The Electronic Enterprise
ERP/SCM, E-Business and Beyond

An Overview of Key Issues and Directions
for Senior Management

Author: Graeme Philipson, Director, Strategic Intelligence

About the author

Graeme Philipson is a Director of analyst group Strategic Intelligence, specialising in the enterprise applications market. He was previously Research Director of GartnerGroup Asia Pacific, where he specialised in user research and ERP applications. He is also a senior Research Associate with The Butler Group, and a founder and principal of Strategic Intelligence's parent company Strategic Publishing Group.

For the last five years he has conducted regular surveys of IT Directors and CFOs throughout Asia Pacific on IT usage, technology directions, and applications buying patterns. He is a regular speaker at IT conferences throughout the region, and frequently achieves high ratings for the depth of knowledge and wit he brings to the subject.

Over a twenty year career he has become one of Asia-Pacific's best known and most respected IT market analysts, speakers and writers. He was founding editor of *MIS* (Managing Information Strategies) magazine, editor of *Computerworld Australia*, and Research Manager with The Yankee Group. He is a regular columnist in MIS and CFO magazines, and writes a popular weekly column on IT Trends for *The Sydney Morning Herald* and Melbourne *Age*. He has written three books for the international market: *Implementing CASE Technology*, *Mainframe Wars*, and *IBM's ESA Strategy*.

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1. Introduction

To remain competitive in the new millennium, enterprises of all sizes are introducing a large range of new IT applications. These range from small accounting packages, to manufacturing and supply chain management (SCM) systems , to sophisticated financial management information systems, to the large integrated ERP (enterprise resource plannning) suites favoured by multinational corporations.

Enterprise applications are increasingly embracing applications like business intelligence (BI), electronic commerce or electronic business (e-business), customer relationship management (CRM) and sales force automation (SFA). Different as they may be in size and scope, all these systems have similar origins and serve a similar purpose: to manage the mission-critical aspects of the organisation's operations.

No-one uses manual accounting systems any more, not even the smallest business. Large organisations computerised in the 1960s and 1970s, medium organisations in the 1970s and 1980s, smaller outfits in the 1980s and 1990s. Throughout these years the software has continued to improve, as new waves of technology sweep through the industry. Now, with the growth of the Internet and other forms of distributed computing, many more changes are on the way.

The challenges posed by the Internet and eletronic business are perhaps the most significant most enterprises have ever faced. E-business means, in many cases, a complete rewriting of the rules of engagement for business-to-business and business-to-consumer transactions. Supply and distribution chains are being broken and re-formed, and cost and profit structures are being turned on their head.

Enterprise applications are, by definition, critical to all organisations. Those early computerised accounting systems were usually custom-written for a specific organisation, but as more people introduced the technology, the first packaged systems came to be written. Most packages had their origins in systems that small software houses wrote as one-off applications, which were then turned into applications suitable for other organisations.

That is how many of the enterprise applications vendors got their start. They wrote an application for one user, then modified it for another, then developed a base system from which they could easily modify it for other users. Even today, many comparatively large vendors work in this way, constantly updating and modifying their software based on changes demanded by individual user organisations.

The computer industry is one of the fastest moving areas of technological development. Innovation continues apace on many fronts, constantly shifting the boundaries of applications implementation. These developments have greatly affected enterprise applications, which has undergone a number of major technology shifts over the last twenty years. But they all have one thing in common: they are increasing the power of the user.

The history of information technology is in many ways the history of improved end user access. Every major development in computers has had to do with making it easier to get at, manipulate and report on the information contained within the systems. Flexibility of reporting consistently rates as the most important purchasing criterion when buying information systems.

The PC revolution, the rise of networking, the development of the graphical user interface, the growth in client/server and distributed computing, the Internet and the World Wide Web: all are manifestations of this trend. And all have greatly affected enterprise applications.

These changes will continue to alter the face of enterprise applications, ensuring that what is state of the art today will be obsolete tomorrow. But even as the technology changes and the software changes, the underlying issues will remain the same.

The role of information systems is to help individuals and organisations work better. A computer is not an end in itself, it is a tool to help someone to a job. These imperatives are always with us. No matter what technological changes occur in future, their practical effect will be to make computer systems easier to use and better able to reflect the reality of the environment in which they operate. That is what technological change is all about.

2. The Evolution of Enterprise Applications

Introduction

The growth in the enterprise applications market has been one of the great computer industry success stories of the 1990s. From its origins in manufacturing, ERP has become the enterprise software of choice for most major organisations, in every industry sector. And whether organisations employ ERP software or not, their core applications are moving towards ERP functionality, integrating a number of different functions into a coherent whole.

Why has ERP software been so successful? There are many reasons, and they tell us a lot about the changing face of business over the last decade, and how business uses and views its information systems.

Most organisations computerised back in the 1970s or 1980s, starting with their financial systems and then moving into areas like payroll, customer information and inventory control. Manufacturers used computers for MRP (material requirements planning), and various other industries developed and introduced their own industry-specific applications.

Most of these applications stood alone. There was very little integration between them. A company would often get its general ledger, its accounts receivable, its human resources, and its stock control systems from different suppliers. Or - another feature of those early days of enterprise applications - it would write its own applications, or have them specially written.

Things have changed significantly over the last decade. The growth in ERP software has been marked by two important trends - a move towards off-the-shelf packages, and a move towards the integration of disparate software applications.

The Move to Packaged Software

In the 1970s and 1980s most organisations built their own applications. There was a fair amount of packaged software, but this usually had to be customised for different users. Software houses did a roaring trade writing custom applications for different companies, and in-house applications development teams grew very large very quickly.

There was enormous demand for the development of new applications and modifications to old ones. This placed major strains on software development teams and on the whole software development process. There was much talk of the “applications development backlog”, and people were constantly looking for new ways to streamline and hasten the software development process.

The great hope of the computer industry in the mid 1980s was CASE (computer-assisted software engineering) – a new technology that would use software to write software. The idea was simple, and very alluring. Users to specify their applications using English language-type parameters, which would then be turned into computer code by cleverly written CASE tools.

CASE did a lot to improve the process of software design, but ultimately it proved a failure. Not because the technology was no good (though the reality certainly fell far short of the promise), but because the applications backlog went away. It went away because most organisations simply stopped writing their own applications.

The massive growth of PCs and end user computing in the late 1980s and early 1990s gave users enormous power. Anybody with a spreadsheet and an understanding of macros could write their own small applications. The growth of tools like Visual Basic and Access, and of technologies like client/server, made it easy for end users to access corporate data and manipulate it locally.

Many of these small end user applications were not clean, and they were not rigorous, but they worked. And the very same tools that gave end users all this power made it simpler for software vendors to write applications that were more flexible and more powerful. This made packaged software a lot more attractive. The new technology meant that packages could be more easily tailored

to suit an individual organisation's needs, greatly enhancing the attractiveness of off-the-shelf solutions.

The make-versus-buy equation has changed forever. The wide range of packaged software available, and the dearth of skills in all but the simplest applications development tools and techniques, have made it much more sensible to buy applications, rather than develop them internally. Increased computing power has also made packaged software more attractive, because it is more flexible and more tailorable than ever before.

Applications Integration

The other key trend in the 1990s has been towards applications integration. Ideally, most organisations want to be able to share information between different departments. It is inefficient in the extreme to keep multiple customer records, or to enter information twice when something is shipped - once in accounts receivable, and once in inventory management. But that is how most organisations did it, and how many still do.

With the rise of MRP software in the manufacturing industry, companies started to connect their production systems with their financial systems. It makes obvious sense to share data between different systems, and it sounds like a very good idea. But it is a lot more difficult than it sounds. Every new application that is brought into the equation greatly adds to the complexity. It is almost as if there is some mathematical formula at work, in which the level of integration complexity is equal to the square of the number of applications being integrated.

At the same time as ERP systems have extended beyond manufacturing into other industries and into all aspects of an enterprise's computer applications, core financial systems have also extended their reach. Software packages that once comprised only general ledger and accounts receivable and payable now routinely include payroll, distribution, and some form of customer relationship management. The rise of client/server software has also made it comparatively easy to integrate these systems with other applications in use in the organisation, through the clever use of applications program interfaces (APIs) and graphical user interfaces (GUIs).

This means that just as ERP software has extended towards general purpose enterprise applications, so has financial software. The two types of software are becoming increasingly indistinct. Most market research companies still distinguish between the two, but it is getting harder and harder to tell the difference. They are merging into the one "enterprise applications" market.

These applications are now even moving beyond the enterprise. Applications like supply chain management, customer relationship management, EDI and electronic commerce, and sales force automation are extending the bounds of the applications suite to include the organisation's suppliers and customers. These issues are examined below.

Integrated Solutions versus Point Solutions

With the emergence of these many different software solutions, we are witnessing an emerging battle between "integrated" and "point" solutions. Integrated solutions, best typified by SAP's R/3 package, cover the whole range of an enterprise's applications in one large suite of programs, typically broken into many modules. Users can pick which modules they want, to provide a system most suited to their needs.

Point solutions, also known as "best of breed", offer just one application, which then has to be integrated with others, usually from different suppliers. Surveys consistently show that users prefer integration, but point solutions sell on the basis that they are the best at what they do, and that users are better off getting the best software for the purpose, and then integrating it.

In reality, most suppliers are somewhere between these two extremes. Oracle and JD Edwards are two such examples. Each presents itself as a total enterprise applications vendor, but their solutions include applications from other vendors, which they guarantee they will integrate. There is now a whole range of similar alliances between different applications vendors. The rise in systems integrators has increased the pool of consultants specialising in bringing disparate applications together, and client/server technology means that applications are now much easier to integrate than they have ever been before. Many users act as their own systems integrators.

This move to integrated cross-enterprise applications has greatly changed the nature of the packaged software industry. As ERP and financial systems have moved towards each other, the very term "ERP" is becoming a misnomer. This software is far broader than enterprise resource planning. But in an industry quick to invent neologisms and acronyms, there is not yet any standard term to describe this new breed of software.

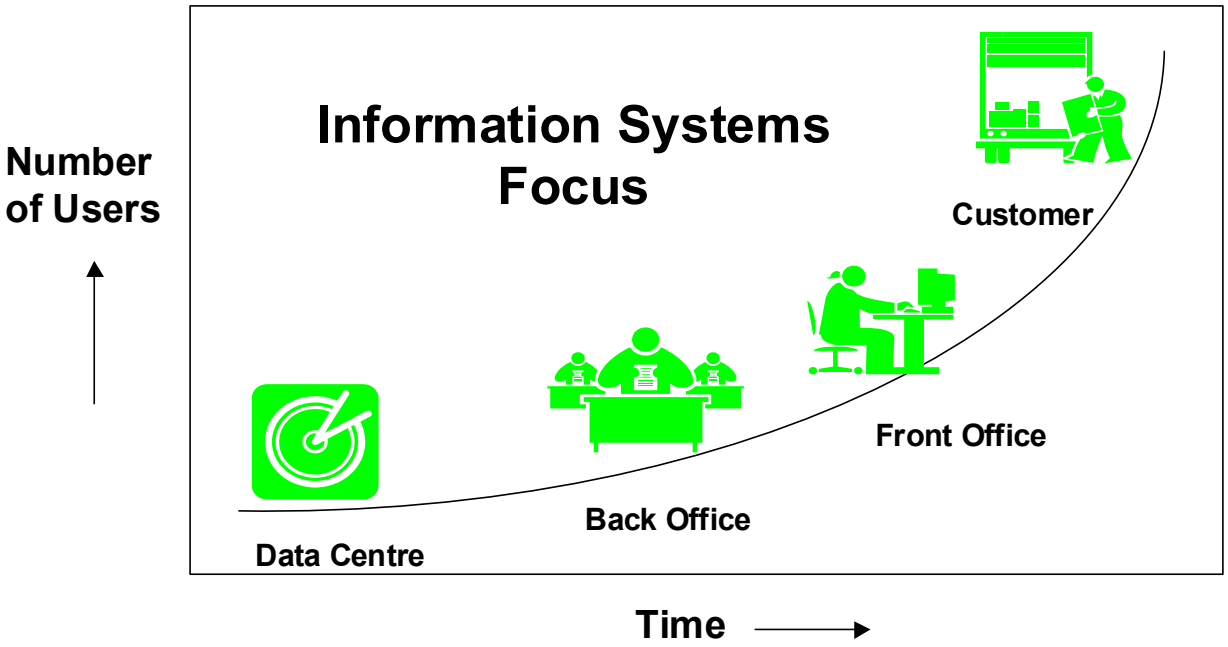
No doubt such terms will emerge. But more important than the terminology is what it represents. We are moving to a new era, where cross-functional integrated software packages are becoming the norm, in every industry and among every size of organisation. The trend is marked by some very uneven offerings from some of the suppliers, and by many implementation problems among users, but it is unmistakable and inexorable.

But even integration itself is a passing phase on the way to total pervasiveness. "Integration" is only a meaningful term if you have discrete applications to bring together. The unmistakable trend is towards enterprise applications that have no discernible internal or external barriers, where the application is all-pervasive and its usage universal. Again, widespread usage of the Internet is a key driver of this trend.

From Back Office to Extra-Enterprise

More important than the move towards software integration is the changing focus of enterprise applications. Early applications were used by just a few people in the organisation. Host-based systems did not lend themselves to being used by massive numbers of end users, and the applications they ran were essentially directed at automating what are often called "back office" functions: those that did not impinge directly on the organisation's customers or the employees dealing with them.

Figure 2-1



This was the era of data processing, a term that is in the process of falling into disuse. The role of computers in the data processing era was to – simply – process data: customer accounts, inventory systems, and the like. With the PC revolution computers and computer applications moved into the front office. Computers automated word processing, making the typing pool a thing of the past. The spreadsheet changed the lives of millions of accountants and others who worked with financial and numerical data.

With these changes, and the growth in distributed processing, came major changes in enterprise applications. The typical application went from having just a few users to having dozens, or even

hundreds or thousands. And for every person directly accessing the financial system, another ten were using data generated from it or supplying data to it.

Now we are on the verge of another major evolutionary change. Applications are moving beyond the front office, to encompass an enterprise's suppliers (supply chain management) and clients (customer relationship management). Again, the Internet will be one of the major drivers of this trend, as virtual information systems extend far beyond the organisation's boundaries. We are moving towards one gigantic global information system, in which data moves freely and individual enterprises must optimise the way in which they employ it.

These issues are examined more fully in Section 5 of this report.

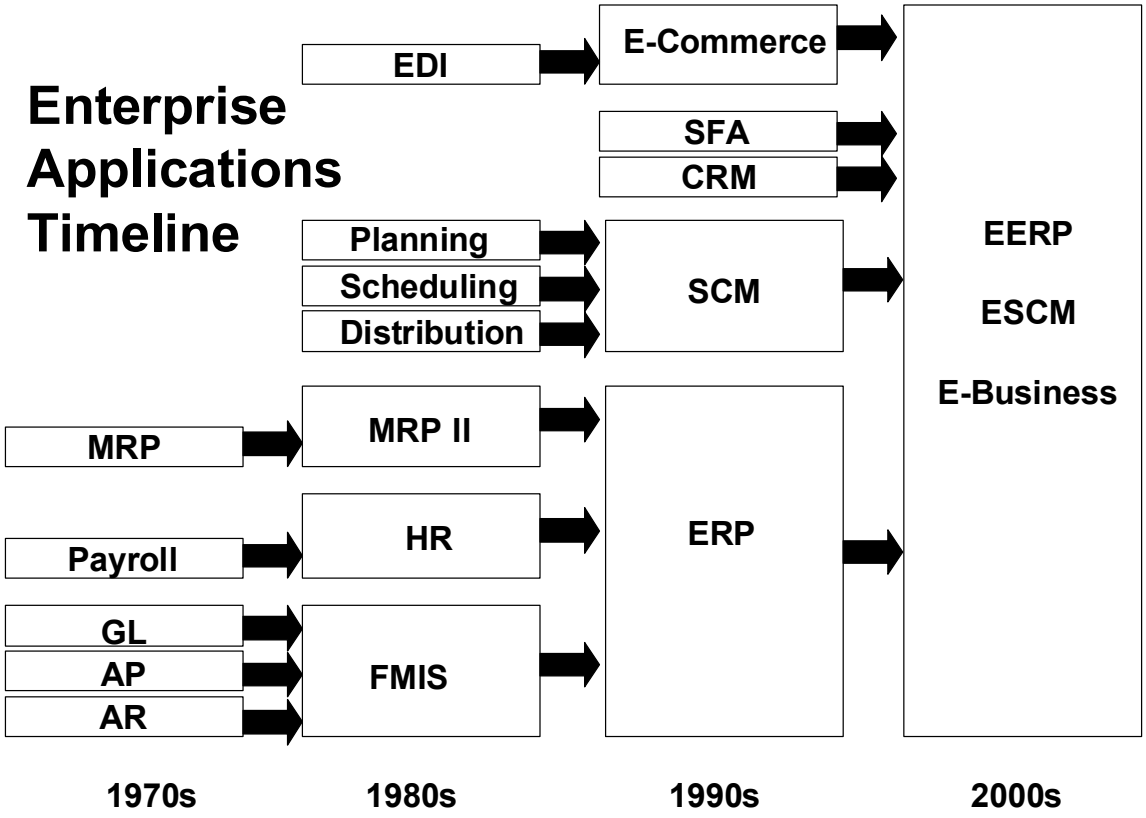
3. Enterprise Applications Components

Introduction

All ERP systems or enterprise applications suites consist of a number of different components, integrated in some manner. Indeed, that is what defines such systems. This section of the report looks at some of the more common components and the key issues surrounding them.

No two enterprise applications systems are the same. Different users employ different components, depending on their size, their industry, and the level of their system usage. As with much terminology in the IT industry, there is no clear definition of what exactly comprises ERP, and even how these individual components should be described.

Figure 3-1



Source: Strategic Intelligence

Figure 3-1 shows how enterprise applications have evolved over time from the discrete, stand-alone packages of the 1970s, to the applications suites of the 1980s, to the integrated ERP/SCM approach of the 1990s, towards the e-business enabled enterprise applications of the next decade.

Various people have coined new phrases to describe the next phase of enterprise applications. Gartner Group is using the term Extended ERP, while Forrester Research uses the similar term Extended SCM. What ever the terminology, the next phase will be marked by full integration of all applications to enable true e-business capability.

The remainder of this section of the report looks at the major enterprise applications components, including the role of data warehousing and business intelligence.

Financial Management Information Systems

Financial Mangement Information Systems (FMIS) are the core of most organisation's IT functions. Everyone needs to manage money Typically and FMIS will comprise a general ledger system, with accounts payable and receivable and financial reporting capabilities. There are often other functions included, such as treasury management, asset management, and the like. The list is potentially very long, depending on the nature of the organisation's finances.

These financial functions are typically integrated, though not always. It is not unusual for an organisation to get its general ledger system from one supplier, its accounts payable from another supplier, and its accounts receivable from a third supplier.

Most ERP systems include FMIS as a core function, though many of these are quite rudimentary. The debate between integrated and point solutions is strong in this area, with many specialised FMIS vendors strongly arguing their case for coexistence with more traditional ERP functions such as MRP II and supply chain management (see below). The continued existence, and success, of specialised FMIS vendors indicates that they have a role to play. But most of them are gradually extending the capabilities of their products, so that they are becoming indistinguishable from those of the ERP suppliers.

Leading specialist FMIS suppliers include GEAC, Computer Associates, Systems Union, Computron, QSP and Great Plains Software. There are many smaller vendors, often specialising in a limited number of vertical or geographical markets.

Human Resources

Just as all organisations have accounts to control, they all have employees to pay and manage. Payroll systems have been in existence almost as long as IT, and have evolved to a high degree of sophistication. Payrolls have become very complex, with changes in work practices and government regulations covering such issues as taxation, holidays and other working conditions differ greatly from country to country.

Payroll systems have evolved into human resources (HR) systems, which also manage such areas as employee records, career development and evaluation. Many HR systems are very complex, and highly tailored to an individual organisation's needs.

HR, and especially payroll, functions are often outsourced, such is their complexity. But most organisations keep the processing in-house, in which case the systems are typically integrated with other applications, particularly in the finance area. They are also often integrated with such functions as activity-based costing and billing.

ERP vendors have not typically included HR capabilities as part of their offering, though this is now changing. SAP has long offered HR (though not in every local market), and Peoplesoft actually had its origins in this area.

MRP and MRP II

MRP (material requirement planning) and MRP II (manufacturing resource planning) are both processes which have come from the manufacturing industry. MRP evolved from simple inventory control systems, but with the evolution of MRP into MRP II in the 1980s, manufacturing systems achieved a high degree of sophistication.

MRP II has become a very specialised discipline in its own right, with its own terminology and its own dedicated practitioners. It has revolutionised manufacturing around the world over the last 20 years, and in this decade many of its disciplines have been applied to areas outside of the manufacturing industry. Many techniques central to MRP II, such as project planning and scheduling, have a much wider application. MRP II was the main precursor of ERP.

Today virtually all ERP systems have strong MRP II functionality at their core. ERP is widely used in many industries, but manufacturing and distribution systems remain the bread and butter of most ERP specialists. Many ERP specialists with strong MRP II backgrounds, such as JD Edwards, QAD and SSA, still sell only into this core market.

EDI

Business has been experimenting with a pre-Internet type of e-business for many years. EDI (which can stand for either electronic data interchange or electronic document interchange) was developed in the 1980s as a means of exchanging basic and standardised transactional information, such as invoices and purchase orders, between organisations electronically.

EDI systems used proprietary technologies and protocols, which meant that they were only useful in closed shop situations where all parties had agreed on the parameters of the system. EDI relied on the definition of very specific formats to simulate paper-based transactions of a specific type.

Despite its many rigidities, EDI was very successful in some areas. Large organisations such as retail chains and car manufacturers were able to mandate that their suppliers used EDI, greatly simplifying their purchasing systems. Other uses included customs and taxation, and other government departments.

By its nature, EDI was a business-to-business technology. It was extremely structured, and totally unsuited to the relative anarchy of business-to-consumer retailing. One of EDI's major shortcomings was also its proprietary nature, and the necessity of having the buyer's and seller's computers talking directly to each other. It was also expensive, and difficult to manage if more than one system was involved. EDI was totally unsuited to ad hoc or small volume transactions, which greatly limited its popularity.

EDI still exists, but it is fast becoming a comparatively small subset of e-business. The growth of the Internet as an open network to which any computer can be connected has given EDI a new lease of life, providing a common and permanent backbone to systems that were previously closed, temporary and proprietary. The term "EDI" is falling into disuse, as its capabilities become subsumed by the much broader field of business-to-business Internet commerce.

Supply Chain Management

Supply Chain Management (SCM) is a term that has come into use to describe software that manages all aspects of the movement of materials into an ERP system and of goods out of it. This includes production planning and scheduling at the front end, through to the mechanics of distribution and logistics at the back end. It is not a clearly defined term, but in some lexicons it has taken on connotations of a superset of ERP: ERP is a part of SCM, rather than the other way round.

Most ERP systems include SCM functionality, but a range of specialist vendors supply products that address specific parts of the SCM process, such as planning (i2 and Manugistics), scheduling (SynQuest) and logistics (Metasys). Many ERP vendors have established close relationships with these suppliers. In 1997 Peoplesoft acquired leading planning vendor Red Pepper, and Manugistics is often mentioned as a takeover target.

SCM has been expanded to include all aspects of the supply chain, including those external to the organisation. This includes customers: with the growth in business-to-consumer marketing on the Internet, SCM is becoming central to systems designed for the emerging world of e-business. These issues are examined in Section 5 of this report.

Customer Relationship Management and Sales Force Automation

Customer relationship management (CRM) and sales force automation (SFA) are related and sometimes overlapping technologies that manage an enterprise's relationship with its customers and the employees who service those customers.

SFA had its origins in contact management systems that allow sales staff to keep track of client details and appointments. These systems have grown significantly in capability in recent years, and now typically bring a high degree of sophistication to the process.

CRM systems automate the process of managing large numbers of clients and prospects. All organisations keep details of their customers in their information systems, but these have rarely been

easily accessible to sales and marketing people. CRM systems extract all relevant information about an organisation's clients, allowing more personalised service and targeted marketing.

This is particularly useful in industries such as banking, where an organisation may have a range of products or services it could be marketing to a client. A CRM allows a detailed and online profile of that client's transaction history to be readily available at all times, which greatly improves customer service and cross-marketing opportunities.

The Role of Data Warehousing and Business Intelligence

CRM and SFA systems work by extracting existing data from an organisation's information system and optimising it for a specific purpose. On a larger scale, data warehouses do the same thing.

Data warehousing refers to the removal, or at least the copying, of corporate data to secondary databases, from where it can subsequently be accessed by end users in the course of their everyday job. Most data stored in corporate information systems is operational data, which is usually stored in large databases that have no relationship with the way users might actually want to use it. It is optimised for transactional purposes, rather than easy retrieval.

Traditionally, end users have had to rely on structured reports generated by financial or other management information systems to get at the data. This has been very difficult, and has lead to low productivity. It has also meant that end users have not really known the quality of the data they are getting.

In the late 1980s there was a minor vogue for software which came to be know as the executive information system (EIS). EISs were essentially small data warehouse which extracted management information and made it accessible to a few users. They never achieved widespread use, mainly because they were very expensive to purchase and to implement.

The EIS has now evolved into business intelligence (BI) tools, which provide EIS-style functionality at a fraction of the cost. BI tools can be used to extract information from operational systems, but they are best used against data warehouses or smaller "data marts", which optimise the data for easy extraction.

Many ERP systems now come with built-in BI and data warehousing capability. For those that do not, a small industry of specialist suppliers exist. Leading BI vendors include Cognos, SAS and Seagate Software.

4. Hardware and Software Technology

Introduction

Enterprise applications operate on a computing infrastructure of hardware, software and communications. Technology trends in each of these areas have a major effect on enterprise applications architectures and implementations. This section of the report examines the key issues in each of these areas.

Hardware

Processor Architectures

All computers are powered by microprocessors, small "computers on a chip" that act as the computer's brain and central nervous system, controlling how the computer's memory and peripherals process data.

The biggest issue in microprocessor technology over the last ten years has been the debate about the relative merits of RISC (reduced instruction set computing) and CISC (complex instruction set computing) architectures. CISC is the traditional processor architecture, in which computer instructions are coded into a large number of complex instructions. RISC is a newer architecture which greatly decreases the number of instructions, using multiple instructions where necessary to perform complex functions.

RISC processors are more efficient, but massive increases in the capabilities of CISC processors, and in particular the aging X86 architecture, have made the debate largely academic. Even though CISC is less efficient, the popularity of the X86 architecture has given Intel and AMD economies of scale which have meant that the relative price-performance of RISC and CISC have been close enough not to be a significant issue to most users. With the release of the IA-64 (see below), this will cease to be an issue.

There are a number of important processor architectures, which nowadays are all available on a single chip. These are detailed in Figure 4-1.

Figure 4-1
Major Processor Architectures

Chip	Architecture	Supplier	Major Users	Notes
X86	CISC	Intel, AMD	Most systems suppliers	Standard chip in most PCs and PC servers. Developed by Intel, AMD supplies clone
Alpha	RISC	Compaq	Compaq	Developed by DEC before Compaq's acquisition. Now manufactured by Intel
PA-RISC	RISC	Hewlett-Packard	Hewlett-Packard	Architecture to be incorporated into IA-64
PowerPC	RISC	IBM, Motorola	IBM, Apple	Used by IBM RS/6000 and AS/400, and Apple Macintosh
SPARC	RISC	Sun	Sun	Sun does not manufacture – licenses this to NEC, Samsung and others
IA-64	CISC/RISC	Intel/HP joint venture	Most systems suppliers	To be released in 2000. Superset of X86 and HP PA-RISC

There are a few other chip architectures besides those mentioned in the table, but they are all declining quickly in popularity and usage. They include MIPS (a RISC architecture now owned by Silicon Graphics), the Motorola 88000 RISC architecture, and IBM's venerable S/390 mainframe chipset.

The most important development on the microprocessor front is the imminent release of the IA-64 architecture, developed jointly by Intel and Hewlett-Packard. The IA-64, due for general availability in 2000, will be compatible with both the Intel X86 architecture and HP's PA-RISC architectures, acting

as a superset of both, with 64-bit processing (the number of bits that can be processed is an indication of the power of the processor – most current processors use 32-bit processing). The IA-64 processor will be supported by most major suppliers, and will be the dominant processor architecture of the next decade.

Storage

Computer storage has become much cheaper in recent years, and is no longer the important issue it once was. There are three significant types of storage: memory (RAM), disk and tape.

RAM (random access memory) is the storage contained within the computer's chips. It is volatile, which means it disappears when the computer is turned off. Data stored in RAM is accessed almost instantaneously. RAM storage is now so cheap that RAM capacity is not a major issue with most computer systems, which contain enough RAM to run almost all applications efficiently.

Disk storage remains the most common sort of non-volatile storage. Like RAM, disk storage has become much less expensive in recent years, and is rarely regarded as a limiting factor in a computer system: adding more disk storage as it is needed is a relatively simple and inexpensive process.

Besides massive price-performance improvements, the major improvement in disk storage in recent years has been the almost universal usage of RAID (redundant arrays of inexpensive disks) technology. Disk storage failures such as head crashes were once a significant problem for computer users, but now RAID technology means that disk storage systems typically comprise a number of small disks that mirror data on other disks. If one small component fails another can easily take its place until it is repaired, often without turning the system off.

But RAID is not yet universal in smaller PC server-based systems, where backup storage is important. The most common type of backup is tape, which is even less expensive than disk, but much slower to access. Tape storage technology has also improved in recent years, with large systems now almost universally adopting the tape silo approach popularised by StorageTek.

Now that the hardware issues have been largely resolved, the biggest issue in storage is storage management . The sheer growth in storage needs, and the increased usage of multimedia and other complex data types, has meant that even comparatively small computer systems need to manage more and more storage types. Mainframe storage management disciplines are increasingly becoming necessary for smaller sites. The most significant storage vendor is now US company EMC, which has grown massively in recent years by positioning itself as the storage specialist.

End User Devices

As the number of end users in an organisation has grown, so has the technology they have employed changed. In the 1990s networked PCs largely replaced dumb terminals as the standard end user device, but in recent years there has been something of a backlash against PCs, which are regarded as being too complex and too expensive for many simple tasks.

In 1996 Oracle's Larry Ellison heavily promoted the idea of the network computer (NC). The NC was to be a small inexpensive computer, basically little more than a screen and a keyboard and some memory, which would download its applications and its data from a network. It would be much cheaper than a PC, and much easier and therefore cheaper to manage.

Many users are now increasingly aware that the true cost of running a PC network is much higher than the initial purchase price of the hardware. Far more significant are the running costs, and the costs of managing and supporting large and disparate PC networks. These issues have gained much publicity, largely through the popularisation of such issues as total cost of ownership (TCO).

Despite its many claimed advantages, the NC proved to be an idea before its time. The takeup in NCs was smaller than the retirement rate of old dumb terminals. But despite not attracting a large following, the NC has had a major impact on the direction of end user computing. One reason the NC failed was because its much-vaunted cost savings proved illusory. PC prices have dropped so much in recent years that a basic PC can now be had for about the same price as that proposed for the NC. Also, Internet bandwidth is not yet sufficient for the downloading of large applications or significant amounts of data.

But the threat from the NC was real enough to force Microsoft and others to look more closely at the management overheads of running large PC networks. Microsoft has announced its Zero Administration Windows (ZAW) initiative, and system management tools for PC networks are now commonplace. Many vendors, such as Compaq, promoted "NetPCs", diskless PCs that would run standard PC applications, but download the applications and store the data on the network. These hybrids gained some following.

Now, as the Internet matures, there is an increasing consensus that the NC, or something like it, will eventually have a major place in information technology. The Internet is becoming the ubiquitous network, with standard protocols and increasing bandwidth. Increasingly, it will not make sense to use PCs to access this network. Most major vendors are now talking in terms of "information appliances", specialised Internet terminals that will perform specific functions.

There will always be a place for general purpose PCs, but they will be supplemented by a range of portable, domestic and commercial devices that will connect to the Internet and perform a range of specialised functions. Many of these will be integral parts of extended enterprise applications, particularly in the area of business-to-consumer transactions.

Software

Operating Systems

The operating system is the basic underlying software on a computer that controls the way the machine runs and how it interfaces with its peripherals, and with its users. Microsoft's Windows is the most common operating system on PCs, but on larger machines, today usually known as servers, there are a number of different and competing operating systems available.

There was a time, not so long ago, when different computers ran different operating systems. These were known as proprietary operating systems. A few of these still exist, such as IBM's OS/400 and Compaq's VMS and Hewlett-Packard's MPE, but the major competing server operating systems can run on many different computers.

The major server operating systems, and the number of new licenses shipped over the last two years, are shown in Figure 4-2. The highest number of new licenses in 1998 was for Microsft's Windows NT, which runs on Intel X86 processors and some other chips, notably Compaq's Alpha. Windows NT has been growing strongly for the last five years, mirroring Microsoft's success on the desktop. But growth is now slowing, as its limitations for high end processing become apparent. NT is mostly used on smaller servers, though it becomes more scalable and more robust with each release. The next release will be called Windows 2000.

Figure 4-2
Server Operating System shipments, 1997-98

	Licenses 97 (000)	Licenses 98 (000)	License Growth 97-98 (%)	% Licenses 98	Revenue 98 ($Usm)
Windows NT	1226	1560	27.2	35.8	1390
Netware	927	1053	13.6	24.2	645
Unix	728	758	4.1	17.4	2875
Linux	240	750	212.5	17.2	33
OS/2	220	131	-40.5	3.0	68
Others	135	101	-25.2	2.3	n/a
TOTAL	3476	4353	25.2	100	5011

Source: IDC, January 1999. Note: Preliminary data only

Windows NT is in a similar position to that enjoyed by Unix ten years ago. Back then, Unix was the new kid on the block, showing great promise in challenging the established order. Unix promised open systems, and a liberation from proprietary architectures, but its growth was hampered by the fact that it was splintered into a number of competing varieties. Now a new "Open Source" operating system called Linux is achieving some popularity.

In January 1999 IDC released preliminary data for 1998 server operating environment (SOE) shipments. The data shows a number of interesting trends. It worth examining the figures closely, because they show how it is possible to interpret this type of data in many ways.

First, the data refers only to server operating systems. In the case of Linux and Windows NT, most new licenses are used at the workstation level (see following arcticle). But the server shipment figures are the best indication of relative strengths.

Total shipments of SOEs grew to 4.353 million units worldwide in 1998, up 25.2 per cent from 3.476 units in 1997. Windows NT grew substantially, by 27.2 per cent, maintaining its position as the leading SOE, as measured by unit shipments. Netware grew reasonably, by 13.6 per cent, proving that it is far from dead. Unix grew only a little, by 4.1 per cent, a figure that IDC ascribes in part to increased rationalisation of Unix boxes.

But the big jump was in Linux shipments, which more than trebled from 240,000 to 750,000 shipments. This puts Linux in fourth place, only marginally behind all the flavours of Unix combined. (Unix is itself rationalising, with growth only in HP-UX, Sun Solaris and SCO Unix). Shipments of OS/2 and “Other” SOEs declined substantially.

The value of these shipments shows a different story. Unix, because it is usually sold on larger machines, is still way ahead, with total sales of $US2.875 million, with Windows NT half that and Netware half that of Windows NT. Because Linux is essentially free (little more than the cost of the packaging), the value of its shipments were marginal.

There is a strong school of thought that says that the Internet will in any case make operating systems totally irrelevant within a few years. With the Internet as the common data exchange mechanism, the operating system of servers and clients will not matter. What ever the case, there will be vastly fewer closed systems than existed in the past.

Databases

The database management system (DBMS) is at the heart of most software applications. The DBMS market has been highly competitive over recent years, though the dust is now settling.

DBMSs have been with us for many years, but it was only with the rise of the relational DBMS in the 1980s that they assumed their central role in the industry. Relational DBMSs enable large and complex tables of information to be linked together, which makes them ideally suited to enterprise applications. One table can contain names and addresses of customers, another product details, yet another transaction details. Most enterprise applications sit on top of a relational DBMS.

For many years the largest DBMS vendor has been Oracle. Its major rivals have been Sybase, Informix and Ingres. These three have all now dropped behind, after well publicised technology and financial problems. They still have many users, but are they are becoming niche players (Ingres is now owned by Computer Associates).

The biggest rival to Oracle is now Microsoft, which has a relational database called SQL/Server. SQL/Server runs only on Microsoft’s Windows NT operating system, but as that operating system has grown so has it. Oracle now regards Microsoft, not its traditional rivals, and its major DBMS competitor.

The other major DBMS player is IBM, which dominates the mainframe DBMS market with its DB2 database. IBM has renamed the integrated DBMS in the OS/400 operating system DB2/400, and when it released a Unix-based DBMS to compete against Oracle and the others it also named it DB2.

This had the effect of associating the new IBM DBMS with the older mainframe version, even though they were two completely different products. IBM has no recovered from this marketing blunder and renamed it UDB (Universal Data Base), but it has still to make a major impact. But IBM has a large installed base of mainframe and AS/400 users and a lot of marketing clout, and UDB must be considered as a rival and serious alternative to the established relational DBMS players.

There is little to seriously differentiate the rival relational DBMSs from each other technically. All of them do the job. Enterprise applications vendors either develop their applications for one of more DBMS, or they develop an open product that will run against any DBMS. The second approach is

more difficult, and there is an increasing tendency for suppliers to write to just a few leading DBMSs. Because of their popularity and momentum, Oracle and SQL/Server are always on this list, with other DBMSs supported if the supplier believes there will be sufficient market demand.

Over the last three years the most of the DBMS vendors have been attempting to promote the concept of "object relational" DBMSs, which are capable of handling large and complex data types (objects) as well as conventional character-based (words and numbers) data. Each of them has adopted a different technological approach, but the user community has not bothered too much with object relational technology, which is often seen as a technology looking for a solution. The vendors with the most advanced object technologies, IBM and Informix, have done worst in the market, while those with the least advanced have done best. Microsoft, with no real object strategy at all, has the strongest momentum.

The User Interface - From Character-based to GUI to Browser

A very important change in enterprise applications, and indeed in all applications software in recent years, has been the move from character-based interfaces to graphical user interfaces (GUIs). Character-based interfaces, typically on green-screen dumb terminals, were rigid and offered a limited number of choices to the user. That all changed with the rise of the GUI.

The best-known and most pervasive GUI is Microsoft Windows, though the Apple Macintosh popularised the technology much earlier. (Contrary to popular belief, Apple did not invent the GUI. It stole the idea from Xerox, and then had the presumption to sue Microsoft for stealing it from Apple).

The difference between a GUI and a character-based interface is profound. With a character-based interface, the computer was very much in charge, directing the user to a narrow range of functions. The systems were usually menu-driven, with each menu option directing the user to a screen designed for a particular activity. There was no standardisation across different systems, and such simple tasks as finding help (if any was available) or saving data were performed differently on different systems.

GUIs brought a number of improvements. The use of standardised toolbars meant that most operational functions were similar, even on different systems. The use of pull-down menus meant that much greater functionality could be built into each screen. The use of colour and high-resolution graphics meant that the screens were easier to read.

But most importantly, GUIs transferred control to the user. They allowed users to do much more than they previously could. Coupled with the power of client/server computing and networking, transferring data between applications became a simple matter of cutting and pasting. GUIs liberated users.

Now, a new interface is with us – the Internet browser. The browser is a type of GUI that allows even greater flexibility and power. And with greater power comes greater ease of use – GUIs are much easier to learn and to understand than character-based interfaces, and those skills are much more transferable.

5. E-Business and the Extended Supply Chain

Introduction

The biggest IT story of the 1990s, even bigger than the growth of the ERP market, has been the emergence of the Internet as a ubiquitous information medium. ERP and the Internet have now come together to form a major new field known variously as electronic commerce, internet commerce (e-commerce and i-commerce), on-line business, or electronic business. This report uses the term e-business to describe these various activities.

As noted earlier in this report, one of the key distinguishing features of the evolution of the IT industry has been the increase in the number of people using information systems. Early computers had just a few users, then came dumb terminals, then networks of PCs proliferated until they became commonplace in business and in the home. The Internet takes this one step further, and offers the potential for virtually everyone on earth to be connected together in one vast network.

Every Internet user is potentially the customer of every supplier who sells on the Internet. ERP systems designed for an organisation's internal use can now be accessed by millions of people. The Internet takes the bounds of enterprise applications way beyond the enterprise, to encompass all of the enterprise's consumers and possible consumers.

E-business is a general term to describe any business-to-business or business-to-consumer activity that is conducted over the Internet, or which uses the Internet for any part of the transaction. The simplest and easiest to understand type of e-business is the simple transaction, such as purchasing a book from Amazon.com. This process is not so far removed from the traditional retail sale, excepting that various stages of the distribution process are disintermediated (see below) in the fulfilment of the order.

But there are many other types of e-business besides this simple example. The Internet is above all an information medium, and the availability and provision of information, in ways that were simply not possible previously, is enabling new types of transactions. Needless to say, this has profound implications. It completely changes most business models. Concepts of wholesale and retail, and distribution chains, are turned upside down.

The Challenge of Disintermediation

A major consequence of e-business is increased disintermediation. Disintermediation is a big word to describe a simple concept: the cutting out of the middle man, otherwise known as the intermediary. This is happening all around us, and information technology is responsible. Consider a few examples.

Anybody who shops on the Internet is cutting out a number of middle men. They are disintermediating retailers, and in many cases wholesalers and distributors. When anybody orders a book from Amazon.com or a CD from CDNow, they are disintermediating their book store or music shop.

In the same way, digital cameras are disintermediating film processors. Word processing long ago disintermediated the typing pool, and along with voicemail and other technologies is disintermediating the secretary. Agents and middle men of all style and type are going out of business as technology disintermediates them into oblivion.

This has been going on for some time, but the Internet has greatly accelerated the process. The Internet totally changes the dynamics of most market-based transactions. The role of the intermediary has traditionally been that of getting buyer and seller in touch with each other, or of gathering information wholesale and retailing it for a profit.

The Internet makes it much easier for people to do this themselves. All manner of newsletters and other information sources are fast disintermediating traditional media. Disintermediation is driving the restructuring of business. Seven or eight years ago, the big buzzword in the business community was "business process re-engineering". Nobody in business today does thing the same as they did ten years ago. If they did, they would not be competitive. We have seen the stripping of layers of

management (itself a type of disintermediation), we have seen product development times shorten, we have seen companies subjected to the necessity of responding more quickly to changing business imperatives.

All organisations have re-engineered their business processes, whether they have gone through a formal process or simply reacted to changed circumstances. The Internet and other technological changes are continuing to force major changes, not just in business processes, but in our daily lives, as the Internet takes the reach of information systems way beyond businesses to consumers.

With millions of individuals connected to the Internet, an organisation's computer network is almost infinite. We are all becoming end users of every organisation's computer system. Disintermediation is rampant, and its consequences are only beginning to dawn on most people.

We are experiencing a fundamental change in the way business is conducted. As middlemen and agents everywhere get disintermediated into the dustbin of history, the relationship between producer and consumer changes massively. The balance of power changes, vastly, in favour of the consumer.

And in favour of the fast-moving supplier. Many businesses will fail to react to the challenges of disintermediation, especially those which are themselves intermediaries. Such organisations need to change their business model, and change it fast, or they will die.

Extending the Supply Chain

Disintermediation and the move to e-business has enormous consequences for most organisation's supply chain management systems. With the extension of enterprise applications far beyond the bounds of the enterprise, to include suppliers and customers, systems need to manage much larger supply chains than ever before. Combine this with the many changes in business structures, business relationships and business techniques, and the challenges become enormous.

Analyst group Forrester Research uses the term Extended SCM to describe these changes and their relationship to traditional ERP systems (see Figure 5-1).

Figure 5-1
ERP and Extended Supply Chain Management

	ERP	Extended SCM
Business Driver	Coordinate manufacturing	Satisfy customer demand
Objective	Cost reduction	High-quality service, responsiveness
Span of Coordination	Plants, warehouses	All internal activities, suppliers, distributors, customers
Product	Finished goods	Available capacity
Relationship to Customer Demand	React	Anticipate, stimulate
Planning Goal	First-cut requirements estimate	Feasible, optimal plans
Planning Breadth	Material, plants	Material, plants, labour, transportation, constraints, demand, distribution
Planning Approach	Serial	Synchronous

Source: Forrester Research

The table clearly shows the differing scope of ERP and extended SCM. ERP is more tactical, SCM is more strategic. The role of SCM is to optimise ERP by anticipating demand, managing capacity, scheduling activities, and generally coordinating the manufacturing and distributing process.

An examination of each of these issues highlights the differences between conventional ERP and production systems, and extended SCM in the new era of e-business.

- The function of conventional ERP is to coordinate the manufacturing process. This has been extended to manufacturing in the broadest sense, describing the coordination of every aspect of an organisation's core activities, in all industry sectors. ERP, as its name implies, coordinates all enterprise resources. SCM extends this key business driver beyond the enterprise, to the customer, who becomes part of the extended ERP system. The focus shifts from process to results.

- Ultimately, ERP is about process efficiency and reducing costs. SCM, with its greater emphasis on the end result of the business process, is about providing service to customers and responding quickly to their needs.

- ERP has been comparatively limited in focus, concentrating on internal functions such as plant and warehouse efficiency. SCM focuses on a much larger range of activities. As well as managing these internal functions, it also coordinates activities to do with suppliers, distributors and customers.

- The product, or end result, of ERP is an organisations finished goods, or services. The end result of SCM is to optimise the capacity of the organisation's total supply chain, not just that part of it which generates product.

- ERP systems react to customer demand. SCM systems, with their much wider scope, anticipate customer demand before it happens and act to stimulate it further.

- Typical ERP systems have the comparatively limited goal of estimating requirements, whereas SCM systems are focused on optimising the planning and production process.

- ERP systems tradtionally treat the production process as a serial, sequential series of steps – a result of its roots in manufacturing. SCM treats the organisation's activities as a range of synchronous processes working towards a common goal.

Effective and extended SCM is the key to survival in the age of e-business. In most traditional business processes there is an enormous amount of unproductive activity and steps that add little or no value to the production or distribution process. Paper shuffling, administrative overheads, and redundant record-keeping are everywhere in business. They will not last. In the world of e-business, maximising supply chain efficiency is the key not just to success, but to the very survival of the enterprise.