there are third parties who are stepping up to fill this gap as well. The manageability challenge is multiplied if multiple virtualization technologies are employed (i.e. from multiple vendors).

One of the more important considerations before deciding to virtualize servers is to determine the level of support of your major application vendor(s). There should be an official support statement issued by the application vendor indicating the specific virtualization vendor and configurations which are supported. If the application vendor is unwilling to state in writing that server virtualization is officially supported then it is a major red flag to the end user company that the virtualization benefits are probably not worth the risk. In some cases application

vendors do have an official server virtualization support policy statement but it comes with certain limitations.

Two specific areas that may have significant implications to manufacturing is the accuracy of the system clock (e.g. virtual server clocks are virtualized server clocks) and the ability to engage the vendor to troubleshoot issues. Here are two excerpts from actual application vendor virtualization support statements in respect to those two issues:

Clock:

*The virtualized system clock is directly affected by resource utilization on the physical host system. The more heavily-utilized the physical system is, the less reliable the virtualized system clock becomes. The result is a virtual system clock that slows and accelerates relative to real-time.*

Troubleshooting:

*<vendor> Technical Support will not require clients running on VMWare ESX to recreate and troubleshoot every issue in a non-virtualized environment; however, <vendor> does reserve the right to request customers to diagnose certain issues in a native operating system environment, operating without the virtual environment. <vendor> will only make this request when there is reason to believe that the virtual environment is a contributing factor to the issue.*

The 2<sup>nd</sup> wave of virtualization (i.e. desktop or application virtualization) is in the early stages and will focus on efficient management and reliability of desktop applications. It will feature thin client technology, a central management and provisioning layer, and a high reliability application server which resides in a managed data center. Application virtualization features built-in redundancy and quick recovery resulting in the isolation of the end-user from technology failures.

These features are ready made to tackle some of the classic manufacturing shop floor issues. Desktop virtualization eliminates the need for personal computer (PC) based fat clients to be deployed directly on the shop floor as the Human Machine Interface (HMI). Because the HMI is a thin client technology it eliminates the routine PC / FAT client maintenance on the HMI (e.g. software revision upgrade, disk defrag, registry pruning, virus scans, malware scans, etc.). One of the more problematic challenges for HMI support is quick recovery of shop floor PCs in the case of catastrophic failure (e.g. hard drive crash). This is especially problematic for off shift support for 24 X 7 operations. With virtualized applications most if not all configuration information is maintained on the application server in a more secure and managed environment. Since the HMI is a thin client device, recovery from an off-the-shelf backup is usually quick and easy.

Another classic issue on a manufacturing shop floor is the need to share a single HMI between multiple applications. Virtual desktops are designed such that applications can be shared either by hot-key context switching or via a home page with links to multiple applications. This allows applications from multiple application servers to share an HMI and present to an operator as if all are local to the HMI. Applications from multiple sources (e.g. site, WAN, intranet, internet, etc.) share the same HMI.

From a pure feature / function perspective, desktop virtualization may offer more benefit to manufacturing than server virtualization. Just as the alarm was sounded in respect to

application vendor support for server virtualization, the same alarm is sounded in respect to desktop virtualization. An application normally must be specially designed for desktop virtualization or at least tested and a formal support statement on record.

The discussion so far has been in respect to use of technology in deployment of applications. Virtualization offers significant advantages during the software and system engineering lifecycle. Increased flexibility affords both owners and integrators lower cost of developing and deploying system solutions. The flexibility takes the form of quick provisioning of the development platform, use of templates (e.g. pre-built virtual machines), re-use of development systems vs. dedicated systems, and archiving of development platforms for later quick reference. Virtualized development platforms are much easier to migrate from the development environment to the production environment. It is reasonable to simulate a full production environment as a virtual system enabling the development team to continue support of the system in parallel to system startup.

Virtualization technology has much to offer the practitioner of manufacturing IT in respect to efficiency and therefore cost. The correct application of virtualization technology requires a thoughtful design process in that the technology has limitations and does interject additional complexities. The practitioner must be aware of both benefits and advantages to correctly assess the potential in his or her specific context.

Some technology futurists have peered into the not too distant future to see the next and most logical virtual phase; i.e. cloud computing. Cloud computing is an infrastructure model where shared resources and software are provided on demand, like the electricity grid. While it is commonly understood that the resources are supplied over the internet, there is the concept of the Private Cloud, which hosts the resources on private networks as opposed to the public internet. Cloud computing offers similar benefits as described earlier in the first two waves but frees the end customer from building and maintaining the virtual infrastructure and moves the service to an on-demand or usage back subscription model.

Some early examples of this paradigm are Salesforce.com, Amazon, and Google. While these examples have not been applied to the general automation market, there is no reason why it could not for certain automation functions; e.g. data storage, analytics, dashboards, etc.