Global dynamic E-marketplaces, and their role in the internet-based economy

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Global Dynamic E-Marketplaces, and their role in the Internet-based economy.

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A Thesis Submitted in Partial Fulfillment of the Requirements for the Degree of Master of Science in Information Technology

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Global Dynamic E-Marketplaces, and their role in the Internet-based economy

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This paper is dedicated to the loving memory of my brother Fayçal.
Abstract

Collaboration capabilities are what will most probably create the gap between winners and losers in business-to-business (B2B) commerce. In this context, the electronic marketplace (EM) comes as a medium for trade and collaboration, and a common entry point where partners can share business processes and adopt a decentralized business model fuelled by market evolution.

The thesis illustrates the advantages of collaborative business and presents the information technologies that support it. The purpose of this thesis is to educate both the author and the reader on the technology and infrastructure that supports collaborative business and to posit that among the three major information technology infrastructures that enable B2B commerce, the EM model provides significant advantages for individual companies and industries compared to Electronic Data Interchange (EDI) and Peer-to-Peer (P2P).

The thesis identifies key tools and value-added services EM’s should provide their participants to meet the requirements of modern companies and the Internet-based economy. Finally, the thesis suggests potential impacts of EM's on the modern business ecosystem.
Acknowledgments

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1- Introduction

1.1 Purpose

The learning objective of this thesis is to educate the author and the reader on the advantages of collaborative e-business, the infrastructures that support it and some of the enabling technologies used in this context. The purpose of this thesis is to suggest that among the three major information technology (IT) infrastructures that enable business-to-business (B2B) commerce, the electronic marketplace (EM) model provides significant advantages for individual companies compared to Electronic Data Interchange (EDI) and Peer-to-Peer (P2P).

1.2 Background

The Internet has extended our reach beyond our physical environment and is allowing us to participate in a radically new culture of communication. In The Medium is the Message, McLuhan states that we live in a Global Village, a simultaneous happening environment where time and space has vanished. The electronic media involves everyone simultaneously, allowing people around the world to communicate as if they were living in the same village [McLuhan, 1967].

George Gilder anticipates the emergence of the new Telecosm, a global infinite bandwidth communications network driving the world information economy [Gilder, 2000, p37]. Gilder believes the Telecosm can “provide people all the experiences that once led them to the great urban centers” [Gilder, 2000, p37]. Today, the Internet constitutes a forum for commerce, information, entertainment and personal interactions that makes access to information available almost instantly at very low cost. Broadband is becoming more accessible and affordable, and the Internet penetration in our lives and its upcoming ubiquity make the prospect of the global village a reality.
Growth of the Internet economy is attracting more companies to promote and sell their products and services via the World Wide Web. Companies first used the Internet as an alternative marketing channel and for those early movers, maintaining a web presence consisted primarily of an effort to make the company more transparent and advertise its brand and products to potential consumers. This served as a milestone and introduced companies to the Information age’s trading system. With the advances in information technology, the Internet began to serve more business purposes and quickly became the backbone of the information-centered economy.

An increasing number of companies engage in electronic commerce (e-commerce) to optimize their business processes, expand their market reach, adopt a more customer-centric infrastructure, and gain visibility and flexibility. E-commerce refers to the use of inter-networked computers to create, sustain and improve business relationships [Keen, Mc Donald, 2000, p112]. Business-to-consumer (B2C) commerce refers to the secure web transactions that allow consumers to purchase products from a company over the Internet. Business-to-business (B2B) commerce, or e-business, is defined by the buying and selling of goods and services between networked companies.

The dotcoms’ crash that started in the US in 2000 had lethal effects on many startups and initiatives that were unsuccessful in generating revenues, and even the IT blue chips have sustained significant losses. Meanwhile, the efficiencies and capabilities IT has introduced leads scholars, researchers and economists to conclude “the long-term effect of e-commerce on business ecosystems has been underrated” [Hoffman, 2001, p4]. Embedding business processes in software increases the speed of service delivery and reduces the cost of business operations.

Furthermore, B2B is bringing structural transformation as it enables corporations to focus on their core capabilities and outsource their non-strategic operations to
their business partners [Kalakota, 2000, p6]. This structural change allows companies to improve the efficiency of business processes in their supply chains and reassesses the role of collaboration. To engage in B2B commerce, companies need to adopt a stable, efficient and secure IT infrastructure that enables the seamless exchange of information. Today we can identify three forms of B2B infrastructures: Electronic Data Interchange (EDI), Peer-to-Peer (P2P) and the Electronic Marketplace (EM).

EDI is a computer-to-computer communication standard for exchanging business documents electronically. EDI has been used since the 1980’s and became de facto the first implementation of B2B collaborative e-commerce. EDI relies on batch processing information sent over Value Added Networks (VAN's).

The P2P business model relies on a system that allows companies to trade and engage in collaborative business without transiting through a central EM [McAfee, 2000, p2]. In this system, each company will have the ability to locate business partners and complete transactions in P2P. The P2P business model is better supported by a decentralized P2P technology. Brokered and centralized P2P systems rely on centralized servers maintained by a third party; inevitably they introduce a level of intermediation. Implementations of hybrid P2P systems have yielded very successful business plans like ebay and e-pinion, and progress of the P2P technology provides interesting ameliorations to the client server model widely used by existing EM’s.

Marketplaces have traditionally served as agoras providing buyers and sellers a space where they can do business. EM's are community centers that aggregate supply and demand participants and provide them with a set of tools and services to collaborate and share information. EM's can benefit from the development of the Internet and advanced information technologies to dynamically adapt to the demands of its participants. By providing the proper information technology capabilities and value-added services to its community,
the EM develops into a virtual medium for trade and a center for aggregating industry specific knowledge. EM's can become a valuable tool for globalization. Providing value and entertaining their communities reflects the power capabilities of EM's to derive their strategic role and revenues.

Using a B2B infrastructure allows companies to engage in collaborative commerce and adopt a disaggregated business model fuelled by market evolution. This thesis will suggest that EM's provide significant advantages for individual companies and industries compared to EDI and P2P.

1.3 Challenges of this thesis

Since the author of this thesis was not involved in the design or implementation of an EM, nor was he exposed to the technologies mentioned, nor was he granted temporary access to established EM's, the thesis is the result of reverse engineering the technologies and operational EM’s and research on the development of electronic commerce and the Internet economy.

1.4 Organization

The thesis first illustrates the advantages of disaggregated business infrastructures and collaborative business. Collaborative business is supported by a growing set of technologies among them eXtended Markup Language (XML), Collaboration Planning Forecasting and Replenishment (CPFR), P2P networking, and data encryption. The paper introduces these technologies and outlines their role in a B2B infrastructure. Then, it introduces the reader to the three B2B infrastructures and compares them in term of their capabilities to support collaborative commerce. From the research, the thesis suggests potential impacts of EM's on modern economy.
2- Collaborative business webs

Collaborative business webs constitute an evolution not a revolution in the way to conduct B2B initiatives. The Internet economy is growing very rapidly and more companies are seeking efficient, secure and flexible infrastructures to engage in B2B commerce. Information technology has significantly enhanced the potential for companies to adopt collaborative business models. The Internet, with its lower costs of connectivity, computing and information infrastructure, extends the benefits of B2B commerce to the majority of businesses.

2.1 Origins and evolution of collaborative business

In the industrial age, entrepreneurs founded companies around Adam Smith’s principle of division of labor [Hammer, Champy, 1993, p33]. In The Wealth of Nations, Adam Smith described how the technology of the industrial revolution created opportunities for manufacturers to increase workers’ productivity. His famous example of the pin factory outlines the concept behind his view on the division of labor. By specializing in a specific task, workers become more skilled at their activities, more team-oriented, and more educated on using and troubleshooting specific machinery. This in turn increases the productivity of the whole work chain.

Henry Ford and Frederick W. Taylor apply Adam Smith’s principles for achieving mass production and increasing the productivity of supply chains. The industrial age business model was vertically integrated, and linked disparate elements of the value chain through ownership [Tapscott, 2000, p.xii]. Vertical integration introduced numerous inefficiencies, among them “inflexibility, unresponsiveness, the absence of customer focus, an obsession with activity rather than results, bureaucratic paralysis, lack of innovation, high overhead” [Hammer, Champy, 1993, p33].
The classic conception of economics introduced by Adam Smith is still very up-to-date in our modern context. The pin factory illustrates the advantages of breaking industrial work into its simplest and most basic tasks and distributing it among workers. The pin factory can also be viewed as a chain of companies that concentrate on their core activities and collaborate with business partners to produce goods or services.

In the same manner that it does for the pin factory, this disaggregated business model maximizes the efficiency of the whole supply chain. By concentrating on their core activities, individual companies optimize their productivity and the efficiency of their business processes.

“A business process is a recurrent set of business rules” [Keen, Mc Donald, 2000, p66]. It is a building block that performs specific functions, and translates or breaks down business practices. Adopting a process-centered view on their activities allows companies to enhance their practices. They will be able to pinpoint inefficiencies and apply optimization techniques like Total Quality Management (TQM) or Business Process Reengineering (BPR) to increase their productivity.

In The eProcess Edge, Keen and Mc Donald claim that modeling a company's activities as business processes and looking at them in terms of value generation mechanisms enable the company to identify its core capabilities. Processes can be viewed as assets and liabilities for the company [Keen and Mc Donald, 2000, p69]. Asset processes are the processes from which companies generate economic value; liability processes drain value however well they are carried out, as they are not part of the core competencies of the company [Keen, Mc Donald, 2000, p81].

Keen and McDonald claim that the term “outsourcing” is inappropriate in describing the disaggregation of supply chains because it does not convey the
integration involved in the process. They employ the term "out-tasking" as it is more relevant to the modern context. Companies can choose to out-task liability processes and capabilities to others electronically and concentrate on their core competencies [Keen, McDonald, 2000, p199]. Figure 1 illustrates this discussion and shows the process portfolio of a company that was able to identify and out-task its liability processes to business partners.

**Company 1**
List of business processes:
- Design
  - Research
  - Industrial design
- Manufacturing
  - Inventory
  - Assembly
- Marketing
  - Brand name
  - Promotions
- Distribution
- ...

**Company 1**
Process balance sheet

<table>
<thead>
<tr>
<th>Assets</th>
<th>Liabilities</th>
</tr>
</thead>
<tbody>
<tr>
<td>Research</td>
<td>Assembly</td>
</tr>
<tr>
<td>Industrial</td>
<td>Inventory</td>
</tr>
<tr>
<td>design</td>
<td></td>
</tr>
<tr>
<td>Promotions</td>
<td></td>
</tr>
<tr>
<td>Brand name</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Distribution</td>
</tr>
</tbody>
</table>

**Company 2**
Process balance sheet

<table>
<thead>
<tr>
<th>Assets</th>
<th>Liabilities</th>
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</thead>
<tbody>
<tr>
<td>Assembly</td>
<td>Marketing</td>
</tr>
<tr>
<td>Inventory</td>
<td></td>
</tr>
<tr>
<td>...</td>
<td></td>
</tr>
</tbody>
</table>

**Company 3**
Process balance sheet

<table>
<thead>
<tr>
<th>Assets</th>
<th>Liabilities</th>
</tr>
</thead>
<tbody>
<tr>
<td>Distribution</td>
<td></td>
</tr>
<tr>
<td>Customer service</td>
<td></td>
</tr>
</tbody>
</table>

Fig 1: Out-tasking liabilities

Based on Keen and Mc Donald's eProcess Edge p 199

In this figure, company 1 identified its asset and liability processes, then out-tasked its liability processes to company 2 and 3. Doing so, these companies engage in collaborative supply chains also known as business webs (b-webs). Out-tasking liability processes across the value network is a win-win-win scenario as it benefits the company, the customer and the network of partners [Keen, McDonald, 2000, p198].
Increasingly, companies compete in their core capabilities to capture a durable competitive advantage [Bleeke, 1993, p3]. At the same time, they collaborate with business partners in associations of mutual benefits to leverage their assets as a team to participate in value networks, also known as b-webs. B-webs are defined in the following section.
2.2 Business webs

Tapscott defines business webs (b-webs) as “fluid congregations of businesses that collaborate to first identify and define needs, design and build solutions and deliver products and services to the end customer” [Tapscott, 2000, p24]. Durable competitive advantage requires companies to concentrate on their core activities and form strategic business relationships to optimize their supply chain or extend their reach into the market [Prahalad, Hammer, 1990, p3-5]. These associations of mutual benefits result in b-webs. In a b-web, a firm operates as a nonlinear nexus of components [Keen, Mc Donald, 2000, p 63]. These components can be located in different countries in case the firm engages in international trade.

Porter defines value chains as the set of activities a specific company performs to create and distribute its goods and services [Porter, 1985, p7-9]. He implies that the value chain of a specific company ends within the walls of the company and does not include the activities of its business partners. Tapscott’s definition of value chains is better portrayed by Porter’s value systems.

B-webs create value to the value chain participants by lowering the costs associated with the supply chain transactions and enhancing the relationship between the business partners. A b-web includes all participants in the supply chain that contribute to the design, production, assembly, distribution, and post-sale service of the end product. To achieve one degree of separation, the customers are also integrated in the value chain. In doing so, companies react instantly to customer demands and process orders faster and more accurately. The two-way relationship between the company and its customer becomes stronger and productive. The company benefits from the feedback its customers provide to reassess and enhance its products, and the customer benefits from having their interests voiced at the level of the company and can benefit from
loyalty incentives and programs. The b-web participants collaborate to leverage their assets and generate value through enhanced relationships.

A new typology of the Internet business model is central to Tapscott’s analysis [Tapscott, 2000, p28]. He expresses this typology in terms of control and value integration [Tapscott, 2000, p29]. Control reflects the organizational structure of the b-web. High value integration characterizes the tight integration of the b-webs participants’ supply chains to facilitate the production of a specific product or service. Low value integration topologies aggregate many products and services and provide their customers with a catalogue of selections [Tapscott, 2000, p54]. This topology and the different b-webs that result from it are shown in table 1.

<table>
<thead>
<tr>
<th>Business web</th>
<th>Control</th>
<th>Value Integration</th>
<th>Example</th>
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<tr>
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<td>Low</td>
<td>Monster.com</td>
</tr>
<tr>
<td>Aggregations</td>
<td>Hierarchical</td>
<td>Low</td>
<td>Amazon.com</td>
</tr>
<tr>
<td>Value Chain</td>
<td>Hierarchical</td>
<td>High</td>
<td>Cisco, Dell</td>
</tr>
<tr>
<td>Alliances</td>
<td>Self-organizing</td>
<td>High</td>
<td>Linux</td>
</tr>
<tr>
<td>Distributive Networks</td>
<td>Medium</td>
<td>Medium</td>
<td>FedEx</td>
</tr>
</tbody>
</table>

**Table1**: Tapscott’s B-webs typology

- **Agoras**

In the golden age of the Greek period, agoras were "public spheres" where true democracy was lived by citizens who made collective decisions about issues affecting their daily lives. They also constituted places where people gathered for public commercial purposes. “The net turns agoras into boundless meeting places” [Tapscott, 2000, p57]. A good example of an agora is Monster.com. Monster.com is a leading global online network for careers, connecting employers and employees and giving them a common ground for meeting. Monster provides its community with numerous tools and value added services like job search tools, professional resume editing and expert advice on career development. Monster has extended the reach of
both employers and employees in terms of opportunities, time and space. For job seekers, Monster.com gives an opportunity to expand their careers by having an ongoing contact with companies and interactive, personalized tools to make the job search process effective and convenient. For Employers, Monster.com offers complete company profiles, real-time job postings and resume screening tools.

- **Aggregation**
  Aggregation b-webs organize and orchestrate the distribution of goods, services or information [Tapscott, 2000, p57]. Aggregations benefit customers as they select and organize goods. Aggregations set prices and help customers match goods with their needs. An open, scalable, ubiquitous network creates perfect conditions for aggregation b-webs. An example of an aggregation b-web is Amazon. Amazon’s business motto “sell-all carry few” is key to its success. The just-in-time (JIT) model they adopted forced them to deal with wholesalers instead of publishers because wholesalers deliver faster. Amazon deals primarily with Ingram, and Baker and Taylor. The JIT model allowed Amazon to build strategic alliances with its main suppliers, integrate its value chain with their business partners, allowed customers to be instantly informed of the price and inventory status of the ordered status and reduced its working capital requirements. Amazon generated profits in January 2002, the first time for an online retailer.

- **Value chains**
  Value chains first identify and define needs, then design and build solutions to fit a specific demand. Through a sequence of steps, value chains transform raw materials into finished goods. These goods are then delivered to points of distribution or directly to the end customers, and often provide documentation service and support. Cisco Systems and Dell are good examples of value chains.


- **Alliances**
  
  Alliances are the most virtual b-web, achieving high value integration through self-organization without hierarchical management [Tapscott, 2000, p59]. Successful alliances require members with mutual trust and a common philosophy. Because an alliance's strength depends on its ability to function as a team, the ability to establish common goals and create consistent values among its members strengthens business relationships. Linux and other open-source software have been developed by an alliance of programmers.

- **Distributive Networks**
  
  Distributive Networks, in their purest form, service the various other types of b-webs by allocating and delivering goods—whether information, objects, money, or resources—from providers to users. Distributive networks fully achieve their potential when the communication between the b-web participants and customers become multi-way [Tapscott, 2000, p60]. FedEx is a good example of a distributive network. FedEx Corporation is the $20 billion market leader in transportation, information, and logistics solutions. Its 1994 revolutionary tracking system over the Internet gave it a considerable competitive advantage over its competitors and allowed substantial savings as they could greatly downsize their personnel in the customer service department. FedEx in-sourced the supply management of several Internet businesses, among them Amazon.

Collaborative business creates many advantages for individual companies: stronger business relationships, visibility across the supply chain, better market response and globalization. These are illustrated in the following section.
2.3 Advantages of collaborative business

Collaborative business strengthens the B2B relationships between companies that engage in decentralized supply chains by increasing their collaboration levels. “Industry-specific collaboration will permit enhancing the overall performance of the industry by taking the inefficiencies out of the marketplace” [Cronin, 2000, p84]. Collaborative business models entail stronger business relationships, visibility across the whole supply chain, better market response. They facilitate targeting new markets and help the globalization efforts.

- **Stronger business relationships**
  Competition is exerting pressure on companies to adapt their business model and information technology infrastructure to remain competitive. In a scenario where companies can seamlessly form and modify b-webs, the bonds between individual companies become weaker as the cost for replacing them is significantly reduced. The reluctance to alter existing business relationships can hinder b-webs to achieve their full potential since “supply chains are as strong as their weakest link” [Boucher Ferguson, 2001, p1]. B-webs perform according to the effectiveness and cohesion of the individual partners.

On the other hand, the depth of the relationship between b-web partners contributes to stronger business relationships. As long as b-webs find value in a particular relationship, their goal is to cooperate, mutually support and complement one-another to leverage their assets as a team. Collaborative business forces the business partners to align and comply with a set of standards and objectives agreed upon between all supply chain participants, which synchronizes business behaviors across the extended supply chain and develops stronger interdependent relationships.

Interactive shared spaces and virtual design environments allow b-web partners to engage in collaborative product design. Collaborative design
software helps companies decrease the product life cycle by providing online and offline communication tools that can be used by a design team to share documents and work simultaneously on a project.

- **Visibility across the supply chain**

  Collaboration tools allow all the b-web partners to have a view across the entire supply chain because of the feedback they receive on every step of the supply chain. They can see what is happening up and down the stream to react instantly to market changes and opportunities, and to identify bottlenecks in the production or distribution.

  Collaborative business allows companies to synchronize their efforts throughout the supply chain. Like a rowing team, b-web partners use collaboration forecasts to put their efforts in phase and react to new opportunities.

- **Better market response**

  Collaborative e-business speeds up the companies’ processes, giving the decision-makers real time accessibility to data, allowing for faster decisions. Information has become closely related to business success as it helps managers make well-informed decisions and trigger new practices that lead to increased productivity [Gelinas, James, 1998, p1]. In a synchronized supply chain, it is crucial for participants to rapidly and seamlessly cooperate to react to business opportunities and market changes.

  Better market response involves a higher level of flexibility based on market forecasts and fluctuations. Better market response can also be created by the ability to tune the companies’ productivity. Being able to adjust to market demand and dynamically produce more or less than regular levels can provide significant enhancement to managing inventories.
Targeting niche or global markets

The prospect of globalization will attract more companies to participate in international trade. Provided with the proper collaboration tools, b-webs can expand to new markets and generate new revenue opportunities. Collaborative business helps companies target broad or niche local and international markets. To enter new markets or augment their market share, companies can employ b-webs to expand to business partners local to the new markets. Companies using b-webs can also benefit from the best assets and the diverse culture each player brings to the extended company. Individual companies can greatly benefit from the knowledge and technology transfer that is collateral to this process.
2.4 Fostering collaborative business

The B2B infrastructure provides an integration platform to bridge the information systems of the business partners. It allows them to communicate and trade seamlessly in a secure manner, to share information more efficiently and to automate redundant collaboration processes by embedding them into software. This thesis concentrates on the technologies and IT infrastructures to support collaborative business and the resulting business models. Economic, legal, and other considerations are not in the scope of this thesis.

- **Integration platform**
  The integration platform uses different communication protocols and adapters to link the company’s information system to the B2B information technology infrastructure. Among these protocols, we find the Simple Object Access Protocol (SOAP), which is a set of conventions for invoking code using XML over the Internet in a decentralized, distributed environment. Integrating the various and (most of the time) incompatible information systems remains a challenge the software industry is facing. Today, we can identify three models for B2B infrastructures: Electronic Data Interchange (EDI), Peer-to-Peer (P2P) and the Electronic Marketplace (EM). These infrastructures are presented and compared later in this thesis.

- **B-web designer**
  Having a b-web designer allows individual companies to create b-webs, add or replace business partners and manage partnership contracts. The following are tools to accomplish these tasks.

  - *Post and reply to Requests For Trade Partnerships (RFTP’s)*
    RFTP’s can be the first step towards establishing a b-web. Using this tool, companies can post or reply to RFTP’s to locate potential trading partners. A simplified example of an RFTP is: “Altec Lansing is looking for a home
equipment distributor in Geneva, Switzerland to deliver its line of products”. Companies can post RFTP's to the whole community or send them to specific companies. Replies to RFTP's are encrypted and sent to the company or b-web that posted the RFTP.

- **Create and modify b-webs**
  The tool that creates and modifies b-webs allows companies to add or remove trading partners from a b-web. The creation and monitoring of b-webs is the responsibility of individual companies. At this level, public keys can be exchanged to permit P2P transactions. This tool allows companies to participate in multiple supply and demand chains.

- **Manage contracts**
  The tool to manage contracts allows b-web partners to generate, update, and digitally sign partnerships contracts. Contracts are legally binding agreements that define the nature of the relationship. They contain sensitive information shared by business partners.

- **Communication platform**
  Keen and McDonald claim that the levels of “texture” and “touch” characterize the strength of online relationships. Texture reflects the “substantive fabric of information” and touch reflects “the degree of interaction” between the b-web partners [Keen, McDonald, 2000, p117]. High touch, high texture relationships characterize collaborative business interactions and permit collaborative product design.

To enhance the texture of these relationships, the communication platform must provide tools to share information regardless of its format. Providing instant messaging and video conferencing capabilities enhances the level of touch between business partners.
• **Information sharing**

Information refers to anything that can be digitized and encoded to a stream of bits [Shapiro, Varian, 1999, p32]. The definition of information as processed data is becoming too restrictive as media technologies evolve and spread through the Internet.

B-web partners share business documents like invoices or purchase orders and other documents like design plans, inventory updates, CPFR forecasts, etc. These documents are confidential and contain sensitive information that can be accessed only by authorized partners. Other documents like company brochures, product manuals, white papers, etc., can be shared with the whole business ecosystem. Information sharing of relevant information allows b-web partners to enhance the texture of their relationship.

It is important that the B2B infrastructure allow for the sharing of any document regardless of its format, else the file-sharing infrastructure would hamper certain efforts like collaborative product design.

• **Instant messaging**

Instant messaging is a powerful improvement to public chat rooms. Instant messaging allows peers to communicate in a private environment. It allows users to know when their peers are online or offline and initiate discussions. In contrast to public chat rooms, users can choose their peers to initiate group discussions. MSN Messenger, Microsoft’s instant messaging software, allows for other P2P capabilities like IP telephony and sending messages on mobile devices.
• **Video conferencing**
  Video conferencing allows business partners to engage in face-to-face communication. Embedding translation tools in the video conferencing software can help to enhance communication in a global market. Video conferencing reduces the need for travel and enables b-web partners to hold meetings online as often as needed.

  **Trading platform**
  To support collaborative business efforts, the B2B infrastructure can provide a flexible trading platform that provides both static and dynamic pricing capabilities.

  Static pricing capabilities require sellers to list the goods and services they provide in a catalogue. Buyers consult these catalogues, perform comparison-shopping and initiate the transaction. Static pricing models are the norm in today’s businesses but they are economically sub-optimal [Utecht, 2000, p4]. Dynamically pricing goods and services makes the product more responsive to economic conditions. In certain scenarios, the price of goods and services can change while the trader is waiting for a trade partner [Lee, 1996, p3].

  Dynamic pricing models are more logical in today’s environment. Prices of products increase or fall with respect to their levels of supply and demand and allow the sellers and the buyers to come to a common ground. The dollar value of orders is usually much bigger in B2B compared to B2C, which gives attractive opportunities for price discovery and negotiation. In auctions, the participants implicitly engage in a self-organizing group process to discover the price and allocation of goods, referred to by Charles Smith as the “social construction of value” [Smith, 1990].
There are three dynamic pricing systems: dynamically ascending, also referred to as forward auctions, dynamically descending, or reverse auction, and dynamically floating which is a combination of the two. In forward auctions, the seller proposes a good or service at an initial low price, interested companies incrementally bid on the product until the auction closes. In reverse auctions, buyers name their own price for a good or service; the highest bidders win the auctions. Expedia.com uses this system for pricing plane tickets, car rentals and hotel fares. In dynamically floating auctions price and quantity determine winning bidders. In such systems, companies can quote different unit prices according to the quantity they are ordering. Auctions, introduced online by business to customer aggregations like eBay and Yahoo, come as a necessity for the B2B commerce participants to achieve economies of scale, extend their market reach and adapt to market demand.

It has to be noted that price is not the only parameter to consider in B2B auctions. Auctions have multidimensional attributes such as the quality of the product, shipping times, reliability of the company, payment options, etc. All these attributes are considered in the making of long time relationships between companies. Real time accessibility to data is important in auction systems because it allows companies to receive live quotes and real time updates of inventories. Auction systems require neutral intermediation.

**Trust infrastructure**

"If Information is the engine of the Internet, then trust provides the essential oil for its friction-free operations" [Cronin, 2000, p99]. The Internet makes establishing trust between online enterprises a particular challenge because automation and data transmission over the Internet introduces new risk factors. Building online trust between companies requires a solid security mechanism, fostering an environment of mutual trust. “Trust is an information catalyst; lack of trust is an action inhibitor” [Cronin, 2000, p79].
Participants can be provided with a secure platform to carry out business transactions, tools to assess the credibility of companies, and decision support systems for evaluating a company's trading history. Expanding b-webs in a virtual environment of potential trading partners that probably never met face-to-face requires a strong security infrastructure as well as metrics and information about the individual companies.

- **Security mechanisms**
  The security mechanisms protect the information technology assets and the data manipulated by the company. Intelligent fraud detection systems are increasing the security levels of security infrastructures. These systems can detect fraud from multiple sources and dynamically react to it. High levels of security enhance the ability to protect sensitive data and information technology assets. The security system allows b-web partners to store and exchange information in a very secure environment.

Encryption mechanisms authenticate individuals and secure information while being stored or transferred between business partners. The Digital Rights Management (DRM) system enables intellectual property owners to set permissions on documents and distribute information on the Internet. DRM technologies provide a solution for managing intellectual property of digital media. The DRM platform offers a highly elaborate multi-layer security system, providing different levels of security to the owner of the intellectual property. Companies like InterTrust, ContentGuard and SunHawk offer a set of proprietary products and services based on the DRM model to protect and distribute digital information and automate most of the commercial transactions relative to the use of this information.

- **Mutual trust platform**
  Adopting more elaborate trust mechanisms and models can significantly decrease the risk factor. In his paper, “E-commerce Trust Metrics and
Models,” Daniel Manchala, developed a quantitative trust model to verify e-commerce transactions based on the concept of mutual trust between the buyers, sellers and intermediaries. Traditional models of trust do not fulfill the requirements for the EM because transactions within value chains cross territorial and legal boundaries [Manchala, 2000, p36]. Castelfranchi and Falcone articulate the importance of a cognitive view on trust. They argue that trust is better assessed by “a subjective probability in contrast with the probabilistic approach supported by economics and the game theory” [Castelfranchi, Falcone, 2000, p1]. Trust can be derived from feedbacks about the company’s products and services. In the same manner that it does for e-pinion, this feedback can enable the creation of trust networks within the business ecosystem.

E-pinion provides an unbiased medium to help users perform informed comparative shopping. It aggregates feedback from its community members on various products and companies and provides links to companies that sell these products. The communities are founded on the principal that people are basically honest and trustworthy, which is further reassessed by trust metrics of the network. User recognition is earned by providing reviews on specific products to the community. The more users agree that the reviews provided are helpful; the more trusted the individual becomes. Trust networks can be built within the e-pinions community. A trust network consists of a group of users who trust each individual user within the group. A trusted member has a bigger potential to influence the decision making of other users.

E-pinion gives credit to users for providing content to the community. The “earning center” provides royalties for the reviews submitted to the site and for referrals made on specific products or companies. E-pinions has introduced "tickets" to flag users who have violated the user agreements.
• **Guaranteed reliable service**
  Companies require the B2B infrastructure to guarantee reliable service with almost prefect up-time statistics. If a company provides this service, it must make sure that its business plan allows it to generate enough profits to continue to provide the services.

• **Value added services**
  Value added services are tools and capabilities companies acquire to support their activities. Among these we find an industry specific knowledge base, education, training and seminars, business intelligence and consulting, international trade logistics, etc.

In essence, the B2B infrastructures serve the particular purpose of collaborative commerce, so it is their ability to provide an infrastructure to support these capabilities that allows us to compare them.

Collaborative business and b-webs were first implemented without leveraging the potential of information technology. Communication and exchange of documents was performed by traditional means like mail, phone or fax. These documents require further manual data entry to input data into the company’s information system which augments the overhead costs associated with the supply chain, introduces potential input errors and slows down the collaboration process.

Embedding processes into software agents automate routine transactions and provide tools to facilitate and support the execution of other operations that require human intervention. Automating collaboration business processes enables the fast and secure transfer of information, and generates cascaded reactions throughout the supply chain. Today, IT provides various tools to permit the seamless exchange of business documents and the processing of information incoming from different channels.
Collaborative business models allow companies to achieve better performance, better pricing, target new markets and increase the end customer’s satisfaction. These levels of collaboration are enabled by a growing set of technologies; among them are eXtended Markup Language (XML), Collaborative Planning Forecasting and Replenishment (CPFR), data encryption and the P2P technology. These technologies are presented in the following section.
3- Information technologies for collaborative business

In this chapter, four key information technologies that help foster collaborative business are examined. These technologies are: eXtended Markup Language (XML), Collaboration Planning Forecasting and Replenishment (CPFR), data encryption, and Peer-to-Peer (P2P) networking.

3.1 eXtended Markup Language

A key technology enabler for B2B is XML, which is a platform for information exchange between computers. XML is rapidly becoming the universal format used by companies to share business information on the web.

3.1.1 Introduction to XML

XML is an open standard that enables system-to-system data exchange even if the systems are using different applications, operating systems and database management systems (DBMS). XML is a simplified subset of Standard Generalized Markup Language (SGML, ISO 8879), which provides a file format for representing data, and a mechanism for extending and annotating HTML with semantic information. XML, through its semantics and grammar, defines other languages [Powers, 1998, p2]. Unlike HTML documents, XML documents contain data that has a structure and a meaning.

Developers recognized the potential to use XML as a mechanism to publish data through the web [Linthicum, 1999, p 280]. XML was not originally designed for enterprise application integration (EAI). It was created to supplement HTML, improving the quality of Web pages. Meanwhile, analysts have promoted XML as being the next generation integration mechanism. XML is text-based; therefore it can be easily transported across different platforms.
Several industry initiatives are under way to accelerate the adoption of XML-based B2B e-commerce standards like e-business XML (ebXML). Several trade groups have been formed to promote industry specific approaches to XML, among them Oasis, BizTalk and RosettaNet. Meanwhile, the proliferation of frameworks for XML, like cXML, ebXML and CommerceNet ECo used by Cisco, 3Com and Microsoft, raises more integration issues. Over 100 XML-based message standards have been developed to serve industry specific requirements [Daudelin, 2000]. Many vendors are proposing standards to the World Wide Web Consortium (W3C) to solve this issue, but no standard has yet been accepted.

The problem of integrating all of all these standards is prohibitive and challenges integration specialists; meanwhile interfacing all the standards will be necessary since companies may use different standards. Since its inception, the large number of standards has hindered XML from gaining widespread use. Meanwhile, in the context of the B2B commerce, XML is key to permit the exchange of information between the various trading partners. Simplicity and portability are the major strengths of XML.

Like Structured Query Language (SQL), XML defines structures, entities, attributes, and content. Meanwhile, data is stored in the file and not in a physical storage organized by a DBMS. Because the tags describe the content they enclose, XML is a self-describing database. XML documents can also serve classes, objects and methods, which enables databases and applications to communicate regardless of their IT infrastructure [Linthicum, 2000, p281].

Unlike plain HTML documents, a file that uses XML “has a logical structure that can be manipulated, queried and changed” [Powers, 1998]. Jay Tenenbaum claims that XML plays a vital role in the process of what he calls “plug & play commerce” [Tenenbaum, 2000].
3.1.2 **XML and Middleware**

Middleware vendors like IBM, Sun and BEA created XML-enabled products. XML is used when needed as a transitory phase before reformatting it to their proprietary standards [Linthicum, 1999, p281]. This approach requires more processing power since the data has to be reformatted twice every time. To handle XML, traditional databases use external conversion layers to translate XML into some other data format. On the other hand, XML databases store XML data natively in its structured hierarchical form. Queries can be executed much faster because there is no need to map the XML data structure to tables. This preserves the hierarchy of the data and increases performance of queries.

3.1.3 **XML in the context of B2B commerce**

"XML is being embraced as a superior substrate for e-commerce interactions" [Daudelin, Greiner, 2001, p4]. In the context of the B2B, XML can be used to transport information from catalogue listings to enable real time updates of data, and serve as the "glue" that enables business transactions to happen between the separate business partners [Tenenbaum, 2000].

System-to-system integration is permitted by the exchange of business documents like invoices, purchase orders, requests for quotes, shipping orders, etc. Businesses are accustomed to handling these documents and have been exchanging them via traditional means like fax, mail or e-mail. Data received through these documents need additional manual input into the companies' information system before any processing can start. The exchange of XML versions of these documents can be used to enable interoperability between the different information systems and automate routine transactions. These XML documents can be compared to neurotransmitters in the human body. Like neurotransmitters, these XML documents carry a limited amount of information, the information needed to generate a chain reaction.
XML Commerce Connectors (XCC) can be set to handle these documents and generate the cascaded reaction. Tenenbaum describes this integration process as "a loose coupling enabled by the exchange of XML business documents". The integration is performed on-demand and is triggered by a transaction. The following figure describes this integration process permitted by XML Commerce connectors.

![Diagram of XML Commerce Connectors](image)

**Fig 2: Description of an XML Commerce Connectors**

The map schema process consists of breaking the many-to-many relationships that exist within the company’s choice of a specific XML format. In this scenario the associative entity consists of translation algorithms that would detect a specific XML format used by the sender and convert it to the XML format of the receiver.

Certainly, this procedure requires overhead processing power and the development of translation algorithms. Such a capability is required to enable transparent many-to-many business transactions between potential business partners willing to engage in collaborative commerce. The reliability of the processes in figure 2 or similar cooperation processes is very critical since most of the B2B trading transactions will transit through these or similar mechanisms.
3.1.4 Pitfalls of XML

- **Data complexity**
  Relational database systems cannot meet all the demands of electronic business because they process data independently of its context. The risk in using XML then is that its popularity will create an even bigger data complexity than the one seen with relational databases, which ultimately impedes the integration process.

- **Redundant data structure**
  XML requires the data structure to be created in memory, rather than having it already stored physically. XML does not provide a good database format for medium and large data sets. The rows and columns representation we are accustomed to in DBMS and spreadsheets is replaced in XML files, each time listing the entity and attribute name enclosed between tags. Redundant data is introduced in this process and increases the size of documents to be exchanged.

Despite its many advantages, XML cannot address every aspect of the electronic transactions required in B2B nor can it automate all the data integration processes. Since XML is written in ASCII or Unicode characters, it does not facilitate transmitting binary data. XML does not support complex data types and XML data must be sent over secure channels by using encryption mechanisms. XML alone cannot serve all the requirements of collaborative business; however, it plays a significant role in the integration process. XML documents require a security mechanism to protect them while being transferred. Encryption techniques are presented in the following sections.
3.2 Data encryption

Encryption is the process of transforming information before sending it to make it unintelligible to all but the intended recipient. Encryption uses cryptography algorithms also known as ciphers and numbers called keys to encode and decode information. “Cryptography refers to numerical algorithms, implementations of those algorithms, and various mathematical and programming tools used to meet security goals” [Camp, 2000, p57]. Encryption and digital signatures allow authenticating the users; unauthorized users can be identified and blocked by the system.

Cryptography is implemented in different manners: symmetric cryptography uses private keys for encryptions, asymmetric cryptography uses public keys provided by a trusted authority or a combination of both that is used by the Secure Socket Layer (SSL) protocol. Cryptography provides a solution for addressing the following four issues:

- **Confidentiality**: the information cannot be understood by anyone for whom it was unintended.
- **Integrity**: the information cannot be altered in storage or transit between sender and intended receiver without the alteration being detected
- **Non-repudiation**: the creator/sender of the information cannot deny at a later stage his or her intentions in the creation or transmission of the information
- **Authentication**: the sender and receiver can confirm each other’s identity and the origin/destination of the information

To secure data transition data encryption relies on various technologies. In the following section we briefly introduce digital signatures, digital certificates and SSL.
3.2.1 Digital signatures

Digital signatures are based on a combination of data hashing with public-key based encryption. "[Hash functions] are one-way functions with the property that given the output it is difficult to determine the input" [Camp, 2000, p243]. These functions transform the information contained in the encrypted message so that it can be used for verification but not read.

Digital signature has the same legal status as handwritten signature in most modern economies. In the US, the Senate Commerce Committee passed the S761 Third Millennium Electronic Commerce law in June 24, 1999, and adopted the electronic signature. The European Union approved electronic signatures in November 1999. The main purpose of introducing the digital signature is to ensure principles of functional equivalency and non-discrimination of the electronic form of contracting. A digital signature, being the functional equivalent of handwritten signature, does not and shall not provide any additional guarantees in comparison with a handwritten one.

A digitally signed document is now acceptable evidence. Basically, most digital signature laws simply state that within it its jurisdiction, the law must recognize a digitally signed contract being as valid as a hand signed contract. Essentially, any contract is acceptable if both parties agree to the method of signing. Hence, a click-to-agree contract is a legitimate contract provided both the seller and the buyer accept it.

One-way hash functions are used to create digital signatures to authenticate the sender and message of a digitally distributed document. They transform the information so that it can be used for verification but not read by anyone but the recipient.
3.2.2 Digital certificates

Digital certificates are small electronic files that uniquely identify a web site or an individual. Trusted third parties, also referred to as Certificate Authorities (Dun and Bradstreet, Verisgn and Thawte) create, issue and use the individual public keys in a cryptographic system. Dun and Bradstreet use a two-step process to investigate and certify businesses and confirm employees.

- **Authentication of the company**: information submitted by the company at the time of registration is matched against a global database. If this information does not match any entry in the database, further investigation is performed.

- **Verification of the individual**: to assert that an individual is an employee of the company.

After these verifications are performed the certificate authority issues a digital certificate for the company that is used to generate the Public Key Infrastructure (PKI). PKI is the system used to encrypt and decrypt messages based on a related public and private key pair. PKI is the cryptography method used for digital certificates.

3.2.3 The Secure Socket Layer

The Secure Socket Layer (SSL) was originally developed by Netscape Communications. It is an information technology for securely transmitting information over the Internet. The SSL protocol has become the universal standard on the Web for authenticating Web sites to Web browser users, and for encrypting communications between browser users and Web servers. SSL can be used in conjunction with special payment protocols such as Secure Electronic Transactions or Electronic Commerce Modeling Language.
3.3  **Collaboration, Planning, Forecasting and Replenishment**

3.3.1  **Definition**

Collaborative Planning, Forecasting and Replenishment (CPFR) is a set of guidelines supported and published by the Voluntary Inter-industry Commerce Standards (VICS) Association. CPFR involves a relationship between two or more trading partners that share demand and delivery forecasts, discuss them, and agree upon a volume of production. The forecasts can extend over any length of time, but in the near term, the forecast numbers become delivery numbers partners have to fulfill [Dobrin, 2000, p4]. These forecasts are based on their information about the market, their estimates of demand, and their ability to deliver. Using CPFR, participants of value networks have a powerful tool to “orchestrate the supply chain choreography” [Keen, Mc Donald, 2000, p99].

CPFR was originally developed to help prevent suppliers’ tardiness and distributors inability to properly manage inventories [Johnson, 1999, p4]. For a company keeping stock is a loss of money. This system has been designed for taking advantage of the opportunity cost for not keeping stock. The CPFR forecasts need to be agreed upon by all parties; therefore a workflow management system is necessary in any CPFR software. Current forecasts and past forecasts are compared by the application enabling the partners to enhance the future forecasting. Once CPFR partners commit to a particular forecast, they would be able to cope with deviations using exception-handling tools. An exception happens when there is a significant drift from the forecast.

CPFR is particularly appealing for distributive networks and value chains. CPFR can also be used by any b-web willing to take a holistic approach to their supply chain. In essence, CPFR is a coordination tool because it gives the capacity to manage the workflow of goods and services throughout the value chain. By synchronizing efforts across the value network, it allows companies to tune their
productivity to adjust to market demand and maximize their inventory turnover. CPFR software permits all the participants in a value chain to have a global view of the supply chain from the design to the production and commercialization. CPFR as described by the VICS can be subdivided into nine steps described in the following table.

<table>
<thead>
<tr>
<th>CPFR step</th>
<th>Purpose</th>
<th>Output</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>1- Develop front-end agreement</strong></td>
<td>Sets and defines each parties' expectations and set rules and</td>
<td>A published CPFR front-end agreement.</td>
</tr>
<tr>
<td></td>
<td>guidelines for the collaborative relationship to operate.</td>
<td></td>
</tr>
<tr>
<td><strong>2- Create a joint business plan</strong></td>
<td>Partners create a partnership strategy and agree on a shared business</td>
<td>A mutually agreed upon business plan that clearly identifies the roles,</td>
</tr>
<tr>
<td></td>
<td>plan for the collaboration, set objectives and develop plans for</td>
<td>strategies, and tactics for the items to be collaborated on.</td>
</tr>
<tr>
<td></td>
<td>promotions.</td>
<td></td>
</tr>
<tr>
<td><strong>3- Create sales forecast</strong></td>
<td>Create a sales forecast that supports the joint business plan.</td>
<td>A sales forecast, initially generated by one party.</td>
</tr>
<tr>
<td>**4- Identify exceptions for sales</td>
<td>Identify exceptions when the partners' plans do not coincide or when</td>
<td>A list of exception items.</td>
</tr>
<tr>
<td>forecast**</td>
<td>the specific objectives are not attained.</td>
<td></td>
</tr>
<tr>
<td>**5- Resolve/Collaborate on exception</td>
<td>To resolve sales forecasts exceptions and adjust their plans.</td>
<td>An adjusted forecast is generated and is used to re-parameter the</td>
</tr>
<tr>
<td>items for sale forecasts**</td>
<td></td>
<td>supply chain.</td>
</tr>
<tr>
<td><strong>6- Create order forecast</strong></td>
<td>Generate an order forecast, and map the time buckets.</td>
<td>A time-phased order forecast.</td>
</tr>
<tr>
<td>**7- Identify exceptions for order</td>
<td>To determine what items fall outside the order forecast agreed upon</td>
<td>A list of exception items.</td>
</tr>
<tr>
<td>forecast**</td>
<td>throughout the supply chain.</td>
<td></td>
</tr>
<tr>
<td>**8- Resolve/Collaborate on exception</td>
<td>Investigate order forecast exceptions and come out with exception</td>
<td>Adjusted order forecast.</td>
</tr>
<tr>
<td>items for order forecasts**</td>
<td>handling techniques.</td>
<td></td>
</tr>
<tr>
<td><strong>9- Order generation</strong></td>
<td>To generate a committed order from the adjusted order forecast.</td>
<td>A committed order generated, an order acknowledgment is sent as a</td>
</tr>
<tr>
<td></td>
<td></td>
<td>result of the order.</td>
</tr>
</tbody>
</table>

Table 2: CPFR nine steps.
3.3.2 **Collaboration Process Modeling**

![Collaboration Process Modeling Diagram]

**Fig 3: Collaboration Process Modeling**
Based on Johnson’s “Collaboration process modeling”, p2

- **Align business plans**
  Aligning business plans and incentives of partners will enable synchronizing the individual efforts and creating order forecasts. It implies identifying collaboration opportunities between the “organization’s plans with another’s, a new version of the organization’s plans with a previous plan, or comparing a plan with actual results” [Johnson, 1999, p2]. In doing so, companies lower the uncertainty level for managing inventories across the supply chain. Those plans are then compared to actual performances. Periodic exchange of data from inventories and production databases permit this planning. CPFR software allows comparing the data with forecasts and taking action to readjust to market opportunities [Johnson, 1999, p5].

- **Align data sources**
  Companies align data sources to create and share a common representation of data streamlined throughout the supply chain. This step also implies coping with the diversity brought by the globalization in terms of date formats, units of measurement, currencies and language. Aligning data sources achieves data integrity.

- **Organize Views**
  This step consists of creating company specific views of the data. Levels of hierarchy can be used to aggregate data by specific store or region.
Define business rules

Business rules govern the relationship and set exception thresholds. These business rules are agreed upon between business partners and are shared in collaboration contracts. Contracts are legally binding agreements that define the nature of the relationship. They contain sensitive information shared by business partners.

3.3.3 CPFR tools

CPFR collaboration processes modeling

These tools allow business partners to define the business rules that govern the relationship and to set exception thresholds. Collaboration process modeling allows business partners to integrate their systems.

CPFR workflow and logistics management

A workflow management allows b-web partners to achieve visibility across the entire value chain. This tool enables the companies to reduce inventory levels, transportation, warehousing, and logistics costs, and to trace the transfer of goods within the b-web.

CPFR exception handling tools

These tools allow business partners to take action to handle deviations from forecasts.

CPFR provides a powerful framework to create incentives for collaborative business. CPFR software provides companies with tools to define short term and long term business objectives, to create common catalogues to simplify the integration process, to construct personalized views on data and to react to market changes quickly using exception handling tools.
In essence, CPFR technology establishes the foundation to build b-webs. Selling unfinished products throughout the value chain accomplishes the integration of b-webs. The value of goods increases throughout the value chain; participants exchange value and draw margins at each step.

Many EM’s in the retail industry like Transora, GlobalNetExchange and Worldwide Retail Exchange offer CPFR as a standard service. These EM’s host the system and provide access to it to the trading partners that do not need to acquire the technology by themselves.
3.4 Peer-to-peer technology

In this thesis, a distinction is made between the P2P business model and the P2P technology. The P2P technology can be used within an IT infrastructure; however, not all IT infrastructures that use the P2P technology provide for the P2P business model. For instance, eBay is an online marketplace that provides tools and services to complete transactions in a P2P manner. Without eBay's web site, these transactions might never have been initiated. The P2P business model relies on a system that allows companies to trade and engage in collaborative business without transiting through a central marketplace [McAfee, 2000, p2]. Rather, companies that engage in P2P collaborative business use a peering portal similar to the Groove Network's workspace to locate one-another and complete the transactions without any intermediation.

In the following section we present the origin and evolution of the P2P technology, the topologies to implement P2P networks and the advantages and pitfalls of such a technology. The P2P business model is presented later in this thesis.

3.4.1 Origins and evolution of P2P technology

The Internet's predecessor, the Advanced Research Projects Agency Network (ARPANET) developed by the U.S. Department of Defense in the 1960s, was essentially designed as a P2P system [Minar, Hedlund, 2001, p1]. The ARPANET connected the different computers, also referred to as nodes, in a decentralized manner as “equal computing peers” [Minar, Hedlund, 2001, p2]. In P2P systems all nodes can serve as clients as well as servers, which permits the one-to-one unmediated dialogue.

Over time, the Internet has progressively migrated towards a client/server model relying on thin client web browsers that retrieve stored or processed information
from servers. In this architecture, all the processing is shifted to the server side. The client is used to send commands or queries to the server, and to display the information received from the server. This restricts the client/server systems capability to scale in terms of processing power and bandwidth. For this reason, many analysts recognized the importance of pushing the computing capabilities at the edge of the network, decreasing the load on central servers, allowing individuals or companies to connect to one another directly, and process information locally. The music sharing application Napster exploited these P2P capabilities and allowed registered users to share music files over the Internet in a P2P manner.

3.4.1.1 Napster

The Napster client installed on the peer computer allows searching and downloading music from fellow Napster users. The Napster servers hold a catalogue of paths and IP addresses to access those files. This catalogue is reconstituted every time the user runs the Napster client or resynchronizes with the servers. Queries are sent to the Napster server but the actual files remain on the users hard drives and are exchanged in a P2P manner. The mp3’s do not transit through the Napster servers.

![Napster servers cluster](image)

**Fig 4: Napster's P2P file sharing.**
Napster is P2P because once the Napster servers query their databases for a particular song and resolve the IP addresses of the computers hosting it; it shifts control of the file transfers to the individual peers [Shirky, 2000, p2]. The client also enables to create a private list of contacts to access each other’s entire music collections and to initialize private discussions. It also provides a chat interface for the community independent from the file sharing capabilities. Napster has given rising artists a convenient medium to advertise and publish their music, a chance they may never have if they only contact record companies. Napster aggregated sixty million users only twenty months after it was launched.

Nirav Tolia, E-pinions.com cofounder and CEO, criticizes the Napster business model because it is not guaranteed to generate profits. Napster will be charging its members a fee for using the service. It will provide its members with high-quality file sharing while at the same time providing payments to rights holders, including recording artists, songwriters, recording companies and music publishers. Meanwhile, most Napster users are not ready to pay a fee for a service they can get for free elsewhere. This leaves Napster with restricted capabilities to generate profits. Stopping the sharing of mp3 and other digital files through the Internet is virtually impossible because non-centralized P2P infrastructures, like Gnutella, can be used to exchange documents bypassing any central server. Adopting a decentralized P2P infrastructure makes the system virtually unstoppable, whereas shutting down the Napster servers blocks the entire system. This happened in 2001 when the court ruled against Napster.

The exponential growth of the Napster community has attracted analysts to study the impact of the P2P technology on collaborative business. Lotus Notes creator Ray Ozzie recognized the positive impacts and capabilities of P2P collaboration. He created Groove Networks to provide software and services that support P2P collaborative business.
3.4.1.2 **Groove networks**

The Groove client creates a shared virtual workplace that can bypass organizational boundaries and firewalls to support collaborative product design. Digital signature encrypted keys authenticate the users to prevent identity theft. These identities reside locally on the Groove client as well as on the central server. Groove’s strongly encrypted platform allows users to create Virtual Private Networks (VPN’s) of peers, or shared spaces, easily across the public Internet. This shared space is viewable only to those who have been invited and agreed to participate in it, and by doing so, agreed to exchange digital signatures.

Groove offers a basic toolset that includes file sharing, instant messaging, calendaring, and co-browsing among other functions. Developers can embed custom developed tools and functions into the Groove workspace using the Groove Development Kit (GDK). GDK allows programmers to insert Component Object Model (COM) and the Distributed Component Object Model (DCOM) objects into the Groove client. These custom tools can be used to complete transactions within or throughout a supply chain and streamline supply chain transactions. Groove is an Intel-based PC application, running only in Windows operating systems. Meanwhile, it integrates data from any number of other systems and operating systems via generalized connectors and bots. Groove’s connectors and bots work best with data sources that use XML.

Groove operates typically as a P2P application. Information is shared directly between the participants of a shared space without transiting through a central server unless one of the users is offline or is behind a firewall, files being transferred are too large, or the number of recipients of a message or file is too large. In these cases, Groove uses a relay hub to temporarily store and forward information. To understand the mechanisms that permit the exchange of information in a P2P system, it is relevant to have a discussion on the different topologies the system can implement to connect the different peers.
3.4.2 Peer-to-peer topologies

P2P systems can be organized around different topologies. A P2P topology is the way a P2P system is created, organized and changes shape over time. This topology describes how the different companies in a P2P system are linked to one another. The following figure illustrates some topologies P2P systems can adopt. In this figure, the links between the different nodes are not permanent and do not reflect the network infrastructure underlying the actual physical connections. Rather, it is useful to conceptualize these links as pointers and the topologies as a linked list of peers.

![P2P topologies diagram](image)

Napster and Groove Networks' platform rely on a centralized P2P topology depicted in Fig 5a. Pure P2P systems do not require any central server to initiate or complete transactions [Doherty, 2002, p3]. The topology of such systems is illustrated by Fig 5b, Fig 5c, and Fig 5d. Peers use a peering portal to send queries to locate a good or service and exchange the information needed to complete transactions. Studying the topology discovery and comparing the
performances of these last topologies is outside the scope of this thesis. We focus on comparing the centralized vs. decentralized nature of the P2P topologies.

Centralized systems function in a similar fashion that Napster and Groove do. These systems can host databases for peers to locate one another, which significantly simplifies and optimizes the query process. Central servers can help to synchronize data between peers so that they keep the latest versions of the shared documents and propagate changes that might occur offline.

Decentralized P2P topologies are characterized by the absence of central storage and processing: no indexing, no central authority, no authentication, no intermediation and no aggregation of information. Truly decentralized P2P systems (like Gnutella) cannot be shut down, whereas a failure at the level of the central servers of centralized and brokered P2P systems blocks the entire system.

Decentralized P2P systems do not rely on a central database to store data or match queries with results; rather the database is distributed throughout the entire system and queries are sent to a neighbor that forwards it to its neighbors. This mechanism is called flooding. Depth first search and breadth first search algorithms can be used for hierarchical systems to perform traversals. After the matchmaking has been resolved, the nodes communicate in a P2P manner.
3.4.3 Advantages of the P2P technology

Providing P2P capabilities brings significant advantages compared to traditional client server architectures that run all the transactions at the central server level. Among these capabilities:

- **Scalability**
  Scalability is the capacity to serve additional users or transactions without fundamentally altering the application's architecture, program design or networking infrastructure. Adding more servers and using load balancing software and hardware improves the scalability of centralized systems. Clustering and load balancing can solve the scalability problem temporarily. However, the network effect of B2B collaborative business will increase the number of transactions exponentially. The P2P technology shifts the processing power and bandwidth requirements to the individual peers decreasing the load on central servers. The resulting infrastructure becomes inherently scalable.

- **System reliability**
  As mentioned earlier, adopting a pure P2P infrastructure makes the system virtually unstoppable.

- **Security**
  By minimizing the amount of confidential information stored in one location, the P2P technology decreases the risk that a hacker would perform a one stop shopping for confidential information on a central server. Increasing the number of locations where confidential information is stored increases the work factor of the system. The work factor characterizes the difficulty of breaking a security mechanism, which is the time and processing power necessary to defeat the system [Camp, 2000, p69]. P2P also introduces new security challenges.
3.4.4 Pitfalls of P2P technology

- **Security**
  The P2P technology allows users to bypass the companies’ firewalls and security systems. By opening more channels to access the information technology resources of companies, the P2P technology opens breaches in the security system and opens the floor to potential threats and viruses [Gonsalves, 2001, p5]. The security of electronic systems is never absolute and breaches in the security system can remain undetected for an extended length of time [Camp, 2000, p68]. To reveal a significant impact on e-business, P2P technology will need to be extended to enable organizations to dynamically share and execute business processes in a very secure environment.

- **Availability**
  In a P2P system, if a computer goes offline, its resources are unavailable to the rest of network.

- **Intellectual property**
  The P2P technology provides a tool to share files easily, which increases the risk of distributing copyrighted material. The lack of a solid and reliable technology to protect intellectual property has prevented authors, publishers and enterprises to deliver their products over the Internet in a digital format. If not protected, information in a digital format can be reproduced easily without degradation in quality, and distributed.

- **Cost**
  Developing P2P systems that provide all the capabilities to support collaborative business regardless of the software platforms companies are using is not cheap. Designing this peering portal is still challenging P2P providers and software developers. Meanwhile, some industry pioneers like
Groove Networks and FirstPeer, and EM's like Gnumarkets.com and GreenShoe.com have taken the challenge and have implemented solutions that use the P2P technology to facilitate collaborative commerce.

In the following chapter we present the three B2B models and assess their ability to support collaborative commerce.
4- Business-to-business infrastructures

4.1 Electronic Data Interchange

4.1.1 System description

EDI is an application-to-application transmission standard for exchanging business documents between business partners. EDI is most widely used in two primary areas: data interchange for orders and invoices, and allowing companies to place orders directly to their business partners; and electronic funds transfer (EFT) used among banks. High volumes and a relatively small number of entities characterize EDI data. EDI is expensive to implement and only the biggest companies can afford to adopt it. This investment significantly increases the switching costs, and forces long-term relationships.

The EDI standards are used to create common business document formats so data can be interchanged between a sender system and a receiver system. EDI uses some variation of the American National Institute (ANSI) X.12 standard or the UN sponsored EDIFACT (ISO 9735:1988) global standard. X.12 and EDIFACT are client server protocols that define the application layer in the OSI model and the syntax of the business documents. These standards enable the transmission and the translation of the business documents between trading partners. EDI is usually transported through batch processing over value-added networks (VAN's).

Depending on the speed of connection required, companies could adopt dial up links or leased line connections to access the VAN. EDI is progressively migrating to EDI over Internet (EDI INT) so that it can benefit from the Internet's cheap communication costs [Daudelin, 2001, p2]. EDI INT uses XML to communicate data between the players of the value chain. The following figure shows the different ways to connect to an EDI network.
4.1.2 **EDI capabilities to support collaborative commerce**

- **Integration platform**

EDI requires a sophisticated setup between the companies exchanging information. EDI links are dedicated, one-to-one software bridges between a buyer and seller. The sender and the receiver EDI systems use a mapping software similar to the XCC described earlier to permit computer-to-computer communication. This software generates the EDI business documents, reformats them into information intelligible by the receiver system, encapsulates the formatted document into an electronic envelope and attaches the EDI ID-identification of the sender to it [McKie, 1997, p1]. This envelope is then sent to the intended recipient's mailbox on the VAN. The message is stored in the mailbox until the recipient retrieves it. To decrease the transaction costs charged by the VAN's, EDI documents are usually sent using batch processing.
- **B-web designer**
  EDI does not provide tools to foster electronic contracting nor does it support the ad hoc formation and management of b-webs. The EDI mapping software has to be integrated with the other information processing systems like the accounting and inventory systems, so that the EDI information can translate into action without any human intervention.

- **Communication platform**
  EDI allows sending large amount of data to any company that is EDI enabled provided both companies implement the software bridges required to exchange information. EDI restricts the variety of information that can be exchanged among business partners to a strict minimum, namely just the information that triggers business transactions in the supply chain. All other information exchange has to transit over different mediums. EDI does not support voice or video conferencing.

- **Trading platform**
  EDI provides a tool to allow businesses to streamline their supply chains. EDI eliminates paperwork and reduces the risk for errors that can be introduced by multiple inputs of data; therefore, the time required to process information is significantly reduced. EDI provides a static pricing trading platform.

- **Trust infrastructure**
  VAN's provide a very secure medium for transmitting confidential information. EDI data is sent over X.12 networks and is only accessible to the intended recipient. By not transiting through the Internet, it prevents the possibility that a third party would intercept the documents. As EDI networks begin to use XML to send EDI data over the Internet, they lose the security provided by VAN's. EDI does not provide an infrastructure for establishing mutual trust since the EDI community is limited to the b-web of participants.
- **Guaranteed reliable service**
  VAN’s are often built and run by the public telephone companies or large computer suppliers. Among these we find ATT, MCI and IBM. VAN’s provide reliable service. The service is guaranteed if no technical failure occurs.

- **Value added services**
  VAN’s providers offer various consulting services to help companies implement the EDI infrastructure.

4.1.3 **Advantages of EDI systems**

- **Stronger business commitment**
  EDI networks are characterized by large switching costs. Because of the long-term investments required to bridge the companies information systems, EDI partnerships last longer. A downfall of the EDI partnerships is that they create a rigid business ecosystem.

- **Process automation**
  EDI based systems have been used primarily by large companies that need to move massive amounts of information and automate the processing of recurrent business transactions.

4.1.4 **Pitfalls of EDI systems**

- **Cost**
  One of the major obstacles standing in the way of EDI becoming a pervasive electronic commerce standard has been expense and software complexity. EDI’s high system setup costs, high maintenance costs, and high transaction costs have prevented its wide adoption. EDI relies on mainframe or microcomputer systems depending on the volume of anticipated transactions, the kind of data expected and the number of EDI trading partners.
The overhead costs introduced by VAN’s were justified by the desire for a secure medium for transmitting large amounts of information and the need to automate routine transactions. The Internet, with its lower costs of connectivity, computing and information infrastructure, extends the benefits of B2B commerce to the majority of businesses and encryption mechanisms have significantly increased the levels of security for exchanging information of the Internet.

- **Low scalability**
  The inflexibility introduced by the EDI model comes from the difficulty in adding or replacing partners in value chains. The number of connection points to be created between the mapping applications and the other information systems is limiting EDI based systems in terms of their ability to integrate new trading partners. Staying in these closed environments can prevent companies from fully achieving their potential. Participating in multiple value chains and acquiring more business partners might achieve this potential. Moving away from a closed loop and joining a pool of a virtually infinite number of partners gives the company more potential business opportunities and visibility in the market.

- **Restricted business ecosystem**
  The size of EDI community is restricted to the group of companies that directly do business with one-another. In these closed environments buyers are tied to a limited number of suppliers and suppliers are tied to limited numbers of distributors. VAN’s and EDI creates a rigid e-business infrastructure.

- **No real time capabilities**
  The exchange of business documents is done via batch processing, often on a daily basis, which prevents real time updates of information. Real time
updates of data are becoming more important as more companies adopt dynamic pricing models and are keen to keep inventory levels up to date.

EDI has been designed to enable a limited set of transactions to be performed, so it is unlikely the system will scale to provide more services.
4.2 *The Peer-to-Peer business model*

Andrew McAfee describes the peer-to-peer (P2P) business model as the next step in the evolution of B2B commerce as it enables companies to avoid overhead costs created by the intermediation. He claims, “When companies can cooperate complex transactions among themselves through peer-to-peer networks, the need for centralized exchanges decreases dramatically” [McAfee, 2000, p2]. This trend is called Napsterization of the supply chain. Napster has been the first company to provide the P2P technology to Internet users willing to share audio files, and is very telling about what the P2P technology enables the network to accomplish.

4.2.1 *Description of the P2P business model*

McAfee claims that the P2P business model comes as an alternative to the EM. It allows individuals or companies to exchange information directly with one another, bypassing central exchanges [McAfee, 2000, p2]. This model provides an alternative cooperation scheme as the connections between the peering partners are only established for the purpose of a transaction. A “push-pull” scenario best describes the process involved in these P2P transactions as it enables companies to locate trading partners on the fly and complete transactions [White, 2000, p4]. P2P requires connections to be established on-demand and would use a connectionless protocol like HTTPS to perform secure transactions.

Trading and collaboration operations between companies that adopt the P2P business model do not transit through a centralized marketplace; each peer operates independently and exchanges documents with its business partners without intermediation. A company can search as widely as it wants for new partners or products or for lower prices or better terms [White, 2000, p3]. The following figure illustrates the P2P infrastructure.
4.2.2 P2P capabilities to support collaborative commerce

- Integration platform
  The P2P business model relies on mechanisms similar to the XCC presented earlier to integrate the different companies information systems. P2P networking assumes that the individual companies have embedded the business processes of e-procurement into their software architecture so that the transactions can be automated [McAfee, 2000, p2]. The peering portal allows business partners to exchange the information needed to perform the transactions. It also allows companies to form VPN's of peers and b-webs.

- B-web designer
  The P2P business model assumes the creation of a universal search engine that would use the user's own natural language to locate peering partners across the Internet. P2P supports electronic contracting and can provide the tools to create and modify b-webs.
- **Communication platform**
  The P2P technology uses the Internet to provide companies with an advanced communication platform to exchange documents regardless of their format, use instant messaging and video conferencing.

- **Trading platform**
  Fully harnessing the power of the P2P model implies finding mechanisms to align, locate and retrieve information regardless of their source. Resource Description Framework (RDF) combined with XML and sophisticated data mining techniques can help in solving this problem [McAfee, 2000, p3]. The P2P business model uses advanced data mining and information retrieval techniques combined with transportable data structures avoid the creation of a common standardized catalog for accomplishing B2B transactions.

  By sending queries through the peering portal, individual partners are able to locate one-another and perform transactions without the mediation of a third party. The catalogues of products and services of the individual companies become logically interrelated and their collection becomes a database distributed over the P2P network [McAfee, 2000, p3]. In this context, the peering portal only serves as a matchmaker. To provide availability in real time, the peering portal has to be linked to the companies individual internal inventory and procurement systems. P2P models do not allow for dynamic pricing and cannot host an auction. Auction systems require a neutral intermediary.

- **Trust infrastructure**
  As presented earlier, the P2P technology introduces new security challenges because it allows companies to bypass firewalls. The security mechanisms of P2P are intimately linked to the proper use of encryption techniques. P2P does not provide an infrastructure for establishing mutual trust.
- **Guaranteed reliable service**
  The P2P business model is better supported by a decentralized P2P technology. Pure P2P systems guarantee reliable service because the failure of individual nodes does not prevent the whole system from operating. P2P systems hosted by a third party like Groove are vulnerable since these companies can bankrupt and interrupt their service.

- **Value added services**
  P2P does not provide value added services from a third party which can increase the total investment costs. The P2P model allows partners to bypass transaction fees charged by exchanges, meanwhile it opens the ground for other expenses like acquiring the peering portal, the CPFR software and industry specific information among others.

In the P2P model, every company is responsible for keeping up with the pace of technological advances. Fast paced technological development creates a climate where new products, services, ways of accomplishing tasks and transacting business are being constantly introduced, which can constitute a challenge for integration.

4.2.3 **Advantages of the P2P business model**

- **Benefits from using P2P technology**
  The P2P business model relies on the P2P technology so it inherits all its advantages and pitfalls. These benefits are scalability and systems reliability.

  P2P business model is better implemented using a pure P2P system as it decreases the chance that the whole system stops because of a single point of failure.
• **Allows bypassing transaction fees.**
  Since the transactions are P2P no third party can charge any transaction fee. This has the advantage of not limiting the number of transactions companies can engage in.

4.2.4 **Pitfalls of the peer-to-peer model**

• **Pitfalls from using P2P technology**
  As examined earlier, the P2P technology introduces security concerns. P2P opens breaches in the security system and exposes the companies’ networks to potential threats and viruses. Also, files stored locally are only accessible if the peer is online.

• **Need to adopt compatible peering portals**
  To be fully functional as described by McAfee, the different peering portals should be able to communicate with one-another. In the reverse scenario, the companies will be constrained to perform P2P transactions only with the companies that have adopted the same peering architecture.

The P2P business model may appear more logical as companies try to remove all the intermediaries within the supply chain. Intermediation adds overhead costs to transactions.
4.3 The electronic marketplace

4.3.1 Description of the electronic marketplace

Electronic Marketplaces (EM’s) have been created to facilitate the trading of goods and services between manufacturers and suppliers [Galdwin, 2001, p2]. They take advantage of the Internet’s cheap, flexible standards to allow dynamic, many-to-many electronic connections between businesses. In essence, the EM is a neutral agora that derives its competitive advantage from fostering trade, communication and collaboration among its participants, and providing business partners with value-added services.

Early movers have developed EM’s to aggregate supply and demand across a specific industry or consortia. This gathering enables both buyers and sellers to perform one click comparison-shopping and initiate business transactions. Inter-industry marketplaces, also known as horizontal EM’s, host or connect many industry-specific sub-communities, and provide them with tools to seamlessly communicate. EM’s, also known as e-hubs or exchanges, host auctions that enable a dynamic adjustment of the price of goods and services with respect to supply and demand.

The EM is also a community center where businesses can share and collect information on their industry and their competitors. The EM allows companies to look beyond the walls of the enterprise and out into the complexity of the marketplace and different business cultures, infrastructures and IT environments to enhance their products and service offerings. By empowering its community and acting as a facilitator for trade, the marketplace can play a major role in the globalization of modern economy.
Traditionally, EM’s were implemented using a centralized client server topology. The participants use thin client web browsers to access the agora and engage in collaborative business. In centralized EM’s (fig 8), all transactions are executed at the level of the EM servers. In this context, the centralized system reflects the power of the agora to aggregate businesses around a common virtual space, a generated mall that takes place in the Internet.

![Diagram](image)

**Fig 8: Centralized EM model**

By joining the EM, companies (in this figure C1, C2...) become virtually represented in the agora, which gives them attractive opportunities for transparency and marketing. The EM provides an environment where transparent competition can take place. This neo-classic concept is very visible in traditional markets and auctions. In those markets, we often find many providers for one product that share a limited space. This proximity gives the customer more choice and ultimately better satisfaction. The sellers compete to attract customers and at the same time benefit from the proximity to reassess their products and readapt their price or service. Good examples of the effect of this proximity are the stock exchange markets.

The EM acts as a middleman between demand and supply [Bakos, 1991, p37]. The role of the EM is also changing as it adopts new information technologies and offers new tools and services to its community. The development of more elaborate information technologies like CPFR for the EM opened up new opportunities like providing tools and services to support collaborative b-webs.
The EM creates a virtually infinite and continuously evolving business ecosystem. By joining EM’s, companies acquire the potential to seamlessly trade with all the EM participants. In case the EM adopts a horizontal model, companies from other EM’s can become part of the business ecosystem.

For higher levels of scalability and to build a fault tolerant system, EM’s use a distributed system to host the agora. A distributed system is defined as a system of multiple computing resources (CPU’s, memory, storage, etc.) connected via a network that allow for the sharing of data and applications and that allow for cooperative work on one or more problem [Eroll, 1996]. The two main advantages of a distributed system are that it can span over a large geographic area, and that the failure of one computer does not prevent the system from operating.

Modern EM’s have adopted a solid infrastructure for collaboration in an effort to provide their communities with virtually infinite capacities to form new B2B strategic relationships to extend their b-webs. EM’s can bring efficiencies to businesses by offering tools to perform collective purchasing, streamlining collaboration and automating business processes. These efficiencies include price savings, flexibility, speed of execution, lower cycle times, greater choice, scalability and more efficient supply chains. Building and upholding a strong and value-adding relationship among participants of the electronic marketplace will in turn lock in the participants into the B2B portal.

As we mentioned earlier, EM were traditionally built as client server systems allowing companies’ access using a web browser. This has been the solution of choice because web browsers can run on any platform. Realizing the advantages brought by the P2P technology, pioneers like Gnumarkets.com and GreenShoe.com have taken the challenge and have implemented EM’s that use the P2P technology to handle certain functions of collaborative commerce initiatives. The P2P EM is a natural evolution of the EM model.
4.3.2 The P2P electronic marketplace

The IT infrastructure of the EM must provide a medium for expansion and growth to sustain the present and future activities of the marketplace and to empower the community in a reliable, secure and scalable manner. Among the EM tools and services, some require the mediation of the EM and others can be performed in a P2P manner. A hybrid system, composed of a browser-enabled thin client interface hosted by the EM and a thick client peering portal that runs on the EM participant's computing devices, provides a logical architecture for EM's.

The peering portal is among the software tools the EM provides its subscribers. Examples of this hybrid combination are the Microsoft Network (MSN) and ICQ. MSN Messenger and the ICQ client provide P2P capabilities; msn.com and icq.com offer other tools and services targeted to the whole community. In essence, the browser-enabled interface of the EM generates an agora, as it constitutes a public sphere accessible by all EM partners.

![Diagram of the P2P electronic marketplace]

**Fig 9: The P2P electronic marketplace**
Providing P2P capabilities brings significant advantages compared to traditional EM's that run all the activities on their own systems. The P2P EM is intrinsically scalable and provides business partners with more tools to enhance the touch and texture of their relationships. At the same time, the EM conserves its role at the center of the business ecosystem to provide tools and services to the entire community and serve as a neutral facilitator for trade.

4.3.3 EM capabilities to foster collaborative commerce

- **Integration platform**
  The EM relies on mechanisms similar to the XCC presented earlier to integrate the different companies information systems. By bridging their information systems with the EM, individual companies can trade and collaborate with all the agora's participants.

- **B-web designer**
  The EM supports electronic contracting and provides tools to create and modify b-webs. The EM can provide templates for RFTP's so that the querying process can be faster and more accurate. RFTP's can be sent to individual companies or posted in the agora so that the whole EM community can access them.

- **Communication platform**
  The first implementations of EM's only provided companies with tools to support trade. Due to scalability concerns, these EM's did not provide instant messaging and video conferencing capabilities. Using the P2P technology, modern EM's have become intrinsically scalable and provide companies with an advanced communication platform allowing them to exchange documents regardless of their format and use instant messaging and video conferencing.
• Trading platform
  The trading platform of the EM can provide tools for both static dynamic pricing models.

• Catalogues
  The EM hosts a catalogue of the product and services offered by individual companies. This catalogue can be used to enhance the data integrity of the system and initiate transactions. B-web partners that engage in CPFR align their data independently of the EM and store them locally so that the P2P transactions involved in CPFR can be accomplished without the mediation of the EM.

• Bidding system
  The bidding system allows companies to post Requests for Bids (RFB’s) and Requests For Quotes (RFQ’s) on selected catalogue items. Bids and quotes can be posted in the agora or sent privately to the buyer or seller. To give accessibility to the whole community, this tool is provided in the agora.

• Auction systems
  Auction systems allow buyers and sellers to price goods and services with respect to market demand and supply.

• Billing and collection services
  Billing and collection services permit closing transactions through electronic invoicing and automated funds transfer mechanisms. The information transferred contains sensitive information so has to be encrypted. For more flexibility, several payment methods can be provided.
- **Trust infrastructure**
  - *Security mechanisms*
    EM’s rely on encryption techniques as well as user authentication from the server side to login users to the system.
  - *Mutual trust platform*
    EM’s provide market registries and feedback forums for establishing a climate of mutual trust within the agora. These tools are presented on p79.

- **Guaranteed reliable service**
  Not every EM is viable. Successful EM’s aggregate enough buyers and sellers to unlock the power of the network effect and adopt profitable business plans. For these reasons, only successful EM’s can guarantee service availability. Critical mass and business plan are examined in section 4.3.7.

- **Value added services**
  The EM can build around the community and offer a vast selection of value added services. These services are presented in section 4.3.6.

4.3.4 **Classifications of electronic marketplaces**

Many categorizations have been suggested to classify electronic marketplaces depending on their structure. EM’s can be categorized as buyer-centric, seller-centric, or neutral [Axelsson, Robertsson, 2001].

- **Buyer-centric exchanges**
  These EM's link many sellers to one or a few buyers. They often involve specialized or standardized products and services. Covicint is a buyer centric exchange.
- **Seller-centric exchanges**
  These EM's link one or a few sellers to many buyers. These marketplaces may be created to sell off surplus inventory [Axelsson et al., 2001]. E-bay is a seller centric EM.

- **Neutral exchanges**
  Neutral EM's provide a balanced transaction environment, which regroups companies from various or specific industries. NewView Technologies (formerly: e-STEEL Corporation) and Transora are examples of neutral exchanges.

Utecht classifies electronic marketplaces in three categories:

- **Company centric e-marketplaces**
  Typically, it allows the company or consortia that hosts the EM to buy from catalogues of potential suppliers [Utech, 2000, p5]. Covcint is a good example of company centric EM. Covcint is a B2B supplier exchange for the auto industry. It was created in 2000 by a consortium including Daimler Chrysler, Ford Motor Company, General Motors, and was later joined by Renault. The EM participants include all the suppliers and distributors of these respective companies, and all the other companies willing to trade with the consortium.

- **Vertical e-marketplaces**
  Individual industries, companies and consortia have created industry-specific, or vertical marketplaces providing industry-specific related products and services. These marketplaces aggregate supply and demand as well as relevant news and information within a specific industry. A good example for a vertical marketplace is e-STEEL Exchange, which is NewView's online marketplace for the steel industry.
- **Horizontal e-marketplaces**
  Horizontal or cross-industry marketplaces provide for horizontal procurement among different industries and help streamline supply chain management processes. The horizontal EM is a community center that hosts and interconnects industry specific e-marketplaces.

Fig 10 illustrates this discussion and shows some of the possible configurations for horizontal EM's. The four configurations presented have different impacts for individual companies. The study of these impacts is not in the scope of this thesis.

**Fig 10:** Horizontal electronic marketplace configurations

- **Fig 10a:** Horizontal marketplace hosting verticals
- **Fig 10b:** Marketplaces that built strategic relationships
- **Fig 10c:** EM-to-EM connection hub enabled horizontal EM
- **Fig 10d:** Peer-to-peer hybrid model
The need for horizontal marketplaces is very visible. To build cars, manufacturers need steel, plastics, tires, semiconductors etc., so there is a need to integrate the different industry verticals to make the e-procurement complete. This evolution of B2B commerce has the potential to dramatically alter established business's strategies and partnerships.

VerticalNet, hosts many industry verticals, aggregates supply and demand, and provides tools to interconnect the various sub-communities together, allowing for cross-industry procurement. Fig 10a depicts VerticalNet business model.

Some EM's build strategic relationships and bridge their information systems linking their communities. For instance, recognizing the potential benefits for both their communities, Covicint and NewView have agreed to cooperate in marketing direct material procurement technology to the automotive industry, which is a first step towards deeper cooperation. This is portrayed by Fig 10b.

Fig 10c shows a horizontal EM that provides a hub for EM's to communicate. Commerce One™ has created the Global Trading Web™, which is an open trading community of interoperable electronic marketplaces and communities [Tennenbaum, 2000].

The horizontal EM shown in Fig 10d is only conceptual and has not been adopted yet in the industry. This horizontal marketplace model would allow companies in any EM to query and perform transactions with other companies from other EM's using P2P technology to link their information systems. Companies joining these EM's increase significantly their visibility on the global marketplace and by network effect the number of potential connections. This model is appealing because the number of integration points is significantly reduced. Companies that join EM's providing this service would not need to register to other agoras to increase their market reach or collaborate with trading partners.
The number of possible b-web combinations that can be formed can quantify the network effect of a vertical EM. The network effect of EM reflects the ability for companies to participate in multiple value networks and choose the best service providers. If the EM has n participants and b-webs are constituted by p partners, this network effect is given by \( C_n^p = \frac{n!}{p!(n-p)!} \). When this EM associates itself with another EM of m participants as depicted in fig 10b, the resulting network effect entailed by this collaboration increases exponentially and becomes \( C_{n+m}^p = \frac{(n+m)!}{p!(n+m-p)!} \).

The Darwinian struggle between B2B marketplaces will induce stronger partnerships and coalitions in order to leverage the network effect and provide the participants with a complete procurement solution.

4.3.5 Advantages of the EM model

The EM provides a wide array of tools and value added services to its participants. The central position of the EM within the business ecosystem gives it special capabilities. Among these capabilities:

- **Central storage and processing**
  Central storage enables the EM to aggregate information. Combined with processing power, it gives the EM the ability to host tools and value adding services within the agora. It gives the participants of the EM visibility and accessibility to all the agora’s capabilities and accesses its bank of data.

- **Aggregation**
  Aggregation of supply and demand allows the EM participants to perform comparison-shopping and opens the floor for dynamic pricing capabilities.
Data integrity
Companies adopt different representation of data. Adoption of common catalogues allows achieving data integrity. Data integrity will reduce the number of transaction mismatches, will reduce data redundancy and simplify the integration process.

Neutral intermediation
Neutral intermediation is required in auction systems and commerce disputes resolution to prevent fraud or provide support.

B2C
In the same fashion as it does for e-bay, the EM can constitute a platform to host other forms of e-commerce allowing companies to sell to individuals or small groups.

4.3.6 Tools and value added services provided by EM’s

In the following paragraphs, some EM’s tools and value added services surveyed from established EM’s are presented. The survey has shown that different EM’s provide different sets of tools and services and that only few EM’s provide wide-ranging capabilities. In essence, these differences result from the business plan adopted by EM’s. The EM and its business partners can add other tools and services to fit specific requirements of the EM’s participants or provide more capabilities.

CPFR
CPFR is offered as a standard service by many marketplaces in the retail industry. The EM hosts the system and provides access to it to the trading partners that do not need to acquire the technology by themselves. Another positive effect of this centralized approach is that companies can benefit from software upgrades simultaneously.
Market registry
The market registry authenticates businesses, lists information about their activities and products, provides contact information and helps assessing their credit worthiness. This aspect is critical within the perspective of globalization. Audit companies or a certification authority can generate these profiles. The EM can add statistics gathered on the activity of the company to this information and real-time market performance data like stock quotes. These profiles are stored centrally so that they can be accessed and queried easily by all the EM partners.

Industry specific knowledge base
“A wealth of information creates a poverty of attention” claims Nobel prize winner Hebber Simon [Shapiro Varian, 2000, p6]. Industry specific content is highly fragmented and most of the relevant information is paper-based. By aggregating industry specific information, the EM can provide a library of resources to its participants, allowing them to stay informed of the latest developments in their respective industries. This requires providing access to industry news, reports, analysis, statistics and enhanced industry knowledge and skills. EM’s can use this information as a significant source of profits.

Feedback forum
The EM aggregates feedback on specific products or companies, provide credit for content submitted to the site and foster open communication and exchange of ideas. The EM, through its feedback forum and community centers, provides relevant information to its participants to do comparative shopping to enjoy a better shopping experience. Feedback forums are used to enable the community and create a medium of mutual trust.

The enabling role of the community is engendered by the exchange of information between the various participants. Sharing information within industries can enhance the competition levels and lead to stronger
partnerships. Relevant information lets customers and companies locate and access products and services and make more knowledgeable decisions. Through its community, the EM provides an infrastructure for assessing products and companies, discussing industry-related issues and creating trust among the individual participants. The feedback forum provides the EM participants with:

- **Message boards:** Message boards allow the marketplace participants to post inquiries and initiate discussion. Message boards make it easy to find information about a particular product or service or discuss industry related issues and provide a tool to communicate asynchronously. Message treads make it easier to follow discussions and selectively participate in the areas of interest.

- **Polls:** Polls allow participants to ask specific questions and gather information. Real-time results let participants learn what their industry colleagues think about the timeliest topics.

Polls and message boards require central storage and are among the community tools the agora provides. The information collected can complement the knowledge base the EM provides.

- **Industry specific online training and seminars**
  Education is becoming a lifetime endeavor for individuals and companies willing to stay up-to-date about the latest trends and developments in their industry or to acquire specific skills. Online learning and seminars augment the ability to create a dynamic, productive knowledge exchange. The EM can use online learning tools like Prometheus or FirstClass to provide industry specific training and seminars.
- Advertising and marketing channels
  The EM can provide advertising channels and capabilities allowing companies to promote their brands and services in the medium of the agora. This capacity is a valuable value-generating tool for EM's. Flash technology, voice and video streaming and more conventional tools like mailings and newsletters provide capabilities that can be exploited by the EM to open advertising and marketing channels.

- Business intelligence and consulting
  By constituting a team of industry specific experts, the EM can serve as an advisor and consultant to its members. The EM can also partner with integration consultants to help companies adapting their information technology infrastructure.

- International trade logistics, customs, tariffs, export documents
  The EM can provide information, guidelines and documents to support international trade. It can also associate itself with distributive networks and freighters to support the logistics of a global market.

- Commerce disputes resolution
  To a certain extent, the EM can participate in the resolution of domestic and international e-commerce disputes. This is not saying that the EM should bear responsibility for such disputes, but provide a neutral intermediation and maybe personnel specialized in such issues. The Better Business Bureau (BBB) has been providing the capabilities and defined a set of standards for commerce disputes resolutions. This capability requires neutral intermediation.

The EM can offer different memberships to its participants so that they can select the tools and services to accommodate their needs and business plans.
4.3.7 Pitfalls of the electronic marketplace model

- **Critical mass**
  If the electronic marketplace is unable to attract enough participants, the service will not gain critical mass sufficient to generate enough revenue; in which case it will collapse. This scenario would be very dramatic for companies that enable their collaboration or b-webs through the EM. Reliable service and guaranteed service availability are key for these companies. It is important for businesses to properly evaluate the marketplace, its viability, the functionalities it provides and the importance and role of its community before centralizing their B2B strategy towards a specific exchange.

  Critical mass of participants has to be achieved so that the mechanisms of the marketplace become attractive. The key challenge for EM’s is to aggregate enough buyers and sellers so that it becomes attractive for both to participate. Examining the number of participants already present and their importance in their respective industry can be considered as an indicator of success for the marketplace. Privately operated Covicint, the auto industry EM created by Ford Motor Co., Daimler Chrysler and General Motors, has a big potential to succeed because of the volume of transactions heralded by these major industry players. The network effect engendered by the abundance of participants can determine the attractiveness of electronic marketplaces.

- **Security**
  The marketplace model also raises issues of privacy and security of personal information. This model can constitute a one-stop shopping for hackers too. Therefore, it is critical for the marketplace to establish the most secure environment. This environment would respect privacy and intellectual property.
- **Distributed system maintenance**
  Distributed systems are more difficult to maintain since the platforms are usually heterogeneous and the individual computers can be scattered geographically.

- **Business plan**
  It is critical to examine the EM business plan and the way it generates revenues. Exchanges that base most of their revenues on transaction fees are very brittle. The EM has to multiply its means to generate profit by providing many value-adding services to its participants.

  Among the critical factors to examine is the management, ownership and funding of individual marketplaces [Wilson, Mullen, 2000, p12]. EM’s sponsored by consortia have more financial backing than the ones that depend on venture capital [Wilson, Mullen, 2000, p13].

  It is also important for the EM to build strategic alliances with key industry players, software providers and other service providers that add value to the marketplace or its participants. For instance, audit companies can be valuable partners for the EM as they can provide reports about the financial situation and credit worthiness of companies. Multinational banking institutions can help in the international transfer of money and currency exchange, etc.

84
5- Comparison between the B2B infrastructures

The intricacy and dynamism of modern economy is forcing organizations to reevaluate their traditional supply chain practices and collaborate with other organizations [Bowles, 2001, p 38]. It is the capabilities each B2B infrastructure provides to support collaborative commerce that allows comparing them. These capabilities are defined in section 2.4 (p 26-27).

- **Integration platform**
  From the previous analysis of the B2B infrastructures we conclude that EDI, P2P and EM provide an integration platform to bridge the company's information system to the ones of its business partners. EDI relies on point-to-point integration, meaning that every time a company joins a b-web it has to create dedicated links to communicate with its business partners. P2P requires companies to integrate their information system with the peering portal. This integration requires a one-time effort unless the company changes its peering portal. Compatible peering portals communicate seamlessly. EM participants have to bridge their information systems with the one of the EM, doing so they are able to communicate with all the participants of the EM. The integration platforms of P2P and EM require only one bridge whereas EDI requires multiple dedicated links.

- **B-web creator**
  P2P and EM provide tools to support electronic contracting, EDI does not. These tools allow companies to seamlessly form or modify b-webs. EDI partners use traditional means to sign partnership contracts.

- **Communication platform**
  P2P and EM use similar technologies and provide companies with a sophisticated communication platform that allows companies to exchange information regardless of its format, use instant messaging and video
conferencing. Doing so, they can enhance the texture and touch of their relationships. EDI restricts companies to exchange a specific set of documents and does not support real time exchange of information.

- **Trading platform**
EDI, P2P and EM provide static pricing trading platforms. Only the EM supports dynamic pricing capabilities because it is a neutral intermediary and allows real time exchange of data.

- **Trust infrastructure**
EDI, P2P and EM provide security mechanisms to protect the information exchanged by business partners. EDI sends information through VAN's, P2P and EM use encryption techniques to protect data. In a context of globalization, the need for establishing mutual trust between companies is becoming more important. The EM provide tools and metrics to assess the credibility of companies, EDI and P2P do not.

- **Guaranteed reliable service**
Not every EM is viable and only successful EM's can guarantee service availability. Most EDI software and network providers are stable companies. Pure P2P systems use a decentralized P2P technology and cannot be stopped from operating. EDI and P2P guarantee service availability, EM's must adopt a successful business plan to do so.

- **Value added services**
EDI and P2P do not provide value added services to the trading community. Companies that use EDI and P2P can acquire these services separately. The EM is a mediator, however the overhead costs it adds provide access to a number of tools and services that if acquired separately by companies, can turn out to be more expensive.
The choice of a particular B2B infrastructure is intimately linked to the company's business plan and to the capabilities it seeks this infrastructure to support. Choosing a specific B2B infrastructure can determine an organization’s growth, direction, structure and viability. The following table summarizes the capability of EDI, P2P and EM's to serve the requirements of collaborative business.

<table>
<thead>
<tr>
<th></th>
<th>EDI</th>
<th>P2P</th>
<th>EM</th>
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<tbody>
<tr>
<td><strong>Integration platform</strong></td>
<td>x</td>
<td>x</td>
<td>x</td>
</tr>
<tr>
<td><strong>B-web designer</strong></td>
<td>-</td>
<td>x</td>
<td>x</td>
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<tr>
<td><strong>Communication platform</strong></td>
<td></td>
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<tr>
<td>Information sharing</td>
<td>*</td>
<td>x</td>
<td>x</td>
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<tr>
<td>Instant messaging</td>
<td>-</td>
<td>x</td>
<td>x</td>
</tr>
<tr>
<td>Video conferencing</td>
<td>-</td>
<td>x</td>
<td>x</td>
</tr>
<tr>
<td><strong>Trading platform</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Static pricing</td>
<td>x</td>
<td>x</td>
<td>x</td>
</tr>
<tr>
<td>Dynamic pricing</td>
<td>-</td>
<td>-</td>
<td>x</td>
</tr>
<tr>
<td><strong>Trust infrastructure</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Security mechanisms</td>
<td>x</td>
<td>x</td>
<td>x</td>
</tr>
<tr>
<td>Mutual trust platform</td>
<td>-</td>
<td>-</td>
<td>x</td>
</tr>
<tr>
<td><strong>Guaranteed reliable service</strong></td>
<td>x</td>
<td>x</td>
<td>*</td>
</tr>
<tr>
<td><strong>Value added services</strong></td>
<td>*</td>
<td>-</td>
<td>x</td>
</tr>
</tbody>
</table>

**Table 3:** Capabilities of the B2B infrastructures to support collaborative business

**Caption:**
- x : Supports the capability
- - : Does not support the capability
- * : Partially supports the capability

The EM offers more capabilities than EDI and P2P to support collaborative business provided it adopts a successful business plan to guarantee service availability. By supporting collaborative business, the EM can entail stronger business relationships, decrease costs and enhance the visibility across supply chains, enhance market response, facilitate targeting new markets and help the globalization efforts.
6- Conclusion

EDI still provides a solution of choice for banks and other institutions that only require an infrastructure to transmit massive amounts of sensitive information, in a secure environment, with a limited number of business partners. Meanwhile, with the Internet and the advances in information technology, the overhead costs introduced by EDI are no longer justified. VPN's over the Internet and encryption mechanisms provide very secure infrastructures for transmitting data. The Internet lowers the cost of connectivity allowing small and medium companies to participate in B2B incentives without incurring the large expenses required by EDI. The investment and operational costs associated with EDI increase the cost of supply chains and limit its participant to a restricted business ecosystem and list of capabilities as shown in table 3. The high switching costs of EDI networks create stronger business commitments between the individual partners. However, this commitment can also be achieved by having productive business relationships. Signing a partnership contract is in itself a commitment.

The P2P business model provides its users with a strong collaboration platform. If fully functional and widely adopted, P2P has a higher potential network effect than the EM because every company would be virtually connected to all the others, provided that all the peering portals are compatible. Meanwhile, participants in P2P networks cannot engage in auctions nor can they capitalize on the business ecosystem's community.

Global Dynamic Electronic Marketplaces are virtual spaces in constant energizing motion that give opportunities for companies around the globe to engage in collaborative business. EM's are characterized by constant competition between large numbers of goods and services providers. This activity is induced by today's market dynamics and expectations, which require from successful companies the ability to adapt quickly to change and react to seize opportunities.
The EM can serve as a virtual connection point between potential business partners. Through EM's, companies can trade and streamline their business processes to foster collaboration and b-webs. To be viable, the EM must provide value to all its participants so that its role as a middleman is justified. It derives its competitive advantage from properly using information technology to connect potential business partners and provide them with tools and value-added services to foster collaboration and trade. Dynamism is key in the Internet-based economy so in an effort to permit flexibility the EM has to be able to link companies regardless of their information platforms. For this purpose XML, CPFR and encryption are playing a vital role enabling communication and collaboration between the various business partners.

EM's are improving economic efficiency across several industries because they reduce the margins between price and cost, and speed up transactions in the supply chains [Feldman, 2000, p1]. By providing a dynamic business framework to its participants EM's allow companies to innovate to remain competitive and increase their trading capability. The EM provides its participants with a large array of products and services to foster collaborative commerce initiatives. The flexibility and dynamism of the marketplace can create a synergy, which by network effect, will spread throughout the supply chains of the business partners including the EM. EM's are becoming active players in the Internet-based economy. They are becoming a vital tool for globalization and transparent competition. The challenge for EM's is to develop the IT infrastructure required to support collaborative commerce and adopt a successful business plan to guarantee service availability to its participants.

Through their communities, the B2B infrastructures can provide the infrastructure for assessing products and companies and create trust among the individual participants. Dynamic pricing capabilities allow participants to discover the price of goods and services in real time based on supply and demand. By empowering
its community and acting as a facilitator for trade, the EM can play a major role in the globalization of the modern economy.

Aggregation, facilitation, interoperability, neutral intermediation, community; and a fast, secure, reliable and scalable information technology architecture are the strengths of EM's. The value-adding characteristics of the EM come from building and maintaining its community of participants. The bigger the network of participants, the more attractive the community becomes.

This thesis concludes that the EM model provides more capabilities to support collaborative business than EDI and P2P, provided that the EM adopts a successful business plan. We anticipate that more EM's will adopt an IT infrastructure that relies on the combination of a browser-enabled agora and a peering portal that uses the P2P technology.
7- Further developments

The learning objective of this work is to educate the author and the reader on the collaborative e-business, the infrastructures that support it, and some of the enabling technologies used in this context.

The research did not lead to results-oriented analysis nor did it attempt to develop the information technology infrastructure of the described EM. The research did not use statistical analysis on the impact of EM’s and the other B2B infrastructures on individual companies because of the inability to gather data.

Many questions could be addressed to expand this research. These questions were not answered because they are not in the focus of the paper or because of the lack of background in the specific fields. Examples of these questions are:

- Is the acquisition/merger model becoming an alternative in the Information age?
- What are the effects and implications of using P2P technology to allow EM’s communicate with one-another?
- Can businesses be operated at different levels of productivity based on CPFR forecasts? If so, what are the heralded repercussions entailed by such a strategy?
- How can EM’s help in the knowledge and technology transfer decreasing the gap between rich and poor economies?
- Should we be resisting the virtual life and the networked economy?

This research can be used to support the following initiatives:

- Develop a platform independent XML commerce connector and the translation algorithms.
- Develop a CPFR solution to streamline b-webs.
- Develop a working model of the P2P EM.
- Develop an RDF based peering portal that uses a pure P2P topology.
- Develop a business plan for the EM to generate profits without charging companies any transaction fee on trade operations.
- Use statistics to evaluate the impact of EM’s on individual companies.
- Analyze the economic and legal requirements involved in globalization.
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## Glossary

<table>
<thead>
<tr>
<th>Acronym</th>
<th>Definition</th>
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<tr>
<td>ANSI</td>
<td>American National Institute</td>
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<td>ARPANET</td>
<td>Advanced Research Projects Agency Network</td>
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<tr>
<td>B2B</td>
<td>Business-to-business commerce</td>
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<td>B2C</td>
<td>Business to customer e-commerce</td>
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<td>BBB</td>
<td>The Better Business Bureau</td>
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<td>BPR</td>
<td>Business Process Reengineering</td>
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<td>B-webs</td>
<td>Business webs</td>
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<tr>
<td>COM</td>
<td>Component Object Model</td>
</tr>
<tr>
<td>CPFR</td>
<td>Collaboration Planning Forecasting and Replenishment</td>
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<tr>
<td>CPU</td>
<td>Central Processing unit</td>
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<td>Database management systems</td>
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<td>DCOM</td>
<td>Distributed Component Object Model</td>
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