ARC Automation Strategies

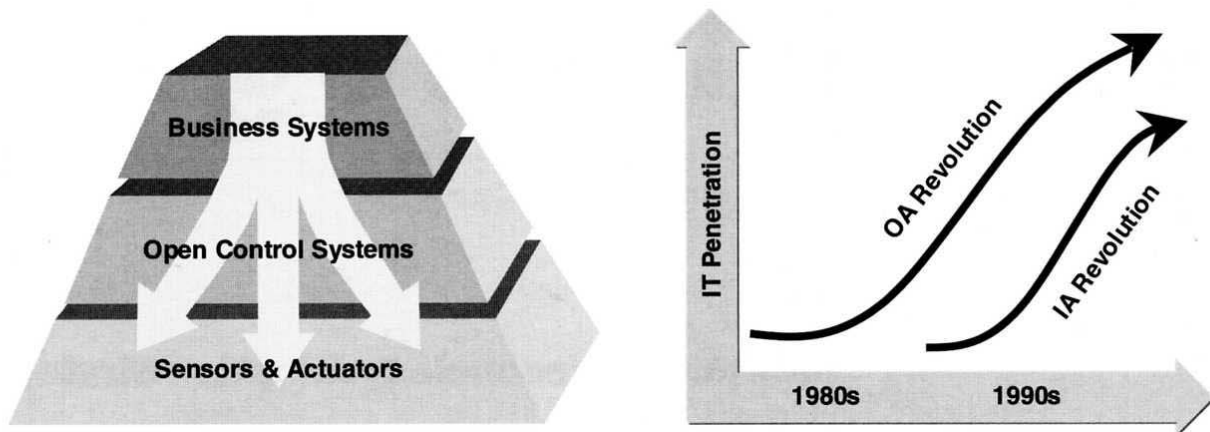By Automation Research Corporation   November 1997

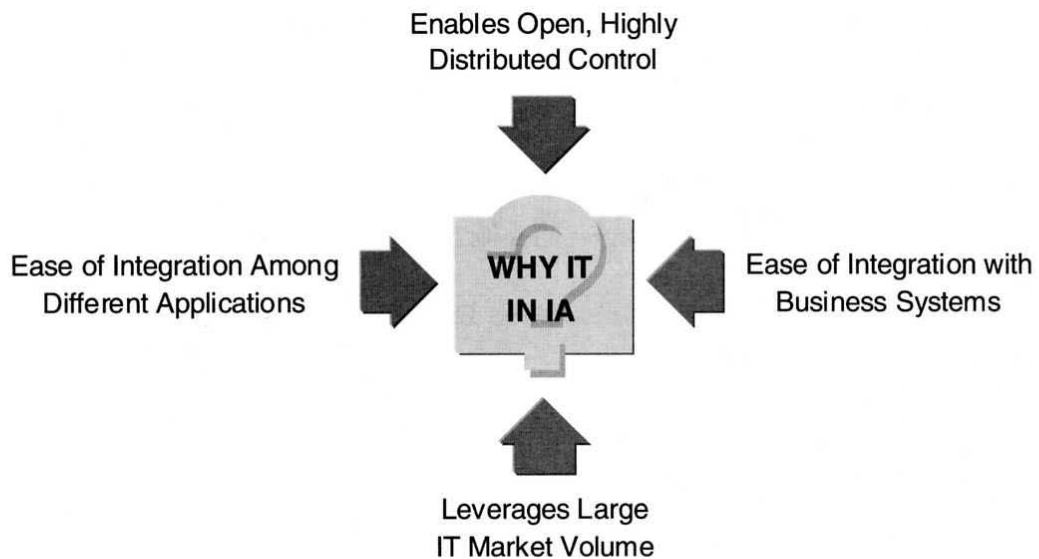## Information Technology Adoption Strategies

> Chorus Systems, FactorySoft, Imagination Systems, Intrinsyc Software, Intuitive Technology, Marimba, NewMonics, ObjectAutomation, Phar Lap Software, PointCast, RadiSys, VenturCom

Industrial Automation Strategies For Executives

IT Revolution Reaches Industrial Automation

Business Systems

Open Control Systems

Sensors & Actuators

IT Penetration

OA Revolution

IA Revolution

1980s   1990s

Why IT in Industrial Automation?

Enables Open, Highly
Distributed Control

Ease of Integration Among
Different Applications

**WHY IT
IN IA**

Ease of Integration with
Business Systems

Leverages Large
IT Market Volume

IT Revolution Reaches Industrial Automation

THE IT REVOLUTION that has been taking place in our offices is now rapidly moving to manufacturing operations. From offices, it moved to business applications a few years ago, and now it is on its way down to control systems as well as sensors & actuators. Commercial IT is now robust, fast, and easy to use, and is ready to run your plants and factories. Now you can reap the benefits of inexpensive commercial IT.

A number of key enablers are pushing commercial IT into process and factory automation. Widespread Internet availability and interest in the technology as a universal information delivery mechanism is undeniable in North America, and interest elsewhere is gaining momentum. Internet and Intranet technologies are creating the backbone for a highly distributed information and control system architecture that is very synergistic to the use of object-based applications.

Objects and components will play an important role in supporting the distributed architecture that Internet technology provides. Object technologies enable users to achieve efficient models of the processes under control, while reducing the time to implement new systems and creating libraries of component models that are easy to reuse in future projects. Objects also allow engineers to make incremental improvements to the control system without having to reconfigure the whole system since they are modular. Instead of using object-oriented tools only for product development, some suppliers are exposing users to the benefits of next generation object-based control systems.

Instead of creating their own proprietary architectures, suppliers are basing their products on the mass-market business operating systems and development tools to leverage the large existing installed base. For example, some HMI suppliers are relying on Visual Basic for Applications (VBA) instead of creating their own scripting language to save internal development costs, using a platform that is familiar to millions of developers.

Office Automation has always been the realm of common technology relative to the closed, proprietary nature of Industrial Automation. That's not the case now, because users are demanding open solutions that are easily integrated with their other packages. Incorporation of Information Technology is seen as a key means of achieving open control, overcoming the limitations of proprietary systems from single sources. This trend parallels the Office Automation (OA) adoption curve in the 1980s.

Growing Evidence

The evidence of this trend comes from many different types of applications in various industries. For the process industries, most DCS suppliers have a Windows NT-based solution, and although many are not as full featured and upwardly scalable as their UNIX-based ancestors, suppliers are responding to users who want open control systems based on NT. There is an emerging group of software suppliers providing SoftDCS systems, who provide mission critical process control solutions on PC-based architectures and open networking protocols.

IT Revolution, continued...

The OMAC Users Group, and especially General Motors Powertrain Group, is busy testing NT real-time extensions to validate their performance and reliability. In OMAC's case, this is not an Information Technology Group initiative thrusting technology upon a group of unsuspecting operations engineers by dazzling them with the latest and greatest buzz words – these are the controls engineers pulling IT down into control, dragging many suppliers along for the ride.

Interest in the OMAC initiative has gone beyond the original proponents in the automotive industry to include users from the aerospace, heavy machinery, food and beverage, and chemical industries. While the new breed of open architecture control systems are not suitable for all applications, PC control is moving out of the test lab and onto the plant floor.
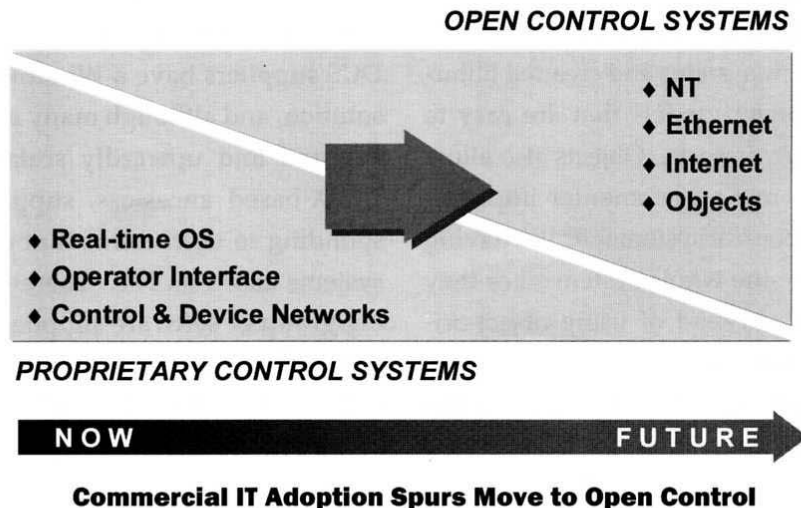
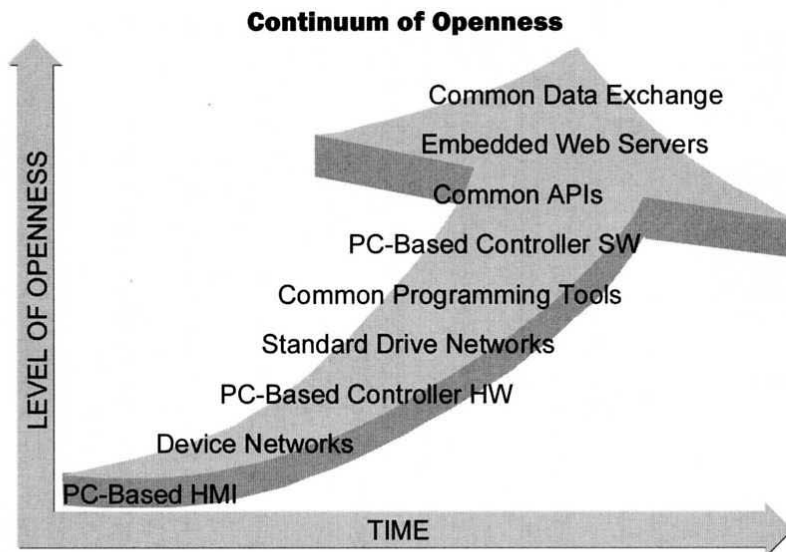The IT adoption trend is not without a downside. Reliability and speed are critical components of many manufacturing processes, and wholesale adoption of general IT needs to be balanced by the application requirements. Suppliers are stepping up to the challenge of making IT robust enough for automation, but many of these solutions are in their infancy.

Interestingly, the spread of FUD (Fear, Uncertainty and Doubt) is coming both from suppliers focused primarily on proprietary control systems, as well as from open control system providers trying to differentiate their product from their open competition. There are a lot of ways to spin the Blue Screen of Death story, in favor of one open controller supplier over another or in favor to stay the course with proprietary controllers.

Software Leaders

Leading players in this revolution include the key suppliers of software technology. Microsoft's Windows NT is emerging as a de facto standard for operator interfaces and PC-based control in both continuous process and discrete manufacturing. Microsoft is also striving to provide Windows

OPEN CONTROL SYSTEMS

- ◆ NT
- ◆ Ethernet
- ◆ Internet
- ◆ Objects

- ◆ Real-time OS
- ◆ Operator Interface
- ◆ Control & Device Networks

PROPRIETARY CONTROL SYSTEMS

NOW   FUTURE

Commercial IT Adoption Spurs Move to Open Control

Continuum of Openness

Common Data Exchange

Embedded Web Servers

Common APIs

PC-Based Controller SW

Common Programming Tools

Standard Drive Networks

PC-Based Controller HW

Device Networks

PC-Based HMI

LEVEL OF OPENNESS

TIME

products in a wide range of scalable configurations, ranging from devices to enterprisewide data servers. Microsoft is also embracing the web with their newly announced Windows Distributed interNet Applications Architecture (DNA), which integrates Web and Client/Server Computing.

Sun Microsystems is making an impact in the automation arena with Java and its potential of delivering software that follows the "Write Once, Run Anywhere" model. Sun recently gained the support of many partners in both business and control system suppliers in their Java Control and Automation Framework initiative. Java-based browsers and components are already available from automation industry suppliers. Sun is also making a play in the embedded controller space with EmbeddedJava and PersonalJava subsets.

While Microsoft and Sun have strategies that feature their own products, the Object Management Group (OMG) has been pro-moting a standard for distributed object computing called CORBA, or Common Object Request Broker Architecture. The OMG has over 700 members that do not espouse any one supplier's technology, but there is a high anti-Microsoft sentiment among its ranks since CORBA competes against Microsoft's DCOM (Distributed Component Object Model). The CORBA model has supporters in the industrial automation market, especially from Foxboro who has followed CORBA principles in developing the Foxboro I/A Object Manager. CORBA also has a wide following in the MIS/IT community, since its roots are in UNIX.

IA Applications Can Require Performance Enhancements

While standard IT products serve many of the needs of IA applications, there are many cases where standard products need to be adapted to serve the real-time determinism, speed and reliability requirements. A growing number of providers are extending the range of standard products with

IT Revolution, continued...
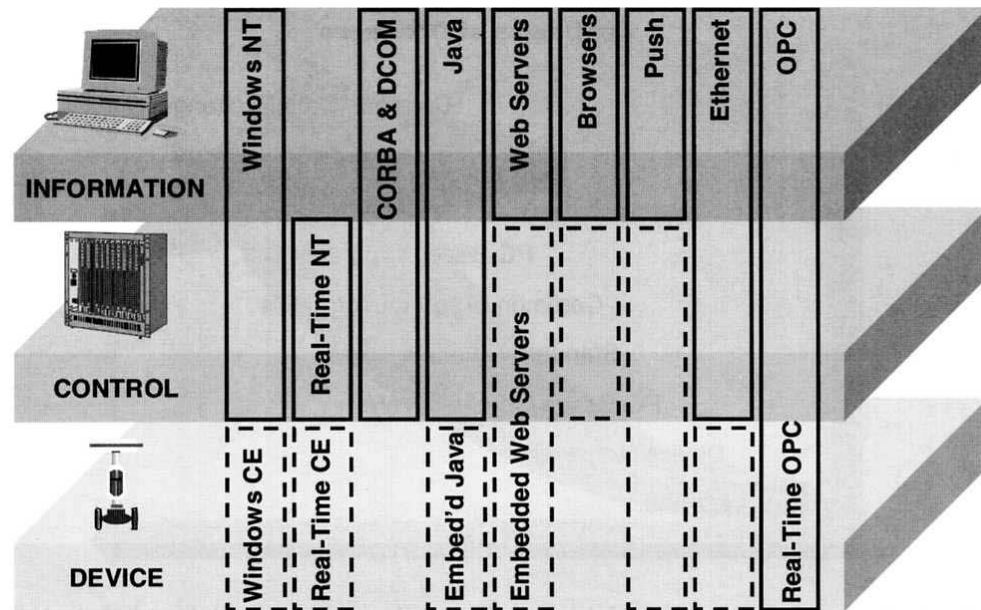
IT Penetration by Automation Level
(Dotted boxes show expected future penetration)

real-time extensions to Windows NT and CE, Java and OPC.

As time goes on, an increasing number of IA applications will be based on architectures consisting of commercial IT products. Similar to the current trend toward Ethernet acceptance in industrial applications, control applications must leverage existing desktop and networking technologies to remain affordable. Automation systems must also easily interface to business systems that are already based on open standards. Furthermore, the introduction of open component-based systems will stress the importance of adherence to open standards, since components enable a best of breed configuration.

IT Penetration in the 3-Level IA Model

To set the stage for the rest of the report, it is useful to consider the traditional three tier automation hierarchy of business sys-

tems, control systems and the device level. If we had considered this model just a few years ago, Information Technology-based products would only impact the business level. Next came the control level, with a classic example of PLC suppliers adding Ethernet connectivity and new open controller architectures based on common PC hardware. Other examples today include the testing of Java-based control systems at pilot plants and continued development of OPC interfaces.

We can also look at this model to see how widespread IT's impact will be in the corporate structure, as the IT organization comes into the factory. This will require a balancing of skills, since IT will need to understand the mission critical nature of the production facility at the same time that IA learns the new set of skills required to configure and maintain IT-based hardware and software. ▄ARC
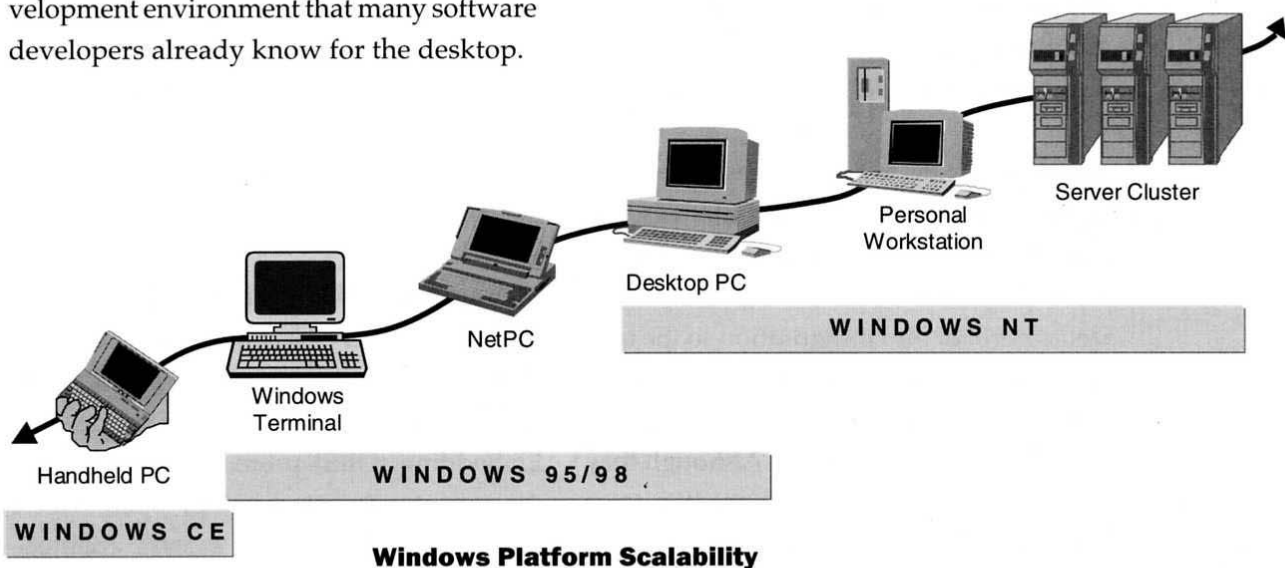
Microsoft Provides Common IT Platform

MICROSOFT CONTINUES TO steam roll the Industrial Automation arena with their Windows everywhere mission. Although the paths vary, the final destination is the same: Microsoft wants suppliers and users alike to adopt Windows. Microsoft has ambitious plans to enhance Windows up the value chain as well as provide a version of Windows at the low-end for embedded applications. For example, PC-based HMI and control suppliers have already migrated from DOS and Windows 3.1 to Windows 95/NT as they scale up their applications to include more than process monitoring. On the other hand, traditional DCS suppliers are moving from UNIX and proprietary operating systems to Windows NT.

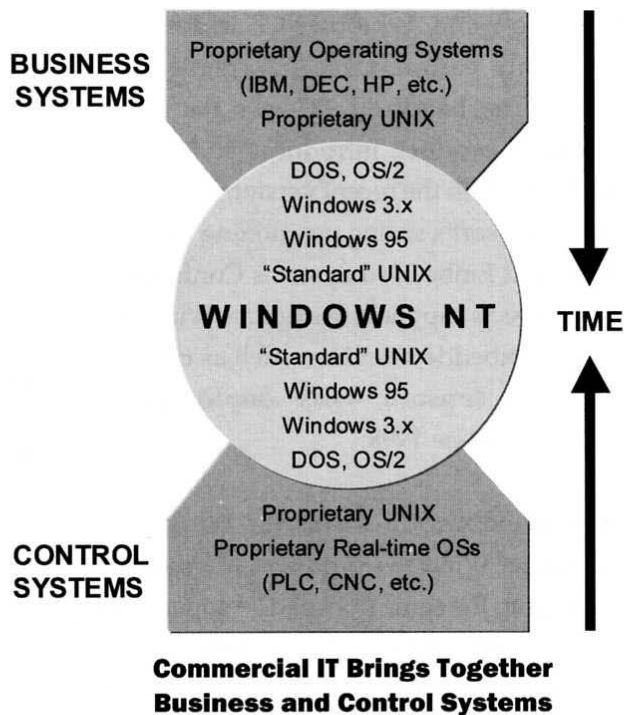## Microsoft Endeavors to Run Windows Everywhere

The Windows operating system has come a long way since many IA suppliers pioneered its use in Human Machine Interface products in the late 1980's. Microsoft's general emphasis is to extend the boundaries of the Win32 API, keeping a consistent development environment that many software developers already know for the desktop.

At the low-end, Windows CE is designed for highly customizable information devices. The handheld PC was the initial CE-based product, introduced in November 1996. With the recent version 2.0 release and Microsoft's strong positioning of CE at the recent Embedded Systems Conference, ARC expects suppliers to evaluate Windows CE for embedded devices, such as controllers and sensors, with deployments expected in late 1998.

Since Windows CE shares the Win32 API with other Windows products, Microsoft is leveraging the same pool of developers and tools that are creating solutions for the desktop. Some solution providers have already made plans for developing CE applications for the automation market. Intrinsyc Software has announced a Windows CE-based web server called Rainbow, and VenturCom has announced plans to port their Windows NT real-time extensions to CE next year. RadiSys has an embedded single board computer designed to run CE, with other CE-based products planned.

Server Cluster

Personal Workstation

WINDOWS NT

Desktop PC

NetPC

Windows Terminal

WINDOWS 95/98

Handheld PC

WINDOWS CE

Windows Platform Scalability

Common IT Platform, continued...

BUSINESS SYSTEMS	Proprietary Operating Systems (IBM, DEC, HP, etc.) Proprietary UNIX

DOS, OS/2
Windows 3.x
Windows 95
"Standard" UNIX

W I N D O W S   N T   TIME

"Standard" UNIX
Windows 95
Windows 3.x
DOS, OS/2

CONTROL SYSTEMS — Proprietary UNIX Proprietary Real-time OSs (PLC, CNC, etc.)

**Commercial IT Brings Together
Business and Control Systems**

The next platform in the price/performance curve is the Windows Terminal, which is a very thin client, diskless PC positioned as a dumb terminal replacement, connected to a Windows NT Server running the multi-user Hydra configuration. Applications are stored and managed on the Hydra server, and Microsoft plans to support older desktop platforms as terminals to help migrate legacy systems to NT-based servers.

The Network PC is another new thin client platform, with a sealed computer case for ease of configuration management. Both of these platforms allow for tighter centralized control of the configuration so the user can focus on the task instead of adjusting settings or trying to run applications not central to their job function. Although they are not widely available, both the Windows terminal and NetPC have a place on the

factory floor for low cost operator interface terminals, and since the software is managed centrally, software distribution and management can be better controlled.

Windows 95, and its follow-on Windows 98, will continue to be the operating system of choice for general-purpose desktops. Windows NT Workstation, however, is coming closer to supporting the broad array of hardware that 95 supports, and the processor and memory requirements are similar, so many IT professionals are likely to bypass Windows 98 and go to Windows NT for business and manufacturing environments.

Microsoft is working hard to extend the upper boundary of NT Server applications with their server cluster configurations. Clustering addresses availability by having a duplicate server ready to take over if the primary server fails. Clustering also provides scalability, where more servers can be added to share the load as either the database size, number of connections or network traffic increases. Along with the hardware configuration improvements, Microsoft is scaling up the BackOffice suite of products to support larger databases with more concurrent users and faster performance.

Microsoft's COM: The Tie that Binds

The Component Object Model has been the glue that holds applications together. From its early basis in the Object Linking and Embedding (OLE) protocol, COM is now the core interface technology upon which Microsoft bases its own system architec-

ture. COM has some related technologies that are finding homes in automation applications.

COM, and Distributed COM (DCOM), form the foundation of the 32-bit programming model. COM and DCOM are platform independent, and both Digital and Hewlett Packard have announced plans to incorporate DCOM into their operating systems to aid in integration and migration to Windows NT systems. Software AG has DCOM running on the Solaris UNIX-based operating system.

ActiveX Controls are software components that allow both experienced and novice software engineers to quickly create interactive Web pages and desktop applications. Several HMI suppliers support ActiveX automation containers for users and OEMs

who wish to write their own operator interfaces in Visual Basic.

Last month, Microsoft announced its latest three-letter-acronym: DNA, the Distributed interNet Applications Architecture which relies on COM infrastructures. The goal of DNA is to integrate both the Web and client/server models of application development and information distribution.

IA Suppliers Enhance Support for COM

The OPC Foundation continues to push the OLE for Process Control as an industry de facto standard. In fact, if they were naming it today, they might drop the "OLE" part in favor of COM to reflect the improvements over the first OLE implementations, and they are currently trying to expand the focus beyond process control. Suffice it to say, OPC is based on COM and has appli-

Windows Desktop Platforms
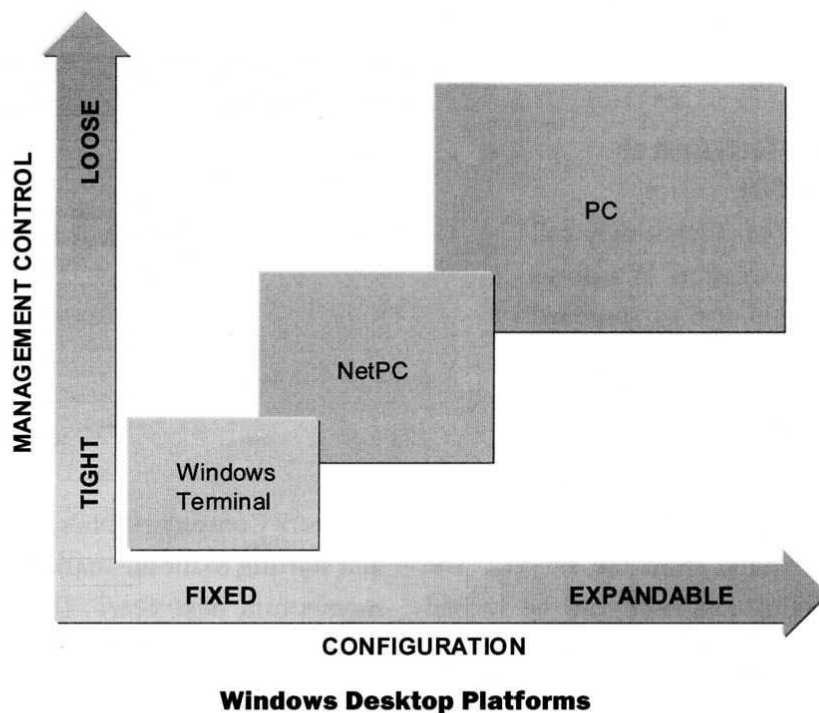
Common IT Platform, continued...

Which Windows Where?			
	Windows CE	**Windows 95/98**	**Windows NT**
Purpose:	Compact	General Purpose	Max Performance
Hardware:	Special Purpose	All PCs, Net PCs	PCs, Servers
Required Memory:	< 4 M	16 M	32 M
Device Compatibility:	Limited	Very Broad	Broad
Security:	Very Limited	Limited	Very Broad
Real-time Extensions:	Planned	No	Yes
Applications:	Handheld Devices Industrial Devices	Operator Interface Browser Platform	Control System Data Server

cations in a broad range of process and discrete applications, and integrating other software modules and business applications.

Recent OPC Foundation efforts center on extending the protocol to include historical data handling, improved data communication speed and increased interoperability. Interest is worldwide, and membership in the foundation totals well over 130 vendors.

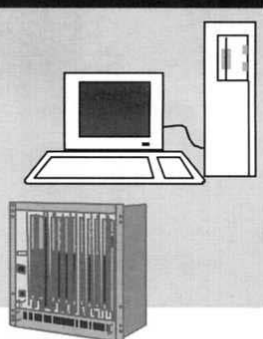### Reducing the Total Cost of Ownership (TCO)

Microsoft will add what they call Zero Administration Windows (ZAW) functionality to standard Windows NT next year, and they already have an add-on ZAW kit for NT 4.0. ZAW relies on a scheme that stores client configuration information on the server, so clients are configured and managed centrally from the server. The client configuration itself can be locked down to prohibit the user from making changes and loading extra software, mak-

ing management of a known corporate standard possible.

Another aspect of the ZAW initiative is software distribution from the server instead of individual installation at each client. As control and data collection systems become more distributed, centralized software version control is a powerful feature for the next generation of products.

NCs & NetPCs Will Lower TCO of IA
☐ Can bootstrap from a remote server
☐ Can withstand harsh environment
☐ Can be used as controllers and workstations
☐ Lower TCO than PCs

Network Computers (NCs) and NetPCs are just starting to hit the market and will gain momentum next year. They will further help lower the TCO of IA systems. ARC

Embedded Web Servers Bring Open Systems Closer to Reality

FOR EVERY BROWSER to display data to an information user, there must be a complementary server to provide that data to the Intranet or Internet. Currently, in the automation market, suppliers are incorporating web servers in their computer-based data collection or control packages. Just as we see the trend toward pushing IT down to the different automation levels, ARC expects a new breed of web servers to be embedded in controllers and eventually in many field devices. Schneider Automation is exploring the use of a PLC as an integrated web server.

A number of companies are looking at embedded web server capability. These applications are primarily in the telecommunications area for devices such as Web phones (telephones/pagers that have embedded web browsers), handheld computers and personal data assistants. Since the current realm of these devices is general information servers, real-time performance is not a critical requirement as it will be in factory automation.

Today, these embedded web servers do not typically provide the speed, determinism and reliability that factory automation requires, but we expect those features to be added as user interest in the Internet continues to rise. One example of an embedded web server from Phar Lap Software is a remote weather station device, so vacationers could assess the weather of their home in the mountains. While far from mission critical, this application demonstrates the potential of small web servers dedicated to simple tasks.

Most of the embedded web server technology suppliers are in the real-time operating system market (RTOS), including Phar Lap Software, Wind River, Spyglass, and US Software. They are extending their suite of products to include embedded server applications, and given their history in the embedded market, they understand the importance of speed, determinism and reliability. Intrinsyc Software has announced plans for embedded web server functionality on the Windows CE platform. ▣ARC

Embedded Web Server Timeline
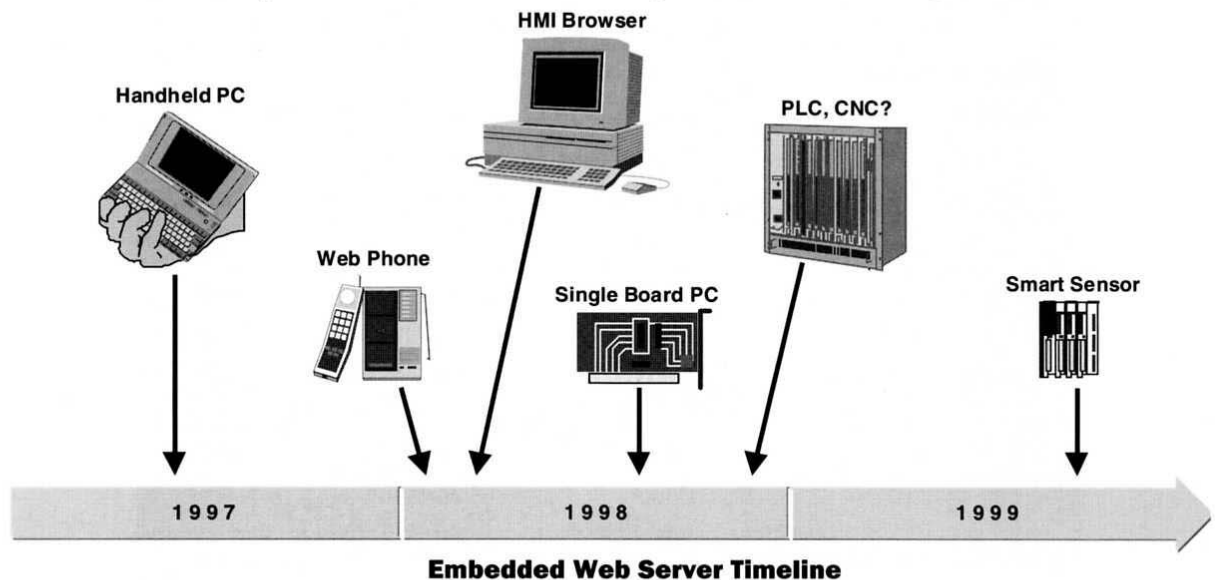
Emerging Automation Technology Suppliers

AN EMERGING POOL of suppliers is working to enhance the application fit for IT-based technology to the automation market. While some suppliers are enhancing their own product lines to encompass factory and process control, other firms are developing real-time extensions to mainstream IT products.

Chorus Systems

Chorus Systems, headquartered in France with offices in California and Japan, is a leader in the embedded marketplace. They were recently acquired by Sun, which is an interesting development that might bring real-time CORBA and Java integration together in one solution.

The company comes from the real-time UNIX world, and they support Java and CORBA in embedded applications with their Chorus Cool ORB product. They have already announced partnerships with Foxboro who will use Chorus Systems in the I/A Series Object Manager. Chorus is currently targeting Information Appliances, such as web phones, which they expect will have an impact in the industrial market in handheld devices.

FactorySoft

FactorySoft is an independent software developer of 32-bit real-time process control and software development tools for the industrial automation market. The first company to introduce OPC-enabled products at ISA/96, FactorySoft now points to over 50 companies around the world that have used its OPC Development Toolkits to create client and server applications.

FactorySoft is leading the OPC Foundation effort to design Version 2.0 of the OPC Automation interface specification, which will provide improved access to OPC data by Visual Basic applications.

FactorySoft is applying its OPC knowledge to work with VenturCom on incorporating OPC concepts into VenturCom's real-time extensions for Windows NT. At FactorySoft's request, the OPC Foundation has announced the formation of a new real-time committee to explore this technology. FactorySoft has also created a complete set of development tools for industrial automation software.

Imagination Systems

Nematron subsidiary Imagination System provides the Hyperkernel real-time Windows NT kernel. Hyperkernel provides the real-time core for Nematron's PC-based OpenControl system for NT-based logic and machine control. The recent release of version 4.21 touts improved interrupt response latency over previous versions, and enhanced memory management features.

Nematron and subsidiaries NemaSoft and Imagination Systems recently announced a major project win at General Motors Powertrain Group. With GM's experience with the DOS-based FloPro, Nematron is now ready to provide their updated NT-based solution.

Intrinsyc Software

Founded in 1992, Intrinsyc Software is extending the Windows NT and CE platforms for industrial automation applications.

They have an Integration Expert for targeting Windows for embedded applications. Intrinsyc also provides plus fault tolerant functions for Windows NT to address users' reliability concerns.

Intrinsyc Software developed a Windows CE-based web server in their Rainbow product, reportedly the first of its kind for Windows CE. They are targeting the embedded systems market with tools to develop low cost, small footprint web servers, garnering substantial interest at the recent Embedded Systems Conference.

Emerging Automation Technology Suppliers

Supplier	Activities
Chorus (Sun)	RT CORBA
FactorySoft	RT OPC
Imagination Systems	Hyperkernel RT NT Extensions
Intrinsyc Software	CE-based Server
Microsoft	CE, 95/98, NT, COM
NewMonics	RT Java Extensions
ObjectAutomation	Object-based Control Architecture
RadiSys	INtime RT NT Extensions
Sun Microsystems	Java, JCAF Initiative
VenturCom	RTX RT NT/CE Extensions

Intuitive Technology

Founded by former Digital Equipment Company employees, Intuitive Technology makes the @aGlance and Web@aGlance product family of client/server process graphic viewing tools. The initial @aGlance product tied data from factory floor and process control systems into desktop applications such as spreadsheets, statistical analysis and viewing applications. By adding the web component, they have allowed process systems of different makes and varieties to be viewed in a common interface.

With their InYourFace animation editor, they break down complex graphics and symbols on the operator interface into basic shapes that are animated using Java animation. Web@aGlance software is used in both Wonderware's and Intellution's HMI browser products.

Marimba

Four primary software engineers from Sun's Java development team formed Marimba in 1996. Marimba's Castanet channel push technology is similar to PointCast. Their recent version 2.0 release adds security via SSL encryption to guard communications between the Transmitter server and Tuner client.

In addition, Marimba's technology emphasizes software distribution protocols using Java technology to extend push beyond only a content or information focus. Marimba and Microsoft recently proposed the Online Software Distribution (OSD) standard to the World Wide Web Consortium (W3C) as a standard data format for describing software components, their versions and underlying structure, as well as their relationships with other components.