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TUTORIAL

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ABSTRACT

The last decade or so spawned a host of business and technology innovations. On the business side, we saw business process reengineering, the management philosophies of customer relationship management and supply chain management, virtual organizations, electronic commerce, and business-to-business trading exchanges. On the technology side, we saw client-server computing, enterprise resource planning systems, the widespread adoption of Internet protocols, intranets and enterprise information portals, software package support for customer relationship management, supply chain management and other activities related to electronic business, and applications service providers.

This tutorial puts put these business and technology innovations into historical context and relates them to one another through the unifying concepts of *business integration* and *systems integration*. One theme of the tutorial is the incomplete linkage between business integration and systems integration. Another is the imperfect relationship between the *management philosophies* of customer relationship management, supply chain management and electronic

business more broadly and the *information technologies* that provide applications support for these management philosophies.

Keywords: e-commerce, systems integration, business integration, business process reengineering, ERP systems, data warehousing, customer relationship management, supply chain management

I. INTRODUCTION

"The Internet changes everything." So we are told, and so many of us believe. But what is the "everything" that the Internet changes? And how and why did the changes come about? In the last decade, we witnessed numerous extraordinary business and technology innovations, such as business process reengineering, enterprise resource planning systems, and electronic business, to name just a few. Each of these innovations is the topic of popular books, research studies, and even whole courses in university curricula. But they are not discrete phenomena, as their separate treatment would suggest. They are related to each other, and they have emerged from a matrix of business and technology change that has been evolving for decades. Therefore, they beg to be examined in historical context and in relation to one another.

This tutorial is an admittedly preliminary unified treatment of some key business and technology trends of the last decade. The unifying theme is the concept of integration. The main arguments are that business integration and systems integration are imperfectly linked and that the applications of electronic business incompletely realize the management philosophies of business integration. The tutorial has four sections: business integration, systems integration, enterprise systems and services for electronic business, and the linkage between systems and business integration.

I am very interested in your reactions (and your students' reactions) to this material. If you send me your comments (islynne@cityu.edu.hk), I will discuss

them in a further contribution to CAIS. Alternatively, CAIS (cais@cgu.edu) would welcome extended rebuttals or different perspectives on the issues raised here.

II. BUSINESS INTEGRATION

This section first defines business integration. Next, the business problems created by lack of business integration are explained with examples. Finally, the origins of lack of business integration are described.

"*Business integration*" is the creation of tighter coordination among the discrete business activities conducted by different individuals, work groups, or organizations, so that a unified business process is formed. Business integration is often believed essential for successful electronic commerce of both the business-to-business and the business-to-consumer varieties.

Business integration can take place within a single organization, as when various engineering, marketing, and manufacturing activities are synchronized into a new "product development process." This form of integration is *internal* business integration.

Or business integration can take place across organizations, as is the case, for example, with Cisco's order fulfillment process: Cisco makes less than half of the products it sells, and most of these products are shipped directly to Cisco's customers without ever passing through Cisco's warehouses. Together, Cisco and its suppliers form a tightly integrated order fulfillment process. Another example of business integration occurs when the customers of the Charles Schwab brokerage house use Schwab's systems to purchase Fidelity Investment's mutual funds. To the customer, Schwab and Fidelity appear to be an integrated business entity. This form of integration is *external* business integration.

Business process reengineering (BPR) is a methodology for achieving internal business integration (integration inside a single company). It involves a top-down approach to business process redesign that often results in major improvements by eliminating *gaps* in the work efforts of two or more departments and *duplications* of efforts across these units.

External business processes also need integration, but no generally accepted methodology for external integration as yet exists. The reason business process reengineering does not apply well to external business processes is that different companies often operate autonomously: there is no higher authority to orchestrate a top-down approach. Inter-organizational business process redesign is difficult: it involves collaboration and careful negotiation among different companies.

THE BUSINESS PROBLEM

Why do companies seek out business integration? The short answer is that customers demand it. Two of the most common business integration scenarios involve presenting "one face to the customer" and having "global inventory visibility" so that the company knows whether products are "available to promise" to the customer.

Consider this common scenario. A company makes several different product lines, each requiring different technology, raw materials, skills, and capabilities to build. Today's best business practice for managing such complex manufacturing activities effectively is to have a different division for each product line, with each division managing its own workers, production facilities, purchasing, and manufacturing schedules. (This strategy is known as the management philosophy of "decentralization".)

But now think of the poor customer who wants to buy products from several divisions. The customer may have to place a new order for each product, filling out different order forms, paying different invoices, remembering different numbers to call to inquire about orders or service. And even if the customer is placing a huge order overall, the customer may be unable to negotiate a good discount because the order is spread across many different divisions. The multidivisional petroleum products company Elf Atochem formerly found itself disappointing its customers in this way, because it could not act internally like a single company vis-à-vis its customers. (Elf Atochem later tried to solve these problems by implementing an enterprise resource planning system.)

A related example is a distribution company with offices in many geographic locations, all selling the same products. Each office might set its own prices and discounts, so that a customer buying a particular product in several different locales might pay different prices for it. Some customers might take advantage of the situation and encourage different parts of the distribution company to compete with each other to gain the customers' business (clearly not a desirable situation for the distribution firm). But some customers get angry when they are charged different prices for the same product and demand that the supplier act as a unified entity and price its products based on the total volume of products ordered, regardless of which location ships them. Pharmaceuticals distributor Cardinal Health found itself in this unenviable position. (Cardinal later consolidated disparate systems and implemented data warehousing to address this problem.)

It is increasingly the case that large customers expect their large suppliers to be easy to do business with. From the suppliers' side, being easy to do business with is often referred to as "customer relationship management (CRM)." The *management philosophy* of CRM requires integrating all the business processes associated with a customer relationship. Usually, realizing the management

philosophy of CRM requires *computer-based systems* that combine (or integrate) operational data about products, prices, customer orders, etc., regardless of the supplier's geographic dispersion or internal management structures. However, implementing the CRM philosophy faithfully usually requires other kinds of changes—such as the restructuring of sales territories, incentives, and marketing responsibilities—in addition to computer-based tools. (Confusingly, the computer-based applications are often called CRM—the same name many experts give to the broader management philosophy.)

Another business integration scenario is the "available to promise" scenario. In this scenario, the supplying company makes a product with a long "supply chain." An example is electronic products assembly: electronic products may consist of many different parts or assemblies, manufactured by different divisions or companies located all over the world. A single missing part can prevent the completion of the final product.

Customers placing orders with an electronic products supplier know exactly when they need their orders to be delivered to various locations. But unless the supplying company knows the status of finished products inventory, raw materials inventory, manufacturing capacity and suppliers' lead times for every item that goes into a customer's order–a situation that is referred to as "global inventory visibility"—the supplier may not be able to promise delivery at a specified time. When that happens, rather than trust that they'll get their orders on time, the customers often go to a competitor who does have inventory "available to promise".

Hewlett-Packard is a company that has achieved a high degree of global inventory visibility and "supply chain integration." Companies like Nortel Networks are working very hard to achieve this goal.

The business integration required for “available to promise” capability is often called “supply chain management” (SCM)—a *management philosophy* involving new ways of dealing with suppliers. Achieving good SCM usually requires the implementation of *computer-based systems* that can coordinate and integrate information from many different manufacturing facilities and suppliers, who otherwise work independently of one another. Again, however, there is more to successful SCM than the implementation of tools. (And, again, the systems that support SCM are often confusingly referred to by the same name as the management philosophy.)

THE ORIGINS OF THE LACK OF BUSINESS INTEGRATION

If business integration is so important, how is it that so many companies lack the abilities to provide one face to the customer or to promise the scheduled delivery of their products? The origins of lack of business integration are simple. Most small companies produce only a few products, and simple management structures are sufficient to ensure effective business performance. But, when companies first started to grow very large and to produce diversified product lines (in the post WWII era), simple centralized management structures (with all the decision-making concentrated at the top) could not cope with the complexity. The management philosophy of “decentralization” was born. Companies were broken into different units (often product based), and the heads of these units were given the authority to make all important decisions. By the 1970s most large companies had adopted decentralized management structures. Their heads developed their own “management information systems” (originally manual, then computerized) to supply them with the data they needed to make business decisions well.

This whole process worked fine until companies realized that serving customers effectively required an approach that coordinates their internal efforts across product divisions and functions. This realization hit US businesses during the recession of the late 1980s. The management philosophy of integrating the

diverse parts of organizations came to be known as business process reengineering (BPR).

The leading advocates of BPR advised companies to take a "clean sheet" approach to the design of their business processes. In other words, companies should forget about the ways they had always done things in the past and should figure out how to do things most efficiently and effectively as seen *through the customers' eyes*. By doing so, companies would achieve, they were told, improvements on the order of ten times or even one hundred times better than they were doing now.

Many companies tried reengineering and achieved spectacular results. But many other companies were disappointed for a whole range of reasons. Sometimes they didn't follow the philosophy carefully enough; sometimes the degree of human resistance to major organizational changes was too great. But one additional important reason for BPR's failure achieve its promised success had to do with companies' information systems. They had been designed and built to support a different way of working and could not easily be adapted to the redesigned business processes. When executives saw the price tag for the systems changes necessary to support streamlined business processes, they often decided to cancel their reengineering plans.

Just a few years later, "the year 2000 (Y2K) problem" reared its ugly head. Companies learned that their computer systems had not been programmed to accommodate dates in a new century and millennium. The upshot was that they were going to have to modify or replace their information systems anyway or run the risk of not being able to do business. Many companies used Y2K as an opportunity to revisit their BPR plans. Today, smart companies are achieving business integration through a combination of new management philosophies like BPR, CRM, and SCM on the one hand, and systems integration and

applications like enterprise resource planning systems and customer relationship management software on the other.

SUMMARY

Large and complex companies need business integration to serve their customers effectively. (Even small companies need business integration when they band together with other small companies to compete with larger businesses.) Business integration requires streamlined business processes and integrated information systems capable of combining information from many sources. Systems integration is the subject of the next section.

III. SYSTEMS INTEGRATION

This section first defines systems integration. Next, three broad categories of systems integration solutions are described. Lastly, the origins of unintegrated systems are discussed.

Systems integration refers to the creation of tighter linkages between different computer-based information systems and databases. Systems integration is often required to achieve business integration. For example, a bank may have one system to process checking (current) account transactions and another to process credit card transactions. For business reasons, the bank wants to know how many current account holders also have credit cards, but their existing systems won't tell them, without a great deal of manual effort—such as special programming. With two unintegrated systems, it might be necessary, for example, to extract data from both systems (by printing it out or downloading it) and load the data into a third system for analysis. (In a bank, this third system is likely to be a custom-developed mainframe application, but in many other situations, a spreadsheet program like Excel would be used to do the integration.) Unfortunately, in some cases, it is not possible to achieve business objectives by integrating systems in this way, because the individual systems do

not contain the data needed, in the correct format, to permit the desired analysis. (For example, the business term “sale” or “customer” might be defined differently in the two systems so that aggregation is meaningless or matching impossible.)

When companies first began doing business with consumers on the web, they often made the mistake of creating separate systems to track their “e-commerce” orders. But people often switch back and forth between ordering on the web and ordering by phone. Imagine the problems when they call the web-only customer support line and ask about their telephone orders! I had a similar problem recently when I wanted to cancel my unexpired subscription to the print version of the *Wall Street Journal* and apply the credit to my subscription to the *Wall Street Journal Interactive Edition*. I was told that this could not be done because each edition has completely separate administrative systems. Each edition is also a completely separate business entity, and this is apparently a sensible strategic decision on the part of the *Wall Street Journal*. But the more general case is that the business need requires integrated customer information across all marketing channels (this is CRM, the management philosophy, again) and lack of systems integration can prevent it from happening.

So, generally, it is not ideal for a company to have unintegrated systems. But there are degrees of integration. One way to integrate systems is to build a software bridge, or *interface,* between two programs, so that data from one system is more or less automatically transferred to another system, on some schedule. This interfacing approach works fine when there are only two systems to connect. But when there are many systems exchanging data with each other, there are many interfaces. Figure 1 shows a conceptual model of systems integrated with interfaces. And it can become extremely expensive and time-consuming for an organization to maintain all the interfaces.

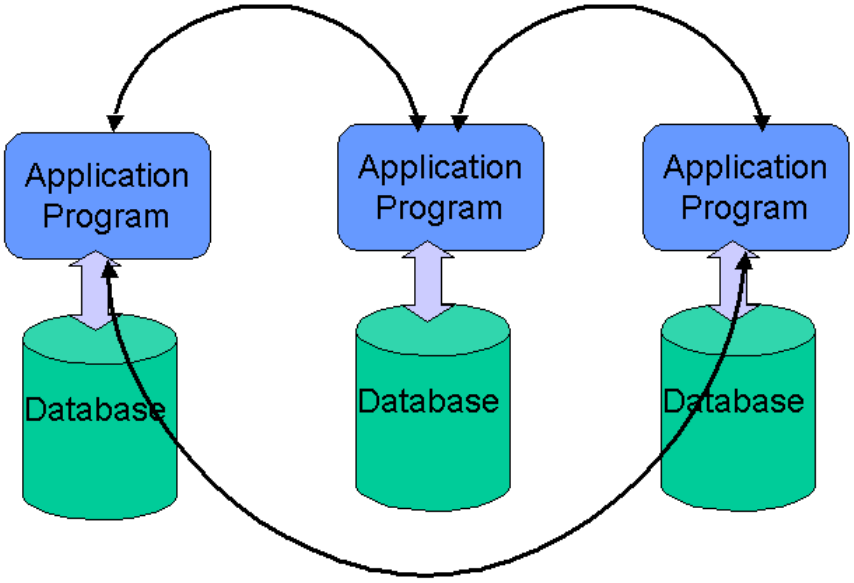

Figure 1. Systems Integrated with Interfaces

Why maintain? Many business programs are constantly being changed: a payroll program needs changing every time wages and salary legislation is changed. If a change in a business program affects its interfaces with other programs, the interfaces may need reprogramming. This “maintenance” activity can significantly slow down the rate at which an organization can adopt systems changes in response to business needs.

THREE BROAD SYSTEMS INTEGRATION SOLUTIONS

Generally, when an organization has many systems, it needs a better approach to integration than building many discrete interfaces. Today, there are three broad approaches to systems integration.

The first approach is called data warehousing. In the data warehousing approach, an organization generally leaves its "source" systems alone (the systems that contain the needed data). Instead, the company makes extracts from these systems on a regular basis and loads them into a "warehouse" from which all sorts of sophisticated analyses can be done using a standard set of analysis tools. There is really a lot more to it than that, but the result is much better than the Excel spreadsheet type of integration discussed above. This approach has the disadvantage that, while it integrates the company's *data* at a highly aggregated level, it is usually not detailed enough to support integration *of operational business processes*. Figure 2 presents a conceptual model of data warehousing.

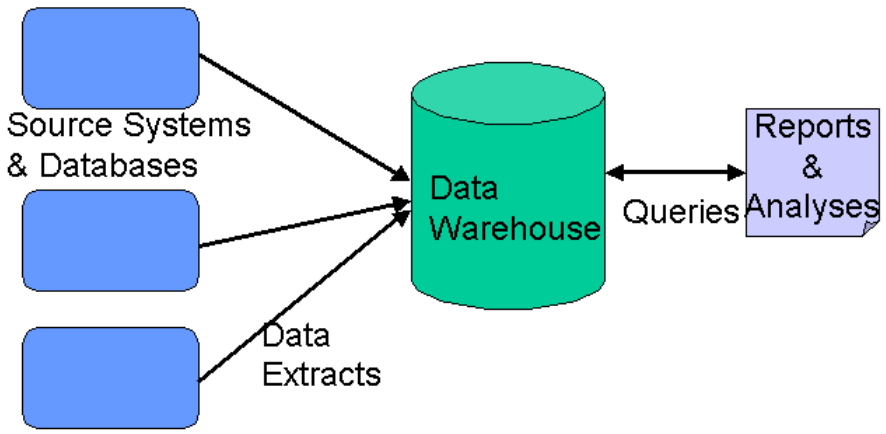

Figure 2. Data Warehousing

The second approach is to adopt an integrated software package, sometimes called an enterprise system or ERP system (for enterprise resource planning). The leading vendors of such systems are SAP R/3, Oracle, Peoplesoft, JD Edwards, and Baan. In these systems, the different computer-based applications—such as sales order entry, inventory, and accounting systems—all use a common database. As a result, when a sales order is entered, the financial system is automatically updated. And because detailed data are stored, it is possible, in principle, to do sophisticated analyses of the data. In practice, most companies with integrated packages like SAP R/3 will also need a data warehouse to facilitate routine management reporting and decision support analyses. (But it is *not* the case that all companies with data warehouses have an integrated source system.) The need for data warehousing in addition to ERP stems from the problems of using the operational ERP systems for ad hoc queries and from the need to integrate data from other sources (e.g., legacy systems not replaced by the ERP system or external data such as the demographics of potential customers). The ERP approach to integration has the disadvantage of frequently requiring a great deal of business process change (reengineering) and organizational disruption. Therefore, it is a costly and failure-prone initiative. Figure 3 shows a conceptual model of enterprise systems.

The third approach is to "re-architect" the systems so that an intermediate layer is created between applications programs and databases. This approach uses commercial off-the-shelf technologies called "middleware" and "enterprise application integration" or EAI. (The applications programs are modified to "call" the middleware, which then "calls" the databases.) Ideally, this approach allows a particular program to be replaced without changing the database. It also reduces the maintenance burden. Instead of having to maintain a separate interface between each system and all other systems it connects to, there is only the interface between each program or database and the middleware to be maintained. This approach does not require much business process change, but

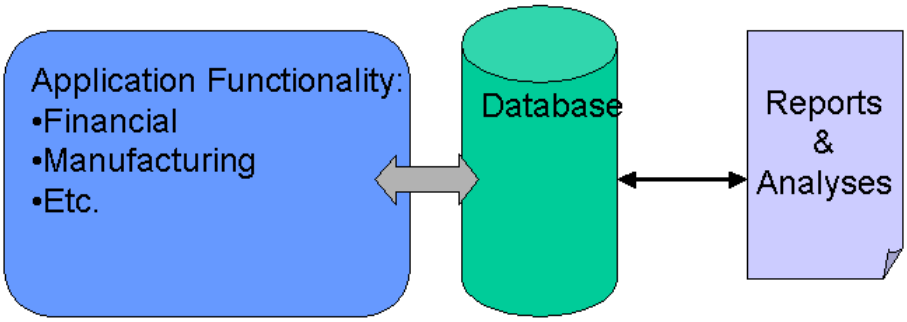

Figure 3. Enterprise Systems

particular program to be replaced without changing the database. It also reduces the maintenance burden. Instead of having to maintain a separate interface between each system and all other systems it connects to, there is only the interface between each program or database and the middleware to be maintained. This approach does not require much business process change, but it requires a vast amount of technical expertise, and the technology is still in its "shakedown" phase. Thus, industry as a whole is still not entirely sure that the technology will work as desired or what it will take to achieve success reliably. (Today, EAI is said to work reasonably well between pairs of systems, but to be "iffy" where multiple applications are concerned. The success of this technology is clearly a trend to watch!) All new information technologies go through a shakedown phase—data warehousing and enterprise systems were no exception. It's just that data warehousing and enterprise systems are now more

mature than the re-architecting solution is. Figure 4 is a conceptual model of the re-architecting solution.

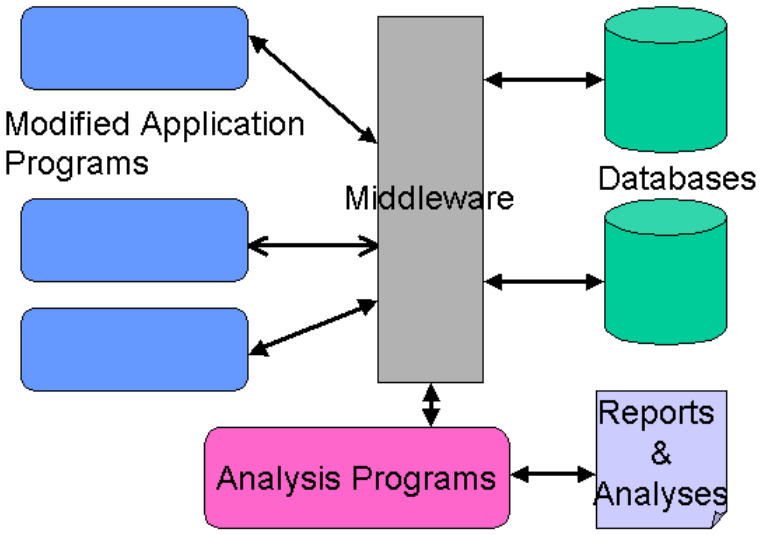

Figure 4. Re-Architected Systems

Each of these solutions has pros and cons. (Table 1) All of them can be very expensive to put in place. They all require scarce technical expertise. And there are many failures, even when the technologies are relatively mature. Worst of all, there is no real guarantee that a successful implementation of integration technology will actually deal effectively with the business need for integration. Success *for the business* requires very close alignment between the business need and the technical solution.

Up until now, we've been talking mainly about systems integration *within* an organization. Systems integration is also needed *across* organizations. Consider two small businesses, one of which buys its supplies from the other. Both organizations may maintain in-house computer-based systems to keep track of

TABLE 1. PROS AND CONS OF VARIOUS INTERNAL SYSTEMS INTEGRATION STRATEGIES

STRATEGY	Pros	Cons
Data Warehousing	• Achieves *data* integration without changes in source systems or business processes • Accommodates both internal data and *external* data (e.g., purchased marketing data) • Provides integrated environment for reporting, data analysis and data mining • Can sometimes be justified and implemented as a technology-driven IT infrastructure project	• Can't compensate for poorly designed data structures in source systems • Generally involves data aggregation • Doesn't support *process* integration • Standardization of data names and data cleaning can require extensive effort and business involvement • Business involvement and significant training are required to benefit from data mining
ERP System	• Achieves excellent internal *data and process* integration when all legacy systems are replaced • Can produce significant business process improvements through adoption of built-in best practices	• Often requires extensive organizational change and hence business involvement in justification and implementation • Certain industry- and firm-specific business processes are not supported by ERP systems; some legacy systems are usually retained • Does not provide integrated reporting and analysis environment for internal *and external* data
Enterprise Applications Integration (EAI)	• Achieves internal *data* integration and can support *process* integration without replacement of legacy systems • Supports use of "best-of-breed" applications from multiple vendors • Can sometimes be justified and implemented as a technology-driven IT infrastructure project	• Requires some modification of source systems ❑ May work better with unmodified industry standard source systems • Process integration requires organizational change and business involvement • Immature technology ❑ Vendor proliferation ❑ Support for n-way integration is still experimental • Proprietary technology ❑ Inability to combine different EAI solutions, for example after mergers

sales, inventory, financial accounts, etc. But what happens when they do business with each other? One company produces an order, maybe even printing one out from its own computer system, and faxes or mails it to the other. There, the order is entered into the other company's computer system and an invoice is generated and printed out, and then the invoice is faxed or mailed to the other company. (Actually, this also sometimes happens in large companies!)

Since both companies are using computers, you may wonder why they don't just communicate automatically, computer-to-computer? Some companies do, using a technology called EDI (or electronic data interchange). But be careful about what companies really mean when they say they're using EDI! EDI is usually defined as *automatic*, direct computer-to-computer processing. However, only in a very few cases (usually the largest firms) are both sides of an EDI transaction able to handle it automatically, without manual intervention. Many EDI users print out computer-generated order forms or invoices and enter the information manually into their computer systems.

Why is this so? It requires considerable technical expertise (and expense) to create (and maintain!) the interfaces between computer-based systems. Many smaller companies do not have this expertise, even if they have the money to afford the basic technology needed for EDI. (EDI is very expensive.) And of course many of the smallest companies cannot afford EDI at all. Therefore, many people are very enthusiastic about the opportunities for the Internet to provide a lower cost alternative for inter-company systems integration that all companies can use. Nevertheless, some significant barriers will have to be overcome before this rosy scenario becomes a reality. Even if it does, there are no guarantees that the highest levels of integration (automatic, with low cost maintenance) will become available to all participants. In the future, as today, some companies may still be printing out orders and invoices and manually reentering them into their computer systems.

THE ORIGINS OF UNINTEGRATED SYSTEMS

Since lack of integrated systems can be such a hindrance to business integration, you may well wonder how lack of integration came about. First of all, it's important to realize that business integration was not always as valued as it is today—and therefore systems integration was seen as unnecessary. Back in 1982, a famous Harvard Business School professor pooh-poohed the idea of integrated systems. He called them a mirage and claimed they were not needed. Around the same time, I was studying a huge American telecommunications company where executives believed in "universal communication access" for all. When I asked them why they had seven different email systems that couldn't communicate with each other (analogous to having different telephone systems in different cities with no ability to make a long distance call), they told me "people in Marketing don't need to talk to people in Engineering."

Today, people think differently. Today, we know it is a problem when engineers and marketers don't talk to each other: when that happens, the process of new product development doesn't work. Because we recognize the need for business integration, we are much more likely today to build systems that are integrated than we were ten years ago.

But there are other factors as well. We sometimes forget that we have more computer power today in our Palm handhelds that did the largest corporate mainframe computers in the 1960s. Because, until quite recently, business computers had severe capacity constraints, systems were often built only to serve small parts of the business. If you needed another system, you often had to buy another computer. And, since computers were extremely expensive, funding them was a problem. Richer departments or divisions would commission systems that met their needs, and poorer parts of the organization would be left out.

Today, the costs of computing and software are way down and the power of systems is way up. But old habits die hard, and it is sometimes still hard to convince people of the benefits of systems integration. Generally, however, new companies and smaller companies just starting to invest heavily in computer-based systems will often choose integrated systems. And many established companies are seeking systems integration at great expense so that they fulfill their objectives of business integration.

Finally, it is important to note that even the best "integrated systems" of today are less than fully integrated. It has been estimated that in the *best* case, integrated enterprise systems only address about 70% of the needs of the average organization. Therefore, the typical organization will need to buy additional new systems or retain older "legacy" systems to handle certain critical needs. Because business needs require these additional systems to work with the core integrated systems, everything will need to be—integrated. Similarly, internal data cannot satisfy all of a company's needs for analysis; external data (most often, economic and marketing data) are purchased from external data providers and then integrated with internal data (via a data warehouse). And, with more companies outsourcing critical functions (as Cisco outsources much product manufacturing to suppliers), the internal systems of the business partners will need to be carefully integrated. In today's computing environment, there's just no getting around the need for systems integration.

SUMMARY

Unintegrated systems create various kinds of problems for companies. First, they may prevent a company (or a set of cooperating companies) from putting in place streamlined business processes or from achieving some other business integration goal like "putting one face to the customer." Second, they may prevent a company (or a set of cooperating companies) from analyzing data for

making important decisions, even when the data can be found somewhere in the company's computer-based systems.

Companies today are using a variety of approaches for integrating data and systems, including: data warehousing, integrated enterprise systems, re-architecting systems using EAI, or some combination. The solutions are far from perfect, however. They are expensive and failure-prone, they require scarce expertise, and they frequently entail organizational disruption. Further, even when technical integration is achieved, the goals of business integration may not be. Put differently, it is possible to have *more* technical integration than the business needs or to have *the wrong kinds of* technical integration. Buyer beware!

IV. ENTERPRISE SYSTEMS AND SERVICES FOR ELECTRONIC BUSINESS

The systems integration approaches discussed in the previous section are intended to provide a company or a set of collaborating companies with an "infrastructure" (e.g., analogous to a city's roads and bridges) to support electronic business. But they are not sufficient for electronic business. Also needed are what we call the "applications" or "services" of e-business (e.g., analogous to a city's transportation services, retailing establishments, restaurants, etc.). This section provides a whirlwind description of the commercially available applications and services for supporting electronic business. The applications are discussed in three categories: buy-side e-commerce tools, sell side e-commerce tools, and portals. (Here, I use the terms electronic business and e-commerce interchangeably, although purists identify differences.) Then, the services are discussed: applications hosting, business process outsourcing, and hubs, exchanges, and vortals.

E-BUSINESS APPLICATIONS

Today, the most important categories of e-business applications are sell-side e-business applications (including CRM *software packages*, as distinct from the CRM management philosophy) and buy-side e-business applications (including SCM *applications*, as distinct from the SCM management philosophy). Other applications pull various software capabilities together into unified presentation frameworks, called *enterprise information portals*.

Sell-side E-commerce Tools

A great many separate computer-based systems fall under the heading of sell-side e-commerce. Sometimes the name CRM is given to this entire array of tools, or to some vendors' offerings in this area, giving the impression that sell-side e-commerce technology is a single integrated system, analogous to an ERP system. But this terminology is misleading.

First, there is confusion between CRM as a management philosophy and CRM as software—a very dangerous confusion. People sometimes believe that installing CRM software will automatically achieve the business benefits of CRM the management philosophy. But unless a company adopts the CRM management philosophy and makes the corresponding changes in the company's business practices (e.g., restructuring sales territories, changing commission systems, ...), the software alone is unlikely to produce satisfactory results.

Second, sell-side e-commerce and CRM software are very immature applications. There is no consensus about what exactly CRM, the management philosophy, is and how to support it with software. Many vendors are selling a wide range of CRM software products designed for different purposes with little guarantee that they will work together in a coherent fashion. Over time, the normal technology development trajectory will follow its course in the CRM area

as it has done for ERP software and many other technologies: products will fail, vendors will go out of business, successful vendors will purchase the products of other companies and knit them together into a coherent whole, a consensus will form around the key features and functions needed in CRM software, and a small number of dominant vendors will emerge. In the meantime, we have a chaos of experimentation as new approaches are developed and tried. So, today's picture of sell-side e-commerce is provisional, at best. Regardless, four categories of sell-side e-commerce tools are described below.

Data analysis, data mining, and business intelligence. One category of sell-side e-commerce tools is a familiar class of IT applications renamed for greater appeal. As mentioned before, companies have always had the need for sophisticated data analysis capabilities, formerly called "decision support." Today, the infrastructure for decision support is data warehousing, described earlier as a data and systems integration approach. One of the most important uses to which data warehousing capability is put is "data mining" particularly in the area of marketing. For example, data mining pioneer, BankAmerica, developed the capability to analyze the characteristics of current customers who use certain services. Then, using external data purchased from market research firms and other data vendors, the Bank is able to target prospective customers with similar characteristics. In this way the Bank has been able to improve the success of its marketing efforts, while reducing its costs. Similar analyses can be applied to other aspects of customer relationship management, such as customer retention, customer profitability, etc. (Actually, there are subtle distinctions between decision support and data mining. The former involves more analysis; the latter involves more synthesis.)

Electronic "storefronts". Another key capability required for consumer-oriented electronic commerce is a web site containing product catalogs, tools to configure complex products (like personal computers), secure payment technology, and customer support features. Just a few years ago, e-commerce pioneers had to

build these web sites for themselves. But today any number of packages are available on the market, considerably reducing the expense of starting up an electronic storefront. In addition to commercial software packages, of course, companies have the option of buying commercial services—getting another company to set up run websites and help desks for them. (These services are discussed below.)

Call center management. Even when customers do their shopping research on the web, they do not always buy online: they may place their orders by phone or fax (or even buy products in a retail store). Often, product selection and purchase are just the first steps in a series of interactions with the selling firm: customers may need help using the products they've purchased, they may want to place repeat orders, and they may need to order ancillary products and support. Call center management refers to the entire business process (and management philosophy) of customer support: sales, help, and service. Call center management software can help companies with various aspects of managing a telephone "call center" (banks of customer service representatives to answer customers' telephone calls, faxes, mail, and e-mail queries). The software has features such as routing calls to the next available or most qualified representative, monitoring wait times so that more operators can be brought on line, keeping track of the number of help or service queries successfully addressed in a single call, and providing essential links between different selling channels (retail, phone, fax, and web). Some companies outsource call center management to service providers.

Sales support. Not all companies sell direct to consumers. Many rely on a sales force of employees or agents to convince business customers to buy their products. Field sales forces represent a considerable expense, and companies are always on the lookout for ways to increase their effectiveness or to reduce the costs of this marketing approach. A class of software tools helps companies keep track of sales calls made on customers and their outcomes. By sharing this

information internally, a field force can avoid duplicate effort, identify promising customer segments, and determine the most successful selling tactics. (However, companies often find it difficult to implement sales lead sharing arrangements if they have incentive systems that discourage cooperation.)

Buy-side E-commerce Tools

Companies also need to manage their relationships with suppliers. *Procurement* is often divided into two distinct areas—the sourcing of the critical raw materials used in product manufacturing (e.g., semiconductors in computer manufacturing, petroleum in refining) and the sourcing of ancillary operating resources consumed in the course of business (e.g., office supplies, travel and temporary personnel services, lubricants and spare parts for production machinery). The first process is referred to as "supply chain management," the second as "operating resource management".

SCM Software. All the products and services a company buys can be considered to be part of its supply chain, but the term supply chain management (SCM) is usually reserved for the critical or strategic components of the company's products. For example, the term SCM would usually be applied to a PC assembler's purchase of semiconductor memories, but not to its purchases of paper or travel services.

Today, the SCM tools about which interest is greatest are software packages to support what is called "advanced planning and optimizing." Recall the discussion of the business need called "available to promise." Advanced planning and optimizing software provides the critical support for available to promise. This software takes as input information about customer demand, current inventories and production capabilities, and suppliers' capabilities (lead time, historical performance) and yields information about optimal production and shipping

schedules and the company's ability to deliver a particular customer order to a specified location at a particular time.

Other SCM tools help with various logistical processes such as transportation management, warehouse management, and so forth. These processes can be extraordinarily complex and, as a result, companies sometimes outsource them to (that is, buy business services from) specialized transportation companies such as UPS and Federal Express.

Procurement Support. Manufacturing companies buy many things other than strategic raw materials, and services firms may also spent a great deal of money in "purchasing" even though they don't manufacture a thing. What are they buying? Travel services, temporary employment services, catering services, and a whole range of things lumped under the heading of "operating resources and materials" (another definition for the acronym ORM!): office supplies, spare parts for production and office equipment, lubricants, and MRO (maintenance, repair and overhaul services).

The total amounts expended for these non-strategic, but nevertheless essential, items can be huge. And the costs of mismanaging purchasing can be high: failure to obtain quantity discounts, carrying costs of excess inventory, and waste. On the other hand, the costs of controlling purchases can also be high: salaries for managers, time taken away from more important business tasks, slowing down the business's responsiveness to customers.

Procurement software is designed to help companies gain better control over their purchases, while lowering the costs of administrative overhead, employee frustration, and business delays. In a typical scenario (which again involves both the application of good procurement philosophy as well as computer software), a company will consolidate its purchases of say, specific office supplies, to one or

a few preferred suppliers. Then, the buyer or the supplier will prepare an electronic catalog of the products approved for purchase by the buying company's employees, and spending limits for different categories of employees will be set. Using either the supplier's extranet or the buying company's intranet, individual employees can select products from the catalog on an as-needed basis and, assuming spending limits have not been exceeded, the products will be delivered to the employee on a rapid turnaround basis. Procurement software also monitors and summarizes purchasing activity so that companies can make appropriate management decisions.

Portals

Procurement tools consolidate information and services related to buying and present them to employees in a unified format. This approach is analogous to an Internet storefront, but one that faces the *employees* of the company, instead of its *customers*. But most employees require access to much more information and many more services than just those related to purchasing. For example, depending on their job type, they also need access to:

- Information, such as company newsletters, financial statements, departmental purchasing histories, customer orders, and product shipments
- Computer-based applications, such as an ERP system (or in-house applications), e-commerce tools, decision support tools, and email
- Self-service internal administrative services, such as expense reporting and human resources (HR) management (e.g., adding a beneficiary, applying for annual leave, or changing elections of particular benefits).

In recent years, companies tried to consolidate internal information, computer-based applications services, and business services via what is called an *intranet*—an in-house web site. Using web browsers, employees access information and services on the intranet that outsiders cannot access.

But managing intranets can be as demanding as managing customer-facing storefronts, and today there are products to help companies set up and manage these complex internal web sites. Software called “enterprise information portals” simplifies the task of internal web site management. For example, not all employees are allowed to access the company’s financial data: enterprise information portals keep track of who in the company is authorized to do what, and they present to each employee only those resources the employee is allowed to see. A customer service representative, for instance, might have access to certain sell-side e-commerce tools, self-service human resources services, and perhaps, with very low spending limits, to the company “store” for purchasing office supplies. An accounting manager might have access to financial systems, data, and decision support tools, to the store, to the administrative applications, and to email and personal productivity software.

ERP system vendors were relatively slow to react to business demand for sell-side and buy-side e-commerce tools and portals. Most of the early products in these categories were developed by startup, independent software vendors (ISVs). But ERP vendors are rushing to catch up. They bought some of the ISVs, made marketing agreement with others, and developed their own product offerings. For instance, the leading ERP vendor, SAP Inc., sells a suite of buy- and sell-side e-commerce applications, and an enterprise information portal by the name of mySap.com. Unfortunately for customer comprehension, SAP also uses this same name to refer to a very different type of service offering—an inter-organizational exchange, discussed below.

E-BUSINESS SERVICES

At various points, our discussion referred to reliance on external service providers instead of the in-house operation and management of e-commerce

tools. No treatment of e-business technology support would be complete without coverage of the burgeoning services market.

Acquiring products and services from outsiders, rather than developing, operating and managing them in-house is referred to as *outsourcing*. In the early days of business computing, only computers and custom programming services were outsourced. Most business software was custom-developed by computer-using companies. Gradually, a market for *business software packages* developed, culminating with ERP systems and e-business applications.

But some companies did not have the expertise or desire to build or buy and run applications for themselves. A market for *IT operations services* began to grow. One common form of outsourcing involves a third party that specializes in a particular, relatively standardized business activity, such as payroll processing. The vendor develops and maintains software and runs it on a shared basis for customers (keeping their data separate, naturally).

Sometimes, in addition to IT operations services, the vendors provide *business* services in their area of expertise (e.g., expert advice about payroll issues). In this case, the vendors are more accurately called *business process outsourcers* than IT services firms. An example is ADP, a company that operates like the payroll department of their customer firms. Behind the scenes, the customer of a business process outsourcer is sharing the outsourcer's software, hardware, and personnel with other customers. Formerly, this form of outsourcing was most used by smaller companies, and it was only available for a few generic business activities.

A second form of outsourcing became common in the 1980s. In *total outsourcing*, the customer sells its computers and software (often custom-developed) and transfers its in-house IT professionals to an external service provider, who

continues to manage the applications for the customer in exchange for fees. Thus, a customer could transform a fixed capital outlay for computing power into a variable expense. Customers benefit from improvements in their balance sheets, professional IT management, and cost reductions owing to the providers' efficiencies and (sometimes) to sharing the use of computing hardware (but not usually software) with other customers. The defining characteristic of this type of outsourcing is that each customer retains, unshared with others, its own applications and data.

(Companies can also, of course, outsource just a small part of their internal IT management, such as the maintenance of PCs or the operation of their telecommunications network. This approach is called *selective outsourcing*.)

Recent years brought outsourcing innovations. One innovation is called *application hosting*, which involves a third party running commercial software (developed and sold by some other vendor) for customers. The second is a radical extension of *business process outsourcing* into a far wider range of shared business services (including accounting, human resources management, and warehousing, transportation, and logistics) coupled with IT support. The third innovation, called by a host of names including *hubs, exchanges,* and *vortals*, is a special case of business process outsourcing involving *collaborative* sell-side or buy-side e-commerce. We now discuss each of these.

Application Hosting

Today, the term in vogue for IT services outsourcing is application hosting, and the companies that provide application hosting are called *applications service providers* or ASPs. Actually, interest in ASPs is so great right now that many IT services companies are calling themselves ASPs, even if they don't provide application hosting; examples include some consulting firms that specialize in e-

commerce technology. So it is important to look carefully at the business models of companies claiming to be ASPs.

What is different about application hosting that warrants a name other than outsourcing? The skeptic may say not much. One difference is that is that, in traditional outsourcing, the software managed by the outsourcer was custom developed either by the customer or by the outsourcer. By contrast, the software managed by ASPs is a commercial product developed by an ISV, such as an ERP system vendor or an e-commerce tool vendor. In other words, the ASP is a third party operating between the customer and the software vendor. (Some ISVs are getting into the ASP business, but to do so they need to create separate business lines, since hosting is a very different business from software licensing.)

That difference aside, there are two variations on the ASP model. In one, the customer commissions the ASP to run a particular instance of enterprise software configured just for them. Contractually, the customer licenses software from the ISV and engages the ASP to run it. The customer accesses the software via the Internet, avoiding the need to manage local application servers and clients.

In the second variation (which, some say, is the true ASP model), ASPs acquire enterprise software from ISVs and operate it on a shared-services basis for many customers, keeping their data separate, of course, and charging them on a per transaction basis. This model is probably more vision than reality today. It remains to be seen how the ASPs will be able to provide tailored services to different customers under this model. Only time will tell whether the shared services ASP model will work. In the meantime, many companies announced their entry into the ASP market, and a shakeout is said to imminent.

As of today, ASPs have had little success selling the hosting of ERP systems, which many companies have already implemented in-house. But application hosting is increasingly popular among companies newly adopting ERP extensions like CRM software, because hosting allows them to get up and running much faster than in-house implementation. This suggests that ASPs may grow in popularity when companies replace their current enterprise systems.

Business Process Outsourcing

Formerly confined to a few process segments like payroll and general ledger, business process outsourcing mushroomed in recent years as a result of the business process reengineering movement. Through BPR, large companies learned that decentralization had created duplication of efforts and high costs in "non-core" areas such as employee expense accounting, accounts payable and receivable, and human resources management. They began setting up "shared services" inside their corporations to provide administrative processes (and the associated IT support) to the various divisions. It was only a short step to the realization that business process services could be provided on a contract basis by third-party providers who had amassed considerable expertise in the process domain. (For these specialist firms, the process was a core, not a non-core activity!)

At the same time, a large number of traditional products and services firms began to realize the profit potential of taking over their customers' business processes. Today, business process outsourcers specialize in almost every aspect of business activity, from manufacturing and warehousing to transportation and logistics. For example, as mentioned earlier, Cisco markets products manufactured by many other firms. And UPS supplies people in Gateway's manufacturing facilities to pack and ship Gateway computers.

Today's business process outsourcers often provide services tailored to the needs of individual customers. But they support these services with an information processing capability that is shared by all customers. (Data, of course, are not shared.)

Hubs, Exchanges, and Vortals

A third type of outsourcing is usually described as a new e-commerce business model. Variously called hubs, exchanges or vortals (a contraction of "vertical portal") and many other names, these outsourcers provide shared business process services (and associated IT support) to members of a collaborating community of businesses (most usually, buyers and sellers in a vertical or horizontal industry category). An example is e-Steel, for the buying and selling of steel products.

Today, the IT support that exchanges provide consists primarily of passing transactions data between participants.. But the possibility exists for these companies to take on a much bigger role in business information processing. This possibility is best contrasted with the situation in which a company sets up its own buy-side e-commerce capabilities with purchased applications.

When a company sets up an in-house purchasing application, the company incurs a certain administrative burden in exchange for benefits. Generally, to keep the burden low and to reap the advantages of quantity discounts, the company will restrict itself to a handful of suppliers. Modern procurement philosophy argues that such "strategic" partnerships with suppliers can be a good thing where *strategic* raw materials are concerned, but strategic partnerships are *not* recommended (though increasingly used) in the case of *commodity* products such as office supplies. In the case of commodity products, experts say, companies should position themselves to take advantage of lower prices or better terms—and this requires arms-length relationships with suppliers and the

willingness to switch suppliers from time to time. The in-house purchasing management approach for office supplies and other non-strategic items, therefore, is not entirely consistent with today's procurement philosophy.

For commodity products, experts believe, buyers would be better off participating in *interorganizational purchasing exchanges*, in which, through a single unified software interface, they could buy from the product catalogs of many different suppliers. The exchanges, run by independent companies, provide the same types of services found in in-house purchasing software: the ability to restrict employee purchases to particular types of goods and to preset spending levels, the ability to summarize and analyze purchasing behavior. But the exchanges also enable buying companies to acquire substitute products easily, thus lowering their costs.

Purchasing exchanges are springing up in many industries today. Some exchanges are dedicated to products like office supplies and travel services that are used by business buyers in many industries. Others are specific to a particular industry group (called "vertical industry segments") such as electronics, metals, laboratory supplies, consumer products wholesaling, and steel. In the latter exchanges, the products for sale are sometimes strategic. (And of course there are the purchasing portals familiar to consumers, such as Yahoo and Travelocity.) ERP vendor SAP Inc. is one of several companies setting up exchanges for a number of vertical industry groups (a market offering the company confusingly names mySAP.com, the same name it gives to its enterprise information portal product). Some analysts estimate the number of business-to-business exchanges to be in the thousands, and most expect that eventually a shakeout will occur.

Exchanges are important, not only because of the specific business benefits they promise, but also because they may represent a very different approach to IT

management than the one most common today. Exchanges could *replace,* not just augment, companies' in-house buy- and sell-side e-commerce applications. Just as some small internet retailers today use Yahoo or Amazon.com rather than setting up their own storefronts, in the future many larger companies may even come to rely on the sophisticated IT processing services provided along with business services by the exchanges. (These ideas are developed more fully in Section V.)

SUMMARY

Companies today can buy a wide a range of computer-based applications and services to support electronic commerce. The usual view is that these computer systems and services are extensions of customers' internal integrated systems (whether ERP systems, or legacy systems integrated via EAI or data warehousing). Because these e-commerce applications connect a company with its suppliers and customers, the end result is expected to be both internal and external business integration achieved through systems integration.

But this view raises several nagging questions: How much *systems* integration is needed to get *business* integration? How much *internal* systems or business integration is needed to get *external* systems or business integration? And, specifically, can companies achieve external business integration by outsourcing systems management to shared-services providers like ASPs, business process outsourcers, and exchanges?

Companies need to be sure that they don't overinvest in systems integration. If the goal is business integration, they should not be pursuing systems integration for its own sake. Therefore, it's useful to understand the linkages between, and limitations of, the different kinds of integration. This is the subject of the next section.

V. LINKAGES BETWEEN SYSTEMS AND BUSINESS INTEGRATION

This section discusses the linkages between business and systems integration and raises the possibility that the future may call for *less* integration or *different kinds of* integration than companies have been pursuing. As a result, IT management in the future may take a very different form than it has in the past.

As mentioned several times already, the relationship between business integration and systems integration is far from perfect. Though lack of systems integration can prevent business integration, and a certain amount or type of systems integration may be necessary to support business integration, it is by no means certain that systems integration will produce the kinds of business integration required. In other words, systems integration may be *necessary* for business integration, but it is not always *sufficient* for business integration. Unfortunately, therefore, some companies over-invest in systems integration (buying more systems integration than they really need) or choose the wrong kinds of systems integration for their particular business needs.

For example, many companies have decided to pursue internal systems integration by means of ERP packages, like SAP's R/3 system. Each company subunit installs SAP, and when new companies are acquired, SAP R/3 is installed there as well. But when the pace of company acquisitions and divestitures increases (as it does in many high growth industries like hightech and biotech), the wisdom of installing integrated systems in every subunit comes into question. How can the company gain a payback from installing an ERP package in a newly acquired company (a process that can take 18 months or more and be very expensive) when the parent is likely to re-sell that company in just a few years? This could be a case of too much systems integration.

In other cases, companies obtain the wrong kind of systems integration. As discussed earlier, large companies with many locations may need global inventory visibility to acquire available-to-promise capability. And ERP systems can provide this capability, but only if they are implemented in a certain way. Each business unit, for example, must use the same names for its products, and must use common business processes around order and inventory management. So, if a large company said to its business units (and many do!) "we're going to standardize on ERP", but then lets each business unit install SAP R/3 on its own without common coordination about data names and business processes, the result can be systems integration inside each business unit but lack of business integration across them. In other words, these companies will have spent a lot of money on systems integration without achieving what they need to run the business.

VIRTUAL ORGANIZATIONS

Part of the problem in the relationship between systems and business integration is that companies today not only need business *integration*, but, on a selective basis, they also need business *disintegration* as well. One example of business disintegration is the divestiture of a business unit. If the business unit is tightly knit into the parent's business systems, it must be cut loose before it can be sold to another business. Another example is a change of a major business relationship (e.g., a supplier or customer). If two companies are tightly integrated via their EDI systems, this systems and process integration must be broken before the two can go on to work with other partners. The greater the integration of the business processes, data, and systems, the harder it is for companies to disconnect.

Today, management philosophy emphasizes business disintegration as much as (or more than) it does business integration. Businesses are encouraged to focus

on their core business (manufacturing, or distribution, or service) and to outsource all non-core activities (warehousing and logistics, human resources management, accounting) to other companies who specialize in that activity. This means that companies must un-link formerly strong internal ties and replace them with external ties—but external ties that they can break quickly to switch to other partners. This new management philosophy challenges conventional ideas about the value of strong systems and business integration.

The process of focusing on core business activities is often amusingly called "sticking to one's knitting." And the assemblages of companies that result from extensive outsourcing are referred to as "virtual" or "networked" organizations. Clearly, the networked business organization (really, a collection of cooperating businesses) requires networked information systems. But the question is whether this type of tight systems integration is the same as that we pursued in the past or whether it is really quite different, involving "quick connect, quick disconnect" linkages, rather than integration.

SYSTEMS SUPPORT FOR "QUICK (DIS)CONNECT" RELATIONSHIPS

How might companies be able to accommodate the business need for quickly connected and quickly disconnected systems between companies? One way, of course, is to maintain large in-house groups of IT specialists to build one-of-a-kind system interfaces between companies, just as many companies currently do to integrate their internal information systems. This solution is expensive, but it may ultimately be the best solution for a class of companies that are "information-intensive" or "systems businesses." Examples include banks and financial services companies, airlines and transportation companies, distributors and certain types of business "middlemen." In these companies, competitive advantage may come from the ability to introduce new computer-based products and services quickly—and the ability to implement "quick connect/quick

disconnect" linkages with business partners is a natural extension of this strong systems expertise.

For many other companies, however, competitive advantage will come from core capabilities (like new product development or marketing) other than IT development. These companies may need quick connect/quick disconnect linkages, but they will achieve no business benefits from the ability to build and maintain these linkages themselves. In other words, they will want to outsource to other companies the ability to do the necessary inter-organizational systems integration.

So who is going to do it? One likely answer is that technology companies (like IBM) and systems consulting houses (like Andersen Consulting) will specialize in providing quick (dis)connect services, just as they already specialize in internal systems integration. Another possibility is that the companies we call exchanges or vortals will provide information processing capabilities for all their business partners. So, in addition to bringing together many different buyers and sellers in a particular vertical industry through an electronic purchasing exchange, the vortals may take on the role of data processor, storing information about the transactions and providing access to this information for purposes of analysis and decision support. (Alternatively, the members of an industry trading group may choose to provide IT support for members on a collaborative basis.)

Over time, the logical extension of the vortal trend may be that participating companies no longer need to manage information processing capabilities as they do at present. Instead they may allow particular kinds of business partners to operate shared information processing services for all members of a business community. An example of such a relationship is being advocated today by logistics companies like UPS and Federal Express in partnership with leading ERP system vendors. In a concept we might call "supply chain outsourcing,"

companies outsource to a trusted third party the processes of "advanced planning and optimizing."

Earlier we discussed how, in IT-enabled supply chain management, companies obtain demand information from their customers, supply information from their suppliers, and combine this information with information about their internal production capacity to produce an "optimal" production schedule. This concept is great on paper, but implementing it requires that your business partners give you accurate and honest information about their capabilities and needs. Naturally, they may be unable (e.g., unable to estimate accurately their customers' demand for their products) or unwilling (e.g., unwilling to tell you how little they really need for fear that you will give them low delivery priority—a low trust situation) to provide you with accurate information. Some logistics companies are starting to realize that advanced planning and optimizing will probably not work if each company tries to do it alone, but that it may well work if a trusted third party coordinates information sharing and business processes for a group of related companies.

In supply chain outsourcing, the trusted third party (often logistics companies, since they are natural intermediaries) would collect information from all others (with a provision for sanctioning those who provide inaccurate data) and produce a plan for everyone to follow. In the short run, it is envisioned that each business partner would maintain its own information systems (e.g., entering data about the collaborative plan and managing internal production processes accordingly). But longer term, it may be that companies will also trust their third parties to manage the relevant systems and information for them.

THE PAST, PRESENT, AND FUTURE OF SYSTEMS MANAGEMENT

Historically, companies managed (built or bought, installed and run) their own information systems. Originally, this happened because so few companies used

computers that there was no market for business applications. Over time, the market for business software and services grew, and today it is common for companies to outsource at least part of their IT management to other companies (though information-intensive businesses like banks, airlines, and distribution companies are less likely to do so). With new business applications like CRM software, the tendency toward outsourcing is even greater, since by having another company installing and running the software, a company can get up and running much faster than if they have to learn how to do everything in-house from scratch.

Until now, much systems outsourcing takes the form of companies engaging a specialized IT products or services firm to build and/or run applications and manage data for them. Put differently, the customer company "owns" (either legally or figuratively) the systems capabilities and more especially the data. The IT specialist firm acts as a custodian of the customer's data, business processes, and systems capabilities.

This model has worked well in the past, and many companies see little need to change it. But the new world of extensive business outsourcing starts to break down traditional notions of who owns business data, business processes, and systems capabilities. If two companies jointly supply a product or service to a third party, who owns the data used and produced in the course of serving that customer? The answer is they both do. As more companies form themselves into virtual organizations and participate in hubs and exchanges rather than in pair-wise business relationships, companies may come to see their information processing capabilities and data as a shared resource, rather than a proprietary one, to be held and managed in common. If this scenario happens, companies may come to see information management as more of a cooperative activity than an internal business process, as it is has been until now.

VI. CONCLUSION

These are interesting times for business and interesting times for information management. New management philosophies are being adopted and new technologies are being invented to enable new ways of working. It is still too early in the course of these new developments to say for certain how they will evolve. What is clear is that companies need to be alert to changes in their business environments, and they must be prepared to innovate in their technologies, systems, and information management policies. Times are changing, and paradigms are shifting.

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TO DIG DEEPER

SECTION II. BUSINESS INTEGRATION

Beniger, James R. 1986. The Control Revolution: Technological and Economic Origins of the Information Society, Cambridge, MA: Harvard University Press.

Explains the historical origins of today's push for business and systems integration

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SECTION V. LINKAGES BETWEEN SYSTEMS AND BUSINESS INTEGRATION

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