GigaTS

ERP, XRP & EAI

in virtual marketplaces

Telematica Instituut

GigaTS

Colophon

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Synopsis:

With traditional ERP systems, attention is placed on internal productivity. To be able to participate in e-marketplaces, ERP systems should be extended to allow companies to participate in e-commerce. In this report, we describe ERP, XRP and EAI in e-marketplaces.

Giga Transaction Services

The project *Giga Transaction Services* supports organizations in the development of innovative transaction services. It does so with state of the art knowledge, methods and software tools that allow for effective development of new services. Giga TS takes the business perspective as a starting point, looking at networks of organizations and the way e-commerce technology can support them. Methods and tools are rooted in a combination of technological and business knowledge of currently available and future components and e-commerce applications. In this way re-use of components is promoted and time-to-market of services is reduced. Fast and effective design and introduction of e-commerce services is our central objective.

Giga Transaction Services has three main results:

- *technology scans and demonstrators*, aiming at (next generation) Internet technology as well as general e-commerce tools, components, frameworks and standards;

- *component libraries for e-commerce and electronic trade,* capturing the essential elements of business models, transaction scenarios and ICT components for e-commerce;

- a tool-supported environment for *Rapid Service Development* (RSD), a methodology for the design and development of transaction services, linked to software and e-commerce development tools.

These products are incrementally built. On a regular basis results come available to public and in seminars and on our web site (gigats.telin.nl) we actively disseminate the results.

Giga Transaction Services is a knowledge-providing project under GigaPort Applications. The Telematics Institute carries out the larger part of the work. The project emphatically tries to actively transfer knowledge and results to companies and organizations in pilot in a next generation Internet setting. Such pilots can consist of experiments with new services, the design or evaluation of e-commerce services and architectures, or company specific scans and demonstrators.

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1 Introduction

Nowadays, the back-office of many enterprises relies on various types of Enterprise Resource Planning (ERP) solutions. Traditionally, these ERP systems were focused on optimisation (planning, controlling and monitoring) of the enterprise-internal processes, and not equipped with interaction possibilities with external parties. Hence, the transition of their existing business model to an electronic commerce model is a major task. E-commerce enabled ERP is also called XRP: eXtended Resource Planning. Enterprise Application Integration (EAI) is the approach that links up the back office of the enterprise with other systems, enabling electronic commerce directly between partners (ERP-to-ERP) or via virtual marketplaces (ERP-to-market-to-ERP). A virtual marketplace can be regarded as a hub where all spokes of electronic commerce come together, and where application integration is a major issue.

1.1 Goal

The goal of this document is to discuss the current state of the art technology in the field of (extended) enterprise resource planning, application integration and virtual marketplaces. We describe how these different systems have evolved over time, what their prospects are and their mutual relationships.

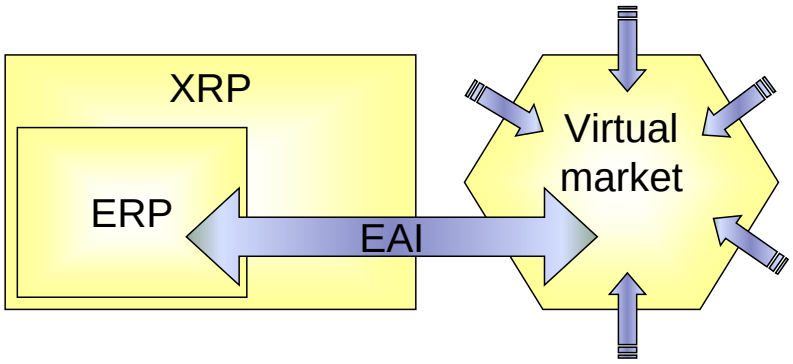

Figure 1-1: First impression of the relationship between ERP, XRP and EAI

1.2 Structure

The structure of this document is as follows. Chapter 2 elaborates on ERP systems and sheds some light on what ERP is, its main functionality, the most important vendors and user groups of ERP systems. In the next chapter, ERP is extended to XRP, and the extended solutions of the traditional ERP vendors are outlined. Chapter 4 deals with the integration of back office systems by means of EAI solutions, and outlines the most important functionality and solutions. In chapter 5, the systems are placed in the context of virtual marketplaces. And the last chapter describes the most important conclusions concerning the use of ERP, XRP and EAI solutions in the context of virtual marketplaces.

2 Enterprise Resource Planning (ERP)

This chapter sketches what Enterprise Resource Planning (ERP) is, what its roots are, and its direction of development.

2.1 What is ERP?

The formal APICS definition of ERP is ‘An accounting-oriented information system for identifying and planning the enterprise-wide resources needed to take, make, ship, and account for customer orders. An ERP system differs from the typical MRPII system in technical requirements such as graphical user interface (GUI), relational database management system (RDBMS), use of fourth-generation language (4GL), and computer-aided software engineering (CASE) tools in development, client/server architecture, and open-system portability.’

Thus, ERP is a software infrastructure that helps to manage the different parts of a (global) organisation. In brief, it is the planning of the 4 Ms: Man, Money, Materials and Manufacturing, and the aim is to improve the co-operation and interaction between all the departments such as the products planning, purchasing, manufacturing, sales, and customers service department.

In the era of globalisation, it basically helps an organisation in addressing needs like reduced cycle time, customer focus, sharing information seamlessly across the enterprise, real-time data access, and just-in-time (JIT) management. But the costs can be high, since the deployment of an ERP system can involve considerable business process analysis, employee retraining, and new work procedures. [ERPprof]

2.2 ERP evolving

Since the 1960’s, the focus of manufacturing systems was on inventory control. Most of the software packages then were designed to handle inventory, based on traditional inventory concepts. In the 1970's, the focus shifted to MRP (Material Requirement Planning) systems. The dictionary of the American Production and Inventory Control Society defines MRP as a set of techniques that uses bill of material data, inventory data, and the master production schedule to calculate requirements for materials. In brief, MRP translates the master production schedule built for the end items into time-phased net requirements for the sub-assemblies, components and raw materials planning and procurement. In the 1980's, the concept of MRP-II (Manufacturing Resources Planning) evolved which was an extension of MRP to shop floor and distribution management activities. In the early 1990's, MRP-II was further extended to cover areas like Engineering, Finance, Human Resources, Projects Management, i.e. the complete gamut of activities within any business enterprise. Hence, the term ERP (Enterprise Resource Planning) was coined. In addition to system requirements, ERP addresses technology aspects like client/server distributed architecture, RDBMS, and object oriented programming.

An excellent overview of the history of ERP has been provided by [Jakovljevic2000].

2.3 Core functionality

In very simple terms, ERP is sometimes described as the planning of the 4 Ms: Money, Man, Material, and Manufacturing. In this section we will describe those main ERP modules.

Finance (Money)
The aim of the financial module is to automate and synchronise the entire money-management chain within the enterprise. Financial data is entered only once and can be analysed in numerous ways to support the decision making process. Examples of applications are budgeting expenses, recording transactions, forecasting revenue, following the status of customer accounts, as well as scheduling of payments to distributors and suppliers.

Human Resources Management (Man)
The human resource (HR) module provides one source for all business needs in HRM context: recruiting, benefits, training, company metrics, and news. HR content is delivered to each employee, based on their specific roles, interests, and responsibilities.

Materials Management (Material)
The material management module seeks reliable, responsive, and competitively priced sources for the material needs of the enterprise. It brings operational ease and cost effectiveness to the purchasing, payment, handling, and administration of materials, services, and assets, and eliminates cumbersome and error prone paperwork.

Production Planning (Manufacturing)
The production planning module performs capacity planning and creates a daily production schedule for a company's manufacturing plants.

2.4 Why (not) ERP?

One of the most important advantages of an ERP system is that it focuses on the customer and the end results. This means overall optimisation of all enterprise-internal processes, leading to higher quality products or services, whilst reducing cost and time aspects. In other words, the organisation's time efficiency is increased, since the ERP system integrates all (or most) parts of an organisation so that it has more control of its operation. People use less time to perform their tasks, since the information they need for those tasks is readily available via the ERP system, which finally improves the time and resources available for decision making. An ERP system can provide a unified customer database usable by all applications, reduces the paper document stream by providing on-line formats for quickly entering and retrieving information, improves timeliness of information by permitting posting daily instead of monthly, faster response and follow up on customers, et cetera.

Before January 2000, one of the main drivers for a company to implement an ERP system was to replace old, non-year 2000 compliant applications and hardware, hereby eliminating

the need for in-house developed software that was originally designed to function independently and not communicate with other applications. An ERP system can be used to consolidate all the software into a simple system. In the course of the year 2000, survey results [CIN] showed that companies are ambitious and optimistic as they enter the new millennium, but they are mindful of the experiences of their peers — they know that ERP is difficult and brings lots of challenges. But that knowledge hasn't dimmed their high expectations — 65% of the interviewees believe that they will stimulate revenue growth, probably through new strategic initiatives that will be kicked off in concert with their ERP initiative. Reasons why enterprises start with ERP are to streamline processes (69%), to develop new business strategies (49%), increase competitiveness (38%), speed (35%), and globalization (35%).

Another benefit of an ERP system is its reporting capability. Reporting has been made easier and more user friendly than in the past. Today, reporting with ERP is a given, not an imposition. Examples include greater accuracy of information with detailed content and better presentation, better monitoring and quicker resolution of queries, and improved cost control. ERP has measurable results. It measures productivity and justifies the cost of automation. ERP has been proven to reduce manufacturing cycle time and the time it takes to get a product or service to market. The strength of ERP lies truly in the manufacturing processes. ERP is used as a competitive tool to determine demand, track inventory, schedule production and speed up the ordering cycle.

Given the amount of advantages of an ERP system, there must be some drawbacks, otherwise all enterprises would have adopted ERP by now. All these advantages are not available for free.

The most important issue here are the costs of implementing an ERP system. The high costs of setting up an ERP system are so prohibitive that it would be out of reach for many small businesses. These costs are of course related to the length of the implementation trajectory. Implementation of ERP is a long and difficult process. A simple ERP project takes between 16 and 18 months. Larger projects may take years to complete. Figure 2-1 gives an overview of the duration of the implementation trajectory for ERP systems.

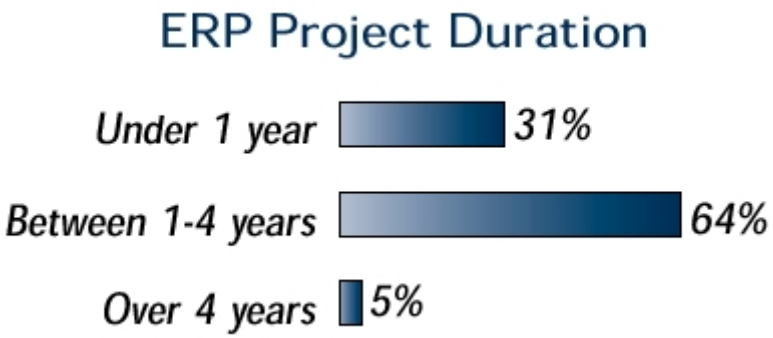

Figure 2-1: Duration of the ERP implementation trajectory [CIN]

Another issue is the security and privacy within an ERP system, since businesses become more reliant on electronic transactions and processes. Who have access to which modules of the system, and who is entitled to modify information in the system? Digital certificate-based authentication and non-alterable digital signatures might be needed to secure ERP systems.

Also, implementation of an ERP system probably means substantial changes in the workflow within an organisation. On one hand, the ERP system takes over certain parts of the tasks, which were taken by people before, but on the other hand also generates new tasks. This is a problem, which affects an organisation as a whole, and many organisations have already begun to work on some employee retraining programs.

Most of these disadvantages concern the implementation trajectory of an ERP system, but once such a system has been implemented within the organisation, the advantages of ERP emerge more and more clearly. Still, ERP systems are not complete. Traditional ERP lacks, for instance, facilities for electronic commerce and unlocking information within the ERP system for third parties. In section 2.6, we deal with possible extensions of ERP, but first, we discuss the most important vendors of classical ERP systems.

2.5 ERP vendors

The peak of the ERP hype was definitely in mid 1998. By that time, the market shares were distributed among the ERP vendors as shown in Figure 2-2. SAP, Oracle, JD Edwards, PeopleSoft and Baan were the five most important ERP software vendors. A short description of these vendors and their products is given in this section, together with their stock quotes over the period 1996-2000. These quotes show the ERP peak in 1998, followed by a downtrend for JD Edwards, Baan and Peoplesoft, and a revival for SAP and Oracle, which makes the latter the most important players in the field in the year 2000.

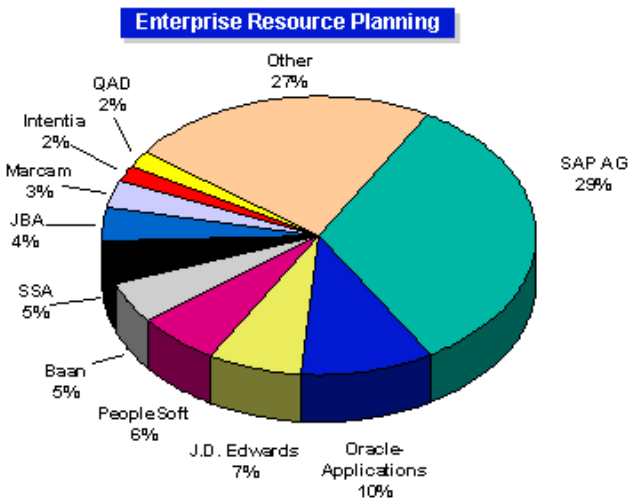

Figure 2-2: Market share of ERP vendors in 1997/1998 [InformationWeek]

We refer to the ERP vendor list of Alluwanted [ERPvendor] for a complete and up to date list of all ERP vendors.

2.5.1 SAP

SAP (Systems, Applications, Products in Data Processing) was established in 1972 in Germany. It is located in 50 countries around the world, has 17.000 employees, and more than 9000 customers, such as Chrysler, Honda, IBM, Bank of Canada, Proctor & Gamble, and GM. All development is done in Germany. SAP R/3 is considered the most well-known business application software in the world. It is used to manage comprehensive financial, manufacturing, sales, distribution and human resource functions. Its core, however, is totally based around a financial accounting module. [SAP]

Figure 2-3: Stock quotes for SAP, 1996-2000

Products

In 1972, SAP released its ERP product R/2 for mainframe applications, followed in 1992 by the release of R/3 for client-server applications. According to SAP, R/3 is the recognised business solution standard world-wide, with over 20,000 installations and hundreds of complementary hardware and software partners.

2.5.2 Oracle

Founded in 1977, Oracle specialises in database applications as well as ERP systems and presently has systems in place in more than 145 countries around the world, has 37,000 employees, and examples of customers are U.S. Postal Services, CBS, Nike, Kodak, and Toronto Dominion Bank. Oracle has developed modules for Finance, Human Resources, Project, Manufacturing, Supply Chain, and Front Office. [Oracle]

Figure 2-4: Stock quotes for Oracle, 1996-2000

Products

Oracle offers a database server, and tools & applications for the following ERP modules: Financials, Human Resources, Projects, Manufacturing, Supply Chain, and Front Office.

2.5.3 J.D. Edwards & Company

JD Edwards was founded in 1977 by Jack Thompson, Dan Gregory and C. Edward McVaney. In 1999, it is a company with $944 million in revenue, approximately 5,700 customers and 5,000 employees. Until 2000, JD Edwards was focused on developing enterprise applications, for example suites for financial management, logistics and distribution, services, manufacturing, payroll, and human resources, in for example, architecture, engineering, construction, mining, real estate, energy and chemical industries, as well as government, education, and non-profit companies. In 2000, JD Edwards announced that the future challenges lie in providing enterprise applications integration (EAI) products and services, rather than its current enterprise resource planning (ERP) role. [JDE]

Figure 2-5: Stock quotes for JD Edwards, 1997-2000

Products

J.D. Edwards' OneWorld is network-centric, object-oriented, multi-national software. It provides companies with the flexibility to quickly adapt business processes to meet market demands, as well as the ability to capitalise on the latest functionality and lower costs offered by emerging technologies. OneWorld, introduced in 1996, provides a distributed object architecture and an advanced business rules engine that transcend traditional client/server technology.

2.5.4 Peoplesoft

PeopleSoft was incorporated in Delaware in August 1987, has 4,500 employees, and more than 1300 customers, among which are NBA, Adidas, Anderson Consulting, Hilton Hotels, and Nynex. PeopleSoft's application areas include Financial Services, Manufacturing, Retailing, Federal Government, Healthcare, Higher Education, Service Industries, Public Sector and Infrastructure (communications, transportation, and utilities). In 1989, PeopleSoft introduced HRMS, which is an integrated family of human resource management applications that leads the market. [PSFT]

Figure 2-6: Stock quotes for Peoplesoft, 1996-2000

Products

PeopleSoft 8 offers tools and applications for Materials Management, Manufacturing, Distribution, Financials, HRMS, and Supply Chain Management.

2.5.5 Baan

Baan was founded in the Netherlands in 1978 by brothers Jan and Paul Baan. Since 1995 the company has significantly expanded its sales and service presence in North America, Latin America, Europe, and Asia. Baan prides itself in producing scaleable systems with multi-tiered architectures, which meet the needs of all different sized companies. Baan has 4000 employees, and more than 3000 customers, such as Motorola, Russell Stover Candy, Mercedes Benz, Boeing, and Nortel. In 2000, Baan was taken over by Invensys.Today Baan offers industry solutions for Aerospace & Defence, Automotive, Consumer Packaged Goods, Electronics, Engineering and Construction, Forest Products, Heavy Equipment, Primary Metals, Project, Semiconductor, Speciality Chemicals, and Wholesale. [Baan] In May 2000, Baan agreed to sell its operations to Invensys, a U.K. automation equipment maker, for 762 million euros, but until now it continues its operations under the name of Baan.

Figure 2-7: Stock quotes for Baan, 1996-2000

Products

The company's flagship product, BaanERP V, is a suite of open-systems-based software applications for enterprise information management. The software enables companies to manage all aspects of the business; from sales forecasting and inventory control, to manufacturing, distribution, and finance in one, integrated environment.

The foundation for the products is Orgware, a suite of tools and methodologies, which reduce the time and costs associated with implementation and enable continuous improvement. With Orgware, Baan is enabling a new paradigm called Dynamic Enterprise Modeling, which delivers a framework for insuring that enterprise applications are in close alignment with an organisation's changing processes and business model.

2.6 ERP prospects

This section deals with the shortcomings of classical ERP and how these shortcomings are solved in new generations of ERP packages.

2.6.1 Shortcomings of classical ERP

In our definition so far, ERP systems are solely aimed at planning and managing a single company's internal processes. In this section, we will elaborate on the characteristics of ERP in classical context, which should be improved to take ERP to the 21st century [Source: Luttighuis2000].

Incomplete

The basic function of classical ERP systems involves company-internal planning and management of business functions. In other words, a company's customers and other

partners have no direct inter-action with the system. Classical ERP systems do not encompass front-office functions for interaction with the business environment. Also, they lack, for instance, functions for negotiating with clients and suppliers.

Monolithic
Modules in classical ERP are strongly interdependent, making it difficult to reconfigure or extend them, or to couple them to other systems, in case of changing requirements or contexts.

Non-coupled
Classical ERP systems are not coupled. They support a single company's planning and management, without interacting with ERP systems of customers, suppliers, and other partners. In practice, of course, this remark should be relaxed: many ERP systems today incorporate for instance supply-chain management functions, and most of them enable EDI messaging.

Single-company
Classical ERP systems are focussed on the planning of individual companies, rather than on cross-company planning or sharing ERP functions. Of course, in some cases, cross-company functions may reside at a single company, typically a powerful company in a chain or network. Still, whether distributed or centralised, ERP functions are currently only offered at a single company's basis.

Restrictive
Classical ERP systems impose rigid structures onto data and processes. A considerable degree of configurability is offered, but in many cases the business process has to be tuned to the system to some extent. Once in use, changes in environment or requirements are difficult to implement, and the system does not support flexibility, nor freer forms of interaction.

2.6.2 Extending ERP

With traditional ERP systems, attention is placed on internal productivity. What will happen to alter that model is the emergence of a more diverse enterprise framework. In the first years of the 21st century, a more dynamic online marketplace will emerge, where companies can collaborate with employees, customers, stockholders, sales channels and suppliers through a multi-enterprise framework. According to a survey [CIN], most companies believe that the traditional ERP systems should be extended in a number of ways. Most important is that ERP systems are made ready for electronic commerce (Figure 2-8). In the next chapter, we elaborate on extended ERP systems, which places ERP systems in the networked economy, and make them e-commerce-ready.

Figure 2-8: How to extend and ERP system? [CIN]

3 Extended Resource Planning (XRP)

3.1 What is XRP?

Currently, two important new trends emerge in the ERP industry: becoming real time and business-to-business electronic commerce (via the internet). The B2B e-commerce software model will eventually become a market ten times bigger than the business-to-consumer internet market [Egeneration]. ERP vendors realise that their ERP systems face a number of challenges in order to remain suitable candidates for use in an e-commerce environment. As an example, future ERP, connected with the internet, could present to a company "buyer" an exhaustive list of business products meeting their purchasing requirement. An authorised buyer would simply select the product that meets their requirement, and the ERP vendor would handle that transaction. A requisition would immediately show up at the manufacturer's site. The product would be delivered or made.

3.1.1 Definition

Extended resource planning (XRP) is the next incarnation of ERP. It is a logical next step: just as MRP was transformed into ERP as it began to integrate more of the core business processes inside an enterprise, ERP will be transformed as business processes are reinvented across the value chain, reaching out over the extended enterprise. A synonymous acronym for XRP is IRP, which stands for Integrated Resource Planning or Infinite Resource Planning.

Simply put, XRP is the infrastructure that delivers on the integrated value chain [CIN]. Industry pundits have been talking about the integrated value chain for years, and business executives have taken their messages to heart, including the promises of unparalleled customer service, competitive differentiation, and superior operational efficiencies. Having then turned to their CIOs to help realize their visions, a new breed of integrated systems has emerged. We call these systems XRP: the critical infrastructure needed to build an extended enterprise.

But what does XRP look like? Clearly, XRP is not a single system — any suggestion that you could gather all of the necessary functionality in one system is ludicrous. Instead, XRP should be viewed as an integrated set of modules similar to ERP. And as we know, ERP will be a critical component of a successful XRP strategy. But unlike ERP, XRP focuses on complete, end-to-end business processes. An ERP way of thinking would help a shipping clerk understand all the steps needed to ship a package, under any set of circumstances. Under the ERP system the combination of hundreds of interlocking processes defines the business. An XRP way of thinking would start with the source of demand and follow a transaction from department to department, across functions, across enterprise boundaries, until the initiating request was satisfied.

XRP will include many components that are well understood today, including call centers, sales force automation, inventory management, and EDI. But XRP will also include

components that are still emerging and undergoing significant transformations in their own right. Tools to target customers and conduct business electronically — whether they are e-commerce, e-procurement, or interactive marketing — have already been establishing significant footholds in innovative businesses today. As these solutions become value-added extensions to ERP, they will deliver a new level of real-time interaction.

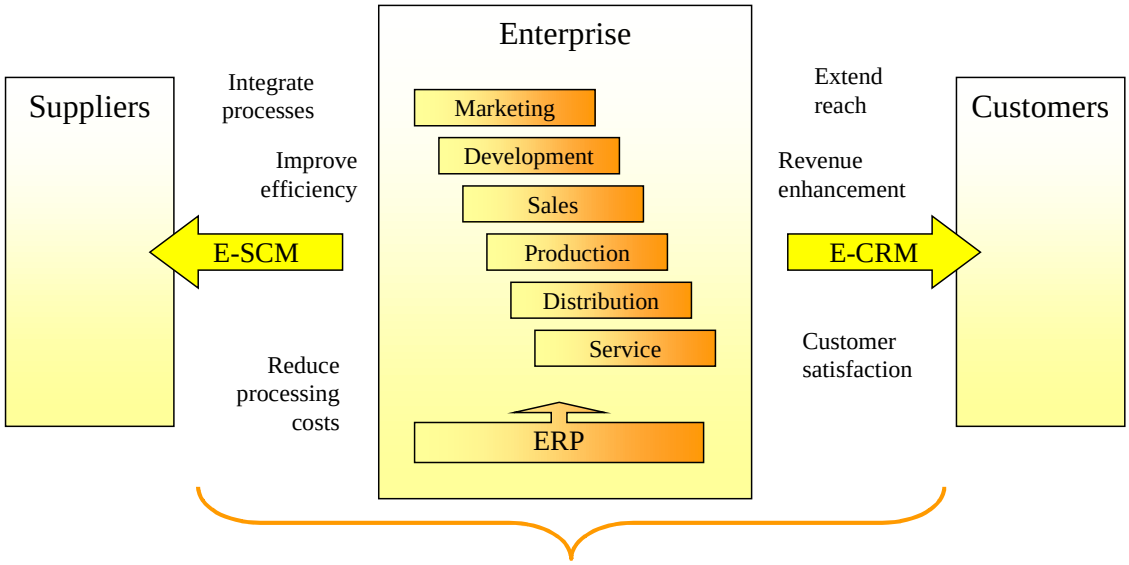

Figure 3-1: Transformation from ERP to XRP

3.1.2 New issues in extending ERP

In fact, ERP systems are extended for e-commerce purposes. This can be split in buy-side and sell-side: extension to the sell-side is usually captured under the acronym CRM (customer relationship management) and extension to the buy-side is called SCM (supply chain management). Additionally, ERP packages are not only offered as a software solution, but also as a service maintained by a third party, the ASP (application service provider). In this section we define the concepts of ASP, SCM, and CRM. Definitions are supplied by [WhatIs].

Application Service Provider

In classical ERP, ERP functions were usually installed and used as a software product. In XRP however, a substantial number of vendors also provides XRP functionality as a service. Third-party services could be used for coupling of ERP systems across companies, and multi-company ERP. The third party is called the application service provider.

An application service provider (ASP) is a company that offers individuals or enterprises access over the Internet to applications and related services that would otherwise have to be located in their own personal or enterprise computers. Sometimes referred to as "apps-on-tap", ASP services are expected to become an important alternative, not only for smaller

companies with low budgets for information technology, but also for larger companies as a form of outsourcing and for many services for individuals as well. Early applications include:

- Remote access serving for the users of an enterprise
- An off-premises local area network to which mobile users can be connected, with a common file server
- Specialised applications that would be expensive to install and maintain within your own company or on your own computer

Extended resource planning extends ERP towards the customer using CRM, and towards the supplier using SCM. Both concepts are shown in Figure 3-1 and defined below.

Customer relationship management
CRM is an information industry term for methodologies, software, and usually Internet capabilities that help an enterprise manage customer relationships in an organised way. For example, an enterprise might build a database about its customers that describes relationships in sufficient detail so that management, salespeople, people providing service, and perhaps the customer directly could access information, match customer needs with product plans and offerings, remind customers of service requirements, know what other products a customer had purchased, and so on.

Supply chain management
SCM is the oversight of materials, information, and finances as they move in a process from supplier to manufacturer to wholesaler to retailer to consumer. Supply chain management involves co-ordinating and integrating these flows both within and among companies. It is said that the ultimate goal of any effective supply chain management system is to reduce inventory (with the assumption that products are available when needed). As a solution for successful supply chain management, sophisticated software systems with Web interfaces are competing with Web-based application service providers who promise to provide part or all of the SCM service for companies who rent their service.

Supply chain management flows can be divided into three main flows:

- The product flow
- The information flow
- The finances flow

The product flow includes the movement of goods from a supplier to a customer, as well as any customer returns or service needs. The information flow involves transmitting orders and updating the status of delivery. The financial flow consists of credit terms, payment schedules, and consignment and title ownership arrangements.

3.2 XRP vendors

Most ERP vendors mentioned in section 2.5 are moving towards extended resource planning. In 1999, SAP, Oracle, PeopleSoft and other big ERP vendors have unveiled plans to host or provide applications and content for vertical communities and marketplaces: one-stop portals

offering specialised, industry-specific content such as news and market analysis plus services such as online procurement tailored for industries.

3.2.1 SAP

MySap.com is an enterprise information portal implementing a collaborative commerce mode, for leveraging the internet for integrating business processes among partners. It transforms SAP into an infomediary, identifying and facilitating business process integration opportunities among its customer base [MySap].

MySap.com consists of three components:

- The Workplace: an enterprise portal providing personalised access to computing elements that users need to perform daily tasks, organised along business processes, such as planning, buying, and selling.
- The Marketplace: an e-commerce hub providing collaboration among enterprises within interest groups, e.g. healthcare, energy, chemical marketplaces. It provides solutions for buying, selling and collaborative supply chain and engineering capabilities
- Application Hosting: a service that delivers mySAP.com solutions and technology across a network, hosted in a professionally managed environment. Application Hosting is targeted to small and medium sized enterprises (SMEs), all verticals, including Public Sector, that traditionally have been locked out of an ERP solution.

3.2.2 Oracle

Oracle has taken the initiative to let ERP, CRM, and e-commerce solutions share the same database. Oracle iStore is an electronic commerce application that provides a web-based channel for unassisted selling of products and services. Using Oracle iStore, businesses can create powerful Internet store sites for selling products in a secure and personalised environment. With seamless integration to Oracle ERP Applications and to the Oracle Call Center & Telephony suite, Oracle iStore enables companies to bring products to market faster and to provide unique customer care. Oracle iStore also represents a framework for building commerce applications through its support for multiple payment systems, and its many open APIs for business functions, such as order and inventory management, tax, and shipping and handling. [iStore]

3.2.3 J.D. Edwards & Company

On June 21, 2000, J.D. Edwards & Company announced the Company's JDe.sourcing application hosting program has expanded its scope through partnerships with leading ASP providers in Asia, Europe, Africa, Latin America and North America. Within a few months, JDe.sourcing was renamed to Application Service Provider (ASP) Solutions. J.D. Edwards' ASP solution is an application hosting initiative that delivers e-business solutions directly to customers across the Internet. J.D. Edwards can now offer industry-specific solutions for industries such as high-tech, plastics, construction and engineering and the restaurant and food industries in major markets around the world. [ASPsolutions]

3.2.4 PeopleSoft

PeopleSoft's solution to the integration problem is the Open Integration Framework (OIF). OIF is an application programming interface layer for linking PeopleSoft's enterprise resource planning (ERP) package to software from other makers.

The Open Integration Framework (OIF) initiative enables flexible and cost effective integration of PeopleSoft applications with best-of-breed software, including e-business solutions and legacy systems. The Open Integration Framework delivers Internet-enabled Application Programming Interfaces (APIs) fully embracing Extensible Markup Language (XML). The new integration technology will be available in controlled release in the fourth quarter of 1999, and will be generally available with PeopleSoft 8 in the first half of 2000. As part of the initiative, PeopleSoft is partnering with leading Enterprise Application Integration (EAI) vendors to deliver certified, packaged integrations to customers.

Expanding on PeopleSoft's robust set of existing integration tools and APIs, the company is introducing Internet-enabled APIs such as Application Messaging, Business Components, and Business Interlink.

Furthermore, PeopleSoft has issued its eStore: a comprehensive online sales and customer service solution. It adds best-of-breed online selling functionality to deep integration into the supply chain and other back office systems, and delivers the kind of value needed to conduct a successful online business. It runs an end-to-end solution and supports sales to both consumers and other businesses.

3.2.5 Baan

Baan offers e-business tools for sales, procurement, collaboration, service and configuration purposes. For example, E-Sales delivers product information to customers and channel partners through multimedia catalogs. It features a complete set of administrative tools to manage security, user personalization and catalog content. E-Procurement is a web-based self-service solution for indirect procurement from selected suppliers. It automates the procurement process to cut costs, shorten cycles and improve productivity. E-Collaboration provides personalised web portals through which business partners interact. Documents like purchase orders, forecasts and shipping notices are published from an ERP system, using XML, and stored in a document repository.

4 Enterprise Application Integration (EAI)

4.1 What is EAI?

EAI stands for Enterprise Application Integration and can be defined as application-independent, business process-oriented software that integrates the applications of the enterprise [Aberdeen], or several enterprises [Gilpin1999]. Although the acronym EAI contains the E of Enterprise, EAI is also used for application integration across multiple enterprises. A synonymous acronym is IAI (Internet Application Integration), which stands for integrating applications, whether built or bought, across multiple enterprises in order to automate multi-enterprise business processes where the internet provides the communications backbone.

Thus, Enterprise Application Integration is a set of technologies that allows the movement and exchange of information between different applications and business processes within and between organisations. An EAI product must provide the following services [Pan1999]:

Messaging
A messaging backbone is the foundation of an EAI framework. This backbone transports messages between resources, reconciling network and protocol differences. It allows applications to share information with the outside world by sending and receiving messages. It adds quality-of-service options to message delivery, such as security and queuing. The messaging services should ideally support both synchronous and asynchronous messaging. Asynchronous messaging is particularly useful when applications must integrate in broadly distributed environments where the availability of applications and network segments is unpredictable.

Connectivity
Having established a common messaging backbone for interapplication communication, the next step in deploying an EAI framework is to plug the applications into the messaging backbone and allow them to send and receive messages. Because each application has its own interface, communication protocols, and data formats, the connectivity setup must include services for orchestrating the flow of data between integrated resources. It has to be able to resolve data coding differences, translate to and from the common protocol used by the messaging service, and transform data content to and from a standard format.

Security
Typically, each application provides security through the user ID and password entered by the user. Integration technology must provide similar services for the entire business process, including user authentication, resource access control, and information encryption. This technology must also integrate with existing security implementations.

4.1.1 Types of EAI

We distinguish four different types of EAI: data-level, application program interface-level, method-level and user interface-level, as depicted in Figure 4-1. [source: Linthicum2000]

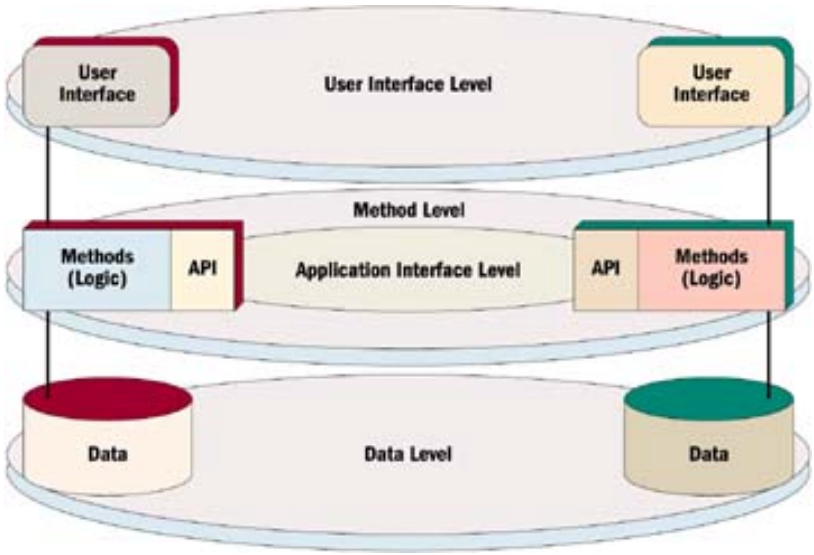

Figure 4-1: The different EAI levels [Linthicum2000]

Data-level EAI is the process as well as techniques and technology to move data between data stores. This means simply extracting information from one database, perhaps processing that information as needed (e.g., transformation) and updating that information in another database. Of course, in typical EAI-enabled enterprises this may include as many as a hundred databases and several thousand tables. It may also include the transformation of data and application of business logic to the data that's being extracted and loaded

Application program interface level EAI refers to the practice of leveraging interfaces exposed by custom or packaged applications. Developers leverage these interfaces to access both business processes and simple information. Using these interfaces (e.g., SAP's BAPI), developers are able to tie many applications together allowing them to share business logic and information. The only limitations that developers face are the specific features and functions of the application interfaces.

Method-level EAI is simply the sharing of common business logic (or method) that may exist within the enterprise. For instance, the method of updating a customer record may be accessed from any number of applications, and applications may access each other's methods without having to rewrite each method within the respective application.

User interface-level EAI is a much more primitive but necessary approach. In this scenario, architects and developers are able to tie applications together by having user interfaces as a common point of integration. For example, mainframe applications that do not provide database nor business process level access may be accessed through the user interface of

the application. In other words, we are accessing the user interface as a user would through an automated mechanism. This process uses windows and menus to get at the relevant data that needs to be extracted and moved to other applications and data stores. While this sounds like an ill-conceived approach and stop gap measure, there is more of this going on than one may think.

4.1.2 Architecture

In this section, we will separate the architecture of EAI solutions into some standard components. This analysis has been provided by [McGoveran2000]. A uniform distributed architecture permits all components to be used together seamlessly. Architectures have evolved from simplistic point-to-point, hub, multi-hub, to finally peer-to-peer or service-oriented, descriptive of the routing that is taken by messages between interconnected software systems in an attempt to improve scalability and performance. As a very generic model, we define the following four major layers in a EAI architecture: business processes, components, messaging and transport services.

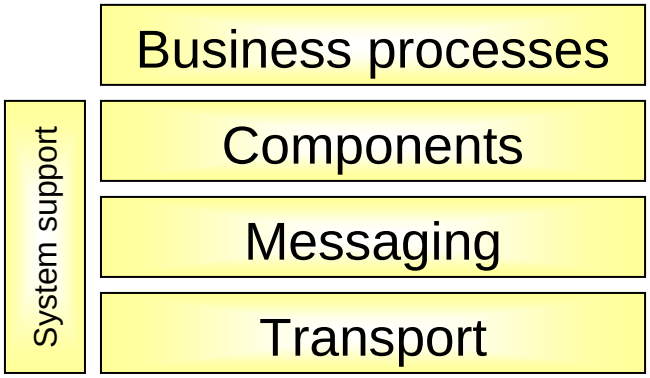

Figure 4-2: EAI architecture

An EAI product without sufficient investment in an architectural stack like the one in Figure 4-2 can still be valuable, but functional benefits must outweigh higher costs of learning, poor usability, deployment, maintenance, and inflexibility in the face of unforeseen business and technology challenges. When it comes to sophisticated enterprise integration, a rich features set implemented on architected simplicity provides the most stable enterprise integrity.

Business Process

Business processes represent sequences of business events and activities, each of which may be implemented under the control of either personnel or software. Support ranges from simple workflow management to complex business process automation. A workflow or process definition controls the routing of messages, and drives destination-based transformation. Unlike the point-to-point routing of a message broker, business process support introduces a higher level of routing control end-to-end. A high-performance process definition and instance status repository is required.

Components

Business components are logical elements without an understanding of the underlying technical infrastructure. Components manipulate data, and have to resolve the technical incompatibilities between the underlying application. This is handled by techniques such as data transformation, and adapters.

- *Intelligent Adapters* are rapidly becoming the primary and most powerful component in integration suites. Early adapters did little more than provide data and message formatting. Today, these components are instrumented as many levels, providing system management and monitoring, meta-data interfaces, error recovery and logging, encryption, and much more.

- *Re-formatting:* As aspects of the message that do not pertain to the content may need to be altered between source and destination, each of the major products offers some means of altering message format (re-formatting). Note that this is distinct from content transformation. Most often re-formatting is done within the adapter, although some products perform such functions within a central broker.

- *Transformation*: Altering message content between source and destination requires a transformation engine. This may range from simple inline translation to event-driven content merge-and-split, XSLT techniques, and asynchronous collection of input from multiple sources. Transformation rules can be extremely complex, using content interpretation, meta-data (such as a record header or trailer), remote function calls, or simply field position, type, and length. Transformation engines may be hub-based, but the trend is adapter-based, providing multi-source to multi-destination transformation and multi-record to single record transformation without programming.

Messaging

Each of the major products offers a mechanism for flexibly routing messages. Most provide request / reply, publish and subscribe routing, as well as both content-based and logical address routing. Content-based routing introduces a conditional element, which can (in principle) be based on anything that can be incorporated as part of the content of the message. Pre-defined routing can be extremely efficient where it is applicable.

Transport

Each of the major products offers some form of native transport, a method of communicating messages. It may be synchronous or asynchronous, with subcategories such as RPC, request/reply, fire and forget (datagram), and publish/subscribe. If asynchronous, then queue management is required. An implementation may very well use multiple transports, requiring adapters between the product's native transport and some pre-existing one. Offering a native transport avoids the potential cost of a third-party product, and the need for additional selection, deployment, support, and compatibility.

System Support

System support facilities include management and monitoring, multi-threading, multi-

processing, load balancing, fault tolerance, public key encryption, and the like. As part of the core architecture, they should be accessible to all components. The product and its implementations come to have a high degree of uniformity, evidenced by a standard API, and upgrades are easier.

4.2 XML and XSL as enabling technologies

XML (eXtensible Markup Language) definitely is a key enabler for enterprise application integration. XML is a universal standard for structuring data [Janssen2000] and provides an open and extensible way to define documents (messages, orders, receipts, etc) and to enable a structured information flow between heterogeneous systems. The structure of a document is specified in a so-called document type definition (a DTD). An XML document can contain or point to its DTD, and this DTD can be used to validate that a document matches a specific format. XML offers a lot more flexibility and extensibility than traditional messaging or electronic data interchange.

Many vendors are starting to bring out their XML-based application integration solutions. For scalable integration of enterprise systems the choice for an open integration standard is a necessity. Unless the integration solution explicitly supports a standard such as ebXML (http://www.ebxml.org/), BizTalk (http://www.biztalk.org/), or Rosettanet (http://www.rosettanet.org/), it should be considered proprietary. For a more elaborate discussion on these XML standards we refer to [Janssen2000].

The extensible stylseheet language [XSL] falls apart in two components: a language specifying formatting semantics XSL-FO, and a transformation language XSLT. The XSLT language operates by transforming one XML tree into another XML tree. It contains operators for selecting particular nodes from the tree, reordering the nodes, and outputting nodes.

4.3 EAI vendors

A complete overview of all EAI vendors published in October 2000 by the EAI Journal is available in the EAI Vendor Guide 2000 [EAIvendor]. The top ten EAI vendors by market share are listed below.

EAI Vendor	Software Revenues (million $)	Market Share (%)
IBM	66.5	12.0
NEON	59.6	10.8
Mercator	55.5	10.0
TIBCO	50.4	9.1
SUN	3.4	6.4
BEA Systems	28.0	5.1
STC	24.5	4.4
Vitria	21.8	3.9
Active	20.5	3.7
Extricity	16.6	3.0

Table 4-1: Top 10 EAI vendors [WinterGreen]

4.3.1 IBM

The MQSeries Family is a complete portfolio of open, scalable, industrial-strength messaging software that enables companies to embrace and extend existing IT investments to integrate complex business processes across different hardware and software. The members of the family are MQSeries messaging products, MQSeries Integrator and MQSeries Workflow. The family addresses the critical areas of IT management; messaging, application and information integration; and business process automation, support and service. [IBM]

4.3.2 NEON

New Era of Networks, Inc. (NEON) provides Enterprise Application Integration (EAI) solutions to financial services, banking, brokerage, telecommunications, utilities, manufacturing, healthcare and other industries. They also provide packaged solutions that successfully integrate legacy applications, client/server and web-based applications, as well as popular Enterprise Resource Planning (ERP) applications. Neon has more than 140 implemented customers world-wide. The NEON product suite supports Enterprise Application Integration across the leading databases, including DB2, Informix, NT SQL Server, Oracle, and Sybase; and provides libraries for SAP and PeopleSoft ERP applications. [Neon]

4.3.3 Mercator

Mercator's e-business integration solutions offer seamless business-to-business integration across all commerce touch points, event-driven application-to-application integration across the enterprise, and integration of existing systems with business-to-consumer applications. [Mercator]

4.3.4 TIBCO

Founded in 1985 as Teknekron Software Systems, Inc., TIBCO Inc. is an active player in the field of information systems integration and a pioneer in advanced middleware development for the global enterprise. With offices worldwide they serve a client base of major financial services institutions, consumer and high tech manufacturing giants and software developers. TIBCO is an independent division of Reuters Group PLC. [Tibco]

4.3.5 SUN

SUN offers Forte Fusion, a state-of-the-art integration suite, which equips customers with all the tools necessary to enable their electronic businesses. These products allow customers to gain competitive advantage by exploiting existing application portfolios. At the same time, they can seamlessly develop and integrate new applications and components. Corporate IT departments can use Forte's tools to deliver scalable, customer-facing applications quickly and reliably, regardless of changing industry and business requirements. [SUN]

4.3.6 BEA systems

BEA Systems, Inc., is a provider of mission-critical middleware and Internet solutions for the world's largest enterprises. BEA's product line enables end-to-end, integrated solutions for electronic commerce and business-critical systems. BEA products include BEA TUXEDO, the industry's market share leader for distributed transaction management software, BEA WebLogic, a leading Web application server providing Java and EJB solutions, and BEA eLink, a solution for integrating enterprise applications [BEA2000].

BEA eLink is a family of off-the-shelf products for integrating existing applications with customer-facing and business-to-business application components. Founded on the BEA WebLogic Business Platform, a distributed application runtime environment, BEA eLink extends this platform with adapters, data transformation, and business process tools. In combination, these tools allow organisations to deploy simple-to-sophisticated integrated systems that stand the test of time as a result of their reliability and continuous adaptability to ever-changing business opportunities. BEA eLink exceeds the reach of traditional EAI solutions to support complex and demanding e-commerce requirements. [BEA]

4.3.7 STC

STC is a provider of eBusiness Integration solutions enabling the seamless flow of information within and among enterprises. Its flagship solution is e*Xchange eBusiness Integration Suite. STC's e*Xchange eBusiness Integration Suite, consisting of e*Xchange Integrator and e*Gate Integrator, is a set of eBusiness integration solutions enabling real-time, end-to-end process integration and trading partner management within and among enterprises (Figure 4-3).

e*Xchange Integrator is a comprehensive, single-vendor solution with a pre-packaged B2B offering, addressing the key challenges companies face as they move rapidly to fend off competitors and to embrace eBusiness opportunities.

e*Gate Integrator, the foundation of STC's product suite, is the fourth-generation product, installed at more than 1,500 customer sites. This open, distributed and proven platform provides accelerated deployment of eBusiness integration, including enhancements such as the collaborative development environment with full Java support, expanded application connectivity, robust Web automation and increased availability for non-stop operations.

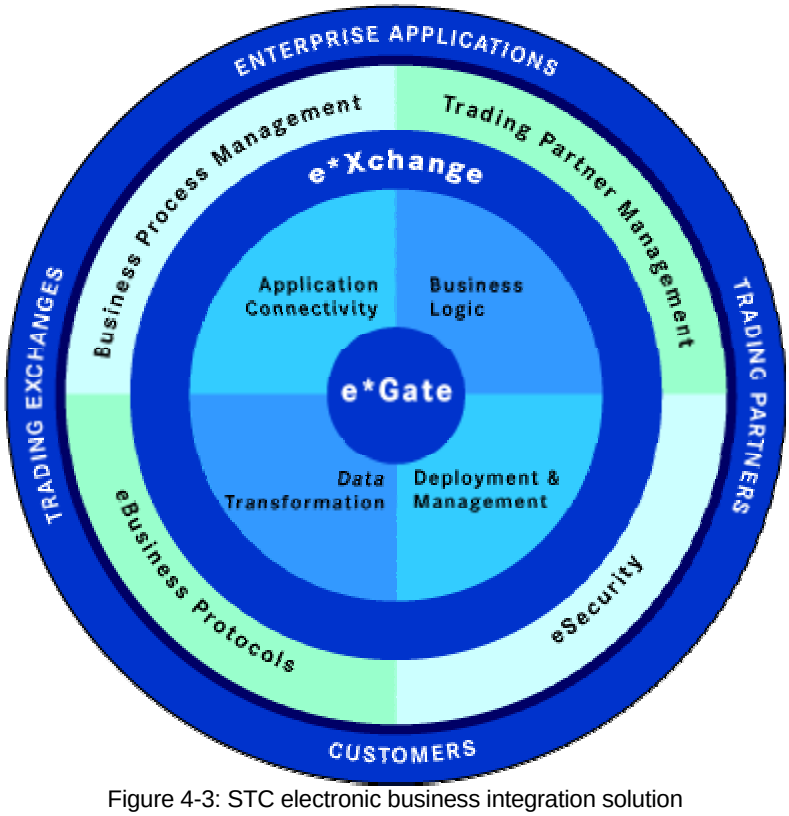

Figure 4-3: STC electronic business integration solution

Since November 2000, STC has changed it's name to SeeBeyond. Still, they offer the same EAI solutions [SeeBeyond].

4.3.8 Vitria

Vitria Technology Inc. provides a business-level, model-driven software solution for enterprise application integration (EAI). Vitria BusinessWare helps companies gain end-to-end visibility and control of business processes that span multiple information systems. BusinessWare solutions are driven by graphical business process models that allow business analysts to control and co-ordinate cross-application information flows without programming. This approach reduces the time and cost of integrating applications, and provides the flexibility companies need to continuously adapt processes and supporting systems to changing business conditions. Leading companies including Deutsche Bank, Federal Express, Hewitt Associates, KPMG, Qwest Communications, SBC Communications, and Vanstar Corporation have already chosen BusinessWare to integrate their business-critical information systems. Vitria also works closely with leading product and service partners including Andersen Consulting, Clarify, HP, KPMG, Netscape, Oracle, and Sun Microsystems. [Vitria]

4.3.9 Active

Active Software™ is a provider of eBusiness integration software products and solutions, enabling customers to become an eBusiness with faster and more efficient operations, real-time information flow, and greater responsiveness to customers within and across the extended enterprise. A pioneer in the new category of Enterprise Application Integration (EAI), Active Software provides the ActiveWorks™ Integration System, a comprehensive suite of products that rapidly deliver comprehensive eBusiness solutions

Active software is acquired by WebMethods, a provider of open solutions for business-to-business (B2B) integration. The WebMethods B2B™ solution provides companies with integrated, direct links to buyers and suppliers, connecting them to major B2B marketplaces and enabling real-time, interactive communication through the Internet, regardless of existing technology infrastructure. Powered by XML, WebMethods B2B can automate critical business processes such as customer relations, procurement and financial services, supply chain management, logistics and sell-side/buy-side e-commerce. [WebMethods]

4.3.10 Extricity

Extricity seamlessly connects disparate line-of-business applications from the likes of SAP AG, The Baan Co.,Oracle and PeopleSoft Inc. so that enterprises, their suppliers and customers can conduct business transactions-including contractual agreements- over the Internet. Extricity is focusing on B2B, and has also introduced Extricity Alliance for Netmarkets enabling net markets to automate the flow of information and business processes with all types of partners. [Extricity]

5 Virtual Markets

5.1 What are virtual markets?

By definition, a virtual market is an online intermediary that connects fragmented buyers and sellers. Virtual markets eliminate inefficiencies by aggregating offerings from many sellers or by matching buyers and sellers in an exchange or auction. For buyers, they lower purchasing costs while reaching new suppliers. For suppliers, they lower sales cost and reach new customers. A central hub where a trusted intermediary integrates both procedures and technology can save costs. These new intermediaries come with a sleuth of different names: infomediary, metamediary, electronic markets, e-markets, Internet markets, I-markets, vertical hubs, e-hubs, butterfly markets, vortex businesses, digital exchanges, online exchanges, fat butterfly. They all share, however, the same goal of facilitating business-to-business commerce by leveraging the Internet and virtual market places.

Typical other business issues driving the virtual market hype are

- Inaccessibility of real-time information/knowledge for customers and suppliers globally
- Lack of collaboration across supply chain
- Costly, inefficient customer care
- Missed sales opportunities
- Inefficiency in new product introduction
- Being paper bound in business processes
- Linking existing technologies with new Internet technologies

A reference model for virtual marketplaces is given by [Iacob2000]. They classify virtual markets according to the following criteria: product type (horizontal or vertical market segment), buying process (systematic or spot sourcing), and the bias (buyer-driven, seller-driven, or neutral).

5.1.1 Horizontal versus vertical hubs

Horizontal (or functional) hubs focus on providing the same functions or automating the same business process across different industries. Their expertise usually lies in a business process that is fairly horizontal, which means that it is scalable across vertical markets. The success of a functional hub increases with the degree of process standardisation, process knowledge and work-flow automation expertise, complementing process automation with deep content and the ability to customise the business process to respond to industry-specific differences. The primary challenge for functional hubs is to deliver industry-specific content. They target functional managers who organise their work around their functional area. The risk: gravitating towards a vertical hub for their industry and relegating the functional hub to become a back-end service provider.

Vertical hubs serve a vertical market or industry focus. They provide deep domain-specific content and domain-specific relationships. Examples: Altra Energy (energy), Band-X

(telecom), Cattle Offerings Worldwide (beef and dairy), SciQuest.com (life sciences), e-Steel (steel), Floraplex (florists), IMX Exchange (mortgages), PaperExchange (paper), PlasticsNet.com (plastics) and Ultraprise (secondary mortgage exchange). The likely success of a vertical hub increases with greater fragmentation among buyers and sellers, greater inefficiency in the existing supply chain, creating critical mass of key suppliers and buyers, domain knowledge and industry relationships, creating master catalogues and sophisticated searching, and adjacent verticals for leveraging existing supplier or buyer base.

5.1.2 Systematic versus spot sourcing

Sites that use systematic sourcing rely on prices determined outside the site. When prices are pre-negotiated or established, a static site is created where the positions of both the buyer and seller are fixed. Systematic sites can aggregate large groups of buyers and/or sellers to increase the size of the audience and create efficient markets.

Spot sourcing, on the other hand, involves purchasing commodity-like products on the spot market from anonymous sellers. Spot sourcing is transaction-oriented and rarely involves long-term or ongoing relationships between buyers and sellers. Prices are not set ahead of time and are discovered, or determined, on the site. By bringing buyers and sellers together in a format that allows for dynamic negotiation, spot sourcing e-hubs allow price discovery.

5.1.3 Biased or neutral

Virtual markets can be either two-sided or neutral, or inherently biased toward either buyers or sellers. Neutral markets typically are operated by third parties and favour neither buyers nor sellers. They are the true market-makers that efficiently and fairly match supply and demand. At their best, neutral e-hubs bring together large groups of buyers to interact with large groups of sellers. They can be compared to market squares that serve as central clearinghouses for "many-to-many" transactions. Neutral hubs work best when both the buyer and seller sides of the market are fragmented.

Biased markets work on the side of either the buyers or sellers to assist in negotiating better terms for their party or streamlining their procurement process. Sites that are biased towards the sellers function by either building supplier power in a highly fragmented industry through aggregating suppliers or by amassing buyers to compete on price in an auction-style format where there is just one seller. In contrast, sites that favour buyers are designed to either aggregate a large number of buyers to collectively increase their bargaining power or to create a reverse auction where a large number of suppliers compete to supply one buyer. Biased e-hubs work best when one side of the market is fragmented and aggregation can add significant value.

5.1.4 Classification

Virtual market can be classified, as depicted in Figure 5-1, into MRO hubs, catalog hubs, yield managers and exchanges, and each of these four categories can be biased or neutral.

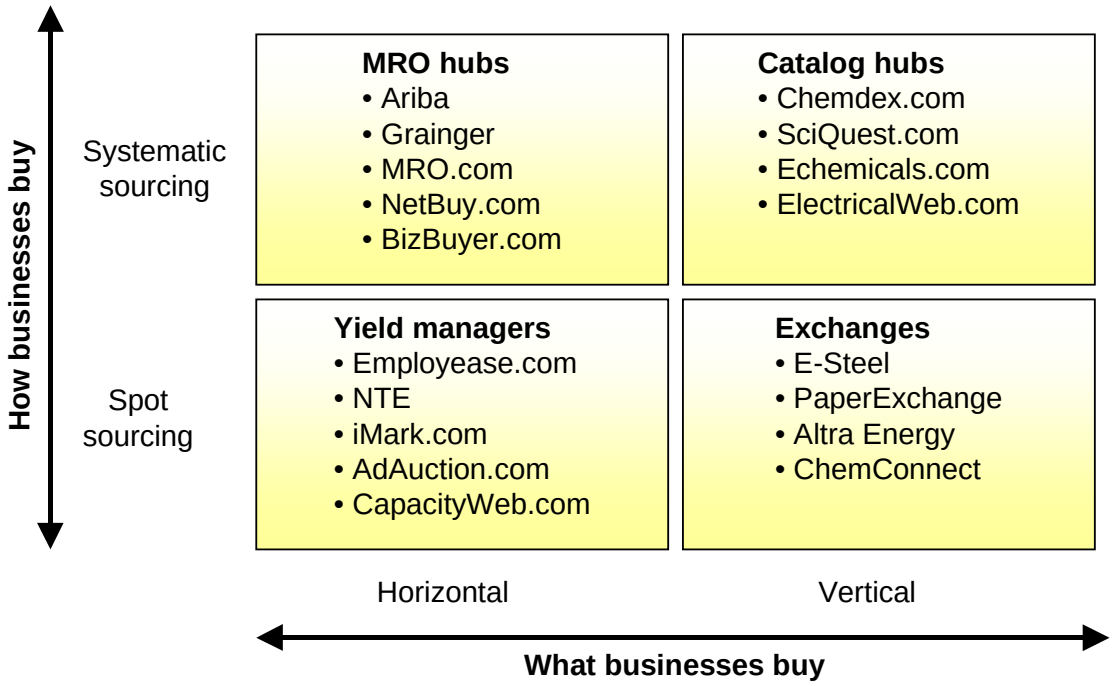

Figure 5-1: Classification of virtual marketplaces [B2B]

These definitions are taken from the NetMarketMakers' glossary. [NMM]

In **MRO hubs** the goods tend to be low-value goods with relatively high transaction costs, so these e-hubs provide value largely by increasing efficiencies in the procurement process. Many of the best known players in this arena, like W.W. Grainger, Ariba, and Commerce One, started out by licensing expensive "buy-side" software for e-procurement to large companies. Newer entrants in this area include BizBuyer.com, MRO.com, PurchasingCenter.com and ProcureNet.

Catalog hubs make sense of buying options by aggregating catalogs from multiple vendors with relatively static prices. They act as a neutral intermediary, but help buyers make sense of multiple vendors, and normalise information coming from diverse sources to enable comparisons of similar products and services. Catalog hubs function as virtual distributors but don't take possession of goods themselves, and collect transaction fees on purchases but can generate additional revenue via credit checks, logistics, fulfilment, insurance, or other parts of the transaction process. They must satisfy suppliers' needs for differentiation while making comparisons possible for buyers. Examples: Chemdex, PlasticsNet, Sciquest (scientific equipment), Testmart (test equipment). Synonym: Virtual distributor.

Yield managers create spot markets for common operating goods like manufacturing capacity, labour, and advertising, which allow companies to expand or contract their operations on short notice. This type of e-hub adds the most value in situations with a high degree of price and demand volatility, such as the electricity and utilities markets, or with huge fixed-cost assets that cannot be liquidated or acquired quickly, such as manpower and manufacturing capacity. Examples of yield managers include Youtilities (for utilities),

Employease and eLance (for human resources), iMark.com (for capital equipment), CapacityWeeb.com (for manufacturing capacity), and Adauction.com (for advertising).

Exchanges Two-sided marketplaces where buyers and suppliers negotiate prices, usually with a bid and ask system, and where prices move both up and down. Exchanges work best with easily definable products without complicated attributes--commodities, perishable items such as food, or intangibles such as electric power. They produce fluctuating, sometimes volatile prices and are particularly appropriate if a true market price is difficult to discover. They work where brokers make high margins by buying low and selling high to purchasers who don't know the original sellers. Examples: Altra (energy), Paper Exchange (paper products), GoFish.com (frozen fish), Arbinet (telecommunications bandwidth). Synonyms: digital exchange, online exchange, dynamic exchange, dynamic trading exchange.

5.2 Technology providers for virtual marketplaces

This section outlines the most prominent solution providers for virtual marketplaces. Among them are CommerceOne, Ariba, and BroadVision. The current state of the art is that most technology providers offer solutions for catalog browsing, management and selection. But Figure 5-2 shows that there is a long way to go to full-fledged virtual marketplaces.

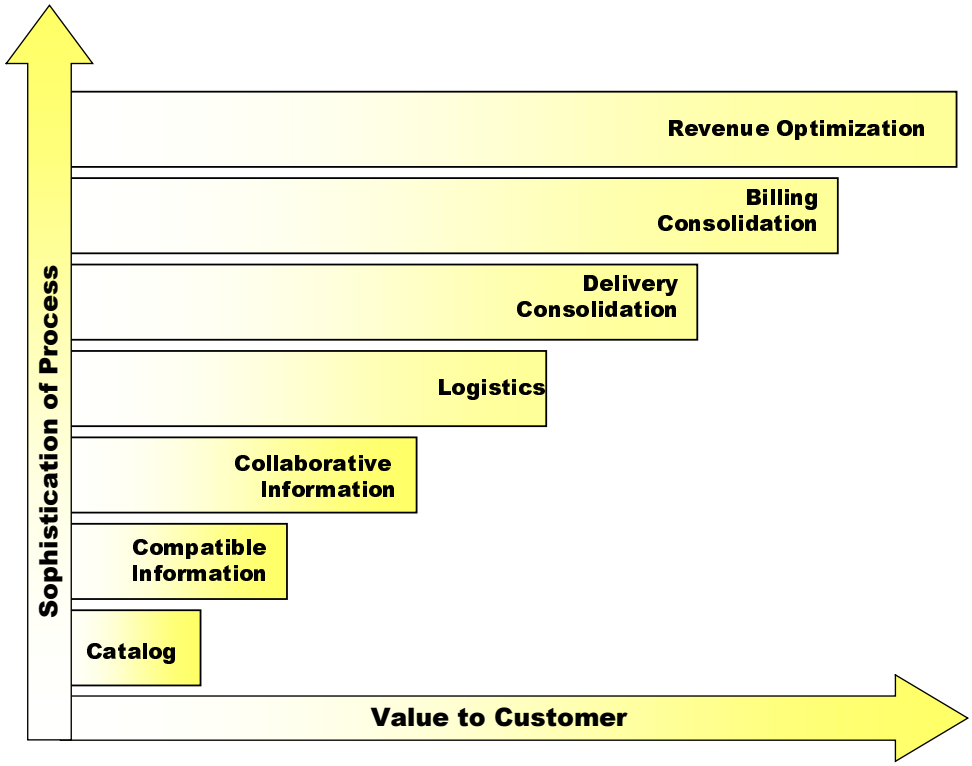

Figure 5-2: Evolution of virtual markets [Vroom2000]

5.2.1 Sterling Commerce

The Sterling E-Marketplace solution includes a suite of applications that integrate disparate business processes. [Sterling] Their Web selling application provides an industry-wide, Web-

based integrated storefront solution specially designed for small-and medium-size enterprise retailers. The E-Marketplace catalog application enables processes such as product replenishment, forecasting, item synchronisation, and information collaboration, while allowing to exchange critical product information quickly and accurately. The E-Marketplace spot buying application is an online exchange for ad-hoc buying and selling of non-inventoried raw materials, discontinued products, product over-runs, and excess or obsolete inventory.

Sterling has been acquired by Computer Associates lately [CA]. (This proofs again that the market for e-marketplace solutions is far from stable. Mergers and fusions are of the order of the day.) CA offers a complete range of eMarketplace-ready solutions, now joined with the expertise of Sterling Commerce.

5.2.2 CommerceOne

Commerce One has developed three distinct e-marketplace solutions: MarketSet is jointly developed with SAPMarkets, and is an advanced e-marketplace solution, customisable for supply chain and manufacturing-based customers in industries. MarketSet combines Commerce One's e-marketplace infrastructure and business services with e-procurement, supply chain management, collaborative design and analysis e-services from SAPMarkets. MarketSite is for regional and horizontally-focused e-marketplaces, and Net Market Maker Solution is to serve small- to medium-sized enterprises. Commerce One handles all connectivity between buyers, sellers, and the e-marketplace including document message routing and transaction processing. The platform directory and server technologies are built upon advanced XML so they are completely open and scalable. CommerceOne partners with Excelon and WebMethods, among others, to allow integration of their virtual market solutions with ERP systems. [CommerceOne]

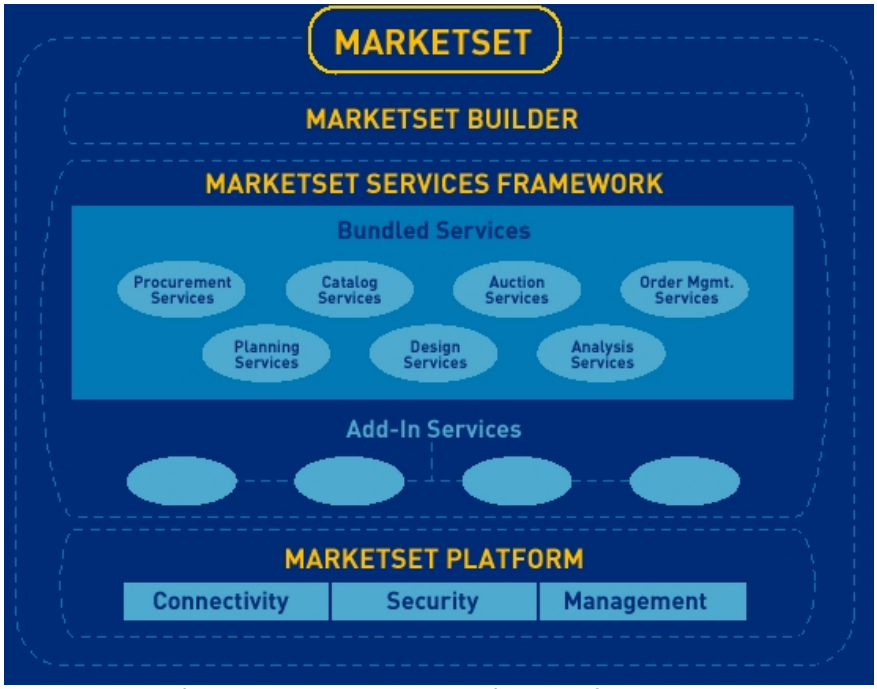

Figure 5-3: CommerceOne MarketSet Infrastructure

CommerceOne is the initiator of the XML common business language (xCBL). Version 3.0 will be available in mid-December 2000 and provides a comprehensive set of over 35 standardised XML document formats, allowing buyers, suppliers and service providers to integrate their existing systems quickly and efficiently into e-marketplaces. Since it is built from a thorough analysis of existing e-commerce standards such as EDI (Edifact and X12), RosettaNet and OBI, xCBL 3.0 will enable users of different e-commerce standards to communicate with one another with an ease that has previously not been possible.

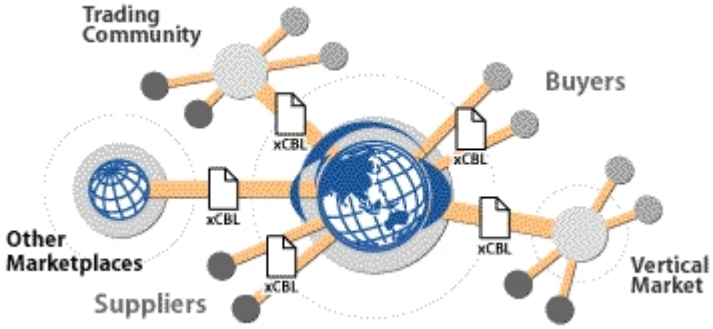

Figure 5-4: CommerceOne Market with xCBL

5.2.3 Broad Vision

The MarketMaker application enables businesses to quickly create B2B exchanges and marketplaces. Besides auction functionality, request for proposal, buyer and seller negotiating, and catalog order capabilities, MarketMaker also allows businesses to manage content and accounts, provide threaded discussion areas for their customers, manage catalogs of buyers and suppliers, receive analytical reports about transactions, and more. [BroadVision]

5.2.4 One i2 Place

The i2 TradeMatrix Platform consists of six integrated layers that can be deployed in various ways to provide support for private marketplaces, public marketplaces, and enterprise applications [i2]. These layers support the distinct needs of marketplace users, marketplace owners, and platform administrators. These layers are:

- Personalised user interface - provides a tailored experience for each user
- Content management - provides the tools to build and manage basic content catalogs, when a customer doesn't require the sophistication and catalog-management capabilities of i2's TradeMatrix Content solution
- Transaction management system - manages transactions throughout their lifecycles, including across multiple tiers of suppliers
- Supply chain model - manages the data about business-to-business, marketplace-to-business, and marketplace-to-marketplace relationships
- Marketplace management - provides the administrative tools to facilitate the running of the marketplace, including accurate and timely billing and associated revenue management

- Infrastructure and integration technology - enable services and applications to run in a secure, robust, and highly available manner

I2 TradeMatrix has been used to set up marketplaces in different vertical industries: Aerospace & Defence, Automotive & Industry, Energy & Chemicals, High Technology, Logistics, Retail, and Service & Utility.

5.2.5 Metiom

Metiom‘s marketplace application is called ConnectTrade, and offers buyers and suppliers the following advantages:

- Supplier-Managed Catalog access—Our applications leverage supplier-managed catalogs instead of the buyer-hosted, aggregated catalogs deployed by many of our competitors. Using our open architecture, buyers eliminate the burden and cost of creating and maintaining a supplier's catalog or content. Buyers can directly access a supplier's electronic commerce catalog for immediate access to the current product, pricing and latest information.
- Open, low-cost architecture—The implementation of our products does not require substantial capital expense either through large incremental investments in desktop technology, internal network bandwidth or enterprise-wide systems upgrades. By leveraging both buyer and supplier investments in technology we offer maximum returns and rapid deployment.
- Adherence to Internet standards and best practices—Metiom ConnectTrade fully supports the leading Internet commerce standards including XML, EDI, (Open Buying on the Internet) OBI and Microsoft's BizTalk.
- Easy integration—The Metiom ConnectTrade product suite is a flexible solution that can be readily integrated at low cost into a buying organisation’s existing systems (ERP, accounts payable, accounts receivable, general ledger and human resources) and electronic commerce capabilities.

5.2.6 Ariba

Ariba Marketplace provides an all-in-one solution that makes it easy for market makers to rapidly and effectively deploy online trading communities [Ariba2000]. Ariba Marketplace offers users the following features:

- Rapid deployment methodology for the entire market making process, including assessment, design, creation, and management
- Flexible commerce process framework to manage transaction flow from requisition to payment
- Distributed administration capabilities to manage large buyer and supplier communities efficiently
- Detailed pricing and catalog management to reflect specific buyer/supplier relationships and market maker revenue models
- Ariba Dynamic Trade capabilities complement fixed-price catalog mechanisms

The Ariba B2B Commerce Platform delivers customised commerce solutions that address the needs of all participants in business-to-business electronic commerce (buyers, suppliers, market makers and commerce service providers) as shown in Figure 5-5.

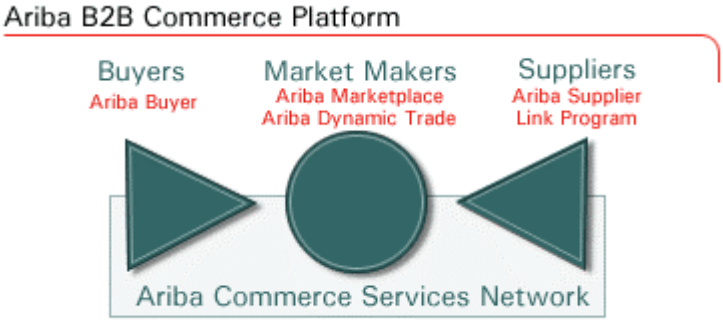

Figure 5-5: Ariba B2B commerce platform

In November 1999, Ariba integrated TIBCO's real-time infrastructure software as its prime integration solution, as a key element for linking the Ariba B2B Commerce solution with ERP software from SAP, Oracle, and PeopleSoft [Ariba].

5.2.7 @TheMoment

The @TheMoment Dynamic Trading Suite is the premier dynamic commerce solution for Net market makers and brick and mortars who are seeking to maximise revenue and facilitate eCommerce more efficiently. Addressing the specific needs of both buy and sell side, this highly flexible solution enables many market configurations. These trading types include: a live bid/ask exchange, negotiated exchange (eRFP), and forward/reverse auctions. Designed to handle high volume, real-time transactions, it is scalable to handle the explosive demands of your eBusiness. [Moment]

5.2.8 TPN

TPN Marketplace is a marketplace of catalogs built using a new technology developed exclusively by TPN Register called Interactive Catalog Management (ICM) -- a unique, collaborative catalog management capability that enables buyers and sellers to interact online to quickly and easily create customised catalog views for every user's individual need. TPN Marketplace's full suite of catalog services includes flexible supplier enablement, superior data transformation, interactive catalog management, personalised searching, strategic off-contract sourcing, and cross-platform Internet catalog distribution. TPN Marketplace provides buyers, sellers, and e-marketplaces with a faster, simpler, more customised, and more economical approach to managing catalogs than today's traditional catalog software solutions based upon older file management technology. [TPN]

5.3 Examples of virtual marketplaces

The following examples of virtual marketplaces are categorised according to the criteria listed in section 5.1: horizontal (functional, business function) versus vertical (industry) hubs, and systematic versus spot sourcing. We will elaborate on at least one outstanding example in each category.

5.3.1 VerticalNet

VerticalNet (http://www.verticalnet.com/) is an example of a collection of vertical hubs. A lot of vertical hubs examples are mentioned at http://www.forworkresearch.com/verthubs.asp

VerticalNet owns and operates 57 vertical marketplaces that unite buyers and sellers from around the world by catering to individuals with similar professional interests, and provides a combination of content, community, and commerce, acting as an essential, comprehensive source of information, interaction, and transaction for each specific vertical market. It provides hosted e-commerce capabilities to help businesses of all sizes increase sales reach and improve efficiency of marketing efforts

VerticalNet trade communities provide an online marketplace through which buyers and sellers world-wide can exchange information, source products and execute online transactions. Targeted content, focused audiences and robust sales leads, combined with our interactive platform, create a premier marketplace for electronic commerce. The Internet can be a powerful tool for building bottom-line growth, and VerticalNet helps companies profit from it with e-commerce services.

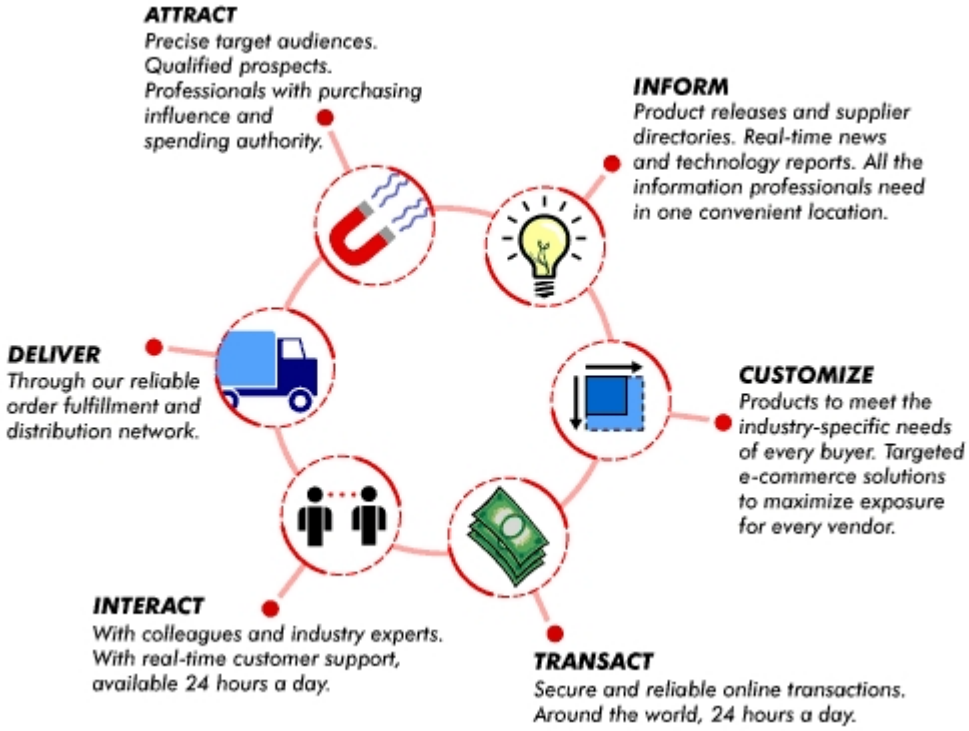

Figure 5-6: Building Strategic Transaction Platforms with VerticalNet

5.3.2 MRO.com

MRO.com (http://www.mro.com/) is an example of a MRO hub.

MRO is short for Maintenance, Repair, and Operations, and MRO.com lets users find and buy indirect MRO goods and services via the internet. It is simply accessible via a web browser, and it is said to work according to the user's business rules and in conjunction with the established EAM (Enterprise Asset Management) and ERP systems of the user.

Searching products is possible by keyword or by category. If the buyer knows the part number (MFR, UPC) he can quickly add items to his shopping cart via a simple web form by typing the part number. The system will prompt the user if a part number could not be found during the search in the product catalogs. When products are found which match the user's query, the user can check product price and availability, and finally, place purchase orders.

On the supplier side, MRO.com provides connectivity for the suppliers to post catalog data and retrieve orders from the marketplace. Additionally, suppliers may connect the marketplace to their business systems in real-time so that buyers can check pricing and availability and place orders. Some companies may have created electronic catalogs with very sophisticated technology already, and will want to preserve that investment. For these suppliers MRO.com can use Punch-Out technology to allow access to their existing sites through the marketplace.

5.3.3 SciQuest

SciQuest (http://www.sciquest.com/) is an example of a catalog hub.

SciQuest is a virtual marketplace for scientific products used by pharmaceutical, chemical, biotechnology, industry and educational organisations. It has over 800 suppliers offering more than one million products. Some of these suppliers are large market leaders who rely on EDI-based transactions linked to legacy ERP systems. Others may vary in size, including smaller suppliers who only receive orders via fax or telephone.

SciQuest offers an open technology platform that easily functions with a variety of customers and suppliers interface systems. SciQuest uses Mercator's Windows NT-based CommerceBroker translation and mapping server to convert purchase orders, acknowledgements and invoices into EDI, XML or formats such as SAP R/3 - whatever each business partner on the exchange wants. SciQuest is also a partner in XMLconnect [XMLconnect].

Searching products is possible by keyword, by category, or by supplier. Suppose we enter the keyword 'geiger' to search for a geiger counter, SciQuest then returns the fitting product categories, which is shown in Figure 5-7.

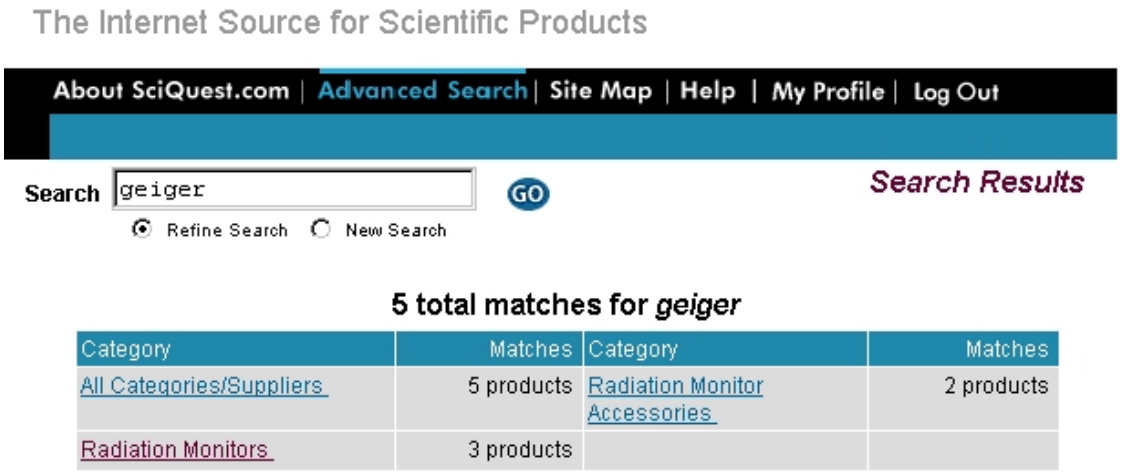

Figure 5-7: SciQuest search by keyword

When we select the category 'radiation monitors', SciQuest shows 3 geiger counters in this category, as depicted in Figure 5-8.

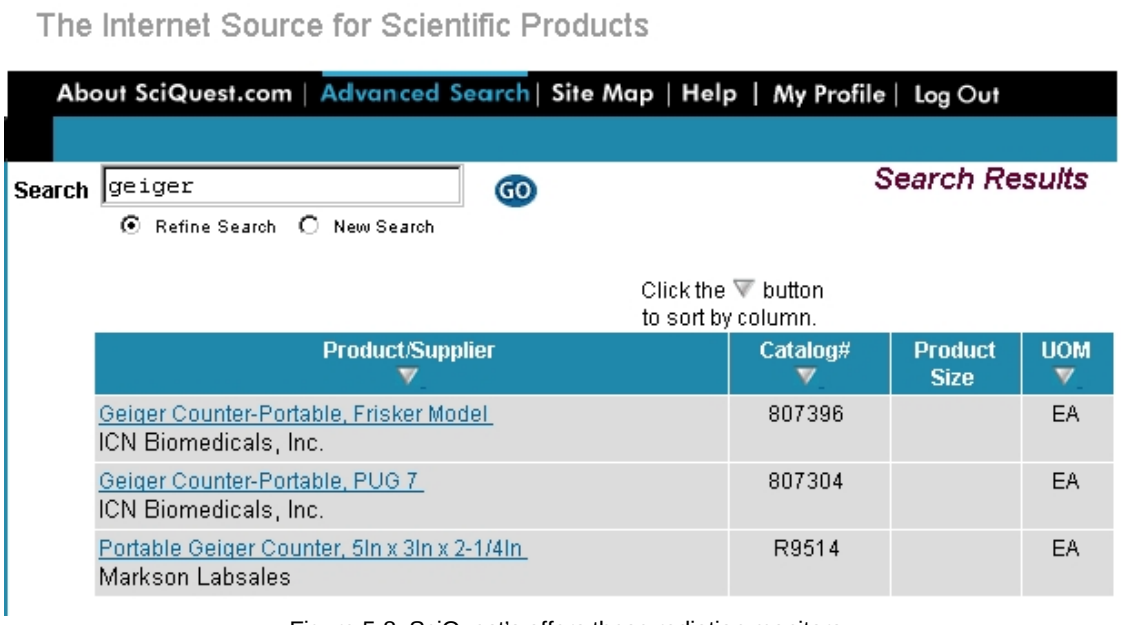

Figure 5-8: SciQuest's offers these radiation monitors

The detailed product information is available for each of the geiger counters. Information about 'Geiger Counter-Portable, PUG 7' is shown in Figure 5-9. Pricing and purchasing information is available, but only to US customers. For international customers this information is not available and hence it is not shown in Figure 5-9.

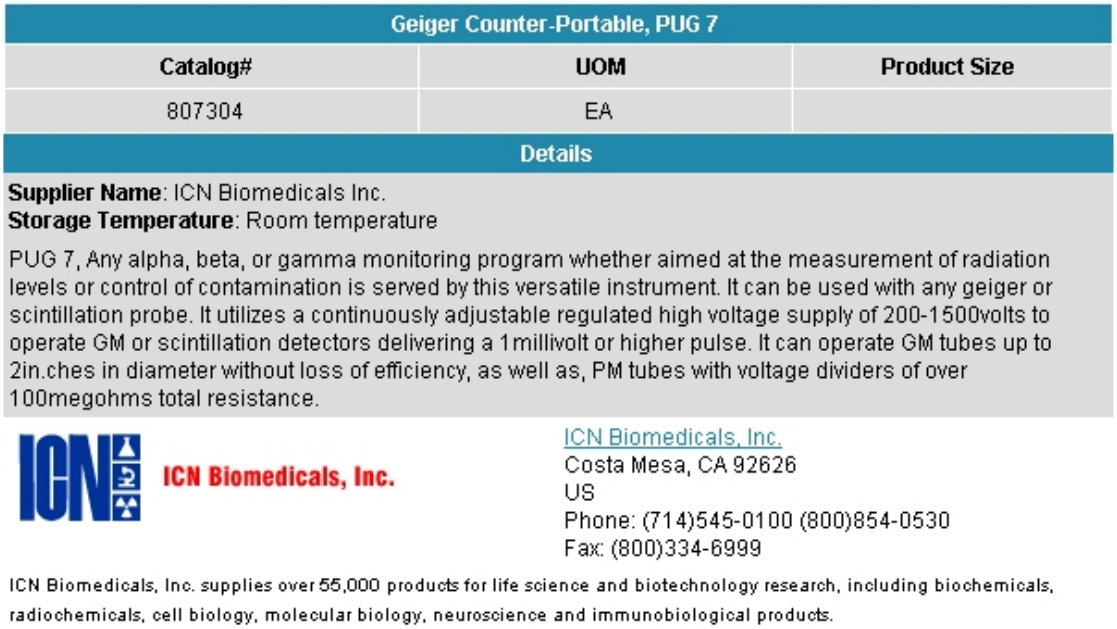

Figure 5-9: SciQuest product information about a portable geiger counter

To place an order, a buyer can add the desired quantity of the selected product to his shopping cart. Payment is done via a credit card or a credit account, and the order will be shipped using UPS, FedEx, or other carriers.

5.3.4 CapacityWeb

CapacityWeb (http://www.capacityweb.com/) is an example of a yield manager.

CapacityWeb allows OEMs (original equipment manufacturers) and mid-market contract manufacturers to optimise their capacity. If demand is high, a company may not be able to meet customer demand without significant investment of capital and time. CapacityWeb enables companies to outsource work to other qualified manufacturers in its member network. If demand is low, a company may have assets sitting idle which leads to lost profit. CapacityWeb brings the company customers from current or similar industries seeking your capabilities.

On their web site, CapacityWeb provides an overview of how the exchange of manufacturing jobs occurs between certified members of CapacityWeb.

- Buying members post their manufacturing project requirements with CapacityWeb. This is done in the form of a detailed RFQ (Request for Quotation) that includes the project description (to include 3-D CAD models and 2-D drawings), the buyer's preference for supplier quality, and commercial terms.
- CapacityWeb's patent pending matching engine then utilises over 600 data points to identify a list of certified manufacturers with the right capabilities and quality processes that best fit the requirements of the RFQ.
- Without revealing the identity of the buyer, suppliers are notified and given the option of bidding on a job that matches their capabilities and processes.
- The shortlist of suppliers willing to bid on the RFQ is then submitted to the buyer for approval. The buyer and the approved suppliers engage in a multi-stage collaborative process using the CapacityWeb's best-of-breed platform. The first phase of this collaboration culminates with the buyer selecting the supplier for the job.
- The buyer selects the supplier that can provide best value across multiple parameters, the most important of them being quality, lead time, price and risk mitigation.
- The buyer and supplier then jointly determine project milestones and delivery schedules. CapacityWeb and its partners provide continued collaboration and value-added services through the life of the project.

5.3.5 PaperExchange

PaperExchange (http://www.paperexchange.com/) is an example of an exchange.

PaperExchange is a global e-business marketplace for the pulp and paper industry. Through an innovative e-commerce Web site, designed by leaders in the paper industry for the paper industry, the company provides an e-commerce environment to more than 4,800 corporate members and 7,000 individual members in 105 countries. PaperExchange partners with leading standardisation organisations to develop XML standards for the paper industry.

PaperExchange enables buyers and sellers to negotiate pricing and directly transact with one another through its marketplace. PaperExchange charges its seller members a commission

based on the total notional value of any successful transaction conducted through the site. The PaperExchange model delivers new levels of efficiency, convenience, choice and flexibility to the pulp and paper industry. All paper is bought and sold by members through private, secured transactions. PaperExchange does not share its list of members nor its transaction information. PaperExchange does not charge buyers to use its site, and does not charge sellers any subscription fees, membership fees, or listing fees. Besides aggregating buyers and sellers in a centralised forum, thereby reducing search time and overall transaction costs for all users, PaperExchange.com offers value-added services such as logistics and credit. In addition to providing origin-to-destination logistic quotations, the company also provides credit clearing services for credit-approved members. Other site services include facilitation of the purchasing and selling of paper industry equipment, such as converting machines. In addition, PaperExchange.com provides members with industry-specific content including job listings, industry events information, news headlines, and a resource directory.

5.4 Connecting virtual marketplaces with established ERP/XRP systems

Now we come to the area that needs our undivided attention: ERP-to-marketplace (or shorter, ERP-to-hub) integration. Traditionally, these ERP systems were set up to be autonomous within the enterprise. The new challenges of commerce via virtual marketplaces require integration of these, traditionally closed, ERP systems with open marketplaces. As described in chapter 4 on EAI, this integration may take place at different levels. Depending on the level of integration. the issues related to heterogeneous information exchange, process logic understanding and standardisation are tremendously complex. State of the art EAI solutions include (proprietary) API, message queuing, or ERP adapters and can be considered as the prime approach for ERP-to-hub integration (see also Figure 5-10).

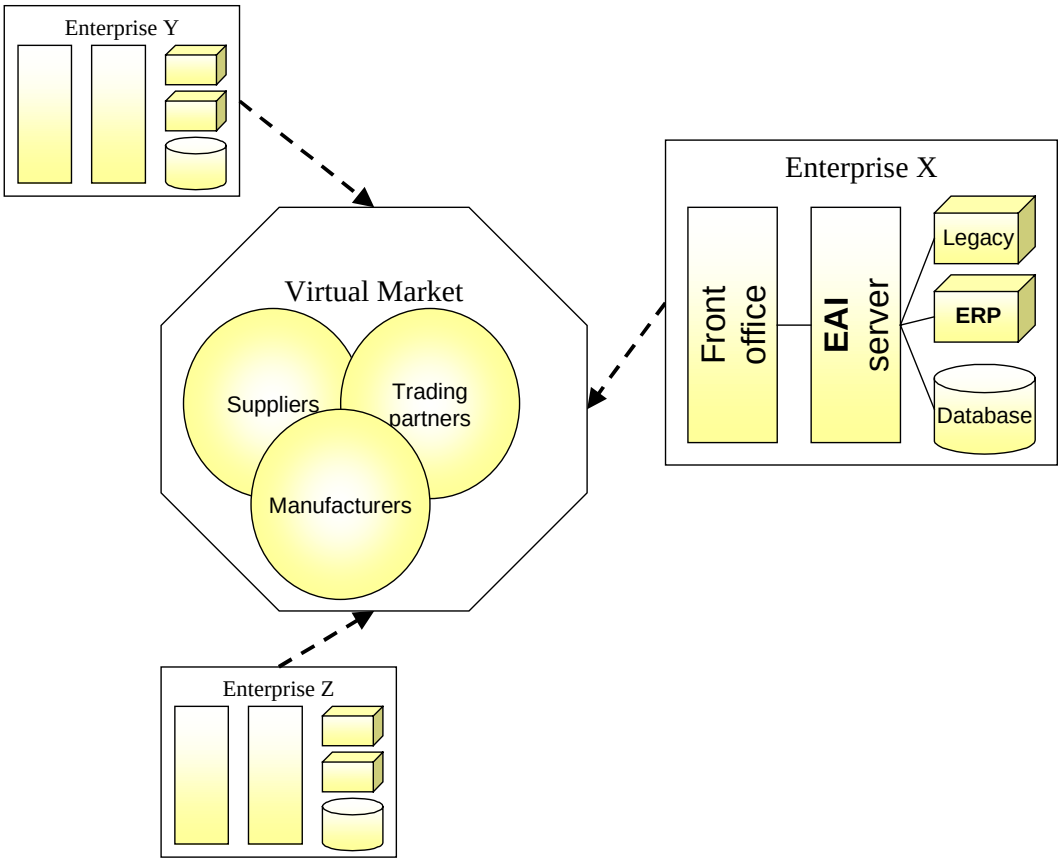

Figure 5-10: Connecting ERP systems with virtual marketplaces

However, the EAI software must deeply understand the business processes of a virtual marketplace. Until now, EAI solutions are strong in supporting the more static ERP-to-ERP connections, but the dynamics of a ERP-to-hub-to-ERP connection are not adequately supported. These dynamic business processes include -for example- discovery of new trading partners, evaluation of products, negotiation about the price, order placing, payment, billing, fulfilment, and customer service and support. Currently, EAI systems assume well-structured interfaces and strictly specified process logic, and have limited dynamic configuration capabilities.

Electronic markets can choose to build, to buy, or to outsource their integration solution. For example, SciQuest has built their own integration product SciConnect that promises to seamlessly integrate with the leading third-party procurement systems providers, including Ariba, Commerce One, Concur, Intelisys and Oracle, and also with popular ERP and financial systems providers. Its flexibility enables to rapidly develop customised interfaces between third-party procurement applications, ERP, and financial systems and the SciQuest.com marketplace. Figure 5-11 illustrates how SciConnect integrates ERP and financial systems with the SciQuest marketplace.

Features	Transmission	Format Supported	Systems Supported
SciQuest maintains catalog Secure transmission of documents Full SelectSite™ capabilities No duplicate data entry Leverages your existing systems and technology	Internet VAN Secure e-mail FTP	EDI XML Flat files SAP iDoc	Clarus Fourth Shift Great Plains JD Edwards Lawson Oracle Peachtree SAP R/2, R/3 Solomon And many others

Figure 5-11: SciQuest ERP and financial system integration

Figure 5-12: SciQuest's process model for a purchase order.

Meanwhile, standardisation efforts of common business functions (e.g. catalog content, order management, invoicing and payment, et cetera) are well under way. For example. the B2B commerce platforms of Ariba and CommerceOne perform EAI functions on top of an ERP system, enable exchange of information about catalogs, orders, etc, between the ERP system and the virtual marketplace, and automate many of these common business functions [Davydov2000].

6 Conclusions

While the ERP systems of many enterprises are slowly reaching completion after a long and costly implementation process, the next challenge has announced itself: electronic business. Because of the large implementation investments, ERP systems will remain the pivotal software application within many enterprises. Hence, the new electronic business systems have to connect to and collaborate with the various ERP systems of different enterprises.

Virtual marketplaces are an overrated yet inportant phenomenon. Most ERP vendors have augmented their ERP packages with supply chain management (SCM) and customer relationship management (CRM) towards extended resource planning (XRP) and facilitate ERP-to-ERP communication. For virtual marketplaces however, only SAP and PeopleSoft have addressed the issue of electronic markets. SAP has created individual marketplaces for its own customers in various verticals, such as utilities and chemicals, and PeopleSoft has partnered with CommerceOne in order to integrate order management with the online marketplace. But for the most part, these ERP vendors have lost ground to B2B solution providers like CommerceOne and Ariba. These B2B commerce solutions often use best-of-breed EAI solutions for integration between the virtual marketplaces and the enterprise-internal ERP system. Application integration is a bare necessity, because the ERP client-server architecture was not designed to work with applications from a myriad of vendors. EAI enables new architectures, which are open, scalable and mutual interoperable. Examples of B2B solution providers partnering with an EAI provider to deliver state of the art application integration are CommerceOne (with Webmethods and Excelon), and Ariba (with Tibco).

There is no real market leader in the field of ERP/XRP and B2B systems. However, SAP, Oracle, Ariba and CommerceOne seem to leap ahead the cloud of other solution providers in this area.

The ERP landscape is definitely changing. The major trends in ERP are all in the direction of electronic commerce between enterprises. We mention the three most important:

- extension of scope towards suppliers, customers and trading partners
- integration of front-office applications
- possible application outsourcing via application service providers (ASP)

The keyword in all these trends is application integration. Hence, EAI is a powerful enabler of B2B e-commerce, directly between enterprises or via virtual marketplaces. These virtual marketplaces certainly have the potential to boost real electronic commerce between enterprises (and their ERP systems).

However, XRP in combination with EAI requires many inter-enterprise agreements and a clear view on the relevant business processes (both intra and inter-enterprise) and the transactions needed for successful electronic business. Hence, thorough electronic business modelling is certainly required before XRP and EAI systems can be deployed optimally.

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[OpenMarket]	Open Market, http://www.openmarket.com/
[Oracle]	Oracle, http://www.oracle.com/applications/
[PSFT]	PeopleSoft, http://www.peoplesoft.com/
[SAP]	SAP, http://www.sap.com/
[SeeBeyond]	See Beyond, http://www.seebeyond.com/
[SUN]	SUN Forte tools, http://www.sun.com/forte/
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