FACULTEIT ECONOMIE
EN BEDRIJFSKUNDE

DIGITAL TECHNOLOGIES IN BUYER-SUPPLIER DYADS

A LITERATURE REVIEW

Aantal woorden/ Word count: 34.919

Lieselot Cauwelier
Studentennummer/ Student number : 01305572

Promotor/ Supervisor: Prof. dr. Steve Muylle
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Masterproef voorgedragen tot het bekomen van de graad van:
Master's Dissertation submitted to obtain the degree of:

Master of Science in Business Engineering

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Lieselot Cauwelier

Preface

This master dissertation is written in order to obtain the degree of Business Engineering at the University of Ghent.

I would like to start by thanking Steve Muylle and Nils Van den Steen for giving me the opportunity to learn more about digital technology use in a B2B context. Next to that, I would like to show my gratitude towards Nils Van den Steen once more, for being such a great mentor. The flexibility in making appointments and the quick responses on questions via e-mail (*yes, a digital technology!*) have made the progress of this dissertation significantly smoother. Finally, I would like to thank my boyfriend, Joren Lambrecht, for always helping me out and supporting me.

During the course of this master dissertation my knowledge of certain aspects related to digital technologies and buyer-supplier relationships has significantly increased. Furthermore, I have learned a lot about business practices within companies. I will be happy to apply the insight I have gained to future work scenarios whenever these present themselves.

To conclude this preface, I can only hope that I inspire others to further investigate the technology use in buyer-supplier dyads and networks, as it is and will stay a hot topic for the next coming years.

Lieselot Cauwelier

Contents

List of Abbreviations

- **AI** Artificial Intelligence
- **ARP** Automatic Replenishment Program
- **ASN** Advanced Shipment Notification
- **ASP** Application Service Provider
- **B2B** Business-to-Business
- **B2C** Business-to-Consumer
- **BBS** Bulletin Board System
- **BI** Business Intelligence
- **BPMS** Business Process Management System
- **CA** Certification Authority
- **CACM** Communications of the Association for Computing Machinery
- **CAD** Computer-Aided Design
- **CAM** Computer-Aided Manufacturing
- **CFAR** Collaborative Forecasting and Replenishment
- **CPC** Collaborative Product Commerce
- **CPFR** Collaborative Planning Forecasting and Replenishment
- **CRM** Customer Relationship Management
- **DBMS** Data Base Management System
- **DCM** Demand Chain Management

- **DS** Decision Support
- **DS** Decision Sciences
- **DSS** Decision Support Systems
- **E-CRM** Electronic Customer Relationship Management
- **E-PO** Electronic transmission of Purchase Orders
- **E-RFQ** Electronic Requests for Quotations
- **EAI** Enterprise Application Integration
- **EC** European Commission
- **ECM** Enterprise Content Management
- **ECR** Efficient Customer Response
- **ECRA** Electronic Commerce Research and Applications
- **EDI** Electronic Data Interchange
- **EFT** Electronic Fund Transfer
- **EIS** Executive Information Systems
- **EJOR** European Journal of Operational Research
- **ERP** Enterprise Resource Planning
- **ESS** Enterprise Software Systems
- **ETL** Extract Transform Load
- **GDSS** Group Decision Support Systems
- **HBR** Harvard Business Review
- **HTML** HyperText Markup Language
- **HTTP** HyperText Transfer Protocol
- **IBPS** Inter-organizational Business Process Standards
- **IJAMS** International Journal of Agile Management Systems

- **IJEC** International Journal of Electronic Commerce
- **IJOPM** International Journal of Operations and Production Management
- **IJPDLM** International Journal of Physical Distribution and Logistics Management
- **ILIMS** Integrated Logistics Information Management System
- **IM** Instant Messaging
- **IMM** Industrial Marketing Management
- **INT** Integration
- **IOIS** Inter-Organizational Information System
- **IOS** Inter-Organizational System
- **IS** Information System
- **ISM** Information Systems Management
- **ISR** Information Systems Research
- **IT** Information Technology
- **JEIM** Journal of Enterprise Information Management
- **JMIS** Journal of Management Information Systems
- **JMR** Journal of Marketing Research
- **JOM** Journal of Operations Management
- **KBV** Knowledge Based View
- **KPI** Key Performance Indicator
- **LAN** Local Area Network
- **LIM** Logistics Information Management
- **LIS** Logistics Information System
- **MISQ** Management Information Systems Quarterly
- **MaSc** Management Science

- **OLAP** Online Analytic Processing
- **OR** Operations Research
- **OSU** Ohio State University
- **PIN** Personal Identification Number
- **PO** Purchase Order
- **POMS** Production and Operations Management
- **PTN** Private Trading Network
- **RBV** Resource Based View
- **RDT** Resource Dependence theory
- **RFB** Request for Bid
- **RFI** Request for Information
- **RFID** Radio Frequency Identification
- **RFP** Request for Proposal
- **RFT** Request for Tender
- **RFX** Request for x
- **SCM** Supply Chain Management
- **SEBI** Standard Electronic Business Interfaces
- **SET** Secure Electronic Transactions
- **SME** Small to Medium-sized Enterprises
- **SOA** Service Oriented Architecture
- **SOAP** Single Object Access Protocol
- **SSL** Secure Sockets Layer
- **TCA** Transaction Cost Analysis
- **TCE** Transaction Cost Economics

- **TCO** Total Cost of Ownership
- **TOE** Technology Organization and Environment
- **TR** Trade
- **UDDI** Universal Description Discovery and Integration
- **URL** Uniform Resource Locator
- **VE** Virtual Enterprise
- **VICS** Voluntary Inter-industry Commerce Standards
- **VIS** Vertical Information Systems
- **VMI** Vendor Managed Inventory
- **VO** Virtual Organization
- **VPN** Virtual Private Network
- **W3C** World Wide Web Consortium
- **WAN** Wide Area Network
- **WECWIS** Advanced Issues of E-Commerce and Web-Based Information Systems
- **WSDL** Web Services Description Language
- **WWW** World Wide Web
- **XML** Extensible Markup Language

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Chapter 1

Introduction

1.1 Preface

1.1.1 Context

In this era, no matter what industry a company is situated in, innovation is key. Innovation brings new solutions. New technologies. New digital technologies. To be competitive, companies continuously need to re-evaluate and adapt the current tools, applications, and methods they are using. The need to interact with other companies is crucial and in doing so, technologies, and in particular digital technologies, can make this relationship much more efficient and effective.

Nowadays, it can be said that companies can't exist without the digital aspect in their business. Digitization of processes, methods, systems... pop up in every department, whether in the supply chain, marketing, finance, human resource division... it simply cannot be ignored.

Like many other things, digital technologies evolve over time. As such, it's interesting to see the dynamics of the use of these technologies within companies. If we specifically look at business processes, we can subdivide these into three different categories: trade, decision support and integration processes. We discuss the technology use of each of these processes in more detail.

1.1.2 Scope of research

This master dissertation identifies and categorizes the different types of digital technologies used in the interaction between the buyer and seller division of companies by means of a thorough literature review. Additionally, the performance aspects are mentioned.

1.1.3 Background information

The aforementioned functional perspective, in which a division is made into trade, decision support and integration processes, can be classified into an e-business process framework (Basu & Muylle, 2011). A distinction into different sub-processes can be made within each type. First, there are five key trade processes: search, authentication, valuation, payment and logistics. Second, configuration, collaboration and business intelligence belong to the decision support processes. Last, integration processes are twofold: data integration can be separated from application integration (Muylle & Basu, 2008).

1.2 Research Questions

The classification above leads to the following main research question:

- What is the state of the literature on the technology use within and across companies in each of the e-business processes of the framework?

In particular, digital technologies will be examined in buyer-supplier dyads. This can further be accompanied by the next question.

- What is the performance impact of the main digital technologies found in the sub-processes?

1.3 Outline

The following structure is used in the remaining part of this dissertation. Chapter two gives an overview of the existing literature. It identifies the digital technologies currently adopted in buyer-supplier dyads, categorized according to the e-business process framework. It also provides other relevant concepts. Chapter three briefly mentions the methodology applied. Chapter four continues with a discussion, which contains answers to the research questions. Chapter five finishes with a conclusion of the work.

Chapter 2

Literature Overview

2.1 Definitions

The **buyer-supplier dyad** is a term used to describe the B2B relationship between a buyer and a seller. A **supplier**, or seller, is "a firm that wants to sell its products to buyers in the industry" (Yoo, Choudhary, & Mukhopadhyay, 2002, p. 46). A **buyer**, or customer, is "a company that wants to buy resources" (Yoo et al., 2002, p. 46). These instances of a company interact with each other, which is dynamic given that the action each takes depends on the action of the other instance. Interaction is "a kind of action that occurs when two or more objects have an effect upon one another" (Virmani & Dewan, 2014).

A **digital technology** can be described as any technological device, method, system or application that functions through web-based communication. Thus, digital technologies is hereafter defined as anything that makes use of the Internet for conducting company operations and interactions. Digital technologies can also be labeled as e-business technologies.

Business processes can be seen as "a set of logically-related tasks performed to achieve a defined business outcome" (Davenport, Short, et al., 1990, p. 4). Within the e-business process framework developed by Basu and Muylle (2011), **trade processes** can be seen as processes that support buying and selling online. These processes involve all activities required to perform transactions of goods and services. Five sub-processes can be found within trade: search; authentication; valuation; payment and logistics. The *search* process is defined as "finding relevant entities and objects for any business trade" e.g. helping customers find the firm and its products (Muylle & Basu, 2008, p. 847). *Authentication* can be described as "a core set of activities used to verify the quality and features of the product offered, the authenticity of the trading parties, and monitor conformance to the contract or agreement among parties" (Kambil & Van Heck, 1998, p. 11). *Valuation* is the price discovery process e.g. prices of the products are listed online, templates are used when buying products or services, etc. *Payment* involves all mechanisms that support payment for online purchases. *Logistics* handles all processes which "enable the movement of products and resources within and between trading entities" (Muylle & Basu, 2008, p. 848).

A second category of business processes are the **decision support processes**, which facilitate individuals and firms to obtain information and use models to improve their ability to make effective business decisions. Key sub-processes are configuration, collaboration and business intelligence. *Configuration* supports "buyers in identifying their needs and helps buyers and sellers to interact to develop a product or service that can meet these needs". *Collaboration* enables "interactions between participant firms that support joint or collaborative work between multiple people in one or more organizations, using web-based computer and communication technologies" (Muylle & Basu, 2008, p. 848). *Business intelligence* includes the provision of information about the business, market conditions and trends as to be able to make better decisions (Muylle & Basu, 2008).

A third and last category of the framework, **integration processes**, "help firms to integrate their information, computing and communication systems on either an intra-firm or inter-firm basis" (Muylle & Basu, 2008, p. 848). This category consists of two sub-processes: data and application integration. The former allows a firm's software applications to access its partners' databases and share data, while the latter involves integration of both data and applications between multiple entities (Muylle & Basu, 2008).

2.2 Digital Technologies

Before we take a deep dive into the technology use in each of the sub-processes of the three functional processes trade, decision support and integration, the e-business process framework developed by Basu and Muylle (2011) is shown in Figure 2.1 in order to have a complete overview of the different sections.

The framework places the three different categories of e-business processes into a strategic context by adding two more layers. The bottom layer is labeled the **network services**, which are the services and capabilities that form the foundation for e-businesses: basic communication services and infrastructure components. The top layer contains the **content services**, which are services that are specific to the industry or sector in which the firm operates, and hence cannot be generalized

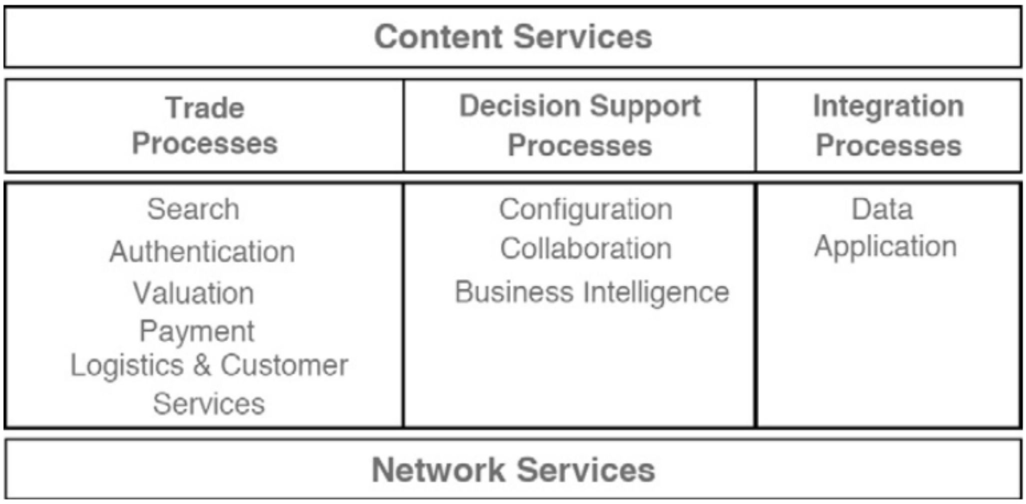

Figure 2.1: The e-business process framework by ©Basu and Muylle (2011)

(Basu & Muylle, 2011). The remainder of this work will focus on the different processes within an organization, that is, the middle layer of the framework.

The foundation of the existence of digital technologies can be identified with the buildup of e-commerce. **Electronic commerce** is defined as "the sharing of business information, maintaining business relationships, and conducting business transactions by means of telecommunications networks" (Vladimir, 1996, p. 3). A more fitting definition in the context of this work is that of Delone and Mclean (2004, p. 31) in which e-commerce is defined as "the use of the Internet to facilitate, execute, and process business transactions". In the literature the term 'e-commerce' is often distinguished from '**e-business**', although sometimes they are used as synonyms, as in the cases above. H. L. Lee and Whang (2004, p. 2) on the other hand do make a distinction, and describe e-business as "the planning and execution of the front-end and back-end operations in a supply chain using the Internet". It may be true that e-commerce relates more to trade processes; while e-business encompasses a broader level of trade, decision support as well as integration. Hence, e-business can be seen as a broader construct that covers e-commerce as well. However, in this dissertation, we will look at e-commerce and e-business as two sides of the same coin.

2.2.1 Trade Processes

Trade processes can be divided according to the customer process of buying products or services. On the one hand, we have the pre-purchase stage which include search, valuation and authentication. On the other hand, we have the post-purchase stage where payment and logistics play an important role (Basu & Muylle, 2003b). Transaction costs are "the costs associated with running a relationship; that is, they encompass the costs associated with negotiating, implementing, coordinating, monitoring, adjusting, enforcing, and terminating exchange agreements" (Frazier, Spekman, & O'neal, 1988, p. 65).

2.2.1.1 Search

The **search** process refers to searching for suppliers or products (sometimes also buyers) to exchange goods and services between relevant parties. Search costs are "the costs incurred by a buyer in finding an appropriate seller and purchasing a product" (Bakos, 1997, p. 1677). Use of Internet-enabled digital tools lower search costs and support *buyers* in finding products of better quality at lower prices that fit the required specifications. The number of alternatives for the buyer significantly increases. Furthermore, firms can locate suppliers, who manufacture qualitative goods and ship them, in a timely manner (Mishra, Konana, & Barua, 2007). High search costs are a 'good' thing in the viewpoint of the seller, since they can derive additional rents from buyers by charging a higher price for their products and/or services (Bakos & Treacy, 1986). Hence, one could argue that lower search costs are detrimental to the *seller*. However, lower search costs can reduce the advertising cost for sellers, thus creating value for them (Kauffman & Walden, 2001).

One mechanism that truly shortened this process while lowering search costs is the **Internet's World Wide Web** (WWW). Since 1993, the World Wide Web radically transformed the e-commerce landscape and the Internet became the prominent driver of e-commerce (Vladimir, 1996). Note that we will use the abbreviation, the 'web', hereafter. Features of the Internet are its open standard, public network and broad connectivity (Bakos, 1997; Zhu & Kraemer, 2005). In Figure 2.2, an e-business value hierarchy is shown. On the bottom of the hierarchy are the three unique characteristics of the Internet mentioned above. These characteristics constitute the foundation to create value. Value creation is obtained in three ways. First, transactional efficiency is increased. *Sellers* can shorten the time to market new products/services through reduced transaction time (i.e. shorter transaction cycles), and enhance inventory control (Strader & Shaw, 1997; Lederer, Mirchandani, & Sims, 2001). *Buyers* have easier access to information, reducing information asymmetry (Lederer et al. (2001); *see later*). Both buyers and sellers can also benefit from more advanced customization (Lederer et al., 2001; Zhu & Kraemer, 2005). Next to that, the Internet enables better matching of suppliers and buyers through enhanced search ability (Zhu & Kraemer, 2005). Second, conducting business is not geographically restricted anymore via the Internet, thus advancing market reach for the *seller* (Strader & Shaw, 1997). Companies can achieve global visibility across their network and the agility/flexibility to changes in business circumstances is improved (H. L. Lee & Whang, 2004). Third, information sharing and integration are significantly facilitated because of the open standards of the Internet (Zhu, 2004). We will discuss this point in detail later (*see collaboration, data integration*). On top of the hierarchy, the effect of e-business on the firm is shown. Procurement costs can be reduced, sales can be increased, and strategic sourcing opportunities and other internal operations can be improved (Chandrasekar & Shaw, 2002; Zhu & Kraemer, 2005). A study conducted by Lederer et al. (2001) shows that companies' main intentions of using the web is to enhance business efficiency, information access and flexibility, with the goal to improve customer relations and ultimately to create strategic advantage.

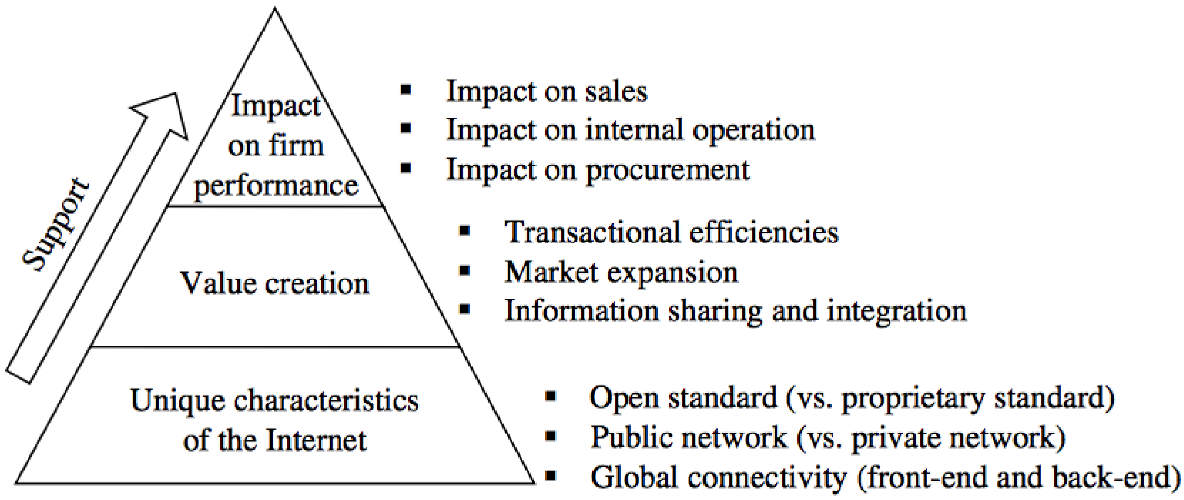

Figure 2.2: E-business value hierarchy, obtained from ©Zhu and Kraemer (2005)

Sellers can set up a **website** to promote their products or services, on which they can display their product catalog to potential buyers, via an **electronic catalog**. These e-catalogs can be customized to relevant buyer organizations. A website is an important means for a supplier in the interaction with its customers. Websites not only reduce costs through efficiency and automation, but also increase the revenues suppliers can reach because of improved customer service (Ba & Johansson, 2008). The higher the service offered, the more likely the website will attract potential buyers and the higher the potential sales. Websites create the possibility to serve customers at a lower marginal cost while simultaneously offering real-time product and/or service information.

Another possibility is to make use of banner ads to enhance product visibility or make use of electronic directories, as we shall see later. Suppliers can personalize their website according to the buyer such that (search) customization is possible (Oliveira and Roth (2012); *see also configuration*). Customization increases the efficiency and completeness of the search process and transactions, helps customers to diminish unnecessary information and minimizes the requirement to repeat needed information with every transaction (Oliveira & Roth, 2012). According to Ba and Johansson (2008), the customer is performing a self-service when he searches through the supplier's website for the required product and/or service. In this context, perceived control on the process and end result has a significant impact on the service. J. Lee and Allaway (2002) find that perceived control stimulates website use and loyalty, which results in higher customer satisfaction. Ba and Johansson (2008) further add that the technological competencies of e-services are the key factor that determines the service quality and customer satisfaction. Features critical to reach satisfaction are website aesthetics; information content; customization; flexibility e.g., to respond to buyer information requests; feedback mechanism; and the integration of procedural and process design capabilities, such as inventory checking and order tracking (Ba & Johansson, 2008; Lederer et al., 2001; Palmer, 2002). Ease of navigation is mentioned as another important aspect every website should possess to improve performance (Oliveira & Roth, 2012; Palmer, 2002). To summarize, it is clear that the web enhances buyer-supplier relationships. A study by Harland, Caldwell, Powell, and Zheng (2007) shows that one of the principal digital technologies SMEs adopt are standalone websites, which they mainly use for marketing intentions. The authors further conclude that "these sites often took the form of 'brochureware', providing limited product/service information and contact details. Most of the SMEs did not have detailed product, price or stock information available on their sites. The websites were not advertised, but a web presence was perceived as protecting them from their competitors. All the SMEs showed a lack of awareness of the potential benefits of enhancing websites to enable online ordering for example" (Harland et al., 2007, p. 1242). Next to that, the study reveals that larger downstream firms used websites as a kind of interactive tool.

Basu and Muylle (2003b) find that suppliers that offer low-cost products online via a website provide more support for searching their company online than sellers of high-cost products. This is due to the switching costs that are considered to be low for low-cost products, meaning that buyers' commitment to these type of products is small. To win these buyers over, suppliers need to put a lot of effort in persuading and keeping the buyers. By offering these products online, their customer base can significantly grow. The findings also state that sellers of high-cost products provide more extensive search-related support services because they involve more buyer consideration. Aral, Bakos, and Brynjolfsson (2017) can further add that investments in digital technologies with the aim to reduce search and coordination costs will increase the optimal number of suppliers, while asset-specific investments are correlated with fewer suppliers, more repeated relationships and high switching costs. Asset-specific investments can be defined as "investments that are highly specialized to the buyer-seller exchange and not easily redeployed, if at all, should the exchange fail" (Frazier et al., 1988, p. 65).

On the *buyer's* side, since the Internet enabled global connectivity; this led to easier and faster comparison of suppliers and their offers in the search process (Mishra & Agarwal, 2010). Digital technologies have transformed the procurement process into a strategic function, aiming to create and sustain a competitive advantage. The time to complete purchasing tasks as well as the related costs are dramatically reduced, which allow the purchasing department to focus on value-adding activities (Rajkumar, 2001). For instance, buyers can use an **e-catalog** created by other organizations to search for the right products or services, or they can consult their own e-catalogs to search for the right suppliers. Electronic catalogs present buyers with a list of product specifications and related prices (*see valuation*). Using individual supplier e-catalogs on their own can be time-consuming and difficult to compare, since users need to be familiar with the variety of catalog formats and data access mechanisms. Rajkumar (2001) proposes two solutions for this matter. One of them is **catalog aggregation**, that is combining the products and services of all approved suppliers into a central catalog. However, these systems are costly to implement, require a lot of setup effort and assume that the supplier organization will provide the information in a certain format. To overcome the drawbacks of aggregation, another solution is **virtual catalogs**, catalogs that retrieve information from multiple supplier catalogs and present the data in a unified manner by means of an **electronic catalog management system** (Rajkumar, 2001; Qizhi & Kauffman, 2002). E-marketplaces can make use of such catalog mechanisms, and a distinction can be made between public, buyer-neutral e-catalogs and private, buyer-specific e-catalogs. The former means that "online market makers publish the same product and price offerings to all potential buyers in the marketplaces. The offerings are not customized for any particular buyer" (Qizhi & Kauffman, 2002, p. 52). The latter can be seen as the opposite, and "by using private e-cataloging an online B2B market is able to present electronic catalogs with different sets of products and prices to different buyers" (Qizhi & Kauffman, 2002, p. 54). Companies use the latter because it makes it easier for buyers to maintain long-term relationships with their suppliers.

Electronic marketplaces can be seen as the foundation of electronic commerce. An electronic marketplace is "an inter-organizational information system that allows the participating buyers and sellers in some market to exchange information about prices and product offerings" (Bakos, 1997, p. 1676). E-marketplaces can also be called e-hubs or electronic hubs (Kaplan & Sawhney, 2000). These markets connect many buyers and sellers via a central database and offer them one-stop shopping, thus performing an aggregation and matching function (Kaplan & Sawhney, 2000; Malone, Yates, & Benjamin, 1987). E-marketplaces are especially useful for trading standard products that have a clear, unambiguous description (Choudhury, Hartzel, & Konsynski, 1998; Malone et al., 1987). Hence, when companies call for a quick exchange of (near-) commodities that are needed for production, B2B online exchanges such as e-marketplaces can come into play. Such exchanges make it easier for buyers and suppliers to conduct business, minimizing or omitting the time needed to negotiate contracts and associated terms and conditions. In many cases, arm's length relationships are established, in which the buyer(s) and seller(s) don't know each others identity (Kaplan & Sawhney, 2000). Transactions are facilitated and more efficient through these market systems and search costs are significantly reduced. Customers need to spend less time and effort to gather product features, quality and price information (Strader and Shaw (1997); *see also valuation*). Hence, from a *buyer's* perspective, unsuitable suppliers can be eliminated and comparison of many suppliers can be done in a rapid, cost-effective and convenient way (Malone et al., 1987). *Suppliers* also benefit since they can find buyers who better match their requirements (Yoo et al., 2002). E-marketplaces are thus created to facilitate and improve transaction conditions between multiple buyers and suppliers, thus enabling "many-to-many" relationships (Vladimir, 1996; Choudhury et al., 1998). E-marketplaces can also offer other functionalities such as **online auctions** (Vladimir (1996); *see also valuation*).

Network effects play a significant role in electronic markets. Network effects arise "when the value of a product depends on the number of users" (Yoo et al., 2002, p. 45). The network effects in e-marketplaces are two-sided, since the number of suppliers is important to the buyer and vice versa. When the marketplace has many suppliers (buyers), positive network effects emerge for the buyer (supplier), since the number of alternatives increases. On the other hand, a higher total number of suppliers create negative network effects for the *supplier*, since the competition increases and profit declines. Network effects influence a *buyer's* valuation of a product depending on the total number of customers using that product in the market. The effects mentioned above affect the optimal pricing strategy and optimal level of participants in electronic marketplaces. The reader is referred to the paper of Yoo et al. (2002) for more information.

Digital technologies have magnified the function of B2B electronic markets as digital intermediaries (Qizhi & Kauffman, 2002). In Figure 2.3, a framework is depicted that shows the relationship between technologies used by a buyer and a seller. The buyer uses internal software to search the e-catalogs, or searches via the marketplace. Once the right product or service is found, an order is placed, either directly through the Internet or in combination with the marketplace. Then the supplier obtains the order via his e-commerce server, which is integrated with his ERP and database systems, and either confirms or rejects the order. A notification is send to the buyer, who now updates his own ERP/database systems (Rajkumar (2001); *see also application integration*).

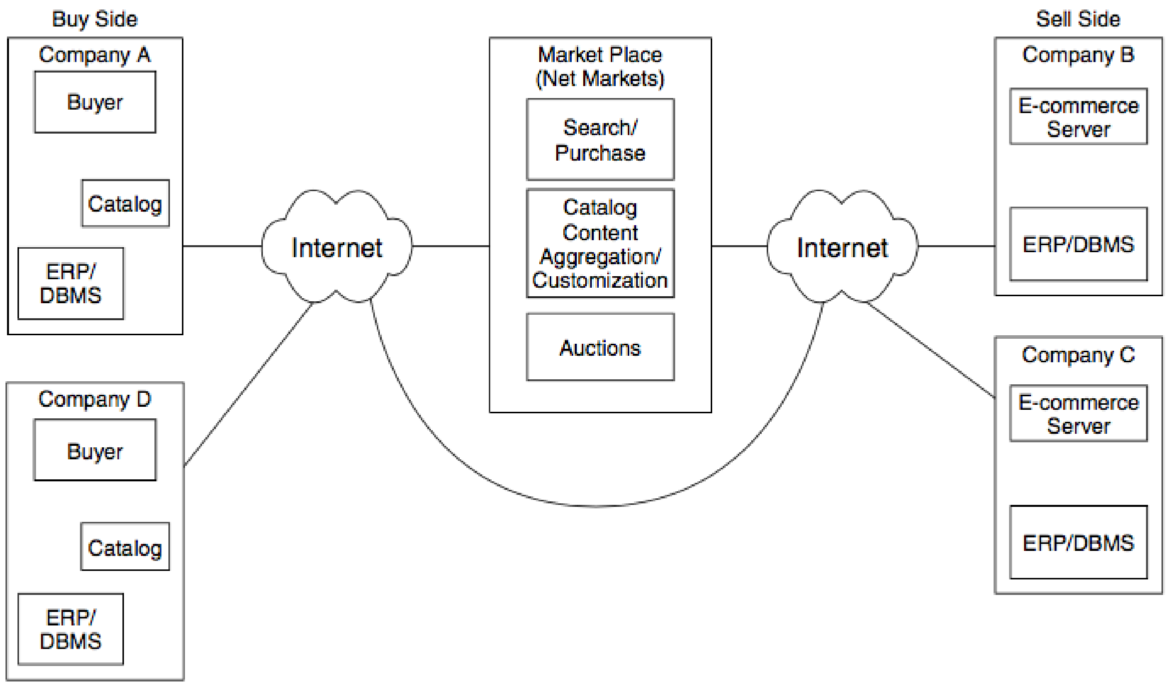

Figure 2.3: An integrated framework, obtained from ©Rajkumar (2001)

E-marketplaces can be classified according to numerous criteria. One possible distinction is between a private and non-private marketplace. The former is owned by an individual company to connect itself to its partners. The latter, non-private marketplaces, can be subdivided in public and consortium-based marketplaces. Public marketplaces are created by an independent third party intermediary, while consortium-based marketplaces are set up by a group of dominant players in an industry. Another approach is to make a distinction between vertical and horizontal e-marketplaces. Vertical marketplaces are industry specific, serving buyers and sellers in a particular industrial sector; while horizontal marketplaces serve more than one industry (Son & Benbasat, 2007; Soh, Markus, & Goh, 2006). Son and Benbasat (2007) found that many buyers purchase goods via

B2B e-marketplaces without tight integration of IT systems, in the context of non-private, vertical marketplaces. According to Kalvenes and Basu (2006), many online electronic marketplaces are set up and owned by market players themselves to improve their own supply and/or distribution chain. One of the main problems with these marketplaces is the distrust concerning privacy of the subsequent participants. To circumvent this issue, the authors propose a model of a B2B e-marketplace with guaranteed privacy, in which the buyer and seller have full control over identity information. Their proposed design of an electronic marketplace that facilitates these business processes is depicted in Figure 2.4. Note that an electronic marketplace not only supports the *search* processes of organizations, but also all the other trade processes; *authentication, valuation, payment and logistics*. The reader is referred to the paper for further information.

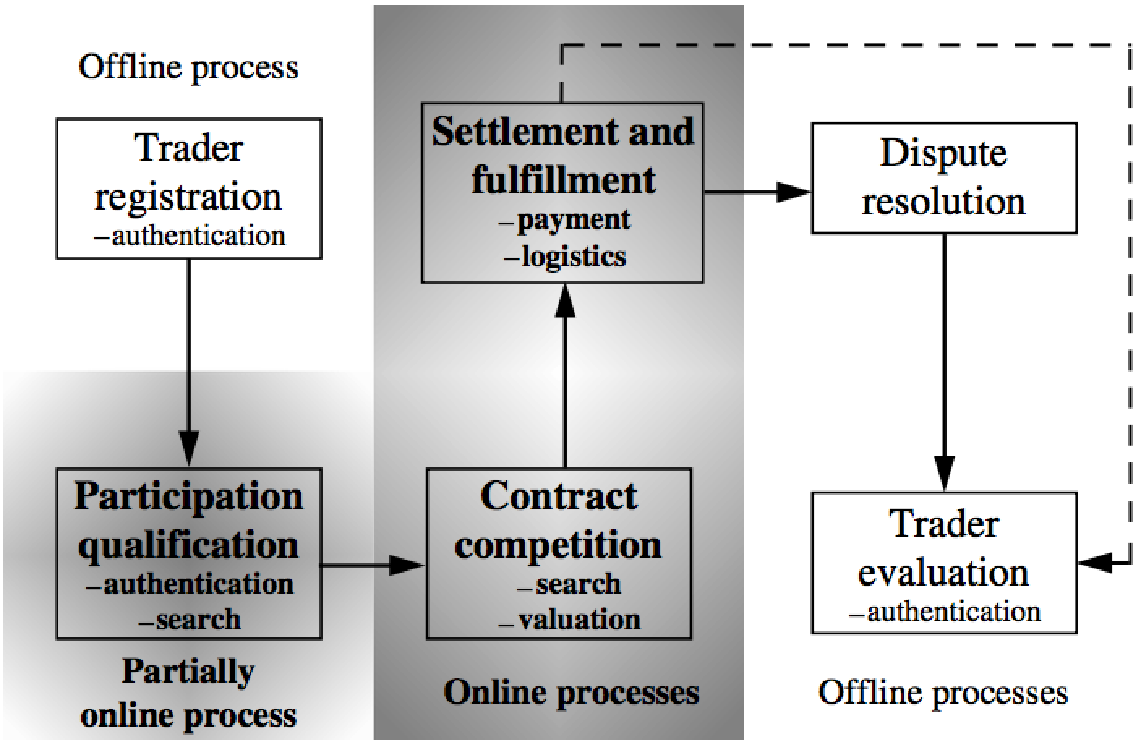

Figure 2.4: Proposed model of an anonymous B2B e-marketplace, obtained from ©Kalvenes and Basu (2006)

Electronic hierarchies differ from electronic markets in that, in hierarchies, buyers don't select a supplier from a group of potential suppliers, but rather work with a single predetermined supplier (Malone et al., 1987). Electronic hierarchies can be defined as "long-lasting supplier-customer relationships between firms, maintained with telecommunication networks and coordinated largely by management, rather than by market forces" (Vladimir, 1996, p. 10). Electronic hierarchies can also be seen as **private exchanges** in contrast to public exchanges such as some e-marketplaces.

In these relationships, transactions often involve asset specificity, which gives an incentive for both parties to continue conducting business with each other. Hierarchies seem to entail higher control and closer coordination than electronic markets (Malone et al., 1987; Vladimir, 1996). However, since IT reduces coordination costs, which are typically higher in markets than in hierarchies, the literature predicts that this will lead to more use of electronic markets. Transactions involving products/services with complex descriptions are also more likely to be traded via hierarchies (Malone et al., 1987; Clemons, Reddi, & Row, 1993).

As mentioned before, a supplier can improve visibility of his website via electronic directories and portals. An **electronic directory**, or online/web/subject/link directory, returns a list of websites according to the chosen subject. The editor(s) determine by means of relevant selection criteria which websites to include in the directory. An electronic directory is controlled by human operators rather than software, and is typically smaller than a search engine database (Collins, 2017; Chamberlain, 2014b). According to Chamberlain (2014b), the difference between electronic directories and search engines is fading, as owners of both are collaborating to integrate with each other. A **web portal** is a directory for commercial means that acts as a gateway to the web (Chamberlain, 2014b). It allows an organization to have one collection point of different kinds of data (Masters & Lingo, 2018). The web portal collects information from multiple sources in a structured and consistent way, which may go from subject categories to additional services such as e-mail, news, stock quotes etc. Web portals can be designed as dashboards and have the capability to interact with applications and databases (Chamberlain, 2014b; *The Difference Between A Web Portal And A Website*, 2015). There are a variety of web-based portals on the market today, such as **vendor portals** and **buyer portals**. Buyer portals possess a search function and can help the customers of the company find relevant information about the procurement process (Bögels, 2013).

Banner advertising is another way for the supplier to promote his products. Findings of a study conducted by Lohtia, Donthu, and Hershberger (2003) show that banner advertising in a B2B context should be more customized than in a B2C context. Next to that, when B2B companies want to achieve high click-through rates, they should not use animation, emotion, incentives nor interactivity in their banner ads.

Buyers can use **search forms** and **search supporting e-mail functions** to facilitate the search process (Basu & Muylle, 2003b). An e-mail is an efficient manner of distributing information about products/services, and can simplify the distribution operations (Bhatt & Emdad, 2001).

This medium is one of (if not) the most popular use of the Internet as it integrates the transmission of multimedia documents and it can be combined with other services such as negotiation tools (Vladimir, 1996). Harland et al. (2007) find that SMEs mainly adopt e-mails, together with websites, as the principal e-business technologies. Additionally, **instant messaging** (IM) tools can be used in a B2B context to facilitate communication in obtaining relevant product/service information (Kauffman & Walden, 2001).

A **search engine** is a familiar technology in the search process and can be used to obtain relevant information quickly. Search engines can be defined as "huge databases of web page files that have been assembled automatically by a machine" (Chamberlain, 2014a). Many types of (B2B) search engines are on the market; however, they can differ in functions. The way users can search depends on the type of algorithm behind the search engine. Some search engines will correspond more to the cognitive knowledge base of the user. Next to that, users can utilize different search engines depending on the task that needs to be executed (Kauffman & Walden, 2001). The best search engines will return complete and focused results to the user request quickly (DeYoung, 2008). Search engines are becoming more and more personalized (Montaner, López, & De La Rosa, 2003). Nowadays, a lot of **meta-search** engines exist, which use other search engines in their process. This makes it possible for the user to use several search engines in one session (Kauffman & Walden, 2001). Next to that, **product/price comparison engines** make it easy for the buyer to compare different products when price is the most important driver.

A **digital library**, or electronic/virtual library, is often confused with electronic databases (Borgman, 1999; Hong, Thong, Wong, & Tam, 2002). Many different definitions exist, of which some are broader defined than others (for example, the opposing view of librarians and computer scientists). Digital libraries can be defined as "a set of electronic resources and associated technical capabilities for creating, searching and using information. In this sense they are an extension and enhancement of information storage and retrieval systems that manipulate digital data in any medium (text, images, sounds; static or dynamic images) and exist in distributed networks" (Borgman, 1999, p. 234). Empirical findings of Hong et al. (2002) show that important determinants of digital library use are perceived ease of use as well as perceived usefulness. The interested reader is referred to both papers for further information.

Virtual communities can also be used in the search for suitable products/services and corresponding suppliers. These communities materialized as a kind of meeting spot for information exchange on particular topics; and as a consequence became search forums categorized according to the chosen subject (Basu & Muylle, 1999). For more information, Hagel (1999) is recommended. Buyers can also consult **discussion forums** if they would like a different point of view on the product/service/supplier they are interested in.

Buyers can set up a **web-based procurement system** in which i.a. electronic catalogs are displayed to select the appropriate supplier(s) and product(s). Via these catalogs, buyers can select the best supplier(s) according to their own criteria and place order(s). Web-based procurement systems offer the user centralized control with a higher range of items on the catalog and an increase in supplier choice. Procurement and processing costs are reduced as the labor costs related to manual processing drops to a minimum because of automation of transaction processes (Chandrasekar & Shaw, 2002; Boyer & Olson, 2002). Web-based procurement systems handle the information flow and online document routing, e.g. the system can automatically route product requests for order placements with suppliers. Hence, **electronic requirement determination tools** such as e-RFQ are implemented, which we will discuss in the *valuation* section. Next to this, manual processing increases the probability of mistakes e.g. wrongly sent documents, incomplete information etc. Hence, these web-based systems eliminate many sources of errors. Furthermore, by providing real-time information, the coordination between buyers and sellers is improved. This decreases the lead time between ordering and receiving products and reduces coordination costs (Chandrasekar and Shaw (2002); *see also collaboration*). Coordination costs can be defined as "the cost of finding suppliers and partners, negotiating and specifying contractual terms, monitoring execution of contracts, and taking corrective actions when required" (Ray, Wu, & Konana, 2009, p. 589). This leads to significantly lower inventory needs and consequently lower overall inventory holding costs (Chandrasekar & Shaw, 2002). Other benefits are improved quality and delivery accuracy (Timmers, 1998; Boyer & Olson, 2002). Boyer and Olson (2002) further confirm this with more advantages such as convenience, and improvements in service and security. E-procurement systems enable the purchasing department to examine purchase patterns of products; and facilitate negotiations with supplier, by obtaining better knowledge. The software systems can easily be integrated with back-end ERP and database systems (*see application integration*). Of course, these systems are not installed without incurring costs, and unfortunately, the costs to implement them are significant. Harland et al. (2007) conclude in their study that almost none of the investigated SMEs used e-procurement. Note that e-procurement systems are able to hold **auctions**, which we will discuss later in the *valuation* subsection (Rajkumar, 2001).

In Figure 2.5 below, four methods of performing web-based procurement are shown, that demonstrate different ways that a buyer or supplier can accomplish a B2B transaction (Chandrasekar & Shaw, 2002). Organizations typically use a mix of these models.

Form of Web-based procurement	Factors that create value	Factors that affect realized value
Buy-side procurement system	Reduced transaction costs Higher process quality Increased system responsiveness Lower development costs Increased control	Process characteristics Degree of centralization Degree of integration with enterprise systems Bargaining power of buyer
Private B2B e-market	Reduced product price Knowledge creation and dissemination Lower search costs to locate sellers	Product characteristics Rate of innovation in industry Supplier fragmentation Bargaining power of buyer
Industry B2B exchange	Reduced product price Increased utilization of surplus assets Lower search costs to locate sellers or buyers	Product characteristics Size of industry Industry fragmentation Power of buyers and sellers Coordination among buyers
Third-party B2B e-market	Lower product price for buyers Lower search costs for buyers and sellers Service quality	Industry fragmentation Liquidity Industry participation

Figure 2.5: The value of different forms of Web-based procurement, obtained from ©Chandrasekar and Shaw (2002)

Zhu (2004) shows in his study that not all firms benefit equally from joining an **online B2B exchange**. In some situations, information transparency issues would overshadow the benefits. Furthermore, firms with higher uncertainty and a lower cost structure have stronger incentives to join the exchange. This is because participants obtain better cost information about other firms, which will lead to more efficient (lower cost or/and better technology) firms producing more and thus outperforming firms with a higher cost structure. Higher-cost firms will prefer to keep trading in offline markets, because there they can better hide their less competitive costs. Yet the consequence of an online B2B exchange is that firms that choose not to participate can be seen by others to be a high-cost firm, which could negatively influence the trade between entities and the higher-cost firm. This in turn will 'push' those firms on the online market as well.

An **online intermediary**, also called **cybermediary**, conducts business over the Internet. Conforming to Chircu and Kauffman (2000, p. 8), an intermediary "facilitates transactions between buyers and sellers by providing value-added services, such as product information, aggregation and distribution of products" (*see logistics*), "quality checks and warranties" (*see authentication*). "They provide transaction-processing capabilities for buyers and sellers, and thus act in an operational capacity; or they bring enhanced levels of knowledge and expertise, and add to the transactability of a given good or service". Intermediaries can also be seen as **information consolidators**. As stated in Basu and Muylle (1999), these consolidators are companies that manage search directories, engines and many other tools such as virtual communities and intelligent agent software. According to Chircu and Kauffman (2000, p. 8), some fear of dis-intermediation, which "occurs when an intermediary gets pushed out by other firms, or when the services it provides become irrelevant in a marketplace that offers other ways to get the same kind of transaction done". According to Vladimir (1996), one can say that the role of intermediaries is vanishing with the rise of digital technology use in business processes. However, these intermediaries can play an important role in trade processes by limiting the risk to the parties, especially when the associated product or service is complex by nature. It is not said that intermediaries will disappear, yet their role in the exchange between entities can significantly change. We could use the term re-intermediation for this phenomenon, as intermediaries can still deliver value by exploiting their industry-specific expertise (Chircu & Kauffman, 2000).

A specific kind of online intermediary is an **online broker**, and is an alternative for an electronic marketplace. A broker is defined as "an agent who is in contact with many potential buyers and suppliers and who, by filtering these possibilities, helps match one party to the other. A broker substantially reduces the need for buyers and suppliers to contact a large number of alternative partners individually" (Malone et al., 1987, p. 488). In e-markets, an electronic brokerage effect takes place, which increases the number of alternatives, the quality of the selected alternative, and decreases the selection process cost (Malone et al., 1987).

An intermediary could set up an **e-mall**, or virtual mall (Vladimir, 1996). The definition of Timmers (1998, p. 5) can be applied: "An electronic mall, in its basic form, consists of a collection of e-shops, usually enhanced by a common umbrella, for example of a well-known brand". An e-mall offers the *buyer* added convenience and ease of use through a common user interface. A *seller* offering his products/services through such e-malls can reduce costs and complexity, and increase traffic. Timmers (1998) further notes that the viability of this kind of business model has been questioned, due to lack of perceived additional convenience, and no attachment to the uniform user interface. Yet the author also states that companies increasingly want to outsource their web-based operations, which would increase the use of these virtual malls.

Another possibility is to use **smart/intelligent agent software**, that can help in finding the desired goods or services (Vladimir, 1996; Kauffman & Walden, 2001). The ability to search, select, negotiate, and transact is substantially improved (Kauffman and Walden (2001); *see also valuation*). In other words, software-based intelligent agents "offer both firms and consumers the possibility of 'artificial life'–based representation in dealing with complex, crowded, fast-paced electronic markets. They also have the potential to change market structure and market performance" (Kauffman & Walden, 2001, p. 18). It is necessary for the agent to interact with its principal to understand his goals and utility in order to provide him with satisfactory results. Computers need to be able to interpret all information streams given by the user to adapt to his behavior, habits and knowledge (Kauffman & Walden, 2001; Montaner et al., 2003). Intelligent agent software needs to make a decision based on the available information, which involves "data about items as well as different profiles of other agents on the web. Since there is so much information, a fundamental issue is to select the most appropriate information with which to make decisions. In other words, an information filtering method is essential. There are three information filtering approaches for making recommendations: demographic filtering, content-based filtering and collaborative filtering" (Montaner et al., 2003, p. 289). For further information, the reader is referred to the paper. Next to that, an agent makes it possible to implement a web service (Daniel et al. (2004); *see also application integration*). Recommender systems by using **intelligent recommender agents** are becoming more and more accepted by users to help them simplify and sort through all sorts of information in their search process. Recommender agents resort to the user profile in order to recommend products or actions (Montaner et al., 2003).

Collaborative filtering and predictive search technologies "exploit characteristics of the user that can be discovered in online interactions with a website, enabling the presentation of information that is uniquely suited to the user. Such predictive presentation of information can reduce the user's need to search, and thus change the potential cost-benefit of use of the Internet" (Kauffman & Walden, 2001, p. 24). In recommender systems, collaborative filtering is one technique that can be used to sort through all the available information. To be able to make appropriate recommendations, collaborative filtering exploits the feedback about an item(s) from other people

(Montaner et al., 2003).

Shopbots, or shopping robots, can also be used in the B2B context to make it easier for participants to search for relevant information and prices (Kauffman and Walden (2001); *see also valuation*). Fasli (2006, p. 75) nicely states the essence of shopbots: "A shopbot can perform searches and comparisons for suppliers and components on behalf of businesses and organizations, such as those in a supply chain. Shopbots can locate the cheapest suppliers or those that satisfy certain conditions, such as delivery deadlines. B2B users would receive the same benefits from the Web services infrastructure, including reduced costs and improved market efficiency" (*see application integration*). Kauffman and Walden (2001) argue that these shopbots will be even more important in the future as companies entrust them to make transactions and negotiate deals on behalf of the company. The authors entitle this kind of agent 'next-generation digital butlers'. Next to shopbots, **chatbots** could also be used in the search process, which are "automated computer programs that are designed to carry on a seemingly natural conversation with a human. They utilize ever-evolving artificial intelligence capabilities to be able to provide information, solve problems, sell products, or simply entertain" (Klatt, 2017). Chatbots can be used in a variety of contexts. If a buyer goes to the website of the seller to get more information, it is possible that the seller installed a chatbot to make it easier for the buyer to find what he is looking for.

Social media platforms can be used to find suitable partners (either customers or suppliers, *see BI*). Social media platforms can install chatbots in order to help customers. Malone et al. (1987) already stated that sophisticated systems that use AI methods to screen advertising messages and product descriptions conforming to the criteria important to the buyer will have a bigger stake in the market. This is in line with the thoughts of Kauffman and Walden (2001) above.

A further tool that can dramatically alter the search process is **XML**, which stands for Extensible Markup Language. An XML protocol replaces the Internet's HTML in business processes; and makes it possible to describe products, features, and prices in much more detail (Zhu, 2004). According to Glushko, Tenenbaum, and Meltzer (1999), the XML standard will create more value than HTML, since the latter focuses only on page formatting, while XML distinguishes web page appearance from data representation. Next to that, XML is readable by machines and associated agents, which enables automated B2B purchasing opportunities (Kauffman & Walden, 2001). Matching criteria can more easily be set between B2B partners and information access and transparency is highly improved (Zhu (2004); *see also data integration*).

Peleg, Lee, and Hausman (2002) compare three different procurement strategies for a manufacturer in their paper. The first strategy - Strategic Partnership - is to develop a long-term relationship with a specific supplier (*see integration*). The second strategy - Online Search strategy - is to buy online for a better price. The third strategy is a combination of both strategies: to develop a long-term purchase contract with a supplier up to a certain level, and if necessary purchase additional quantities online. The paper discusses the condition under which one strategy is preferred above the others, and demonstrates that web-enabled procurement facilitated the use of a combined strategy to optimize the results.

2.2.1.2 Authentication

Authentication guarantees the credibility of the different entities as well as the quality of the exchanged products and services. Next to this, the conformance to the contract or agreement between the parties is ensured. If we take a look at this process, we can divide the authentication into three different categories: the authentication of the buyer, the authentication of the seller and that of the product or service (Basu & Muylle, 2003a).

Two factors that play a very important role in this process are trust and information (Basu & Muylle, 2003a). Trust can be described as "the willingness to be vulnerable to the actions of another irrespective of having the ability to monitor or control" (R. Klein & Rai, 2009, p. 741). Information asymmetry, on the other hand, is defined as "the difference between the information buyers and sellers possess" (Ba & Pavlou, 2002, p. 244). Sellers typically possess more information about the quality of the product/service offered. In an online environment, buyers cannot physically inspect the product and as such have to rely on online product information. This leads to potential risks and uncertainties associated with fraudulent transactions. Two types of uncertainties materialize. First, there is seller quality uncertainty; which can be in the form of sellers hiding their true characteristics, shirking, contract default (i.e. suppliers refusing to accept payment and send the product), making false promises and so forth. Second, product quality uncertainty exists; and occurs when the product is not as promised, there is a delay in product delivery or when the product quality is bad. Trust can mitigate information asymmetry since it reduces the perceived risks associated with the transaction (Ba & Pavlou, 2002). Buyer-supplier dyads are in essence principal-agent relationships, in which the buyer acts as the principal and the supplier as the agent. The principal selects an agent to deliver a product or service as promised and on time (Pavlou et al., 2007).

A summary of the elements of the principal-agent perspective is shown in Figure 2.6, in which some of the risks and uncertainties are represented. For all the reasons stated above, authentication is particularly important in e-transactions.

Characteristics of the Principal–Agent Perspective	Online Buyer–Seller Relationships
Human Action: Principal delegates authority or responsibility to an agent who acts on her behalf.	A buyer (principal) delegates responsibility to a seller to deliver products, and the seller (agent) acts on behalf of the buyer.
Divergence of Interests: Principals and agents have different interests and goals.	Buyers want to get high quality products for as little money as possible, whereas sellers want to deliver as low a quality of products as possible and receive as much money as possible.
Potential for Agent's Gainful Exchange: Possibility for agents to gain by shirking or acting opportunistically.	Sellers have the potential to act opportunistically by accepting money and not delivering products, delivering products of lower quality than promised, and failing to acknowledge product guarantees and post-purchase support.
Difficulty in Monitoring and Enforcing Human Action: Principals cannot easily monitor agents and enforce their expected actions.	Buyers cannot easily monitor how product delivery is undertaken or easily enforce that sellers will fulfill their end of the transaction.
Agents Not Bearing Consequences of Their Actions: Agents act on behalf of principals who own the assets being managed.	Upon the buyer's (principal's) payment, the products to be delivered are no longer owned by the seller (agent) but they are essentially owned by the buyer. The seller thus manages the delivery of the buyer's products.
Temporal Duration: There is a time lag in which the agent's actions can be manifested.	Online buyer–seller relationships extend over a long period of time in terms of product delivery, product warranties, product returns, and post-purchase service and support.* Moreover, sellers maintain their buyers' personal and monetary information over virtually an infinite time after purchase.

Figure 2.6: Application of the principal-agent perspective to online buyer supplier relationships, obtained from ©Pavlou et al. (2007)

An online feedback mechanism, or **reputation system**, is one way to circumvent these issues. Online feedback mechanisms "are using the Internet's bidirectional communication capabilities to artificially engineer large-scale, word-of-mouth networks in which individuals share opinions and experiences on a wide range of topics; including companies, products, services, and even world events" (Dellarocas, 2003, p. 1407). Feedback mechanisms can be very important as they generate credibility-based trust, even in one-time transactions between entities (Ba & Pavlou, 2002). Next to that, feedback mechanisms can provide the *buyer* with quality assurance, since the supplier has an incentive to fulfill contractual obligations. It can also reduce the legal costs of conducting business (Dellarocas, 2003). According to Basu and Muylle (2003a), it is a low-cost, easy-to-use and secure method. Such mechanisms can be used in both B2C and B2B settings, in which buyers, for example, can rate suppliers and communicate their transaction experiences (Ba & Pavlou, 2002).

Closely related to an online feedback mechanism is a **web-based supplier evaluation system**, in which suppliers are evaluated on different factors such as qualification, development and certification. Empirical evidence shows that strategic purchasing positively influences supplier evaluation systems, in that more efforts are made to manage, certify, formally evaluate and reward suppliers (A. S. Carr & Pearson, 1999). This could potentially lead to price premiums for *sellers* with a good reputation, since buyers are willing to compensate them to guarantee safe transactions. Price premiums in this context are described as "the monetary amount above the average price received by multiple sellers for a certain matching product" (Ba & Pavlou, 2002, p. 248). The riskier the transaction is perceived by buyers, the higher the possibility of price premiums (Ba & Pavlou, 2002).

One way for the seller to find out more about the buyer's legitimacy and integrity is by asking the buyer, when he visits the seller's **website**, to provide his registration information. Likewise, buyers can consult the supplier's website to find relevant information about the credibility and quality of the supplier. Other authentication mechanisms are cookies on websites, URL advertising, and website content available through public sources (Basu & Muylle, 2003a). Creators of websites can legally safeguard the website via copyright protection services.

Digital certificates (approved by financial intermediaries) can be used in the authentication process by assigning a digital **certification authority** (CA) server software agent or a **third party** who acts as the CA (Basu & Muylle, 1999, 2003a; Kauffman & Walden, 2001). A digital certificate can be defined as "a document containing a party's public key (and possibly the party's signature, encrypted with its private key), encrypted with the private key of a certificate authority" (Kalvenes & Basu, 2006, p. 1726). Next to the public key and digital signature, a digital certificate includes user's identity information and a time period for which the certificate is valid or an expiration date (Shinder, 2002). Trusted third parties can validate market players by using such public key encryption technology. The digital certificate gives assurance about the identity and reputation of the market participant (Ba, Whinston, & Zhang, 1999). According to Basu and Muylle (2003a), those certificates are the best digital mechanism for the buyer authentication process. It is a formal, low-cost, secure and reliable mechanism for both the buyer and the supplier to validate each other. In line with Ba et al. (1999), Kauffman and Walden (2001, p. 68) note that "participants who were dishonest in the past are not able to produce a valid certification. This removes the incentive to cheat because the gain from cheating is outweighed by the loss of future revenue streams due to the inability to provide a valid certificate". Authentication can also be done by a **blinded signature**. This is "a mechanism by which a document can be endorsed by an authority using its digital signature, without the authority knowing the document's contents" (Kalvenes & Basu, 2006, p. 1726).

The seller and product authentication process can be done by using **trusted third parties/intermediaries** to set up or display e.g. independent virtual communities, URL advertising and website content from public sources. Online third party intermediaries offer buyers the opportunity to obtain product reviews and specifications. The services these intermediaries offer is known as referral services (Ghose, Mukhopadhyay, & Rajan, 2007). **Virtual communities** can be either owned by the seller or be independent and they can support both buyer and seller to investigate identity, quality of the other party and its products/services (*see search*). According to Basu and Muylle (2003a), independent virtual communities are a secure, easy-to-use, low-cost and portable means for the authentication process. Other third parties such as **credit card companies** can also be used in the verification process. According to Basu and Muylle (2003a), credit cards are the most effective way to authenticate the *buyer*; and this authentication cannot be done without such financial intermediaries. These credit card companies adopt **Secure Electronic Transaction** (SET) schemes.

Authentication is also done in electronic marketplaces to identify trust-worthy and credible partners (*see search*). **Active digital market makers** or interactive service providers register and verify all actors and their contributions as to make sure a well-functioning market is created. **Passive market makers** on the contrary do not authenticate the participants themselves; yet they facilitate the authentication process through reputation systems in which feedback is provided (Basu & Muylle, 2003a).

Digital authentication services such as **online trust services** "guarantee secure and legally valid electronic transactions" (EC, 2016; Basu & Muylle, 2003a). These services include an electronic signature, electronic seal, electronic registered delivery, time stamp, website authentication and legal adequacy of e-documents. An EU trust mark logo can be used by certified trust service providers to demonstrate their status (EC, 2016).

Endorsements by objective and reliable entities can be a useful tool when companies are new to online business and so did not have the chance to develop a reputation yet. **Experts** can be appointed to verify the authenticity, as well as **long-term players** e.g. an e-mall (Basu and Muylle (1999); *see also logistics*). The latter allow sellers, via an incomplete contract, to use the service to authenticate them to their buyers as long as their quality levels are acceptable (Ba et al., 1999).

Smart cards or tokens can be used in the verification process if buyers or sellers need to identify themselves (Basu & Muylle, 2003a). Smart cards, such as an ID or banking card, are secure portable elements on which data can be stored (Gemalto, 2018). Smart cards can add another security layer by requiring a password or PIN next to the smart card itself, and they can also store digital certificates (Shinder, 2002). Employees can for instance use smart cards to access the intranet, on which a database of qualified suppliers is stored (Harland et al., 2007). Next to smart cards, the buyer can authenticate himself with a machine/access device by entering the password and/or PIN-based authentication (Basu & Muylle, 2003a).

Biometric authentication, such as fingerprints or voice recognition, is a common method and can be used as a complement to smart cards and tokens (Basu & Muylle, 2003a; Gemalto, 2018). It is "the process of comparing data for the person's characteristics to that person's biometric 'template' in order to determine resemblance" (Gemalto, 2018). However, Basu and Muylle (2003a) argue that these methods are not that often applied in practice in e-commerce, as they became redundant by the existence of digital certificates and credit card mechanisms.

According to Basu and Muylle (2003a), no pervasive product authentication mechanism is available. However, by advertising the quality of the products/services offered by the seller, the need to assure the quality can be reduced as track records are built. Electronic marketplaces can be a very helpful tool in this process. Another problem according to these authors is the trustworthiness of third parties. These intermediaries are almost employed in all authentication processes. Circumstances in which a party wants to remain anonymous are also of concern, since most authentication mechanisms reveal the party's identity. Nevertheless, anonymity could tamper the possibility to establish long-term relationships. Next to that, the authors point out the need to authenticate independent software agents.

Basu and Muylle (2003b) find that companies selling low-cost products support the authentication processes more than companies offering high-cost products by providing more options for authentication. Unfortunately, their study finds that most of the authentication is achieved unrelated to digital technologies such as the Internet.

2.2.1.3 Valuation

The **valuation** process discovers the purchase or sales price of products/services and related price information. A distinction can be made between fixed and dynamic pricing. Fixed pricing is used for standardized products by offering a fixed price, while dynamic pricing can be supported through templates for auctions, exchanges and online negotiations by changing the price over time (Muylle & Basu, 2008). Digital technologies enable real-time pricing initiatives (Kauffman & Walden, 2001).

Electronic marketplaces are once more an important technology used in the price discovery process (*see search*). These marketplaces and the **Internet** dramatically reduced prices of products and services by allowing price visibility and comparisons to *buyers*, thereby increasing the competition on prices between sellers (Bakos, 1997). According to Bakos (1997), e-marketplaces can also diminish the ability of *suppliers* to hide quoted prices and reduce their market power. This leads to lower price premiums and seller profit margins. The author proposes three solutions to overcome this problem. First, sellers should own/control the digital technology, and the system should focus on product information rather than prices. This will allow suppliers to keep high profits but still support buyers to find the sellers with the best fit. Second, sellers should make it more difficult for buyers to compare the price of alternative product offerings. Third, suppliers should increase the differentiation of products offered. Hence, as discussed, e-marketplaces can either limit price transparency to attract sellers or they can enable price transparency to appeal to buyers, in both cases compensating the other party in order to encourage participation (Bakos, 1997). Electronic marketplaces incur some switching costs, as buyers and suppliers need to make some adaptations to their current distribution channel. Although electronic marketplaces offer several benefits, it is not for free. Participants need to pay a fee for using the marketplace (Yoo et al., 2002).

Soh et al. (2006) classify electronic marketplaces in their research as a function of the strategy the marketplace pursues. They focus on e-marketplaces operated by **intermediaries**. Two possible strategies are discussed, the first is a low cost strategy, in which buyers' costs are reduced through lower prices and transaction costs. The second strategy is that of differentiation, which means offering differentiated services to buyers and/or sellers; such as superior communication, fast and accurate matching of supply and demand, integration options, and so forth. On the one hand, they find that an electronic marketplace that pursues a low cost strategy always enables high price transparency. As a result, these marketplaces perform badly, because sellers are not willing to participate due to the lack of compensatory benefits. On the other hand, an e-marketplace with a differentiated strategy is more likely to be successful, because it can exploit its strategic resources and capabilities to deliver value. When an electronic marketplace fails to position itself with a clear-cut strategy, it is stuck in the middle and consequently doomed to fail.

The price discovery process can be done by using **online auctions**, in which online bidding/tendering between and against entities takes place. An auction is "a market institution with an explicit set of rules determining resource allocation and prices on the basis of bids from the market participants" (R. P. McAfee & McMillan, 1987, p. 701). Online auctions is one kind of electronic marketplace and can be seen as a dynamic pricing scheme. Next to that, online auctions can provide the functionality to integrate the bidding process with contract handling, payment and delivery (Timmers (1998); *see also payment, logistics*). The primary goal of an electronic auction is to match buyers and suppliers and to provide depth and liquidity for the trade items (Qizhi & Kauffman, 2002; Kauffman & Walden, 2001). Auctions have roughly three functions: "bidding rules, information revelation, and clearing policy" (Kauffman & Walden, 2001, p. 20). Some of the benefits mentioned in the literature of using online auctions are reduced transaction costs because of a higher efficiency, time savings, accessibility to more buyers/suppliers (global sourcing), a clear description of complex products/services, and the possibility to handle more complex auctions (S. Klein, 1997; S. Klein & O'Keefe, 1999; Timmers, 1998). Additional benefits are easier data collection about auctions and participants, and the ability for participants to join everywhere at any time (Pinker, Seidmann, & Vakrat, 2003). *Suppliers* can sell (low value) goods in small quantities, such as surplus goods, thus reducing surplus inventory cost; and can increase the production capacity utilization while reducing sales overhead cost. *Buyers*, on the other hand, can lower their purchasing overhead cost and the price of goods/services altogether (Timmers, 1998). S. Klein and O'Keefe (1999) further show that the success or failure of an online auction is mainly dependent on the level of trust and quality provided. To this point, we haven't answered the following question: why do firms use online auctions to conduct B2B exchanges? On the one hand, *suppliers* are using **forward** auctions to sell off excess inventory, which Pinker et al. (2003) call surplus auctions. Many buyers compete and bid for one supplier's good and/or service. On the other hand, *buyers* are using **reverse** auctions to find a suitable supplier(s), which are called procurement auctions. Thus, in this type of auction, many sellers compete and bid to fulfill the order of one buyer (Gupta, Koulamas, & Kyparisis, 2009). A procurement auction makes it easier for buyers to expand their supply base, which could potentially weaken its relationship with long-term suppliers (Pinker et al., 2003). However, it is doubtful if procurement auctions are really causing significant negative impact on buyer-supplier relationships. According to Pinker et al. (2003), auctions have an important advantage over negotiations, in the sense that auctions have a strict protocol to which the sellers need to comply. As such, the transparency that results from this protocol give participants assurance that the process is fair. Yet, according to Zhu (2004), cost transparency in B2B exchanges remains a real issue. For *suppliers*, this transparency leads to competitors seeing what they and every other party are bidding. Together with the lack of market liquidity, meaning that the transaction volume and participation levels aren't high enough, Zhu believes this is really troublesome for suppliers and sometimes obstructs them to participate. Of course, supplier trust and reputation issues also play an important role in auctions. One type of auction that circumvents this concern is private, invitation-only procurement auctions (Pinker et al., 2003). A **feedback mechanism** is a tool often used in auctions to help buyers distinguish reliable and trust-worthy suppliers from those that aren't (Ba and Pavlou (2002); Kauffman and Walden (2001); *see also authentication*). Next to all these findings, multi-item/multi-unit auctions, or **combinatorial** auctions, are also advancing. Herein, bundles of items are traded on the market, as opposed to individual units. The valuation of the bundle can be entirely different than that of individual items (Kauffman & Walden, 2001).

An **electronic catalog with posted prices** is a type of e-marketplace and an alternative to online auctions (*see search*). According to Soh et al. (2006), electronic markets can be classified as posted prices when public online searches return price information (thus without using e-mails in the communication process). These can further be supplemented by discounts and frequency marketing programs (Basu & Muylle, 2003b).

A third type of electronic marketplace and dynamic pricing scheme is an **electronic price negotiation** (product-price mix negotiations). This is a kind of private negotiation mechanism "in which firms can preselect participants for their bids. Firms benefit by being able to maintain privacy while negotiating deals electronically with various partners...Buyers usually identify qualified suppliers based on their previous purchasing experiences, and they attempt to maintain these established buyer-supplier relationships. Private negotiations help them to achieve this objective by rewarding a few preselected suppliers with their business, while also enabling them to benefit from the low search costs afforded by the electronic market" (Qizhi & Kauffman, 2002, p. 55,56).

A **web-based procurement system** offers an online tendering functionality for goods/services (*see search*). Benefits for *suppliers* are broader tendering opportunities (on a larger scale), lower tender submitting costs, and collaborative tendering possibilities (if supported by the system). As already mentioned, some of the benefits for *buyers* are reduced procurement costs and time savings

(Timmers, 1998; H. L. Lee & Whang, 2004). There are many e-procurement software applications on the market which can return price and availability quotes, which are discussed in the following paragraph.

Suppliers can request the price a buyer is willing to pay for its product and/or service. Likewise, the buyer can ask the price of a supplier, through submitting a request for quotation, termed **RFQ**, in which this price is returned. No further bidding is allowed (Basu & Muylle, 1999). Sometimes suppliers choose not to display prices on their websites, but rather distribute them via **e-mail**. Buyers can use e-mails to request information (RFI); quotations (RFQ); tenders (RFT); bids (RFB) and proposals (RFP). These requests are all **electronic requirement determination tools**, and can be grouped in a general term RFx, i.e. request for 'x' from the supplier (Soh et al., 2006).

Intermediaries can facilitate the price discovery process significantly by accessing newly available price-comparison information that might not be available in the presence of systems where the seller has full control over this information (Chircu & Kauffman, 2000). These price-product comparisons are thereby made easier in online markets, thus further reducing search costs for *buyers* and enabling them to get binding price quotes from their suppliers (Ghose et al., 2007). According to Chircu and Kauffman (2000), this new kind of information based intermediary, called **infomediary**, can represent the buyer in the interaction with sellers. As such, they can obtain greater buyer power by aggregation and consolidation of demand. Ghose et al. (2007) argue that suppliers can use these intermediaries as a kind of screening device to identify high-value customers as to enable price discrimination in this manner. According to their model, only high-valuation consumers buy online, so suppliers can screen out low-valuation customers. In his paper, Zhu (2004) shows that increased market transparency in online markets adversely affects firms' incentives to join an online exchange. **Online brokers** can be used (*see search*). Next to that, companies can use **product/price comparison engines** to compare prices (Kauffman & Walden, 2001).

A kind of intermediary that can also be used in the valuation process is **intelligent agent software** as well as **shopbots** (Basu and Muylle (1999); Kauffman and Walden (2001); Montaner et al. (2003); *see also search*). These software systems improve the ability to negotiate and transact for the desired products/services (Kauffman & Walden, 2001). For further information on both types of technologies, the reader is referred to the paper (Kauffman & Walden, 2001).

According to Sankaranarayanan and Sundararajan (2010), prior research has shown that price information is relatively easy to obtain in an online setting. In a B2B study conducted by Ghose and Yao (2011), their findings indicate that price dispersion in electronic markets is significantly lower than in traditional markets. *Buyers* can more efficiently discover lower prices because of reduced search costs in online markets, thus providing empirical support for this phenomenon.

From a *buyer* perspective, even if - because of electronic markets - the number of potential suppliers for an existing product increases, this doesn't necessarily mean that the buyer is willing to change suppliers as soon as their prices are lower. There still is a cost to gather relevant information about new sellers. According to Strader and Shaw (1997), switching costs will inhibit buyers to purchase from unknown sellers, unless their price is significantly lower than those of a reliable supplier. Next to this, not all products are suited for electronic markets. The level of risk involved in the transaction will be greater the higher the product price, especially when these buyers and sellers are geographically distant and have never had any transaction before (Strader & Shaw, 1997).

2.2.1.4 Payment

The **payment** process offers support for ordering and receiving online purchases via e-payment instruments. Fulfillment of online payments often include partnerships or even integration with banks, credit card companies and transaction service companies (Muylle & Basu, 2008). Online payment brings with it concerns about information security and seller's opportunism (Pavlou et al., 2007). An example of the former is sellers using buyer's monetary information to their own advantage, such as credit card and social security numbers. In the latter situation, since payment and delivery does not follow each other immediately, buyers are concerned that the product is not as described and promised, or that sellers are exploiting them by collecting payment but not delivering the product (*see authentication*). These information security concerns can be reduced by social presence, "the extent to which a consumer feels that the online environment closely resembles a physical interaction with a seller" (Pavlou et al., 2007, p. 107). There are four parties/roles involved in the payment process: the acquirer bank, the cardholder, the seller (the merchant), and the issuer bank (Takyi & Gyaase, 2012).

Payment processes mostly happen via an **electronic fund transfer** (EFT) **system** (Bhatt & Emdad, 2001). "Electronic funds transfer, or wire transfer, is used for direct transfer of funds from a payer to a payee, both usually corporations, using a bank's centralized computer as an intermediary" (Doggett, Jaffe, & Anderson, 1997, p. 15).

Online payment instruments can be classified according to two dimensions: **account-based payment** systems such as credit/debit cards, online banking, mobile payment systems and intermediaries; and **electronic currency systems** such as smart card and online cash systems (Muylle & Basu, 2008; Takyi & Gyaase, 2012).

When a **website** is used to offer products/services, buyers can purchase them via **online banking**. Online banking occurs when the "merchant redirects to the customer bank's website to effect payment" (Takyi & Gyaase, 2012, p. 233). The customer payment details are either filled in manually or automatically from the electronic bill. When it happens automatically, all the customer needs to do is authorize the transaction.

Mobile business applications on wireless devices containing **mobile payment systems** can significantly reduce the payment cycle for the buyer, by closing a purchase order faster. Mobile business applications can be invoked without any time or geographic constraint. This can help improving relationships with suppliers (Gebauer & Shaw, 2004). Mobile payment can either be done through a bank account or a telephone bill (Takyi & Gyaase, 2012). A study by Luarn and Lin (2005) shows that intention to use **mobile banking** is influenced by perceived self-efficacy and perceived financial cost, next to perceived ease of use and perceived usefulness.

It is possible that some customers are still insecure about online payment systems. One solution for this issue could be to appeal to **financial intermediaries** or **trusted third parties** who could facilitate the payment by external means, without using financial tokens via the Internet (Vladimir, 1996; Basu & Muylle, 2003b). They act as intermediaries between financial institutions and online e-businesses. Since B2B payment processes are often complex, Qizhi and Kauffman (2002) predict that market service providers offering these financial settlement services, thus **financial services providers**, will increase. Financial service providers can transfer the funds and/or extend the credit required for transactions (Malone et al., 1987).

Online payment support can be facilitated by digital technologies such as e-wallets, online credit card payments, and shopping cart mechanisms (Basu & Muylle, 2003b). An **e-wallet** "is capable of storing a wide variety of different types of payment accounts. An identification of a user's payment accounts is displayed to the user and he or she is allowed to manipulate these accounts (for example, add new accounts, change information in accounts, delete accounts, add funds to accounts, transfer funds between accounts, etc.)" (Blinn, Coco, & Marks, 2006, p. 10). The electronic wallet is stored on a **wallet server**, which can connect funds from several different accounts into one account (Blinn et al., 2006). Websites and procurement systems, for instance, are nowadays integrated with **online credit card payments** and **shopping cart mechanisms**, which increases the user convenience.

Next, **smart-card payment systems** collaborate with intermediaries and hardware providers (Basu & Muylle, 1999). Smart cards are "plastic cards with memory chips and embedded microprocessors which store more information than credit cards with inbuilt transaction processing capability" (Takyi and Gyaase (2012, p. 233); *see also search*).

E-money, e-cash or electronic/digital money, is a substitute for cash, credit cards and debit instruments (Vladimir, 1996). Online cash systems "work via prepaid cards with different arrangements, but most require merchant subscriptions. Electronic tokens representing a certain value are exchanged in a similar way to cash" (Takyi & Gyaase, 2012, p. 233).

A **micropayment** is "an e-commerce transaction involving a very small sum of money in exchange for something made available online, such as an application download, a service or web-based content" (Rouse, 2009). Micropayments need a special type of system, since it is too small to be processed by credit card companies. It can for instance be done by a third-party service provider (Rouse, 2009). **Scrip payment systems** can also be used to pay for very small transactions. The buyer purchases an amount of scrip directly from the seller or via a broker, who collects many scrips from several sellers (Basu & Muylle, 1999).

Electronic billing/invoicing systems can enable timely payments by customers (Subramani, 2004). Findings of Mukhopadhyay and Kekre (2002) state that e-invoicing lowers the probability of delayed payment, since related information is available much sooner than in offline situations. Next to that, e-invoicing consists of more accurate information. Hence, the payment-authorization process is moved forward.

Another tool that can be used to facilitate payment processes is a **subscription-based payment system** (Basu & Muylle, 1999). According to Gagliardi (2016), there are three strategies for adopting a subscription-based payment system. First, you have the prepaid subscription model, which is based on a prepaid monthly or annual subscription, with no long-term obligation. The second model is a term-based contract subscription, in which customers agree to a specific period, say one year, but they are billed on a different cycle, e.g. on a monthly basis. The customer incurs a penalty fee when he cancels the arrangement before the agreed term. Third, there is the usage-based billing, in which the customer only pays for what he uses (Gagliardi, 2016). Subscription-based payment can increase the efficiency for companies as well as simplify the billing process. According to Richardson (2014), it can increase B2B revenue because of three reasons: it reduces repurchase decision points for the customer when billing occurs automatically. Next, since subscription-based payment can be seen as a long-term agreement, it fits well with long-term buyer-seller relationships. Finally, it also lowers the acquisition costs by decreasing associated administrative costs, since additional purchases can be added to the ongoing subscription system.

Electronic marketplaces also integrate payment to facilitate transactions (*see search, valuation*). **Digital cash-based marketplaces** facilitate payment between a buyer and a seller and guarantee that the money transfer between them is private (Kalvenes & Basu, 2006).

As reported by Takyi and Gyaase (2012, p. 232), "to effectively support e-commerce, e-payment systems must be secure, reliable and convenient with good authentication, privacy, integrity and non-repudiation". There is a lot of controversy around the security and anonymity of online payment systems. That's why, in order to ensure transaction safety, **payment protocols** and encryption such as SET (Secure Electronic Transaction) and SSL (Secure Socket Layer) came to existence (*see authentication*). Takyi and Gyaase (2012) developed a robust electronic payment protocol (REPP), which is easy to use and implement, and minimizes the risk of online fraud. The interested reader is referred to the paper for further information.

Basu and Muylle (2003b) note that for high-cost product industries, companies are more and more abandoning support for offline payment in favor of online payment instruments. One possible reason for this phenomenon is that online payment mechanisms are more attractive for larger payment sums, due to the associated transaction costs.

2.2.1.5 Logistics

The **logistics** process handles the movement of products, resources and other services within and between the different involved parties. Logistics include warehousing, transportation (shipment and delivery), return management, tracing and tracking of the different flows, etc. The logistics process plays an important role especially in products that can be sold online but still require delivery, i.e. physical products, as opposed to digital products. Digital products can be digitized and delivered via electronic networks. Industries that offer digital products include air travel, gaming, music and the news industry (Basu & Muylle, 2003b). However, in our context, most B2B transactions still handle physical products. Logistics is an important part of the order fulfillment process, since it can affect the lead time to the customer drastically. Being able to handle the logistics process efficiently, by using few resources while delivering in a short time period, can significantly improve the firm's competitive advantage. E-commerce is a useful way to increase speed of delivery (Strader & Shaw, 1997). According to Rosenzweig and Roth (2007), real-time exchange of logistics information between different entities in the supply chain is crucial to reap efficiencies in delivery while maintaining low inventory levels. The coordination of information becomes especially important in global logistics, as visibility across the supply chain is critical to success (Rosenzweig & Roth, 2007; Alshawi, 2001). R. Klein and Rai (2009, p. 736) state that "the logistics process is inherently intensive in its use of physical assets and information and requires the management of high process interdependence between buyers and suppliers". Hence, data and - even more - application integration will determine the degree of success that a particular supply chain can reach (Alshawi (2001); *see also data, application integration*). The Internet facilitates the tracking of shipments, supplier schedules and digitization of inventory management processes (Rai, Im, & Hornyak, 2009).

Virtual logistics was introduced by Clarke (1998, p. 486) and is described as follows: "With virtual logistics the physical and information aspects of logistics operations are treated independently from each other. In such operations, ownership and control of resources is effected through Internet (or Intranet) applications rather than direct physical control, and resources can, thereby, be owned and utilized remotely. This removes numerous operating constraints, and allows for the more efficient design of logistics networks". The constraints are eliminated since assets are valued according to their availability and functions instead of their physical terms. Virtual logistics enables higher flexibility and resource utilization. Other benefits of using the concept are increased efficiency, reduced lead times and a more responsive supply chain. Internet applications are deployed in order to share and grant access to (public) logistics resource information, and are also used in the trading process of logistics resources between suppliers and buyers. Product availability and stock control is guaranteed as a result of the integration of warehousing, transportation and production. Virtual logistics systems entail several new concepts such as virtual warehouses, virtual stock control, virtual markets, virtual logistics services etc. The author predicted that the initial application of virtual logistics systems would be for high value, low volume products. SMEs could also benefit from such a system since it enables more economies of scale through merging product flows from different companies. The reader is referred to the paper for additional information (Clarke, 1998).

According to Chircu and Kauffman (2000), **online intermediaries** can also play a huge role in the logistics process by capturing dominant market share, either in a single industry or by becoming e-market makers across several industries. The rise of digital technologies offered new opportunities to carriers and third party logistics providers (Alshawi, 2001). They can facilitate different aspects of the logistics process, such as inventory management and transportation. Logistics intermediaries, also called logistics service providers, can then gain a competitive advantage by obtaining economies of scale and scope. Such economies can be achieved by effectively implementing a digital technology that can achieve an installed user base large enough to minimize the transaction costs (Qizhi & Kauffman, 2002). According to Basu and Muylle (1999), an intermediary such as an **e-mall** can significantly add value to the logistics process (*see search*). Electronic marketplaces themselves can also have built-in mechanisms to facilitate the logistics process related to the transaction, by streamlining the flow of information between entities (Qizhi and Kauffman (2002); *see also search, valuation*).

Next to that, a supplier can integrate a store locator on his **website** to support customers in finding the nearest store to buy the product. If the product is completely digitized, the seller could provide the buyer with multiple source sites of which the buyer can choose the nearest server to obtain the product (Basu & Muylle, 1999).

Just as buyers and suppliers can conduct electronic price negotiations to obtain the valuation of products/services, shippers (sellers) and carriers can **negotiate the (freight) rate over the Internet** in a faster and more cost-effective way (Lancioni, Smith, & Oliva, 2000).

Quick response technologies in the retail industry are used to shorten lead times (Aviv, 2001). "Under QR, the retailer has the ability to adjust orders based on better demand information" (Iyer & Bergen, 1997, p. 559). For example, in the apparel industry, using QR can remarkably reduce forecast errors. It is an initiative of the Efficient Customer Response (ECR) movement to maximize customer satisfaction. According to Mukhopadhyay, Kekre, and Kalathur (1995), QR programs only burden suppliers with higher inventory holding costs and more frequent deliveries.

Bar code readers can be integrated with **web applications** in order to improve the visibility and accuracy of inventory levels (Lancioni et al., 2000). **RFID**, Radio Frequency Identification, is an important technology used in logistics processes that enables real-time and accurate data collection. RFID tracks the movement and flow of items and brings visibility to managers about the location and condition of the tracked items. It is a very valuable tool since it helps to minimize logistics-related costs, increase utilization and shorten the time lag of information sharing between partners (Gupta et al., 2009). According to Dutta, Lee, and Whang (2007), value of RFID is mainly obtained from savings in labor cost, inventory visibility and shrinkage reduction. Results of a case study involving an aircraft engineering company conducted by Ngai et al. (2007) indicate that implementing a RFID-based traceability system has several benefits; including improved lead times, increased productivity by automation, reduction of human errors, real-time monitoring and access to detailed information, and improved customer relationships. However, adopting RFID requires large initial investments and significant potential risks. Issues such as lack of in-house RFID expertise, inadequate technology support, existence of different sets of industry standards, and so forth can impede adoption and use (Ngai et al., 2007). RFID can be integrated with web-based technologies to obtain a **logistics information system** (LIS), which is "a business application for collecting, retaining, and manipulating logistics data" (Chow, Choy, Lee, & Chan, 2007, p. 224). This can dramatically increase logistics service responsiveness and information transparency. An **integrated logistics information management system** (ILIMS) is "a web-based system that integrates RFID technology to visualize logistics processes...It is a common platform that allows different parties to transmit, capture, share and collect the required logistics data via the internet...Selected data is incorporated into the ILIMS database and associated with the business objects such as purchase orders, shipping notices and invoices so that exceptions, status updates and notifications can be generated in real time to improve operations responsiveness" (Chow et al., 2007, p. 224). When the product is shipped, all information is centralized including shipment information into the ILIMS database and is disclosed via an advanced shipping notice (ASN). For more details on the ILIMS, the reader can be referred to Chow et al. (2007).

Orders can be placed through the electronic transmission of purchase orders (PO) via **e-documents**. Once the order is being processed, the customer can check the status update through accessing a **web page** (Chow et al., 2007). These order status reports can for instance alert the customer of unanticipated delays, or that the supplier is able to ship popular items in advance (Subramani, 2004). Time slots for delivery can be booked online, which potentially can reduce the idle time of the vehicles at the warehouse. The supplier can send the buyer an online shipment notification via an advanced shipping notice (ASN), and can also notify him of any changes in product specifications, packaging, quantities etc. (Subramani, 2004). The customer can request shipping documents or bills by accessing a web page (Chow et al., 2007). Digital technologies used to support the logistics process include i.a. **online order tracking functionalities** such as a supplier online tracking site and provision of basic order status services via **e-mail**. E-mails are especially useful if there are pressing (supply) issues since buyers and sellers can communicate with each other 24/7 (Lancioni et al., 2000).

Automated routing software, or routing and scheduling technology, calculates "efficient route plans in mere minutes, incorporating work hours, equipment restrictions, truck capacities, service windows, and more in their calculations. Plans can be re-run quickly to accommodate last-minute orders and schedule changes, and the optimized results improve on manual methods by maximizing loads, and minimizing miles and total transportation costs" (Kositzky, 2012). Hence, automated routing software can save time and money and increase asset utilization (Lancioni et al., 2000).

Supply chain management (SCM) systems can significantly improve forecast accuracy and demand collaboration through information sharing capabilities (*see application integration*). Information sharing reduces information distortion and hence the bullwhip effect (H. L. Lee, Padmanabhan, & Whang, 1997a; Grover & Saeed, 2007). It also enables companies to develop accurate plans and make adequate replenishment decisions. SCM systems can include advanced planning systems, advanced shipment notice systems, automatic alert systems and automatic replenishment systems (Grover & Saeed, 2007).

Automatic replenishment programs (ARP) are a very popular approach to inventory management. According to Subramani (2004), integrated distribution programs like automatic replenishment is linked to improved performance. ARP include both continuous replenishment planning and vendor managed inventory. ARP is often complemented by other technologies such as barcoding and EDI (Daugherty, Myers, & Autry, 1999). **Vendor managed inventory** (VMI) signifies that "the supplier, usually the manufacturer but sometimes a reseller or distributor, makes the main inventory replenishment decisions for the consuming organization. This means that the vendor monitors the buyer's inventory levels (physically or via electronic messaging) and makes periodic resupply decisions regarding order quantities, shipping, and timing" (Waller, Johnson, & Davis, 1999, p. 183). VMI is part of ECR and can be web-enabled, as "successful implementation of VMI often depends on computer platforms, communications technology, and product identification and tracking systems" (Waller et al., 1999, p. 186). It "provides suppliers visibility into the demand and consumption patterns, and enables retailers to benefit from quasi-integration with suppliers" (Ray et al., 2009, p. 600). VMI requires the buyer to share information relating to his inventory positions and production schedules to the supplier. It enables the supplier to achieve a better management of capacity and peak periods (R. Klein & Rai, 2009). A study conducted by Waller et al. (1999) shows that VMI significantly reduces inventories for the associated parties while maintaining service levels. Companies need to adjust their organizational structure appropriately and technology-related costs need to be made. For example, it can be implemented in combination with web-based EDI. Fortunately, technology costs are continuously going down as a result of the Internet. Waller et al. (1999) also find that sound business processes and inter-firm relationships are necessary in order for VMI to succeed. Next to that, incentives of the companies need to be aligned with the goals of VMI. However, VMI is not installed without risks. Suppliers gain insight into the inventory levels of the buyer, which could potentially lead to higher pricing schemes. Next to that, it is possible that the volume discounts granted by the supplier are more restricted. The supplier bears the risk that the buyer might behave opportunistically by sharing confidential information to other suppliers in order to obtain a better offer from them. Confidential information can for instance relate to the cost structure of the supplier (R. Klein & Rai, 2009).

Collaborative planning, forecasting and replenishment software (CPFR) can also be used to dramatically change the logistics process. It is motivated by the ECR movement. CPFR can be described as "a web-based attempt to coordinate the various activities including production and purchase planning, demand forecasting and inventory replenishment between supply chain trading partners. Its objective is to exchange selected internal information on a shared web server in order to provide for reliable, longer term future views of demand in the supply chain" (Fliedner, 2003, p. 14). Both QR and CPFR technologies require extensive collaboration. Aviv (2001) states that CPFR and QR tools complement each other. CPFR can obtain greater benefits when QR is implemented as well. More information on CPFR will be given in the *application integration* section.

Order cycle time plays a key role in the logistics process. Arcelus, Pakkala, and Srinivasan (2002) show that differences in order cycle times lead to differences in product prices. The service level offered by suppliers to their customers is also strongly related to the order cycle time. Since e-commerce enhanced supplier transparency, sellers are more likely to set their price based on their actual service level (Ghose & Yao, 2011).

According to Basu and Muylle (2003b), the adoption of online logistics appears to be very slow. Digital technologies like the Internet are not extensively used to deliver products. The authors also note that companies that do support online logistics also support offline logistics. However, they argue that completely digitizing products would offer huge opportunities for customization, price discrimination and cost-effective online logistics. Furthermore, their research findings state that, within the digital product industry, companies that offer more complex products more strongly support online as well as offline logistics and logistics customization than companies offering simple products.

2.2.1.6 Additional information on trade processes

Tsikriktsis, Lanzolla, and Frohlich (2004) investigate the enablers and barriers of the use of web-based processes (e-transactions and e-CRM) in service organizations. The study assesses the impact of 'rational' efficiency, the bandwagon effect and internal/external barriers. Rational efficiency covers both expected performance benefits and access to new markets. The bandwagon effect relates to the external pressure to adopt a particular technology. Empirical support is found for the claim that an increase in expected benefits and an increase in external pressure positively influence the adoption of web-enabled technologies for both e-transactions and e-CRM. The opposite is found for internal barriers, in that these lower the adoption rate, while external barriers are not found to be significant. However, an increase in anticipated access to new markets positively influences the adoption of e-transactions. These results highlight that managers should focus on the expected performance benefits to stimulate e-CRM adoption, while they should advocate the access to new markets when it comes to implementing e-transactions (Tsikriktsis et al., 2004).

We can conclude the previous sections with the statement of Tsikriktsis et al. (2004, p. 216): "The use of web-based processes between service providers and their customers enables companies to be much more efficient in terms of many routine transactions such as order taking, billing, payment and order tracking (e-transactions)".

2.2.2 Decision Support Processes

Decision support processes help companies make better business decisions by providing the means to receive information and use analytical models effectively. These processes can support the company on an intra-firm and inter-firm level (Muylle & Basu, 2008).

2.2.2.1 Configuration

The **configuration** process supports buyers in defining their needs, and subsequently helps them interact with sellers to find, design and produce a product/service that can satisfy the buyer's needs (Muylle & Basu, 2008). Alshawi (2001, p. 239) argues that "a supply chain must do more than provide visibility of materials, information, and money. It also must be flexible enough to offer business partners the ability to make changes in their operations or products". The Internet and the web have facilitated the availability of customer-related information, creating opportunities to customize products/services (Bhatt & Emdad, 2001). Prior research has suggested that online customization enables stimulation of customers to engage in product design/creation that conforms to their needs (Alba et al., 1997; Wind & Rangaswamy, 2001; Barua, Konana, Whinston, & Yin, 2004). Customization can significantly reduce the informational burden by displaying relevant information that can assist in making better decisions (Ansari & Mela, 2003). *Suppliers* can enhance their financial performance in terms of cash inflow and profitability because customization leads to customer loyalty (Ansari & Mela, 2003). Targeted marketing is "useful for both customer acquisition and retention and can engender successful, long-term relationships" (Ansari & Mela, 2003, p. 131). However, implementation issues and inadequate customer information inhibit successful personalization and targeting.

A supplier can customize his **website** to the buyer's needs (*see search*). Important factors that need to be taken into account to improve website performance are its functionality and ease of use. Next to that, data accuracy and ability to handle transactions quickly and efficiently are seen as other essential aspects (Boyer & Olson, 2002). "Firms can collect and update preference information of customers from on-site surveys and from the traces customers leave as they navigate through the website. This knowledge can then be seamlessly integrated with algorithms and software to customize content automatically for individual customers" (Ansari & Mela, 2003, p. 131).

Collaboration platforms "provide a set of tools and an information environment for collaboration between enterprises. This can focus on specific functions, such as collaborative design and engineering, or in providing project support with a virtual team of consultants" (Timmers, 1998,

p. 6). **Customer relationship management** (CRM) **systems** are designed to improve the relationship between companies and their customers, and can help in the configuration process (*see application integration*).

Suppliers can also send **customized e-mails** which contain hyperlinks to the website. In this way, website traffic can be increased (Ansari & Mela, 2003). According to these authors, e-mails have the following typical structure: a brief description of the content and a link to the site for more detailed information. Companies can use **e-mail marketing software** provided by other companies with the primary goal of maximizing the amount of click-throughs (Ansari & Mela, 2003). E-mails can also be used in the more traditional way, by enabling interaction between buyer and seller to support product/service development.

CAD/CAM technology, Computer-Aided Design and Computer-Aided Manufacturing technology, is a configuration tool that "allows both design and manufacturing engineers to access and manipulate their respective data to test potential designs and to create a product more acceptable to both sides" (Malone et al., 1987, p. 488). Hence, CAD technology assists companies in product development.

A configurator tool can be very useful if standardized components are assembled together, since buyers can choose which standardized components they need in the final product (Muylle & Basu, 2008). Configuration processes can be supported by **product configuration software packages** e.g. that allow potential buyers to configure a product/service on a supplier's website. A product configuration software package is "a software tool that is capable of 'translating' the customer specifications in all the product information that is needed for tender generation and product manufacturing" (Forza & Salvador, 2002, p. 41). Forza and Salvador (2002) investigate the use of configuration software in SMEs and find that even small enterprises can achieve the payback of the IT investment quickly while gaining competitive advantage. The company needs to restructure the organization, especially the technical office, to adapt to the configuration software. The study also finds that the tool improves internal operations as well as inter-firm coordination, since business practices are more aligned between the firms involved in the bidding–tendering process. **Intelligent agent software**, such as recommender agents, can also be used in this process (Kauffman and Walden (2001); Montaner et al. (2003); *see also search*).

An **online intermediary** can be used for configuring products/services. For example, intermediaries can "assemble products/services from different companies, and sell them to customers by bundling or unbundling these products or services" (Bhatt & Emdad, 2001, p. 83). A software house, for instance, is a kind of intermediary that can develop and install a stand-alone product configuration package (Forza & Salvador, 2002).

If the buyer's needs are complex, he can use **electronic requirement determination tools** such as eRFQ, eRFI, eRFT, etc. (Muylle and Basu (2008); *see also valuation*). For example, when the customer wants a product that is not available on the supplier's e-catalog, he can include a technical drawing of the product in the bid. In that way, the supplier has enough information to prepare an appropriate tender (Forza & Salvador, 2002).

2.2.2.2 Collaboration

Decision support processes involving **collaboration** enable interactions between members of one or more organizations by using web-enabled technologies and tools (Muylle & Basu, 2008). Collaboration is particularly important in today's environment because of the rapidly changing market requirements. Companies need to be flexible and responsive to be successful. M. Johnson and Whang (2002) note that collaboration between business entities over the Internet facilitates coordination of various decisions and activities above those in pure transactions. In other words, collaboration is more than pure transactions and can even be seen as relationships. According to A. S. Carr and Pearson (1999), a buyer will prefer a collaborative buyer-supplier relationship when the items procured are crucial and supply sources are relatively limited. M. Johnson and Whang (2002) further add that collaboration can be in the form of - among others - information, resource and process sharing between entities. Gupta et al. (2009) use the term C^4 to refer to competition, conflict, collaboration and coordination in online business processes. Coordination and collaboration are closely related, since web-enabled collaboration facilitates coordination of various decisions and activities in transactions (M. Johnson & Whang, 2002). Trust also plays a very important role in the collaborative process between buyers and sellers. Bensaou and Venkatraman (1995) conclude that the degree of communication, cooperation and coordination is increased when a higher level of trust is built. Finally, Kumar (2001, p. 60) summarizes the importance of collaboration in the following sentence: "Despite widely differing objectives, all supply chains ultimately rely on collaboration between human beings. Collaboration, in turn, is a function of articulating expectations, making mutual commitments, delivering on the commitments, and tracking their delivery. Of such commitment-articulation and commitment-tracking processes, trust is born".

An **Executive Information System** (EIS), or executive support system, can be described as "a computer-based information system that supports communication, coordination, planning, and control functions of executives and managers in an organization" (Bajwa, Rai, & Brennan, 1998, p. 32). Previous literature research find that top management support, IS support and vendors/consultants support are important in order to implement a successful EIS (Bajwa et al., 1998). Empirical evidence by Rai and Bajwa (1997) shows that some characteristics of firms that adopted this technology are greater environmental uncertainty, a higher level of heterogeneity, and a more hostile personality of the firm.

Groupware, or **collaborative software**, are "computer-based systems that support groups of people engaged in a common task (or goal) and that provide an interface to a shared environment" (Ellis, Gibbs, & Rein, 1991, p. 40). Most tools described below can be categorized as a groupware technology.

Group Decision Support Systems (GDSS) "combine communication, computer, and decision support technologies to support problem formulation and solution in group meetings...A GDSS aims to improve the process of group decision making by removing common communication barriers, providing techniques for structuring decision analysis, and systematically directing the pattern, timing, or content of discussion" (Desanctis & Gallupe, 1987, p. 589). Ellis et al. (1991, p. 42) can further add that "the goal is to improve the productivity of decision-making meetings, either by speeding up the decision-making process or by improving the quality of the resulting decisions". GDSS is closely related to groupware, although groupware is a much broader term. GDSS could be seen as a part of groupware (Ellis et al., 1991). Group decision support systems enable employees to access more information and interact with other employees more efficiently. Participants feel more involved in decision-making processes and find that they can exert more influence on the point of view of others (Williams & Wilson, 1997). GDSS involve several communication technologies, such as electronic messaging, local- and wide-area networks and teleconferencing (Desanctis & Gallupe, 1987).

A local area network (LAN) electronically connects group members that are located in the same building. Long distance networks such as a wide area network (WAN) can connect members who are not in the same place, for instance when they are working at home or traveling (Desanctis & Gallupe, 1987). Companies use **private trading networks** such as a business **VPN** (Virtual Private Network) to ensure privacy and protection of data via encryption (Rose, 2018).

According to Ellis et al. (1991, p. 42), "the most familiar example of groupware is the computer-based message system, which supports the asynchronous exchange of textual messages between groups of users". **E-mail** traffic within and between organizations is one example of web-based message systems. **Secure messaging apps** can be used to communicate quickly and exchange private information safely with employees, clients and partners without compromising the company's data. There are numerous B2B secure messaging apps on the market today (Rivera, 2018). Other examples are web-based conferencing (described below) and **electronic bulletin board systems** (Ellis et al., 1991). An electronic bulletin board, or a Bulletin Board System (BBS), is "a computer or an application dedicated to the sharing or exchange of messages or other files on a network" (Rouse, 2005). The difference between e-mails and electronic bulletin boards is that the former is a private exchange while the latter is a public exchange of messages.

Electronic or **web-based conferencing** can significantly facilitate collaboration. Ellis et al. (1991) distinguish three types of computer conferencing. First, there is real-time computer conferencing, which "allows a group of users, who are either gathered in an electronic meeting room or physically dispersed, to interact synchronously through their workstations or terminals". Second, there is computer teleconferencing, which is "telecommunication support for group interaction", such as conference calls and video conferencing. Teleconferencing doesn't allow users to share text and graphics. The third and final type is desktop conferencing, which is a kind of hybrid of the previous two, since you can share text and visuals and it offers video capabilities (Ellis et al., 1991, p. 42,43). Companies can use electronic conferencing to connect two or more separate decision rooms (Desanctis & Gallupe, 1987). On occasion, group meetings continue over multiple days, and it is possible that not all group members are online simultaneously. According to Desanctis and Gallupe (1987, p. 599), "an electronic or human facilitator can prompt participants for specific inputs to the meeting or guide the session according to a predefined agenda or decision procedures. The technological basis for this will be long distance telecommunications networks and group decision support software". However, an exploratory study by Warkentin, Sayeed, and Hightower (1997) states that this technology does not outperform the traditional face-to-face conferencing. The literature poses several benefits of virtual teams; including efficiency, time and geographic flexibility, and automatic documentation. However, downsides to the technology are limited bonding, and lack of unity (Warkentin et al., 1997; Kendall, 1997). One suggestion would be to let the team meet face-to-face for the first meeting, and conduct further meetings virtually. In this way, expectations and measures can be exchanged, to make sure everyone is on the same page (Warkentin et al., 1997).

Other web-based conferencing tools are explained below. For example, there is **webcasting**, which is "essentially 'broadcasting' over the internet or streaming. In webcasting, an audio and/or visual content source is distributed simultaneously to multiple viewers/listeners. This content is usually distributed live and is non-interactive". A **webinar** is "a specific type of web conference that is typically one-way (speaker to the remote audience with limited remote audience interaction). There can also be a live audience in the room with the presenter of the webinar" (OSU, 2011; Basu & Muylle, 1999). **Whiteboarding** can also be used in web-based conferences. Whiteboarding is "a collaborative tool to facilitate discussions by writing and sketching on a shared space resembling a whiteboard" (LS, 2015).

Electronic brainstorming and voting is a method "in which group members can simultaneously type ideas into a computer which then distributes the ideas to the screens of the other group members" (Gallupe et al., 1992, p. 352). The members can interact by building on others' ideas and combining them with their own. Electronic brainstorming is mostly done anonymously and is a part of GDSS.

Electronic conferencing can be complemented by the use of **intelligent agents** (Ellis et al. (1991); *see also search, valuation, configuration*). These agents can be employed to improve the interactions between different business entities.

Collaboration platforms can be set up to facilitate collaboration, as well as **virtual communities** (Timmers (1998); *see also search, configuration*). **Online feedback mechanisms**, discussed earlier in the *authentication* section, can not only increase trust in e-marketplaces, it can also promote collaboration, since these mechanisms reinforce the linkages between companies and their customers, partners and competitors (Dellarocas, 2003).

A **shared data repository** is another tool that can be used to facilitate collaboration (Muylle & Basu, 2008). A data repository is "a distributed aggregate of data storage devices connected to the network, which together maintain a collection of data items in a single logical address space" (Margolus, Knight Jr, Floyd, Hartman, & George, 2008, p. 18). A data repository can also be called a data library or data archive, and consists of a large data set that can be used for data analysis (Aldorisio (2018); *see also business intelligence*).

Companies can use **intranet-based collaboration** and information sharing to conduct e-commerce with their partners. Intranets support organizational databases and data warehouses, next to team-oriented collaboration within the corporate firewalls (Vladimir, 1996). Hence, it is primarily focused on internal collaboration (Riggins & Rhee, 1999). Furthermore, "intranets help employees collaborate on business processes such as product development or order fulfillment, which create value for a company and its customers" (Alshawi, 2001, p. 238). Other uses of the intranet include online collaboration on common projects via electronic documents and videoconferencing (Vladimir, 1996, p. 10). Alshawi (2001, p. 239) argues that "the best intranets encourage collaboration by creating shared and familiar spaces that reflect the personality of the company and create a common ground for all departments and employees".

Parties can collaborate in the sense that they grant access to each others' database. According to Malone et al. (1987), there are three kinds of databases: stand-alone, linked and shared databases. Stand-alone databases are not connected to other application systems. In linked databases, supplier and buyer databases are still independent, but there exists a formal online tool that shares information between both. Shared databases even go a step further, in that one database is shared between both business entities (Malone et al. (1987); *see also data integration*).

When private intranets become accessible to a limited set of authorized customers or business partners, an **extranet** is created (Alshawi, 2001; Riggins & Rhee, 1999). An extranet can be defined as "a collaborative network that uses Internet technology to link businesses with their suppliers, customers, or other businesses that share common goals" (Riggins & Rhee, 1999, p. 2). Companies set up firewalls to make sure that only access to internal information is granted when it is needed (Alshawi, 2001). These extranets are mainly based on **middleware** software, which connects and facilitates inter-firm collaboration, and coordinates business processes of the trading partners (Fliedner, 2003).

The entry of intermediaries can hurt supplier's performance significantly, as argued in Ghose et al. (2007), by i.a. squeezing its optimal wholesale price. As a solution, suppliers could set up their own referral service, but they could also set up a strategic alliance with **online portals**, thus directing a large number of customers to these supplier-sponsored referral services. Another strategy suppliers could adopt to bring back profits is to invest in **electronic customer relationship management (e-CRM) packages** to collect more information about customers who visit their referral services (*see application integration*).

Vendor portals, or supplier portals, are web-based proprietary systems that facilitate communication and collaboration with suppliers in a secure environment (Masters & Lingo, 2018). It can be used "to transfer and organize data or to facilitate transactions for both the buyer and the supplier" (Flynn, 2016). It allows a supplier who is interested to conduct business with the company to register himself via the portal. "A typical system will enable the supplier to edit his contact information, download bid packages, submit invoices, and monitor transactions" (Masters & Lingo, 2018). A **buyer portal** can also serve to enhance procurement-related communication, with the customers of the company (Bögels (2013); *see also search*).

Next, intra-firm, and even inter-firm collaboration can be improved by **web 2.0 technologies**. These technologies include i.a. wikis, blogs, podcasts, crowdsourcing, and social networks. Andriole (2010) assesses the business impact of web 2.0 applications. He finds that the majority of these technologies are mainly used to enhance internal collaboration, because they give companies the opportunity to try them out safely while investigating the impact on several dimensions, such as security, TCO, and intellectual property. For further information, the reader is referred to the paper.

Another digital tool available for use is **mobile applications**. According to Leung and Antypas (2001), mobile commerce can improve business efficiency by distributing information to the workforce remotely and by offering new channels on which to interact with customers. Varshney, Malloy, Ahluwalia, and Jain (2004) further note that organizations able to use mobile applications to automate their business processes can expect benefits such as improved decision making, improved productivity, increased customer satisfaction and lowered operational costs. An example of mobile commerce are mobile e-procurement applications that can support the request, approval and delivery of purchases. However, a study conducted by Gebauer and Shaw (2004) confirms that users of these mobile applications prefer to adopt them for simple, straightforward tasks. According to the authors, there is a trade-off between portability and usability of these mobile devices; meaning that as these devices are more portable than alternatives, they also possess smaller screens and limited keyboards which limit their usability. Thus, the acceptance of mobile commerce to be used in a large array of functions is still to be improved. The study finds that employees who are more frequently out of the office tend to value mobile business applications to a greater extent than employees who spent more time at the office. Furthermore, their findings confirm that mobile commerce can improve organizational efficiency and employee productivity. The highest impact on procurement processes in their study is that of notification; keeping the involved parties informed about requests, approvals, tracking etc. Flexibility and the ability to handle emergency situations can also be increased by using these systems (Gebauer & Shaw, 2004).

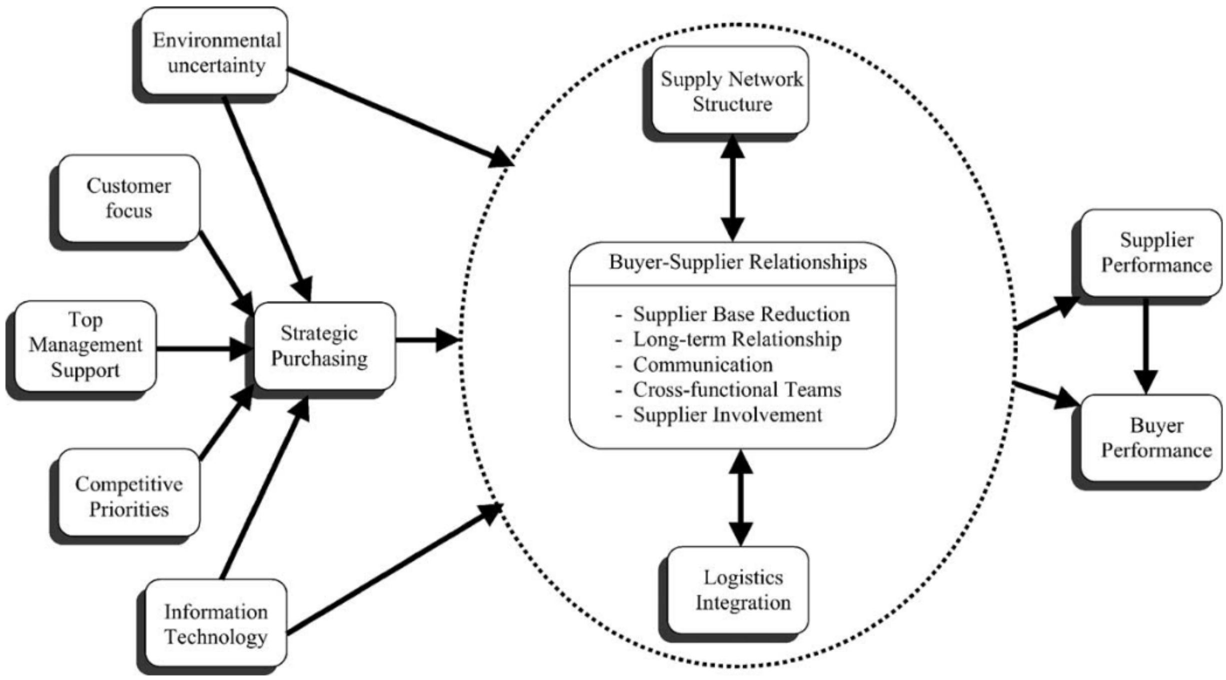

Figure 2.7: A supply chain management framework, obtained from ©I. J. Chen and Paulraj (2004)

In Figure 2.7, a conceptual framework of SCM is shown in which relevant constructs are depicted that have an impact on supply chain performance. These constructs are gathered together from previous relevant literature streams. For the purpose of their research, I. J. Chen and Paulraj (2004) opt for the buyer-supplier dyad as the level of analysis, which is consistent with the relational view of the firm (Dyer & Singh, 1998). Key aspects of the buyer-supplier relationship are shown in the middle. Several antecedents influence the buyer-supplier dyad, which you can see on the left. Environmental uncertainty is a composite standing for supply, demand, and technology uncertainty. Customer focus is important considering that if companies satisfy and/or exceed the needs of customers, they can gain a significant competitive edge. Top management support is required to recognize the importance of strategic purchasing and information technology, as well as supplier development. Competitive priorities (cost, quality, flexibility, innovation, speed etc.) and strategic purchasing are part of the supply strategy. Information technology changes the interaction as well as the nature of the linkages among entities and is a vital part of today's SCM. Supply network structure involves non-power based relationships, inter-firm collaboration, and informal social systems. Logistics integration indicates the integration of the firm's logistics functions with various business entities. All these factors can be considered as key driving forces in supporting and preserving the buyer-supplier relationship. Finally, the performance of the supply chain as a whole is influenced by both supplier and buyer performance.

Findings of a study conducted by Rosenzweig (2009) confirm that e-collaboration positively affects performance, and that on average smaller-sized firms encounter larger performance improvements than bigger firms. The study also provides evidence that the link between e-collaboration and operational performance is especially strong when high competitive pressures are present. Furthermore, "e-collaboration may, over time, engender specialized routines and/or standard operating procedures, which enable manufacturers and their customers to work together more efficiently and effectively than their less-integrated counterparts...E-collaboration also expands the cognitive capacity of managers because decision responsibilities can now be more readily apportioned to the most knowledgeable supply chain partner(s) for that particular decision-making situation/activity" (Rosenzweig, 2009, p. 464). Sanders (2007) finds empirical evidence that the use of digital technologies has a direct and positive impact on organizational performance, intra-organizational collaboration and inter-organizational collaboration. However, an empirical study led by Devaraj, Krajewski, and Wei (2007) shows no direct benefits of digital technologies on organizational performance, due to the fact that a technology on its own is not enough to reap the benefits, it must be supported from within the organization. Sanders (2007) makes a distinction between intra- and inter-collaboration. He perceives collaboration as a composite of behaviors and interactions. Taking this distinction into account, the author observes that inter-organizational collaboration has a direct and positive impact on intra-organizational collaboration, and that intra-organizational collaboration on its turn has a direct and positive influence on organizational performance. Hence, inter-organizational collaboration only has an indirect influence on performance. This is in accordance with the literature, in that external collaboration has a direct effect on internal collaboration (Subramani, 2004; Stank, Keller, & Daugherty, 2001). Sanders (2007, p. 1343) proposes that "companies should invest in strategies that promote cooperation and integration across the functions of the organization. As use of e-business technologies is shown to promote and facilitate internal collaboration, companies should consider investing in these type of information technologies". However, e-collaboration initiatives are accompanied by various costs such as administrative-related costs, IS investments, and process changes (Rosenzweig, 2009; Clemons et al., 1993).

Rai et al. (2009) distinguish between four different collaboration modes: price-only, exploitation, exploration and a dual mode of collaboration. In the price-only mode, firms enter into an arm's length relationship which is primarily based on reducing operational costs. In the exploitation mode, companies want to gain additional value from the relationship, thus they start focusing on short-term improvements of existing narrow business opportunities with low risk. The exploration mode goes a step further, in that the relationship involves identifying new, long-term business opportunities that involve a high risk of not paying off. Finally, the dual collaboration mode is a combination of the exploration and exploitation modes. Both parties collaborate to improve and innovate their supply chains. Knowledge of existing and new opportunities is shared with the objective of delivering both short- and long-term value, and business opportunities range from a narrow to a broad scope. The last three modes involve some (varying) degree of mutual learning and knowledge exchange. The authors investigate the impact of five KPIs on each collaboration mode. The results confirm that the more the relationship goes from price-only to dual, the more KPIs that are positively affected and the more value that is created. Furthermore, the authors examine the use of three IT capabilities in each collaboration mode: IT to synchronize operations, enable business intelligence (*see BI*), and IT as a digital boundary spanning capability (*see data integration*). The results show that the business intelligence and digital boundary spanning capability are the highest in the dual mode, while both the dual and exploration mode have an equal capability to synchronize operations. The interested reader is referred to the paper for further information (Rai et al., 2009).

In Figure 2.8, a framework is depicted from Rai and Tang (2013) underlying the different elements that interplay to obtain value from business models implementing information technologies. On the left, five key strategic motivations are shown that explain why companies participate in inter-firm collaboration. Three business model design requirements are introduced: content, governance and structure, based on Amit and Zott (2001). The reader can be referred to both papers for definitions. Next, two B2B IT capabilities are necessary to meet the design requirements: IT customization on a dyadic level and IT standardization on a business network level (*see data integration*). Leveraging these capabilities lead to value creation and appropriation. There are three ways to create value: by novelty, efficiency and complementarity. Value appropriation consists of three mechanisms: bundling, lock-in and barriers to imitation. Definitions can again be found in the paper. IT capabilities enable bundling of products and services across inter-firm relationships that unite more with market valuations, and hence the firm can capture more value (Rai & Tang, 2013). Lock-in limits the movement of customers or partners to competitors (Zott & Amit, 2007). Dyadic IT customization facilitates customization of products/services and processes to the requirements of a specific client, which in turn will lead to better relationships and more recurrent transactions. Customized IT systems require significant investments, and hence increase the switching costs perceived by customers/partners (*see configuration*). IT standardization also contributes to the lock-in mechanism, by augmenting switching costs as follows. By agreeing to implement standards with partners, customers and suppliers, network effects materialize. More firms will be attracted to participate and as such, the inter-firm network of the firm will expand and more value can be appropriated. Higher barriers of imitation lead to longer time periods in which value appropriation can occur. The authors propose a hybrid approach of IT capabilities, in that "the focal firm can combine easy-to-access information accessed with standardized IT capabilities with hard-to-reach information accessed with customized IT capabilities. Such an approach can mitigate the risk of imitation of the business model and involuntary knowledge spillover from partners" (Rai & Tang, 2013, p. 9). To summarize, the authors believe that both B2B IT capabilities - dyadic IT customization and network IT standardization - are mutually reinforcing, or complementary, in value creation and appropriation.

Web-enabled technologies assist firms in sharing real-time information with their partners, thus facilitating collaboration between business entities and accelerating decision making (Devaraj et al., 2007; Cachon & Fisher, 2000). Knowledge-based competition is arising and inter-organizational relationships become crucial to obtain/maintain competitive advantage (Malhotra, Gosain, & El Sawy, 2007). There is empirical evidence that buyer-supplier relationships that share accurate information are more successful (Vanpoucke, Boyer, & Vereecke, 2009). Companies engaging in such relationships enhance their comprehension of assets, competition and market needs. These companies will be more attentive to changes in the external environment, and according adaptations will be easier to implement (Malhotra et al., 2007). Information that can be shared between business entities take the form of demand forecasts, product availability, inventory levels, shipment status and production schedules/requirements (I. J. Chen & Paulraj, 2004; Lancioni et al., 2000). This can result in shorter lead times and smaller batch sizes (Cachon & Fisher, 2000). Yet, the sharing of information can go beyond information related to transactions, to include sharing of strategic information

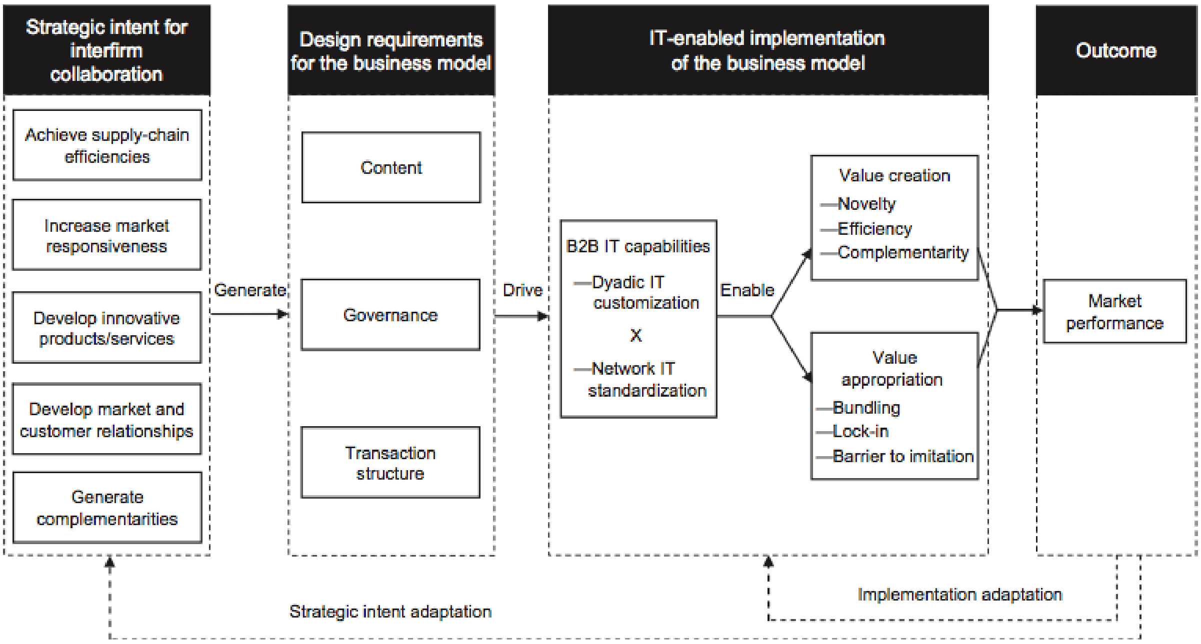

Figure 2.8: Framework to obtain business value from an IT-enabled business model, obtained from ©Rai and Tang (2013)

such as production strategy and financial operations (R. Klein & Rai, 2009). Empirical evidence of R. Klein and Rai (2009) shows that if both buyers and sellers share strategic information with each other, the dyadic performance will improve with a considerable extent. Furthermore, the strategic information flow between the partners will be higher when the buyer invests in relation-specific resources and when mutual trusting beliefs are established. Trusting beliefs can be described as "those characteristics that serve as the basis for trust and engagement in trust-based actions" (R. Klein & Rai, 2009, p. 741). Hence, strategic information sharing can achieve additional rents. A firm's ability to use information technology in inter-organizational processes depends on their partners' ability to use IT to support these processes. From the *buyer's* perspective, digitized suppliers can help buyers enhance the efficiency of the procurement process (Mishra et al., 2007).

2.2.2.3 Business Intelligence

Business intelligence (BI) processes provide information about the business, the market, existing trends, and trading patterns (Muylle & Basu, 2008). **Business intelligence software** can then be described as "a collection of decision support technologies for the enterprise aimed at enabling knowledge workers such as executives, managers, and analysts to make better and faster decisions" (Chaudhuri et al., 2011, p. 88). BI technologies can be adopted in a variety of industries: whether in the manufacturing, retail, financial, transportation, or healthcare industry, it has useful applications for all of them. There are numerous kinds of data that can be analyzed. Take point-of-sale data for instance, that can be analyzed to detect patterns in customer preferences; or take product-return data, of which issues can be identified to decrease the return rate (Subramani, 2004). In order to enable this process, knowledge and data need to be made available and shared with partners. Saraf, Langdon, and Gosain (2007, p. 323) define inter-firm knowledge sharing as "the extent to which an enterprise shares insights and knowhow about its business context with its partners. Direct knowledge sharing with key customers will help a firm better understand market needs". Rai et al. (2009) argue that, in business intelligence processes, inefficiencies are identified and tackled by analyzing the allocation and trend of significant costs. According to Chaudhuri et al. (2011), the cost of acquiring and storing huge amounts of data have been declining over the past years, which boosted the amount of products and services available as well as the adoption of digital technologies.

According to Mishra and Agarwal (2010), **B2B electronic markets** enable *buyers* access to better information that firms can use to make more informed and superior decisions in the procurement process, thus increasing the efficiency of purchasing activities. This information can help to choose the right products and/or services. Online transactions produce data which can be used to analyze procurement trends and costs. Qizhi and Kauffman (2002) argue that this is exactly what some B2B e-markets offer by providing companies with tools and reports about these trends and costs. **CRM** applications can also offer built-in analytics to e.g. perform customer segmentation (Chaudhuri et al. (2011); *see also application integration*).

In Figure 2.9, a business intelligence architecture is depicted. Without going into the details, the framework will be briefly explained. There are two potential data sources: external data sources such as vendor-obtained data, and several operational databases within the company. **Extract Transform Load** (ETL) **tools** are "back-end technologies for preparing the data for BI", more specifically, they are "a collection of tools that play a crucial role in helping discover and correct data quality issues and efficiently load large volumes of data into the warehouse" (Chaudhuri et al., 2011, p. 90,96). **Complex Event Processing engines** support making business decisions on the operational data itself, as this is increasingly being requested by companies. Data warehouse servers manage, as you can guess, the data warehouses. The data warehouse contains the data used for BI tasks. You can find more on data warehousing below. These data warehouse servers are then accompanied by mid-tier servers, "that provide specialized functionality for different BI scenarios" (Chaudhuri et al., 2011, p. 90). The mid-tier servers are **online analytic processing servers** (OLAP), **data mining and text analytics engines**, **enterprise search engines**, and

reporting servers. Some of these will be discussed below. Finally, users perform BI through the front-end applications such as **search portals**, **spreadsheets**, visual **dashboards** that display KPIs measured by performance management applications, and **ad hoc query tools**. The authors further add that "rapid, ad hoc visualization of data can enable dynamic exploration of patterns, outliers and help uncover relevant facts for BI" (Chaudhuri et al., 2011, p. 90). The reader is referred to the paper for additional information.

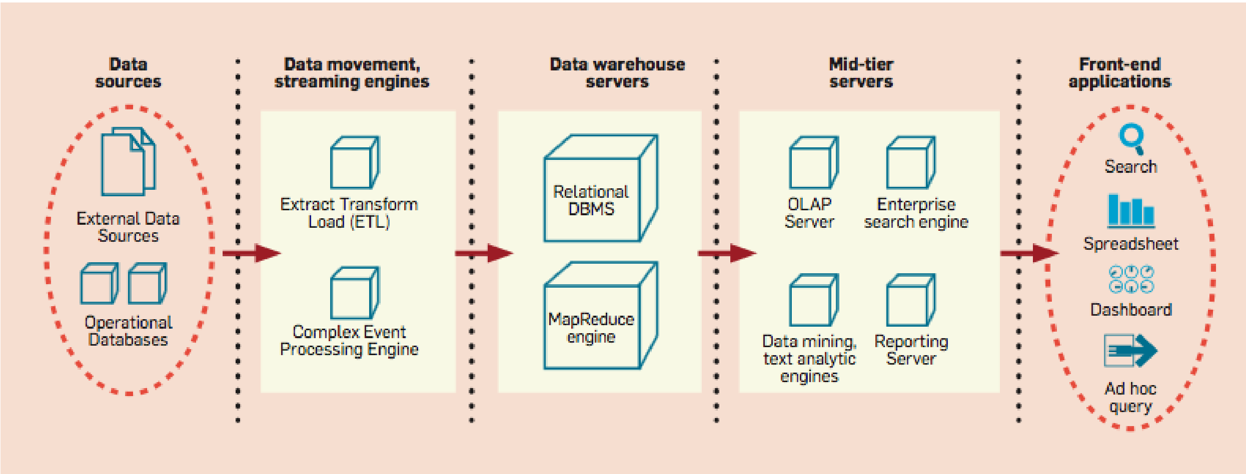

Figure 2.9: A business intelligence architecture, obtained from ©Chaudhuri et al. (2011)

Data warehousing is used to enable data mining to detect error patterns, identify problem sources or other trends in the data. Data warehousing can also be used to perform process mining, with the goal to identify problems, solve them and to come up with new opportunities. In process mining techniques, the execution of activities and events are scrutinized, while at the same time examining why and when deviations from standards occur (Rai et al., 2009).

Various **data mining and data analysis techniques** exist that support business decisions and personalization of products/services, such as the analytic tools shown in Figure 2.9 (H. L. Lee & Whang, 2004; Chaudhuri et al., 2011). **Data mining** makes it possible to analyze data in a sophisticated, detailed way. Online intermediaries such as **statistical software companies** can offer data mining technologies. Chaudhuri et al. (2011, p. 97) explicitly describe the method of data mining: "The approach is to select a subset of data from the data warehouse, perform sophisticated data analysis on the selected subset of data to identify key statistical characteristics, and to then build predictive models. Finally, these predictive models are deployed in the operational database". Another intermediary is a **database vendor** that offers **cloud database services** that enable data to be virtualized. This initiative improves resource utilization and reduces costs. Chaudhuri et al. (2011) argue that as cloud database services will be adopted at a higher rate, it will require several changes in the BI back-end architecture.

Another BI technology is **web analytics**, which "enable understanding of how visitors to a company's website interact with the pages" (Chaudhuri et al., 2011, p. 90). Next to that, **mobile BI applications** are on the rise, since these are more and more adopted by 'knowledge workers', who request interactive BI experiences (Chaudhuri et al. (2011); for more information on mobile applications, *see collaboration*).

A more recent tool that is growing in the B2B arena and is part of web 2.0 technologies are **social media platforms** such as Facebook, LinkedIn or Twitter. Customers can complement the search for suitable suppliers by looking at the supplier's Facebook page while suppliers can also search for potential customers via their Facebook page. Companies who are looking for new customers can use the data generated by the Facebook page in combination with e.g. website data. According to Meire, Ballings, and Van den Poel (2017), using this source creates opportunities to boost the performance of the sales force in the company, by making the sales process more cost-effective. The process of predicting and finding good potential customers can be realized by models including social media data. The authors further believe that social media information is a richer data source than websites and commercially purchased data.

The emergence of **text analytic engines** is a result of the need to reduce the costs associated with manually reading extensive amounts of text data. This text data is derived from e-documents, blogs, social media platforms, and surveys. Text analytic engines then extract structured information that answers the questions that the company distributed through these different platforms (Chaudhuri et al., 2011).

As stated by A. McAfee and Brynjolfsson (2008, p. 104,105), "data analytics drawn from enterprise IT applications, along with collective intelligence and other web 2.0 technologies, can be important aides not just in propagating ideas but also in generating them...Web 2.0 applications that bring collective wisdom to the fore can also uncover potential business innovations".

A related term is **web 3.0**, which is now still in its infancy (Andriole, 2010). Web 3.0, or the 'semantic web', exploits big data and machine learning capabilities. The aim is to bring a more personal web browsing experience by analyzing user data and behaviour (Casey, 2016). According to Casey (2016), "businesses will increasingly be able to take a more natural approach to the search engine optimization on their websites, rather than resorting to tricky keyword strategies". Next to that, web applications will also provide better user experiences.

2.2.3 Integration Processes

Integration processes support companies in integrating their information and systems on an intra-firm or inter-firm level. According to Muylle and Basu (2008), a distinction can be made between vertical and horizontal integration. Vertical integration occurs when a company integrates its systems with those of one of its partners, e.g. its supplier or its customer (Muylle & Basu, 2008). Some of the benefits of vertical integration found in the literature are better communication, coordination, lower costs and improved quality (A. S. Carr & Pearson, 1999). It can also add entry barriers, improve market power, and offer one-stop shopping possibilities, thereby increasing switching costs (Ray et al., 2009). However, vertical integration can be associated with a loss of focus and diseconomies of scale (A. S. Carr & Pearson, 1999). Horizontal integration, on the other hand, happens when a company integrates its systems with other systems of a horizontal partner e.g. a buyer's IS with another buyer's IS (Muylle & Basu, 2008). Malone et al. (1987, p. 488) label the influence that IT has on creating and facilitating closely coupled processes among partners as the **electronic integration effect**, in which "a supplier and a buyer use information technology to create joint, interpenetrating processes at the interface between value-added stages...This effect occurs when information technology is used not just to speed communication, but to change - and lead to tighter coupling of - the processes that create and use the information". Finally, evidence showed that competition is no longer firm against firm, but rather supply chain against supply chain (Kumar, 2001; Harland et al., 2007).

2.2.3.1 Data Integration

Data integration "allows a firm's software applications to access its partners' databases, enabling data to be shared between multiple entities regardless of the specific database structures, software and systems of each entity" (Muylle & Basu, 2008, p. 848). Data integration "ensures that data have the same meaning and use across time and across users, making the data in different systems or databases consistent or logically compatible" (Goodhue et al., 1992, p. 294). According to Chircu and Kauffman (2000), when the buyer and supplier make more use of shared databases and processes in their relationship in electronic markets, they become more like electronic hierarchies. This finding is based on Malone et al. (1987), who suggest that shared databases are the core of electronic hierarchies, thus fostering long-term buyer-supplier relationships (*see search*). One of the findings of exploratory research conducted by Qizhi and Kauffman (2002, p. 66), states the following: "By providing collaboration platforms based upon data and process standardization, B2B markets will foster a higher level of inter-organizational integration".

Hence, data integration allows sharing of information between buyers and suppliers (Devaraj et al., 2007; Feeny, 2001; Cachon & Fisher, 2000; Lancioni et al., 2000). Devaraj et al. (2007) refer to this phenomenon as product information integration, and their empirical research finds that digital technologies have an influence on this integration. Next to that, supplier integration has an impact on the operational performance of the firm, and there is a strong mutual effect of customer and supplier integration. This suggests that companies possessing both types of integration outperform other firms remarkably. In a normal supply chain, information distortion between entities takes place, which is better known as the bullwhip effect (H. L. Lee, Padmanabhan, & Whang, 1997b). H. L. Lee et al. (1997a, p. 93) note that "distorted information from one end of the supply chain to the other can lead to tremendous inefficiencies: excess inventory investment, poor customer service, lost revenues, misguided capacity plans, ineffective transportation and missed production schedules" . Data integration is the best counteractive measure for diminishing this effect, since the transparency of information is significantly enhanced (H. L. Lee & Whang, 2004). Vanpoucke, Vereecke, and Muylle (2017) show in their study that, in order to achieve operational benefits, information exchange between parties will not be sufficient. Instead, information exchange should be used in conjunction with operational integration to gain a competitive advantage.

Electronic data interchange (EDI) was seen as one of the most important business practices in traditional e-commerce since the 1970s (Bhatt & Emdad, 2001). EDI "involves the computer-to-computer exchange of business documents in a standard, machine-processable format between and among inter-organizational trading partners" (Angeles, 2000, p. 45). However, the traditional EDI systems are not truly web-based, which means they do not comply with our definition of digital technologies. Hence, only **web-based EDI** will be explained further. Riggins and Mukhopadhyay (1999) show that when transferring from traditional to web-based EDI, the adoption and implementation risks are still the same, thus indicating that findings from previous EDI research can still be relevant. When these systems became web-enabled, smaller firms could also reap the benefits, since the Internet created much more affordable EDI systems (Ranganathan, Dhaliwal, & Teo, 2004). According to Standing and Lin (2007), many companies still use EDI as their primary B2B e-commerce system. As reported by Son and Benbasat (2007), one of the most important factors explaining the adoption of EDI is the pressure from trading partners. Porter (2001) argues that web-based EDI reduces the switching costs between customers and suppliers, which is in contrast to traditional EDI, as this led to bonding between both partners. This is in line with the reasoning of Bons, Lee, and Wagenaar (1998), who argue that easier implementation of web-based EDI will make relationships more superficial. They argue that close collaboration is not a necessity any-more because of standardization of EDI protocols. According to Zhu (2004), data exposure and information transparency is less of an issue in traditional EDI than in online B2B settings. EDI does not support market transparency since it is usually controlled by one party e.g. a large buyer, and administered across private networks. Thus, Zhu advocates online B2B exchange owners to balance between information transparency and data confidentiality to fully obtain the benefits of the former while minimizing the risks of the latter. However, according to the knowledge based view (KBV) of the firm, the potential benefit of reduced costs of knowledge transfer offsets the risk of opportunism in closer buyer-supplier relationships (Power & Singh, 2007). Opportunism risks involve "the risks associated with a lack of bargaining power or the loss of bargaining power directly resulting from the execution of a relationship, that is, a difference between ex ante and ex post bargaining power" (Clemons et al., 1993, p. 16).

To facilitate sharing of information, buyers and suppliers can participate in a so-called **information hub**. An information hub "instantly processes and forwards all relevant information to all appropriate parties. It is a node in the data network where multiple organizations interact in pursuit of supply chain integration. It has, among others, the capabilities of data storage and information processing" (H. L. Lee & Whang, 2004, p. 6,7). The overall network is a hub-and-spoke system in which the spokes are the participants' internal information systems. An information hub model is shown in Figure 2.10.

Using digital technologies is one way to facilitate inter-organizational relationships, yet there are many companies that seem to miss out on the benefits of these technologies. According to Chabrow and Sullivan (2004), a possible explanation for this is the fact that the inter-organizational business processes between companies are not appropriately integrated and coordinated. A solution to enhance inter-organizational relationships are so-called **web-enabled inter-organizational business process standards** (IBPS), which are open specifications that can facilitate integration and automation of business processes (Gosain, Malhotra, El Sawy, & Chehade, 2003; Markus, Steinfield, & Wigand, 2006; Bala & Venkatesh, 2007). These standards also go under the names **standard electronic business interfaces** (SEBI) and **vertical information systems** (VIS) **standards**,

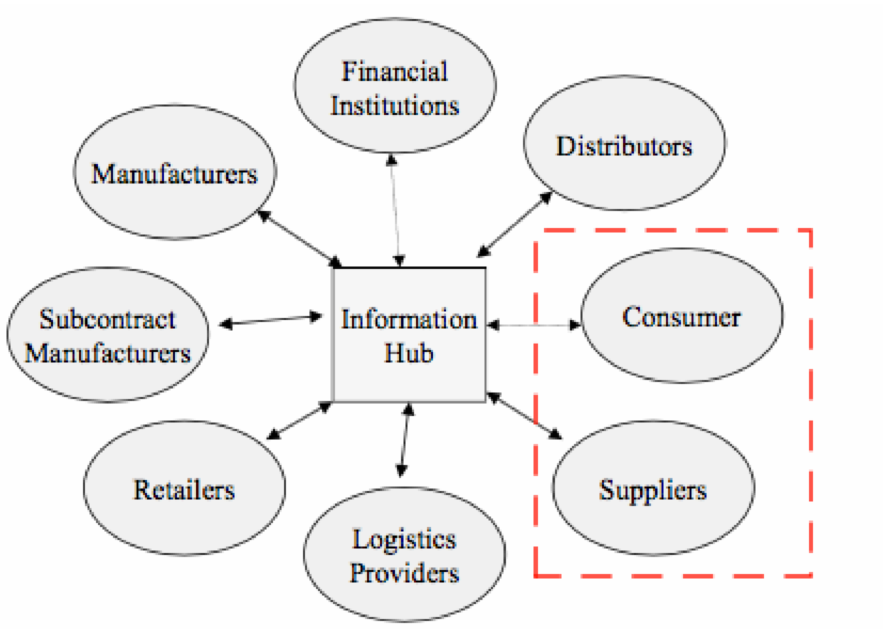

Figure 2.10: Information hub model, obtained from ©H. L. Lee and Whang (2004)

because they facilitate guidance between companies in vertical industry sectors (Markus et al., 2006; Malhotra et al., 2007). In fact, data integration is often seen as "the standardization of data definitions and structures through the use of a common conceptual schema across a collection of data sources" (Goodhue et al., 1992, p. 294). As such, by network IT standardization, integration costs with partners' assets are reduced (Rai & Tang, 2013). IBPS are a form of IOS requiring collective adoption and are typically based on XML protocols (Venkatesh & Bala, 2012). To properly understand the concept of IBPS, the following statement from Bala and Venkatesh (2007, p.341) can be given: "IBPS are semantic standards that not only specify and define the structure and format of business messages through a common language but also orchestrate the message exchange choreography, i.e. sequence of steps required to execute an atomic business process among trading partners...In addition to business process choreography, IBPS specify transfer, routing and security protocols, and implementation frameworks. It is important to note that IBPS are standards only for public processes that involve interactions among the trading partners". Findings of their study state that IBPS can facilitate companies in improving relational depth, which is "the degree to which a firm finds new avenues to collaborate with existing partners, leading to enhanced collaboration, cooperation, and knowledge sharing", and relationship extendability, which is defined as "the degree to which a firm can redeploy and leverage existing relation-specific assets and routines in other relationships" (Bala & Venkatesh, 2007, p. 343,356). They further state that the use of IPBS in inter-organizational relationships will help in reducing opportunism in the dyad and will instead support versatile relationships offering significant business opportunities. Other benefits of these standards found in literature are enhanced operational efficiency, reduction of cycle time, reduction of costs, improved coordination, knowledge creation and sharing, and partnering flexibility (Malhotra, Gosain, & Sawy, 2005; Gosain et al., 2003). However, the use of IBPS requires significant resources, effort and expertise. Firms need to adjust their business processes to be able to comply with the standard specifications (Bala & Venkatesh, 2007). Next to that, smooth and real-time information flow between partners is necessary. As is the case for many technologies, several factors influence the adoption and implementation of IBPS. Venkatesh and Bala (2012) investigate which factors impact IBPS adoption. The core of their model is the concept of 'partnering synergy', since a firm's decision to adopt IBPS is not only affected by factors that directly impact the firm, but also "on factors that are synergistic to trading partners" (Venkatesh & Bala, 2012, p.4). One of the factors that influences IBPS use is process compatibility: it is possible that the standards are not compatible with the existing processes in a company. When this is the case, the company may be unwilling to use the standards. However, if the trading partner has a high process compatibility, it is possible that they are able to convince the company to adopt IBPS even though its process compatibility is low. This is due to the fact that the trading partner could support and help the company in making the transition, thus creating a synergistic effect on IBPS adoption. The same can also be said for technology readiness, that is technology infrastructure and IT human capital (Zhu, Kraemer, & Xu, 2006). A trading partner with a high technology readiness can influence the implementation of IBPS in the company, regardless of its technological readiness. Next to that, a synergistic effect is formed when standards uncertainty is taken into account. A company may choose not to implement a standard until it becomes a 'de facto' standard in the industry (David & Greenstein, 1990). A trading partner who has a low level of standards uncertainty indicates stability and legitimacy of IBPS, and this will influence the IBPS adoption of the firm (Venkatesh & Bala, 2012). The authors further confirm that IBPS adoption will increase operational efficiency, since these "IBPS will standardize the message and document exchange between two trading partners and reduce the amount of time needed to complete a process cycle. Furthermore, standardization through IBPS will reduce transaction errors and increase clarity in message and documentation" (Venkatesh & Bala, 2012, p. 10). IBPS will also contribute to partnering satisfaction given that "IBPS provide seamless information flow between trading partners, improve coordination and synchronization in inter-organizational processes, and reduce process variations and errors" (Gosain et al., 2003). Finally, relational trust will increase the use of these standards (Venkatesh & Bala, 2012).

The World Wide Web Consortium (W3C) is an international organization that developed four key web standards. One of them is the XML standard. Other key standards are UDDI, WSDL and SOAP (Leymann, Roller, & Schmidt, 2002; Fensel & Bussler, 2002). All four standards are discussed below. Standardization of communication **protocols** (by all participants) facilitates electronic collaboration among trading entities (Qizhi & Kauffman, 2002). Freeware communication protocol such as **TCP/IP protocol** can also be used (Tsikriktsis et al., 2004).

When business transactions are communication rather than information intensive, marketplace communication standards such as **XML** become more attractive, and they reduce the unit cost of the buyer-supplier relation (Sankaranarayanan & Sundararajan, 2010). XML, or Extensible Markup Language, is an accepted document specification language to communicate and exchange data, regardless of the underlying programming language or operating system (Daniel et al., 2004). By exchanging XML-based messages, web-based applications can interact with other applications within the organization or with those of external parties (M. Chen et al., 2007). Qizhi and Kauffman (2002, p. 50) further note that "by using industry-specific XML standards, many B2B e-markets standardize the data formats used in exchanging business documents. Also based on XML standards, B2B markets can implement common business processes among trading partners" . Hence, information sharing is easier by applying these standards. Standardization can also help in improving the compatibility and connectivity of digital technologies (Qizhi & Kauffman, 2002).

Second, **UDDI**, Universal Description Discovery and Integration, is a certain type of directory that encloses structured information that characterizes a web service (Daniel et al., 2004). UDDI "provides a mechanism for clients to find web services. Using a UDDI interface, businesses can dynamically look up as well as discover services provided by external business partners. A UDDI registry has two kinds of clients: businesses that want to publish a service description (and its usage interfaces), and clients who want to obtain services descriptions of a certain kind" (Fensel & Bussler, 2002, p. 115). Web services are explained in the *application integration* section.

Third, **WSDL**, or Web Services Description Language, "is a language that is used to describe what the particular web service will do. It separates their description from the data format and concrete protocol, which act as bindings. The information includes how to invoke the web service, including the port type (an abstract collection of operations); the operations that the port supports; and the structure of the input and output messages" (Leymann et al., 2002; Daniel et al., 2004, p. 353).

A last standard, **SOAP**, or Single Object Access Protocol, "defines a means for communicating with web services over the internet by describing the message layout specification. It provides a one-way as well as a request-and-reply mechanism (Remote Procedure Call) using XML messaging over HTTP, thus avoiding conflicts with firewalls. SOAP enables communication between the service requestor, service provider and the service directory" (Leymann et al., 2002; Fensel & Bussler, 2002; Daniel et al., 2004, p. 353).

Data warehousing is also employed in data integration, together with **Extract Transform Load tools** (ETL). For more information, the reader is referred to the *BI* section.

Companies can set up private B2B exchanges such as **extranets** (*see collaboration*). An extranet enables a firm's ERP system to connect internal departments or to connect with partners' systems to share information such as order status, to plan promotions and to integrate business processes (Overby & Min, 2001). Daniel et al. (2004, p. 352) can further add that "in a service oriented architecture (SOA), applications can be accessed as services over a network, such as the publicly accessible Internet or a private intranet or extranet. Organizations can create or build applications to support their business processes by selecting required services from those available over the network. The services are called upon and run each time the application is executed" .

Next to that, **intermediaries** such as VANS providers (Value Added Network Service), statistical software vendors and database vendors can be called upon (*see BI*).

Goodhue et al. (1992) discuss data integration within an organization. In Figure 2.11, the authors suggest that the impact of data integration on the costs and benefits of IS originate mainly from three potential elements. First, data integration has a positive impact, and is thus more desirable, when departments are interdependent (note that departments are equivalent to subunits). This is because of the higher capability to share necessary information. Second, data integration decreases the "ability to meet unique department information requirements", because the level of standardization is increased (Goodhue et al., 1992, p. 299). Local autonomy of departments in the design and use of data within the organization will be lower, leading to less local flexibility. The authors thus argue that "rational firms will integrate their data less extensively when there are many heterogeneous departments involved" (Goodhue et al., 1992, p. 305). Third, data integration influences the associated costs of IS in two ways. On the one hand, the design and implementation

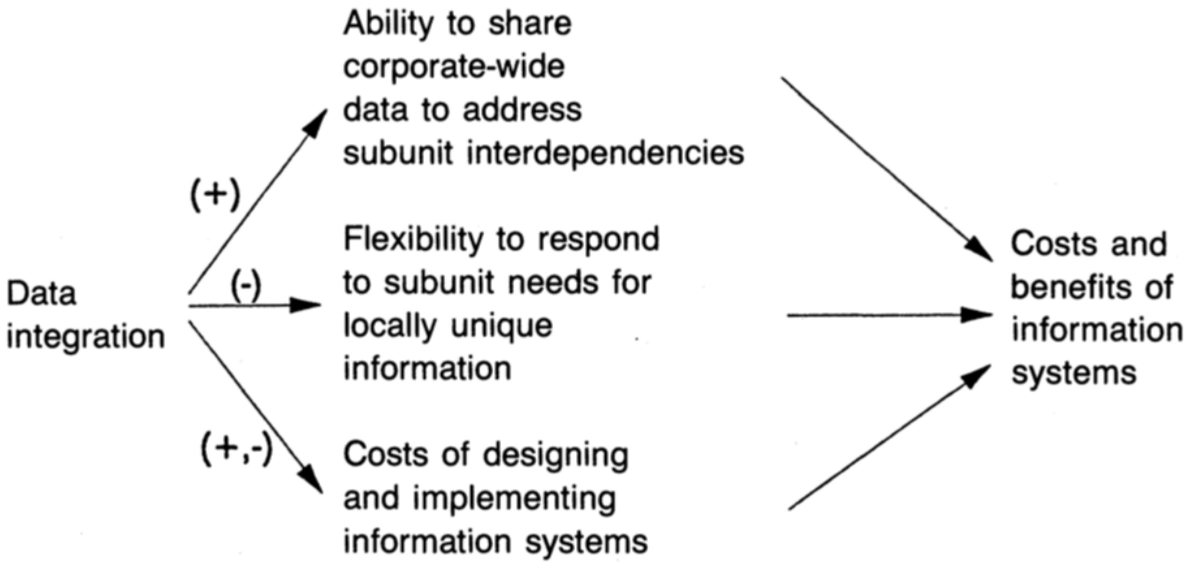

Figure 2.11: The impact of data integration on the costs and benefits of information systems, obtained from ©Goodhue et al. (1992)

costs will increase due to a higher complexity and/or because all involved parties need to agree on changes, which causes bureaucratic delay. On the other hand, data integration will diminish the redundancy of design efforts, which will lead to lower costs. Overall, data integration will lead to increased organization-wide communication, better operational coordination and improved decision making, especially when organizations are dealing with complex, interdependent problems. However, the authors warn that the benefits should be balanced against the costs. They argued that "partial integration" can already be sufficient to achieve the key benefits while bypassing some considerable costs. Partial integration can be achieved by for instance only implementing data integration in a few departments or only implementing it for the *supplier* or *customer* side.

There are two types of functional capabilities that need to be installed in order to enable e-business: front-end functionalities and back-end integration. The former is defined as "functionalities that provide product information to consumers on the Internet (*see search*), facilitate transaction processing, and enable customization and personalization"; while back-end integration "links web applications with back-office databases and facilitates information sharing along the value chain" (Zhu & Kraemer, 2005, p. 67). Back-end integration thus connects independent systems on shared data standards and communication platforms (Dong, Xu, & Zhu, 2009). Zhu and Kraemer (2005) discuss that the higher these two e-business capabilities, the higher the value that can be created and appropriated. Another finding is that back-end integration has a higher influence on e-business value than front-end functionalities, because the latter can be more easily copied by competitors. A study of Dong et al. (2009) confirm that back-end integration influences process-level performance along the supply chain. They underline that IT can significantly contribute to value creation by improving upstream (with suppliers), downstream (with customers) and internal activities.

Empirical research by R. Klein (2007, p. 1370) shows that information/knowledge exchange of suppliers (*in his case service providers*) with clients has a positive direct influence on client customization of integrated e-business supply chain vendor solutions. "Providers need to foster environments allowing clients to make the most of solutions, focusing on becoming strategic partners, enhancing client's value chains" (R. Klein, 2007, p. 1378). The author also concludes that information/knowledge exchange from the seller to the buyer is increased when the seller perceives higher levels of trust in the customer. Next to that, firms that accomplish higher customization realize more benefits.

It is certainly possible that not all firms equally apply digital technologies to enable data integration in their supply chain. Harland et al. (2007) discuss potential barriers to adoption of e-business technologies. They find that - among others - absence of awareness of possible benefits accruing from e-business technologies, lack of motivation, lack of strategic alignment in the supply chain and industry-related differences are major barriers to data integration. For other potential barriers, such as limited access to capital resources or security issues, the reader is referred to the paper (Harland et al., 2007). In addition, the literature poses that the size of the firm affects the adoption rate of e-business technologies. The paper investigates the adoption in SMEs in comparison with larger firms over a time span of four years. Harland et al. (2007) come to the conclusion that larger downstream firms are more likely to employ digital technologies than upstream SMEs. The development of e-business technologies was more profound/advanced in the case of larger downstream firms, and they were also planning to use such technologies more in the future than SMEs. SMEs didn't see the possible benefits accruing from digital technologies, and would only invest in them if they were forced by larger downstream firms (*customers*). However, Zhu and Kraemer (2005) state in their empirical study that the use of e-business is lower in larger firms, mainly due to structural inertia. Next to that, Harland et al. (2007) find that, the larger firms didn't motivate the SMEs enough to adopt the technologies, indicating a lack of leadership to "push" data integration further upstream. Furthermore, although large firms are motivated in setting up e-mechanisms in their own business, they also need to encourage the use of digital technologies more to other upstream firms in the supply chain. Hence, the authors conclude that "the downstream larger businesses are forging ahead with e-business in 'e-Isolation' and are not providing supply chain leadership. They are creating 'e-Lands' with SMEs adrift of them" (Harland et al., 2007, p. 1234).

2.2.3.2 Application Integration

Application integration involves both integration of data and applications (Muylle & Basu, 2008). **Enterprise Application Integration** (EAI) is a term associated with these business processes (Saeed, Malhotra, & Grover, 2005). Power and Singh (2007) find in their study that when web-enabled technologies and applications are used in the integration process between companies, the need to integrate resources and make asset-specific investments increases to ensure potential benefits can be reached. Furthermore, using Internet applications in integration has to be accompanied by a significant change in the structure of participating organizations, meaning processes need to be redesigned. Hence, organizations need to accept the need to change processes, provide acceptable and reliable data and give access to their systems. Therefore, collaboration between trading partners is crucial. The results of a study by Saraf et al. (2007) state that information systems (IS) integration between entities positively influences operational integration and knowledge sharing. Next to that, IS flexibility has a positive impact on IS integration. When a company has a high IS flexibility, it is relatively easy to adapt its IS applications to changing circumstances, such as differing products, partners and environmental changes. Having this flexibility can create value by lowering switching costs, and thus will increase the willingness of companies to participate in integration processes (Saraf et al., 2007).

H. L. Lee and Whang (2004) argue that e-business has an impact on supply chain integration along four key dimensions, as shown in Figure 2.12. They describe the dimensions in an increasing order of integration and coordination between supply chain members, and give the elements and benefits of each dimension. For the first dimension, information integration, we can refer to *data integration*. The third dimension, workflow coordination, "refers to streamlined and automated workflow activities between supply chain partners" (H. L. Lee & Whang, 2004, p. 4). **Scientific replenishment software** is increasingly used for this, which are solutions relying on statistical algorithms, AI, OR and other predictive analytic techniques (*see BI*). Companies that use these software packages can better control the timing and quantity decisions in procurement. The fourth and final dimension, new business models, characterizes new ways of doing business, new business opportunities and so forth. Integration requires tight collaboration between partners and appropriate performance measures, clear communication channels and aligned incentives (H. L. Lee & Whang, 2004).

Dimension	***Elements***	***Benefits***
Information Integration	▪ Information sharing & transparency ▪ Direct & real-time accessibility	▪ Reduced bullwhip effect ▪ Early problem detection ▪ Faster response ▪ Trust building
Synchronized Planning	▪ Collaborative planning, forecasting & replenishment ▪ Joint design	▪ Reduced bullwhip effect ▪ Lower cost ▪ Optimized capacity utilization ▪ Improved service
Workflow Coordination	▪ Coordinated production planning & operations, procurement, order processing, engineering change & design ▪ Integrated, automated business processes	▪ Efficiency & accuracy gains ▪ Fast response ▪ Improved service ▪ Earlier time to market ▪ Expanded network
New Business Models	▪ Virtual resources ▪ Logistics restructuring ▪ Mass customization ▪ New services ▪ Click-and-mortar models	▪ Better asset utilization ▪ Higher efficiency ▪ Penetrate new markets ▪ Create new products

Figure 2.12: Dimensions of supply chain integration, according to ©H. L. Lee and Whang (2004)

Web-based inter-organizational information systems (IOS) can be used to enable an electronic supply chain (Yao, Palmer, & Dresner, 2007). By sharing information in a joint system, supply chain partners can access accurate and real-time demand and inventory data. This helps firms to enhance supply chain coordination, delivery reliability and reduce variability, errors and required safety stock (Guo, Fang, & Whinston, 2006; Saeed et al., 2005). Information processing costs together with coordination costs are significantly reduced (Saeed et al., 2005). Companies that are backed up by top management support or receive external pressure from their partners in their digitization processes perceive greater benefits, not only for themselves but also for their supply chain partners (Yao et al., 2007). Gunasekaran and Ngai (2004) confirm that a necessity for integrating business processes among partners by implementing digital tools is top management support, applying not only to financial support but also to moral and technical support. Yao et al. (2007) propose to managers who are leading the development of web-enabled supply chains that they should not only consider internal benefits but also investigate external benefits of technology use. Implementing an IOS system between business entities involves setup costs and mutual commitment, thereby raising switching costs. Both parties need to commit resources to set up the inter-organizational system (Grover & Saeed, 2007). IOS integration can then be described as "the extent to which the systems shared by two or more firms are integrated to facilitate access to information residing in either firm" (Grover & Saeed, 2007, p. 194). An empirical study conducted by the same authors shows that when component complexity is high, market fragmentation is low (meaning there are less small competing firms), and there is an open information sharing context; companies favor IOS integration. Note that most of the systems described below are a form of IOS. **Web-based EDI** discussed before is also a type of IOS (*see data integration*).

A study by Saeed et al. (2005) examines the impact of several variables related to IOS on process efficiency and sourcing leverage objectives. Process efficiency refers to cost reduction and the increase in effectiveness of boundary spanning processes. Sourcing leverage specifies "an increase in monopsony power through instant and efficient access to alternative sources of supply" (Saeed et al., 2005, p. 371). Hence, monopsony power relates to the power of a particular buyer in its interaction with several suppliers. This is correlated to IOS since IOS enables these "one-to-many" relationships. They find that the initiator of IOS can improve process efficiency as well as sourcing leverage. Thus, just as in the case of electronic marketplaces, the party that launches and owns the IOS has a better chance to reach his performance objectives, and can control access to information and participation. Empirical evidence is found to demonstrate that external (i.e. inter-firm) integration does have a positive impact for the firm in that process efficiency can be reached through improved inventory management, reduced coordination costs and reliable lead times; thus supporting previous research (Frohlich, 2002; Clemons et al., 1993). This is once more confirmed by the following statement: "an integrated IOS that not only automates the ordering process but also enables the firms to undertake joint planning and forecasting is pivotal for gaining efficiency benefits" (Saeed et al., 2005, p. 387). Next to that, the study shows that the more the *buyer* connects the IOS with several suppliers, the higher the alternative supply sources and the more market intelligence can be gained. This in turn increases the sourcing leverage for the buyer and supports the electronic brokerage effect (Saeed et al. (2005); Choudhury et al. (1998); Malone et al. (1987); *see also search*). Finally, the authors state that obtaining process efficiency through higher external integration with IOS is more important for firms manufacturing standardized products and/or functioning in highly competitive industries.

Web-based procurement systems enable the procurement process by interacting with other information systems within the company and across the supply chain (*see search*). Chandrasekar and Shaw (2002) state that, in the context of the *buyer*, web-based technology made it possible to facilitate integration between several echelons, e.g. suppliers and distributors, with the enterprise systems of the buyer. The paper further notes that the full potential of a web-based procurement system can only be realized if all the information exchange and sharing is done electronically. Chandrasekar and Shaw (2002, p. 32) find that "web-based procurement systems that have greater integration with existing enterprise systems yield higher value than procurement systems with lower integration". When two closely related IS are connected, the synergy among the systems can remarkably improve. Furthermore, when the supplier supports the system set up by the buyer, and adds capabilities to it (i.e. additional investments), a supplier may also extract considerable strategic benefits (Mukhopadhyay & Kekre, 2002). The authors explain this through a theoretical lens in that the situation above will achieve the highest decline in transaction costs for the buyer while maximizing the negative externalities perceived by other suppliers not participating in such a system. By implementing e-procurement systems, overhead cost savings can be achieved through less errors and faster payments (Mukhopadhyay & Kekre, 2002). E-procurement systems also possess **electronic invoicing mechanisms** (*see payment*). Furthermore, when a supplier agrees to implement a system initiated by the buyer, a higher sales volume can be reached as a kind of compensation by the buyer. Finally, the total order completion process (at the buyer and supplier) is significantly enhanced. A further remark Chandrasekar and Shaw (2002) annotate is the fact that buyer organizations shouldn't simply add more of their own suppliers to the system, but should also encourage the suppliers of their own suppliers further upstream to join the web-based system. As such, a digitally-enabled extended enterprise can be formed in which entities at all levels can integrate their supply chain in order to discard inefficiencies and respond effectively to demand changes. This enables a truly networked business system.

There are numerous enterprise-focused systems that exist to facilitate application integration. Just think about **Enterprise Resource Planning** (ERP) **systems** such as SAP and how popular they are in the business world today to coordinate decision making. ERP systems use the company's intranet to improve internal collaboration. Internal financial and transactional processing needs can be standardized with ERP systems. Next to that, ERP systems of trading partners can be connected to each other (Fliedner, 2003). Furthermore, "ERP systems are increasingly being used to provide the interconnected transaction foundation among the various planning systems comprising a company's intranet" (Fliedner, 2003, p. 20). **Online intermediaries** such as

Application Service Providers (ASP) can provide these ERP packages to companies, without the need to pay for the development and acquisition cost. Such third parties are mostly used to enhance IT-related activities or web-based IS capabilities within an organization (Daniel et al., 2004; Kauffman & Walden, 2001). As already mentioned in Figure 2.3, a *supplier* can integrate its e-commerce server with its ERP and database systems (DBMS), and conduct business in this way via an electronic marketplace (Rajkumar, 2001). Another type of enterprise-focused system are **Enterprise Content Management** (ECM) **systems** (A. McAfee & Brynjolfsson, 2008).

Customer Relationship Management (CRM) **systems** are another type of enterprise system in which customer-related processes are digitized (Xue, Ray, & Sambamurthy, 2013). CRM systems may result in less error-prone data input, less paperwork and a smaller sales force. At the same time, it passes the buck to the customer; in that search, order and tracking processes are now the customer's responsibility (Johnston & Vitale, 1988; Weill & Vitale, 2001). Consecutively, the customer has higher (perceived) control on the decision making process, which results in higher customer satisfaction and ultimately in increased sales and customer loyalty (Ariely, 2000; Rust & Zahorik, 1993). Barua et al. (2004) confirm this in their empirical study, by stating that there is a positive correlation between higher levels of customer-side digitization and financial performance. Empirical evidence shows that e-CRM is more a customer retention tool, to strengthen existing customer relationships (Swift, 2001; Tsikriktsis et al., 2004).

Supply Chain Management (SCM) **systems** or supplier management systems are the complement of CRM systems, since the focus here is on digitization of supplier-related processes (Xue et al., 2013). SCM systems facilitate integration, in turn reducing costs, and improving lead times, supplier reliability, inventory visibility and communication (Frohlich & Westbrook, 2002). These web-based applications reduce uncertainty related to demand, quality and inventory, which has a direct positive influence on financial performance (Barua et al., 2004). Prior literature shows that the benefits of SCM systems primarily go to the *buyer* in the buyer-supplier relationship; especially when the buyer is a large, renowned firm with a high bargaining power over the supplier (Clemons et al., 1993; Subramani, 2004). Why would suppliers then agree to participate in SCM systems? What do they have to gain from it? A study by Subramani (2004) confirms that suppliers do benefit from applying SCM systems. In particular, combining the SCM system with relationship-specific intangible resources creates causal ambiguity. The authors indicate two relationship-specific assets that are worth the investment for suppliers: business process and domain knowledge specificity. Business-process specificity "arises from the development of relationship-specific routines or standard operating procedures for efficient task execution"; while domain knowledge specificity is "the degree to which a supplier's critical expertise such as competitive analysis, strategy formulation and new-product development is particular to the requirement of the focal firm in the relationship" (Subramani, 2004, p. 48,50). The latter helps the supplier understand the customer's market and preferences, enabling him to better respond to customer's needs and/or exploit future opportunities. Causal ambiguity makes it hard for competitors to estimate what resources contribute to value creation, and consequently obstructs imitation and increases the supplier's competitive performance. The supplier is able to differentiate himself, which in the process lowers the bargaining power of the buyer. In this way, lock-in is created, thereby further extending the buyer-supplier relationship and creating value for both parties (Subramani, 2004).

Empirical research led by Barua et al. (2004, p. 588) indicates that digitization of supplier-side processes strongly influences digitization of customer-related processes, and that "the total effect of customer and supplier-side digitization on financial performance is significantly positive". This implies that SCM web applications both directly and indirectly influence financial performance. Next to that, the authors claim that SCM systems necessitate more collaboration and asset-specific investments made by suppliers than CRM applications. However, ERP, SCM, CRM systems all require extensive collaboration between business entities (M. Chen et al., 2007).

It can be argued that CRM and SCM systems are actually the same, yet are looked at from a different perspective, namely that of the *supplier* or that of the *buyer*. In most cases, CRM and SCM systems are implemented independently of each other, which limits the overall benefits that could be reached. This observation gave rise to the birth of **Demand Chain Management** (DCM) **systems**, in which customers and suppliers are connected together into deeply integrated networks that are looked at from a demand perspective (Frohlich & Westbrook, 2002). There is a thin line between the concepts of SCM and DCM, and Vakharia (2002) argues that the main difference is that SCM is more a 'push' system, while DCM can be seen as a 'pull' system. The Internet made it possible to implement these systems successfully, even though they require extensive integration between all business entities (Frohlich & Westbrook, 2002). Frohlich and Westbrook (2002, p. 731) further note that "web-based technologies now permit strong customer and supplier integration for inventory planning, demand forecasting, order scheduling, targeted marketing and customer relationship management". Coordination is significantly improved, lead times and uncertainty are reduced, and non-value-adding activities are eliminated. DCM systems also counter the bullwhip effect by immediately sharing all necessary information (Frohlich, 2002; H. L. Lee et al., 1997b).

In Figure 2.13, four web-based strategies are illustrated. Model D constitutes the highest level of web-based integration, that of the entire demand chain from customers backwards to suppliers. Empirical research conducted by the authors shows that a DCM integration strategy (model D) has the highest level of operational performance, followed by web-based supply or demand integration (model B and C respectively). There is strong empirical support for the fact that low web-based integration has the lowest level of performance. Furthermore, the study finds that implementation of DCM integration is driven by the perception of greater access to markets, higher expected benefits, and external pressure. The authors combine the first two factors together in the concept of 'rational efficiency'. External pressure is to some extent less influential than the other two factors, and is a consequence of the bandwagon effect. On the other hand, web-based demand integration (model C) is primarily driven by access to new markets, while supply integration (model B) by external pressure (Frohlich & Westbrook, 2002).

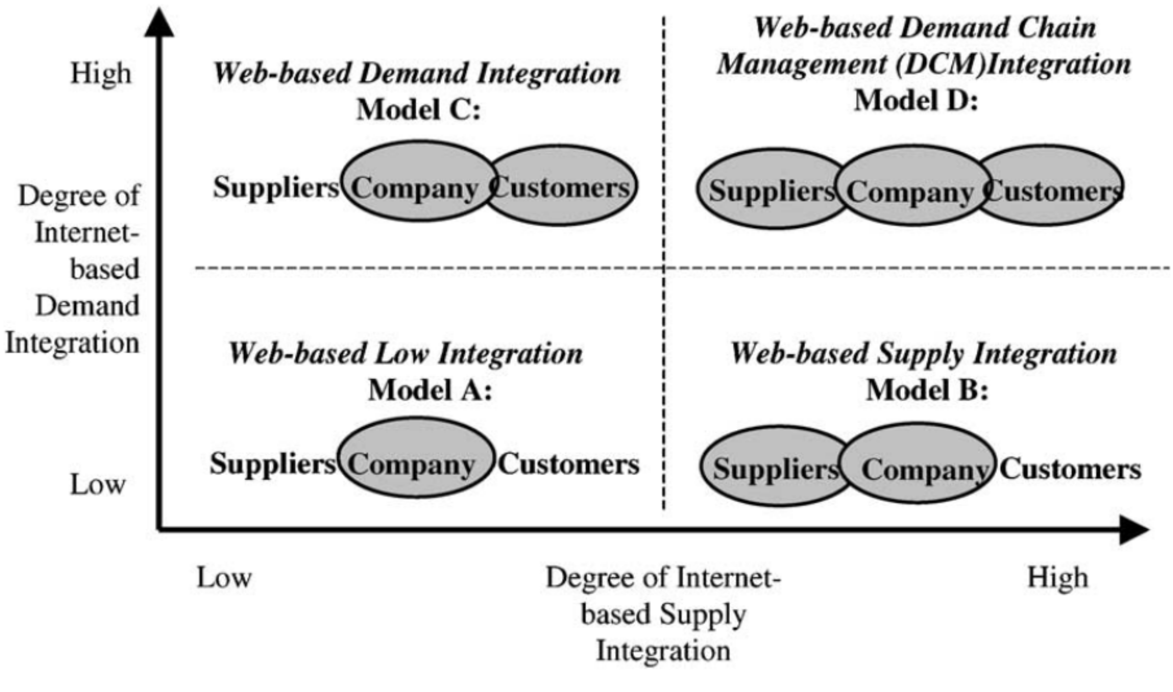

Figure 2.13: Four web-based integration strategies, obtained from ©Frohlich and Westbrook (2002)

A **web service** ensures the integration of internal and external information systems, and tackles the problem of incompatible platforms and application software differences (Daniel et al., 2004). Web services can be defined as "a set of inter-related technologies that allow information systems to be assembled from standard components. Use of open standards for the interface and communication between these components ensures that these web services can be integrated with each other, and with existing applications, regardless of the programming language used to create them or the platform upon which they are run" (Daniel et al., 2004, p. 351). A web service thus communicates via open standards, such as XML. Another way to put it is by applying the following definition, which tries to define web services in a more comprehensive way: "web services are business and consumer applications, delivered over the Internet, that users can select and combine through almost any device from a personal computer to a mobile phone. By using a shared set of protocols and standards, these applications will permit disparate systems to 'talk' to one another, that is share data and services, without requiring humans to translate the conversation" (Patil & Saigal, 2002). Web services aim at reducing acquisition, development and distribution costs and as such enable companies to swiftly establish flexible IS linkages with trading partners at a competitive cost. At first, web services were adopted in intra-firm (internal) integration of different applications, but later was extended to also facilitate integration between different firms (inter-firm). In the latter case, third party **intermediaries** can come into play, whose functions can be threefold: facilitate the use of these web services, thus acting as matchmakers; bring additional value-adding services to the table; and/or develop trust and regulation. As matchmakers, intermediaries can connect users and providers in a reliable and regulated environment; and can accommodate UDDI directories/repositories. They need to provide security (*see authentication*), billing and payment options (*see payment*). Next to that, when involved processes and web services are complex, third parties can significantly add value by managing these business processes. In Figure 2.14, a web services framework is depicted. In the center of the figure, the three main functions mentioned above are shown: enabling services, matchmaking, and developing trust and regulation. As already mentioned, web services can be used within an organization to improve internal integration and in this case, the three functions can be performed in-house. If these web services are used for integration between two companies that are familiar to each other, the functions will probably be performed by the entity that developed the web services. The authors argue that, in cases of integration of one entity with many other organizations or when parties are not yet known to each other, a third party intermediary can be very useful to deploy in setting up and managing these web services (Daniel et al., 2004).

Collaborative commerce, also known as C-Commerce, is a term often associated to the extended enterprise and includes the use of digital technologies to integrate a firm's business processes with those of its partners. It supports companies in enhancing their value chains remarkably on an inter-firm level (M. Chen et al., 2007). M. Chen et al. (2007) propose a model of web-enabled collaborative commerce, which is depicted in Figure 2.15. A web services registry "stores metadata about web services published by enterprise applications or trading partners and is used for

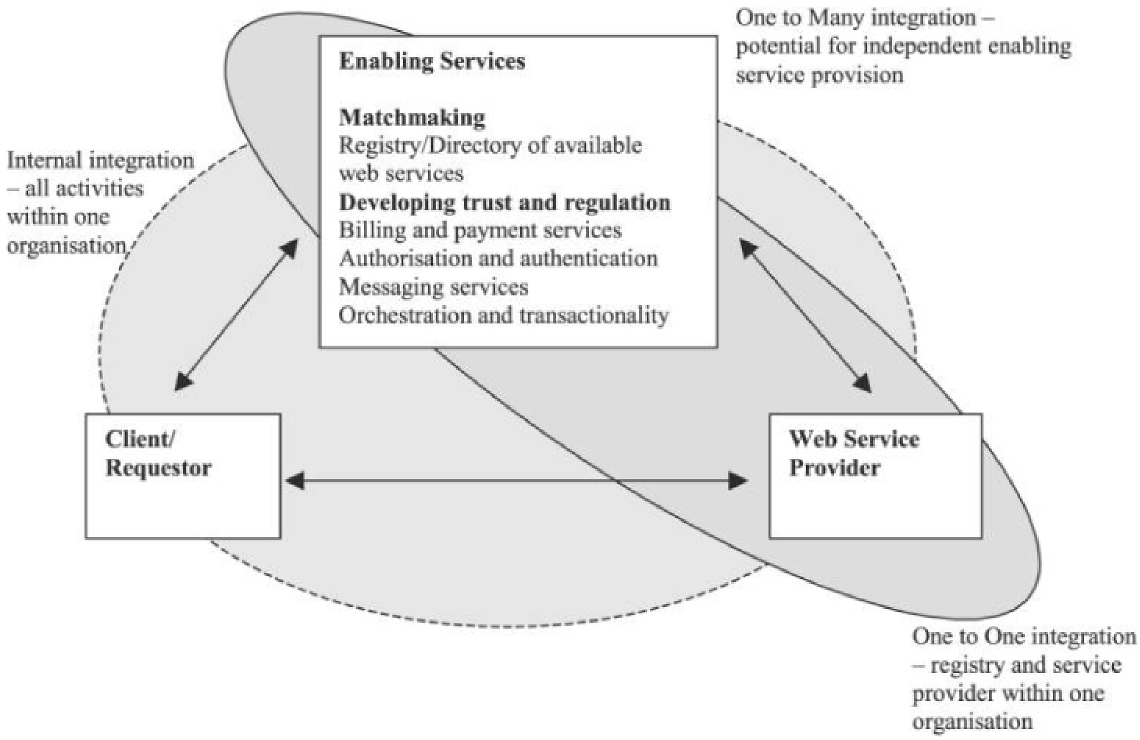

Figure 2.14: A web services architecture, obtained from ©Daniel et al. (2004)

discovery of web services by other applications that need to consume web services" (M. Chen et al., 2007, p. 538). C-commerce consists of a collaborative e-business system. Crucial elements of this system are CRM, ERP and SCM, which are all enterprise software systems (ESS). The reader is referred to the paragraphs above for more information. The software systems can be supported by combining it with the Internet. Integration with B2B partners is facilitated because all partners are granted access to data and functions in the legacy and software systems. This access can be obtained directly or via a business process management system (BPMS). The final result of collaborative commerce use is a dynamic electronic supply chain that simplifies business processes within and across companies. Two types of c-commerce are collaborative product commerce (CPC); and collaborative planning, forecasting and replenishment (CPFR).

Collaborative planning, forecasting and replenishment (CPFR) **software**, formerly known as Collaborative Forecasting and Replenishment (CFAR) systems, is software in which "both the buyer and the seller make use of the Internet to share forecasts, detect major variances, exchange ideas and collaborate to reconcile differences, so that eventually both have a common forecast and replenishment plan" (H. L. Lee and Whang (2004, p. 8); *see also logistics*). It is a part of C-commerce described above. Fliedner (2003) argues that CPFR is a replacement of traditional EDI. It can significantly reduce inventories and order cycle time, lower inventory obsolescence and

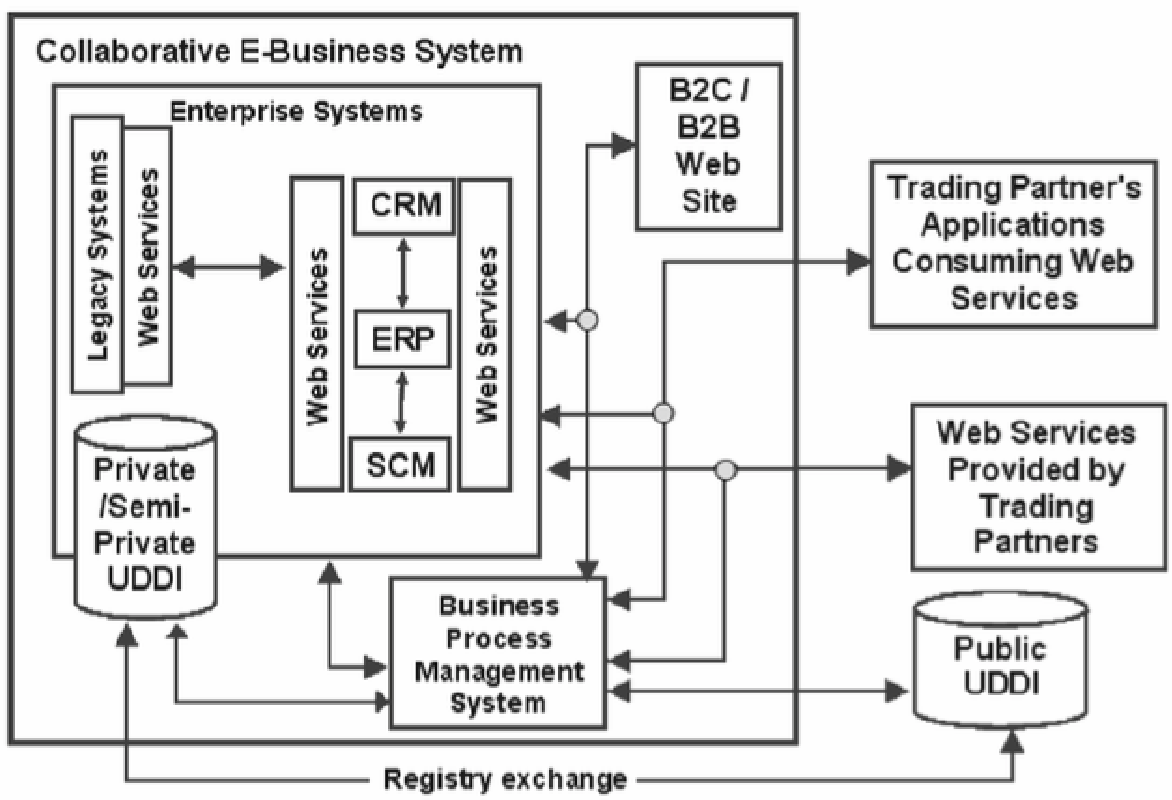

Figure 2.15: A model of web-enabled C-commerce, obtained from ©M. Chen et al. (2007)

deterioration, lower system expenses, reduce capacity requirements, increase sales, improve forecast accuracy and enable higher fill rates and higher service levels (Aviv, 2001; Fliedner, 2003). Hence, the bullwhip effect is reduced (H. L. Lee et al., 1997b, 1997a; Ray et al., 2009). However, significant resources (both business and technical) need to be invested, partners need to be willing to share a broad array of information, and a high level of collaboration is absolutely necessary to reach desirable outcomes (Aviv, 2001). Furthermore, trust issues, lack of internal forecast collaboration, availability and cost of technology/expertise, fragmented information sharing standards and fear of collusion have been stated in the literature as potential obstacles to adoption (Fliedner, 2003). Figure 2.16 shows a CPFR framework that is created by the Voluntary Inter-industry Commerce Standards (VICS) association. The framework is applied to the retail industry. The retailer (buyer) and manufacturer (seller) work together to satisfy the requirements of the end consumer. There are four collaborative activities: strategy and planning; demand and supply chain management; execution and analysis. There are eight collaborative tasks, shown in the figure by the coloured arrows. The remaining tasks are enterprise tasks that need to be executed by the manufacturer or retailer. For further information, the reader is referred to VICS (2004). A numerical study by Aviv (2001) shows that collaborative forecasting can significantly reduce supply chain costs (in their case a cost reduction of 19,43 percent on average was observed). Furthermore, the benefits are higher when the forecasting capabilities across the supply chain are diversified, and when the lead times are smaller. In the latter case the supply chain entities can make better use of shared demand-related information. To summarize, both parties can benefit from implementing CPFR, demand uncertainty is resolved earlier in the process and consequently performance is improved (Aviv, 2001).

Figure 2.16: The detailed CPFR model, obtained from ©VICS (2004)

Vendor and buyer portals can be integrated with internal enterprise and/or external systems. The portal can then function as a centralized starting point to access other applications; such as e-mail, CRM systems, invoicing systems, web-based procurement systems, and so forth (Flynn (2016); *see also search, collaboration*). According to Flynn (2016), some confuse supplier portal software with intranets. However, the author argues that supplier portals are "more complex, automated, organized, and provides more interactivity compared with the intranet software". A buyer portal, on the other hand, integrates all e-procurement-related information, tools and systems (Bögels, 2013).

2.2.3.3 Additional information on integration processes

The use of digital technologies is associated with a lower degree of vertical integration, and hence more outsourcing, i.e. via the market, since coordination costs are reduced by adopting IT mechanisms (Clemons et al., 1993; Malone et al., 1987). Ray et al. (2009) explore the relationship between IT and vertical integration under differing competitive circumstances. They find that IT relates to lower vertical integration if demand uncertainty is high or industry concentration is low (i.e. an unstable, competitive environment). IT induces higher vertical integration when the opposite is true. Either way, vertical integration is lower/higher in order to reduce the coordination and production costs. When demand uncertainty is high, firms need to be flexible enough to adapt to changing needs. Hence, the authors demonstrate that the level of vertical integration is influenced by IT as well as the competitive environment.

It can be said that digital technologies facilitate buyers in using more suppliers. According to Riggins, Kriebel, and Mukhopadhyay (1994), most of the benefits of digitization go to the buyer while the supplier faces negative network externalities. In such situations, it is important that the buyer forwards the supplier a share of the achieved benefits to attract suppliers to participate. Next to that, the supplier will need to make relationship-specific investments to engage in partnerships, which is something that stimulates the buyer to take on more profound relationships with fewer suppliers (Qizhi & Kauffman, 2002). Empirical results obtained from Benton and Maloni (2005) show that supplier satisfaction is influenced by the extent of the buyer-supplier relationship. The authors define supplier satisfaction as "a feeling of equity with the supply chain relationship no matter what power imbalance exists between the buyer and seller dyad" (Benton & Maloni, 2005, p. 4). Hence, the nature of the relationship matters, in that if the buyer holds the most power but wants to obtain supplier satisfaction, a relationship-driven supply chain strategy is the way to go (instead of a performance-based strategy). The authors propose that rather than seeing power as a bad thing, we should recognize that power may be exploited as an avenue for effective integration (Benton & Maloni, 2005).

A study conducted by Ranganathan et al. (2004) states that the diffusion of web-enabled technologies to other entities in the supply chain is affected by a number of factors. First of all, the diffusion is greater when the interdependence between a firm and its supplier(s) is higher. If one of them is already using a web-enabled system, **electronic partnerships** will be promoted and the likelihood that the other party will agree to participate in web-enabled IOS increases. Second, the diffusion is also greater when the usage of IT in a firm's internal processes is higher. Companies that make more use of digital tools have a higher incentive to promote the technologies to their partners because they can obtain even higher savings and reduce costs even further. Third, diffusion is greater when the industry's IT use is higher. By industry IT use we mean the amount of digital technology use by a firm's suppliers, customers and competitors. "The more industry players deploy and use information technologies, the greater will be the firm's ability to diffuse web technologies and systems in its SCM activities" (Ranganathan et al., 2004, p. 135). The diffusion of digital technologies across the supply chain facilitates integration of the firm with its supplier(s). Next to that, the study states that when IT knowledge of managers in the company is more profound, the digital technology use will be higher. Finally, Ranganathan et al. (2004) find that the higher the digital technology use in internal processes (internal assimilation) and in external processes of other parties in the supply chain (external diffusion), the higher the benefits that will be achieved.

Clemons et al. (1993) discover two contrasting results in their study. On one side, highly integrated inter-organizational relationships can be created and facilitated by IT investments. According to Barringer and Harrison (2000), companies develop inter-organizational relationships to control or access crucial assets, to offer superior products/services, to influence the competitive market, and/or to increase competence through knowledge transfer. Clemons et al. (1993) further add that buyers will tend to choose fewer suppliers to do business with to reassure their investments (set-up costs, customization) and to achieve economies of scale. Implementing IT will tend to encourage the firm to install long-term relationships with their suppliers. This can be explained by three reasons: it will give the firm time to recover the investment, it will result in higher learning effects, and it will create incentives for suppliers to invest in non-contractible relationship-specific resources. On the other side, digital technologies decrease operations risk, opportunism risk and coordination costs, which reduce the need for asset ownership. Operations risk can be defined as "the risk that the other parties in the transaction willfully misrepresent or withhold information, or underperform; that is, 'shirk', their agreed-upon responsibilities. Operations risk stems from differences in objectives among the parties and is supported by information asymmetries between the parties or by difficulties in enforcing agreements" (Clemons et al., 1993, p.15). IT reduces this risk since monitoring can be improved and incentives will be better aligned, because of higher information availability and processing capacity. The risk of opportunism is also reduced by implementing IT, because access and use of information and expertise can be closely monitored. Thus, when the need to own assets diminishes, the result will be more outsourcing, and potentially a higher supplier base (Clemons et al., 1993; Qizhi & Kauffman, 2002). This is clearly in contrast with the first statement.

Rayport and Sviokla (1995) came up with the concept of **virtual value chains**. A value chain is "a model that describes a series of value-adding activities connecting a company's supply side (raw materials, inbound logistics, and production processes) with its demand side (outbound logistics, marketing, and sales)...The value-adding steps are performed through and with information. Creating value in any stage of a virtual value chain involves a sequence of five activities: gathering, organizing, collecting, synthesizing, and distributing information" (Rayport & Sviokla, 1995, p. 76). Hence, a virtual value chain is fundamentally different than a physical value chain, since information plays a strategic and key role in the former.

More and more companies are developing relationships with their partners and consider taking part in a **virtual enterprise** (VE). A virtual enterprise or virtual organization (VO) is defined as "a temporary network of independent institutions, businesses or specialized individuals, who work together in a spontaneous fashion by way of information and communication technology, in order to gain an extant competitive edge. They integrate vertically, unify their core competencies and function as one organization (or organizational unit)" (Fuehrer, 1997; Jägers, Jansen, & Steenbakkers, 1998). In a virtual enterprise, partners gather swiftly to capitalize on opportunities (Browne & Zhang, 1999). IT will help in expediting this partnership because it allows the partners to access the right information at the right time. Virtual reality is implemented in as many areas as possible. However, significant challenges are present. Often organizational restructuring is required if new systems such as ERP systems are to be implemented. Other challenges that need to be considered are workforce management, IT investment and business processes reorganization (Gunasekaran & Ngai, 2004).

A virtual enterprise is fundamentally different from an **extended enterprise**. According to Browne and Zhang (1999, p. 30,31), an extended enterprise "focuses more on long-term enterprise relationships across the value chain, while the virtual enterprise suggests a more dynamic environment where individual enterprises work together for a relatively short time, to satisfy niche market demand quickly...An extended enterprise extends beyond traditional organizational boundaries; and can be defined as a kind of enterprise which is represented by all those organizations or parts of organizations, customers, suppliers and sub-contractors, engaged collaboratively in the design, development, production and delivery of a product to the end user". Hence, an extended enterprise relies more on long-term relationships, involving shared responsibility and trust; while a virtual enterprise stresses the temporary and independence aspect more. Furthermore, both rely on thorough information sharing, but since the time aspect is even more important in a VE, the availability of fast and accurate information is slightly more critical. Finally, concerning the digital technology use, IT has a facilitating and enabling role in an extended enterprise; while a VE relies on sophisticated IT systems to enable short-term and successful integration between business partners (Browne & Zhang, 1999).

2.2.4 General remarks on digital technologies

The literature mentions further benefits of digital technology use, such as better systems quality, higher savings, advanced innovativeness, improved employee satisfaction and higher inter-organizational coordination and synergy (Standing & Lin, 2007; Delone & Mclean, 2004; Overby & Min, 2001). Potential downsides/obstacles of digital technology use in buyer-supplier relationships are failure of inter-firm processes due to coordination difficulties, problems in managing new processes, continuing need for effective change management, scalability, and more general problems with the quality and flow of data between trading partners (Barratt & Oliveira, 2001). According to Barua et al. (2004), companies are not only relying on their own capacity to leverage IT, but also depend on business partners' IT capacity. In other words, "even if a firm has the necessary IT applications to do business online with customers and suppliers, a lack of readiness on the part of customers and/or suppliers will impede the adoption of the technology" (Barua et al., 2004, p. 595). Hence, companies are highly recommended to implement and promote digitization efforts along the entire value chain to enable superior business performance (Barua et al., 2004).

The adoption of digital technologies does not only depend on the quality of the tools, but an equally important aspect that needs to be considered is the context in which the technology is used. A widely used framework is TOE, which stands for Technology, Organization and Environment, developed by Depietro, Wiarda, and Fleischer (1990). More information can be found in Tornatzky, Fleischer, and Chakrabarti (1990); Zhu and Kraemer (2005). Next to this, a firm's performance is also influenced by its IT-enabled business model, which "elucidates how an organization is linked to external stakeholders, and how it engages in economic exchanges with them to create value for all exchange partners" (Zott & Amit, 2007, p. 181). We can conclude this paragraph with the statement of Subramani (2004, p. 67): "As firms increasingly rely on IT-mediated inter-firm relationships to develop and deploy capabilities, recognizing the complex interplay of contextual features, appropriations of technology, and firm strategies is important in explicating the role played by information technologies".

An important determinant of technology use according to Mishra and Agarwal (2010) is the so-called technological opportunism, which indicates the firm's agility with respect to adopting emerging technologies. Firms possessing this capability proactively search in the environment for new digital tools and respond properly to perceived opportunities and threats. They are able to acquire information about these technological opportunities and have the resources to exploit technological innovation. Another important factor is the technological infrastructure already in place in the organization. Sophisticated infrastructures and previous experience can significantly help in setting up and exploiting new technologies (Mishra & Agarwal, 2010). Furthermore, the organizational competitiveness will not be improved by digital technologies alone. As Gunasekaran and Ngai (2004) note, the workforce needs to be motivated to work in a transparent and open communication environment. Companies need to be willing to change the way they work.

Chapter 3

Methodology

The method used to represent the literature proceeded as follows. First, two kinds of journals were recommended to start the search. On the one hand, world top journals in technology use were suggested: Decision Support Systems (DSS), Information Systems Research (ISR), Journal of Management Information Systems (JMIS) and Management Information Systems Quarterly (MISQ). On the other hand, economic journals were advised: Journal of Operations Management (JOM), Management Science (MaSc), and Production and Operations Management (POMS). The references of the respective papers were examined, which brought about additional journals. A complete list of journals in which interesting additional papers were found is given below. The reader is referred to the list of abbreviations for the full name of the journal.

- CACM
- DS
- ECRA
- EJOR
- HBR
- IJAMS
- IJEC
- IJOPM
- IJPDLM
- IMM
- ISM
- JEIM
- JMR
- LIM
- Springer
- WECWIS

Although the total list of additional journals seems considerable, the focus remained on the first set of journals. Reasons for using other journals were twofold: either the journal contained papers of high relevance and importance to a certain topic; or the papers of the journal were relevant while also having a high amount of citations by other research. The references of the papers of the additional journals were also examined, to see out of which journals they came to be able to estimate the quality of the paper.

Second, a table was made consisting of all relevant papers for the master dissertation, which the reader can find in the Appendix (see Table 7.1). The table consists of several columns, from left to right: the short reference in APA style with the respective journal abbreviation (in alphabetical order), the title (publication, in alphabetical order), an indication to which process(es) of the e-business process framework the paper belongs, and finally the relevant sub-processes discussed in the paper. After the classification was made based on the three e-business processes, the relevant statements and findings of all papers were used to construct the literature overview.

The following keywords were applied: *agency relationships, B2B markets, business relationship, buyer-seller agents, buyer-supplier dyad, buyer-supplier relation, digital markets, digital technology, dyad, dyadic negotiation, dyadic relationship, electronic markets, integrated communication tools, inter-organizational relationship, IT use B2B, IT supply chain, online marketplace, principal-agent, process digitization, social media, technology benefits, technology performance, technology supply chain, virtual meetings.*

Chapter 4

Discussion

4.1 Answer to the research questions

4.1.1 Overview of digital technologies

Table 4.1 provides a complete overview of the digital technologies used in each of the different subprocesses. In the next sections, the most important findings will be stated, differentiating according to the functional perspectives. A separate section is made for technologies that overlap multiple processes. Each section will also present the performance impact of the main technologies.

4.1.2 Shared technologies

In every process of the e-business framework, companies could use **websites**, as they offer a high range of functionalities. Websites are perhaps the most used digital technology and is often complemented by **e-mail** supporting functions. The study by Harland et al. (2007), however, finds that although SMEs mainly use websites, they provide limited information and contact details. According to them, the SMEs don't seem to value the benefits of website adoption. Since this finding is stated ten years ago, and in that time period a lot could have happened, this perception is most likely changed by now. To compete in the dynamic environment of today, a website that offers basic functionalities, and is easy to use and understand, is a minimum requirement. Table 4.2 and 4.3 show the performance impact of the main technologies that are used in more than one process.

An **electronic marketplace** is also a mechanism that can be used in almost every process. There are many different kinds of e-marketplaces currently available. The literature mentions private, consortium, public, horizontal and vertical marketplaces. There is much research to be found investigating the difference between electronic markets and electronic hierarchies (Malone et al., 1987; Vladimir, 1996; Clemons et al., 1993). Predictions were made stating that electronic markets will be applied more than hierarchies. For example, Son and Benbasat (2007) find that buyers purchase goods via e-marketplaces without integration of IT systems. While this may be true for standardized products, electronic hierarchies are still very important. Since products/services are

Table 4.1: Classification of digital technologies based on the e-business process framework

Business process	**Sub-process**	**Digital technologies**
Trade processes	Search	Banner advertising Chatbots Collaborative filtering and predictive search Comparison engine Digital library Discussion forum Electronic catalog Electronic directory Electronic marketplace Electronic requirement determination tools E-mail Instant messaging Intelligent agent software Mobile applications Online intermediaries Search/Meta-search engine Shopbots Social media platform (web 2.0) Virtual community Virtual mall Web portal Web-based procurement system Website XML

Table 4.1: Classification of digital technologies based on the e-business process framework (continued)

Business process	**Sub-process**	**Digital technologies**
	Authentication	Biometrics Blinded signature Digital certificates Electronic marketplace Online feedback mechanism Online intermediaries Online trust services Smart cards Tokens Virtual Community Web-based supplier evaluation system Website
	Valuation	Comparison engine Electronic catalog with posted prices Electronic marketplace Electronic price negotiation Electronic requirement determination tools E-mail Intelligent agent software Online auction Online feedback mechanism Online intermediaries Shopbots Web-based procurement system Website

Table 4.1: Classification of digital technologies based on the e-business process framework (continued)

Business process	**Sub-process**	**Digital technologies**
	Payment	Electronic billing/invoicing system
		Electronic fund transfer system
		Electronic marketplace
		Electronic money
		Electronic wallet
		Micropayment
		Mobile payment
		Online banking
		Online credit card payment
		Online financial intermediaries
		Payment protocol
		Scrip payment
		Shopping cart
		Smart card payment system
		Subscription-based payment system
		Website

Table 4.1: Classification of digital technologies based on the e-business process framework (continued)

Business process	**Sub-process**	**Digital technologies**
	Logistics	Automated routing software Automatic replenishment program Bar code readers CPFR software Electronic freight rate negotiation Electronic requirement determination tools E-mail E-mall ILIMS system Mobile applications Online intermediaries Quick response technologies SCM system Virtual logistics Web-enabled RFID Website
Decision Support processes	Configuration	CAD/CAM technology Collaboration platform CRM system Electronic requirement determination tools E-mail Intelligent agent software Mobile applications Online intermediaries Product configuration software Website

Table 4.1: Classification of digital technologies based on the e-business process framework (continued)

Business process	Sub-process	Digital technologies
	Collaboration	Collaboration platform Electronic brainstorming and voting Electronic bulletin board system Electronic marketplace Executive information system Extranet E-mail Group decision support system Groupware Intelligent agent software Intranet Mobile applications Online feedback mechanism Online portal (vendor/buyer) Private trading network Secure messaging application Shared data repository Virtual community Web-based conferencing Webcasting Webinar Website Whiteboarding Web 2.0 technologies

Table 4.1: Classification of digital technologies based on the e-business process framework (continued)

Business process	**Sub-process**	**Digital technologies**
	Business Intelligence	Ad hoc query tools
		Cloud database services
		Complex event processing engine
		CRM system
		Dashboard
		Data mining engine
		Data warehousing
		Electronic marketplace
		Enterprise search engine
		Extract transform load tools
		Intelligent agent software
		Mobile applications
		Online analytic processing server
		Online intermediaries
		Reporting server
		Search portal
		Spreadsheet
		Social media platform (web 2.0)
		Text analytic engine
		Website analytics
		Web 3.0

Table 4.1: Classification of digital technologies based on the e-business process framework (continued)

Business process	**Sub-process**	**Digital technologies**
Integration processes	Data	Data warehousing Extract transform load tools Information hub Online intermediaries SOAP TCP/IP protocol UDDI Web-based EDI Web-enabled inter-organizational business process standards WSDL XML
	Application	Collaborative commerce CPFR software CRM system DCM system ECM system ERP system Online intermediaries Online portals (vendor/buyer) Predictive analytic techniques SCM system Web-based EDI Web-based IOS Web-based procurement system Web services

becoming increasingly complex and entangled, long-term buyer-supplier relationships will be needed to be able to understand and satisfy each others' requirements. Thereby, integration will only stimulate these relationships.

E-mails are a very simple and fast way to communicate with buyers/suppliers. Can you imagine a company that does not use e-mail or supported functions in their business operations? That's right, you can't. E-mails facilitate the search and valuation process, in that information about products/services and prices can be exchanged easily and quickly. Next to that configuration and collaboration are facilitated, along with so many other e-business processes. It is, together with websites, the main digital technology used, which is consistent with the findings of Harland et al. (2007).

Next, a **web-based procurement system** assists several aspects of the trade process, such as search, valuation, payment and logistics. It can offer many benefits to companies, as you can find in Table 4.2. Harland et al. (2007) state that almost no SME used e-procurement. A reason for this could be the high implementation cost, or that their supplier base is too low to justify the investment. Future research should further investigate the use of e-procurement systems in SMEs. Next to that, application integration is significantly supported, and can increase the value that can be appropriated, which is in line with Chandrasekar and Shaw (2002). Even though the implementation costs can be high, both buyers and suppliers can benefit from adopting web-based procurement.

In almost all of the discussed processes, **intermediaries** emerge. This again stipulates the important role they play in governing buyer-supplier relationships. Intermediaries can for instance manage consolidation of information in online marketplaces, financial or logistics services, or can have auction capabilities. In line with Daniel et al. (2004), intermediaries can act as matchmakers, facilitating both buyer and supplier organizations. There are many different types of intermediaries, such as online brokers, smart/intelligent agents, shopbots, etc. Intermediaries such as application service providers can also facilitate the integration process. Hence, intermediaries can be both humans and machines. However, the literature questions the use of intermediaries in the digital age (Vladimir, 1996; Chircu & Kauffman, 2000). Digital technologies make it easier for companies to bypass them, although they also raise security and privacy issues. Therefore, intermediaries could be important as they can offer assurance to both buyers and suppliers. In this way, they can provide trust and regulation (Daniel et al., 2004). Furthermore, using intermediaries allows the company to focus on its core competences. Intermediaries such as statistical software and database vendors will only increase in the future, because of the important role they play in business intelligence opportunities.

In multiple discussed disciplines, there is a clear trend to use more AI techniques such as **intelligent agents**, **shopbots** or **recommender agents**. Companies begin to see the benefits of these techniques, and that they can significantly facilitate or simplify some of their business processes. From here on, intelligent technologies will only become more valuable, which is in accordance with Kauffman and Walden (2001); Malone et al. (1987). An interesting topic for future research could be to investigate the use of and trust in these machine intermediaries.

Electronic requirement determination tools, such as e-RFQ, are also mechanisms that return in multiple processes, such as search, valuation, logistics, and configuration. They are a fast way for companies to achieve different kinds of information.

Mobile applications are a very useful tool for business users who are frequently out of office. They can perform a variety of functions, such as e-procurement, online banking, or instant messaging. The study by Gebauer and Shaw (2004) finds that they are primarily used for simple tasks. By now, this will be extended to more complex tasks. However, future research is needed to confirm this statement. The performance impact of mobile applications can be found in Table 4.3.

Social media platforms can be used in several processes. Many suppliers and customers alike nowadays have a Facebook page representing the firm. However, not much research was found investigating this.

Collaborative planning, forecasting and replenishment software is a combination of the logistics, collaboration and integration process. The performance impact of CPFR is given in Table 4.3. CPFR and **collaborative commerce** are important tools for the entire supply chain, as they can support in gaining a competitive and strategic advantage. This is particularly true in today's environment, as competition is now between supply chains (Harland et al., 2007; Kumar, 2001).

To summarize, there is a clear distinction between basic digital technologies, such as e-mail and websites; and more advanced digital technologies, such as web-based procurement and CPFR systems. The former may facilitate administration-related, routine tasks and the interaction between multiple entities, but it are the latter that truly enable strategic advantages.

4.1.3 Technologies specific to trade processes

Inspecting Table 4.1, there are many digital technologies that can be used in the search process. Perhaps the most prominent is the use of **online catalogs**, which is in accordance with Rajkumar (2001). They are easy to use and offer a clear overview of all available products/services and their prices. Hence, they can also be used in the valuation process. The performance impact of the main trade technologies is shown in Table 4.4. In many instances, companies also rely on **search engines** to facilitate the search process. There are a variety of search engines available, which can differ enormously in their quality. Companies should consult reliable sources to find out which one(s) can be utilized to achieve the desired objectives. There appears to be a trend to use meta-search engines instead of the regular search engines. A meta-search engine uses several search engines in the process (Kauffman & Walden, 2001), which augments the chance that the user will find exactly what he is looking for. A **digital library** is also found to ease the search process. This technology may be more fitting in a B2C than in a B2B context. This argument can be backed up by the difficulty to obtain papers discussing the technology. However, corporate digital libraries do exist, and employees can access them to get all kinds of different information. Although it is probably more fitting in an intra-firm context than in an inter-firm context.

Authentication is more and more important in the present digital age. Issues such as cyber attacks and fraud are not uncommon, which is why it is important to establish this when conducting business transactions. It can be done in a formal way as well as in an informal way. **Digital certificates** are an example of a formal way; while **online feedback mechanisms and websites' registration information**, for example, are a more informal way of validating the products and trading partner(s). The formal way of authentication, especially digital certificates, is preferred, which is in agreement with Basu and Muylle (2003a). The same authors argue that there is no common mechanism for product authentication. Next to that, Basu and Muylle (2003b) find that authentication is mostly done without using digital technologies. In the mean time, this could already have changed. However, no paper was found that confirms/contests these statements.

The valuation process uses many of the digital technologies used in the search process, such as **electronic catalogs and online brokers**. It is clear that both search and valuation processes are closely linked to each other. A widely used valuation mechanism is an **online auction**. Online auctions have many advantages, as the reader can see in Table 4.4, and they can also provide payment and logistics capabilities. According to Pinker et al. (2003), online auctions could potentially damage long-term buyer-supplier relationships, since they increase both the potential buyer and supplier base. It is not clear whether this is the case in practice, and should be further investigated. Trust and quality issues are reducing over the years, as online auctions are increasingly being complemented by e.g. **feedback mechanisms** (Ba & Pavlou, 2002). However, price transparency still seems to be a matter of considerable concern for suppliers in reverse/procurement auctions, due to competitors gaining insight into their price/cost structure, corresponding with Zhu (2004). To summarize, in agreement with Sankaranarayanan and Sundararajan (2010), nowadays price information is not at all difficult to obtain.

In comparison with the other trade processes, there was less research to be found on payment. Perhaps this is because there are already some web-enabled tools in place that are very good for this purpose, and that are an accepted technology among business users. A more appropriate reason is the fact that mostly, payment still happens via traditional payment methods such as bank transfers or physical delivery of cash. This is a bit counterintuitive, since most customers - private or business - have no legitimate trust issues in using the Internet for financial settlements. It is also common for businesses to outsource their financial activities to intermediaries that take care of the process. Next to that, **micropayments and scrip payment systems** are mentioned in the literature overview. However, these systems are probably not much used in B2B transactions, as transactions mostly involve large payment sums. Further research should be conducted on the findings of Basu and Muylle (2003b) that high-cost product industries are increasingly adopting online payment technologies.

In opposition to what was expected, it was hard to find research about digital technologies in the logistics process. One possible explanation could be the fact that the research was mainly restricted to journals such as MISQ, JMIS, ISR etc. These journals do not contain as many logistic-related articles than other journals that were not examined. Nevertheless, the emergence of the Internet and related technologies has a huge impact on the logistics world. Inefficiencies are being tackled, lead time is reducing and responsiveness is increasing (Rosenzweig & Roth, 2007). Clarke (1998) came up with the term **virtual logistics**, however, no further research was found about this topic. It is doubtful if the term virtual logistics is still used. Order tracking functionalities via the Internet, automatic replenishment and routing software all improve customer service. **RFID** has been a very important technology that revolutionized the logistics industry. Although the core of RFID is not particularly Internet-related, it uses the Internet to connect with other systems, such as databases and wireless devices. An **integrated logistics information management system** (ILIMS), which also includes RFID, can offer tremendous opportunities. ILIMS, ARP programs such as VMI, SCM systems, QR technologies etc. all have one thing in common: collaboration. Collaboration is a must to deliver outstanding results. Next to that, companies seem to outsource the logistics process to specialized **intermediaries**, such as third party logistics providers. In this way they can focus on their core competences.

Reflecting on all trade processes discussed here, one thing is particularly clear: transaction costs, including processing and coordination cost, can significantly decrease by employing digital technologies. They can achieve considerable time savings. Routine and administrative tasks can be automated, which allow the company to focus on value-adding activities and strategic opportunities.

4.1.4 Technologies specific to decision support processes

As you can see in Table 4.1, there are less technologies for configuration than for other processes. In general, finding papers that focus on configuration was challenging. Most companies have some kind of **product configuration software package** available that helps them with customization. This is needed in the present-day since buyer organizations are increasingly demanding customized products/services. In line with Forza and Salvador (2002), companies of all sizes can benefit from adopting configuration tools that more than justify the investment. There is a great amount of research on **CAD/CAM technology**, especially in journals focusing on the topic. However, these journals were not taken into consideration, and only a brief explanation was given.

There is an abundance of technologies to facilitate collaboration. Every company requires at least some form of collaboration. Next to that, all the other processes of the e-business process framework rely on collaboration, which stipulates once more its prominence. Research on **executive information systems** seems to be undertaken many years ago. Nonetheless, it is a technology that still proves to be valuable for executives and managers to support them in decision making related activities. **Groupware** and **group decision support systems** include several other collaboration tools described in the literature overview, such as **electronic conferencing**, and electronic messaging tools such as **e-mails, instant messaging apps and electronic bulletin boards**. A lot of research can be found on electronic conferencing, which goes beyond the scope of this work. A study by Warkentin et al. (1997) points out that web-based conferencing technologies don't outperform face-to-face conferences. In the past years, the collaboration technologies have evolved and offer more sophisticated and user-friendly capabilities than ever before, which makes it doubtful if this statement still holds. Support for the utility of web-based conferencing can perhaps be found in the fact that companies currently conduct business on a more international and global scale. Most likely, there will be a trend towards more use of **web 2.0 technologies** such as wikis and forums. Andriole (2010) finds that businesses adopt these mainly for internal purposes, because they are uncertain and insecure about the characteristics of these technologies. It could be an interesting avenue for future research to investigate the adoption in inter-firm interactions. There is a contradiction between Sanders (2007) and Devaraj et al. (2007), in that the former finds empirical evidence of the positive performance impact of digital technologies, while the latter don't. This is because the technology will only deliver results when it is integrated into and accepted by the organization. Hence, the difference can be explained by a dissimilar point of view on digital technologies and organizational performance. Finally, there are numerous papers to be found that discuss the performance impact of e-collaboration between buyers and suppliers, as the reader can find in the literature overview.

It was a challenge to find papers describing business intelligence, as this is a rather 'new' phenomenon. One reason for this could be the fact that there is a considerable time lag between papers published in journals and real-life technologies. Obviously, research on business intelligence technologies is still in its infancy. Not much literature research was found to support these processes. However, there is a clear trend in adopting BI technologies. The importance of **website analytics, mobile BI applications, social media platforms for BI**, etc. will only increase in the future. BI requires specialized knowledge and expertise, which is why most companies outsource this process to **third parties**.

To conclude this section, knowledge creation and sharing has never been so important as in the current environment. It increases visibility and coordination, supports decision making, and reduces uncertainty (Barua et al., 2004; Vakharia, 2002).

4.1.5 Technologies specific to integration processes

There is an abundance of research discussing both data and application integration aspects. The performance impact of these technologies can be found in Table 4.5 and 4.6. Data integration can significantly improve performance, which is in agreement with Frohlich (2002); Lancioni et al. (2000); Gunasekaran and Ngai (2004). Nowadays, tools such as EDI and even web-based EDI are replaced by other more efficient mechanisms, such as CPFR mentioned above. Goodhue et al. (1992) state that companies should use 'partial integration' in order to reach the benefits of data integration while avoiding the high design and implementation costs. Nevertheless, the paper is from 1992 and nowadays data integration is mostly implemented through digital technologies, which makes the entire process a lot easier. IT and digital technologies also reduce the associated costs, which once more make some of their propositions questionable.

Many companies apply application integration technologies in their operations as a result of the many benefits that **inter-organizational systems** have to offer. The performance impact of IOS systems in general is listed in Table 4.5. The specific performance aspects of CRM and SCM systems, which are types of IOS, can be found in Table 4.6. Note that all ESS systems require collaboration between the parties.

There is much controversy about the fact that web-enabled technologies can increase as well as decrease the total number of suppliers (for example, Clemons et al. (1993)). Data standards lower the need to invest specific assets in the relationship. While it is true that buyers can increase their supplier base, digital technologies will not harm (existing) relationships. Instead, they offer other possibilities and can facilitate integration. It all depends on a number of factors, such as the use of digital technologies by partners and the competitive environment.

A considerable amount of research has investigated the relationship between e-business technologies (or IT in general) and vertical integration. However, much less research was found in the field of horizontal integration.

Table 4.2: Performance impact of main shared technologies

Type of digital technology	Benefits	Drawbacks
Electronic marketplace	Aggregation[7,8] Easier and faster comparison[8,13] Increased transaction efficiency[9] Lower prices and price dispersion (buyer)[15] Matching[7,8,10] One-stop shopping[7,8] Price transparency (buyer)[13] Reduced search costs[9,15] Time savings (negotiation)[7]	Adoption costs[10] Distrust[11] Information transparency issues[12] Lower margins (seller)[13] Price competition (seller)[13] Price transparency (seller)[13] Privacy issues[11] Reduced market power (seller)[13] Switching costs[10]
Web-based procurement system	Broader tender opportunities (seller)[5,14] Centralized control[4] Convenience[6] Faster payment[4] Higher sales volume (supplier)[4] Improved delivery[5,6] Improved order completion process[4] Improved quality[5] Improved service[6] Improved security[6] Less errors[4] Lower tender submitting costs (seller)[5,14] Reduced coordination costs[4] Reduced inventory costs[4] Reduced processing costs[4] Reduced procurement costs[4,5,14] Time savings (coordination, lead time)[4]	High implementation costs[6]
Website	Customization[2] Easier comparison[3] Improved customer service[1] Increased efficiency[1] Increased sales[1,12] Real-time information[1] Reduced costs[1]	

[1] (Ba & Johansson, 2008)
[2] (Oliveira & Roth, 2012)
[3] (Mishra & Agarwal, 2010)
[4] (Chandrasekar & Shaw, 2002)
[5] (Timmers, 1998)
[6] (Boyer & Olson, 2002)
[7] (Kaplan & Sawhney, 2000)
[8] (Malone et al., 1987)
[9] (Strader & Shaw, 1997)
[10] (Yoo et al., 2002)
[11] (Kalvenes & Basu, 2006)
[12] (Zhu, 2004)
[13] (Bakos, 1997)
[14] (H. L. Lee & Whang, 2004)
[15] (Ghose & Yao, 2011)

Table 4.3: Performance impact of main shared technologies (continued)

Type of digital technology	Benefits	Drawbacks
CPFR	Direct material flows[5] Higher fill rates (supplier)[4,5] Higher service levels (buyer)[5] Improved forecast accuracy[5] Increased sales[4,5] Lower system expenses[5] Reduced capacity requirements (supplier)[5] Reduced inventory levels[4,5] Reduced inventory obsolescence[5] Reduced supply chain cost[4] Reduced uncertainty[4] Time savings[4,5]	Fear of collusion[5] Lack of internal forecast collaboration[5] Resource requirement[4] Implementation cost[5] Trust issues[5]
Mobile applications	Ability to handle emergencies[3] Flexibility[3] Improved decision making[2] Improved productivity[2,3] Increased customer satisfaction[2] Increased efficiency[1,3] New interaction channel[1] Notification ability[3] Portability[1,3] Reduced operational costs[2]	Limited keyboard[3] Smaller screens[3] Usability issues[3]

[1] (Leung & Antypas, 2001)
[2] (Varshney et al., 2004)
[3] (Gebauer & Shaw, 2004)
[4] (Aviv, 2001)
[5] (Fliedner, 2003)

Table 4.4: Performance impact of main trade technologies

Type of digital technology	Benefits	Drawbacks
E-catalog	Customization[1,4]	Implementation costs[3]
	Easier and faster comparison[2]	Set-up effort[3]
	Higher range of items (buyer)[5]	
	Higher supplier base (buyer)[5]	
	Reduced procurement costs[3]	
	Time savings[3]	
Online auction	Easier data collection[10]	Lack of market liquidity (practice)[11]
	Easier product/service description[7,8]	Price transparency (seller)[11]
	Higher production capacity utilization[8]	Privacy issues[7]
	Higher supplier/customer base[7,8,10]	Quality issues[7]
	Location independent[10]	Trust issues[7]
	Lower prices[8]	
	Market liquidity (theory)[4,9]	
	Matching[4,9]	
	Price transparency (buyer)[10]	
	Reduced inventory cost (seller)[8]	
	Reduced procurement cost (buyer)[8]	
	Reduced sales cost (seller)[8]	
	Reduced transaction cost[6,7,8]	
	Time independent[10]	
	Time savings[6,7]	

[1] (Ba & Johansson, 2008)
[2] (Mishra & Agarwal, 2010)
[3] (Rajkumar, 2001)
[4] (Qizhi & Kauffman, 2002)
[5] (Chandrasekar & Shaw, 2002)
[6] (S. Klein, 1997)
[7] (S. Klein & O'Keefe, 1999)
[8] (Timmers, 1998)
[9] (Kauffman & Walden, 2001)
[10] (Pinker et al., 2003)
[11] (Zhu, 2004)

Table 4.5: Performance impact of main integration technologies

Type of digital technology	Benefits	Drawbacks
IBPS	Improved coordination[7,8] Improved relational depth[6] Increased clarity[9] Increased operational efficiency[7,8,9] Information creation and sharing[7,8,11] Partnering flexibility[7,8] Reduced costs[7,8,10] Reduced integration cost[5] Reduced opportunism[6] Reduced process variation[8] Reduced transaction errors[8,9] Relationship extendability[6] Synchronization[8] Time savings[7,8]	Effort[6] Expertise requirement[6] Lower local flexibility[12] Process restructuring[6] Resource requirement[6]
Web-based EDI	Improved productivity[19] Increased coordination[18] Increased customer satisfaction[18,19] Increased operational efficiency[18] Increased process performance[18] Interoperability of standards[19] Real-time information exchange[19] Reduced processing cost[18,19] Reduced switching cost[2,3,18]	Data exposure risk[4] Implementation risks[1] Opportunism[4]
Web-based IOS	Improved coordination[13,14] Improved customer service[15] Improved delivery reliability[13,14] Improved inventory management[17] Increased process efficiency[13] Information sharing[13,14] Reduced coordination cost[13,15,17] Reduced errors[13,14] Reduced processing cost[13,15] Reduced safety stock requirement[13,14] Reduced variability[13,14] Sourcing leverage[13] Time savings[17]	Mutual commitment[16] Resource requirement[16] Set-up cost[16] Switching cost[16]

[1] (Riggins & Mukhopadhyay, 1999)
[2] (Porter, 2001)
[3] (Bons et al., 1998)
[4] (Zhu, 2004)
[5] (Rai & Tang, 2013)
[6] (Bala & Venkatesh, 2007)
[7] (Malhotra et al., 2005)
[8] (Gosain et al., 2003)
[9] (Venkatesh & Bala, 2012)
[10] (Sankaranarayanan & Sundararajan, 2010)
[11] (Qizhi & Kauffman, 2002)
[12] (Goodhue et al., 1992)
[13] (Saeed et al., 2005)
[14] (Guo et al., 2006)
[15] (Subramani, 2004)
[16] (Grover & Saeed, 2007)
[17] (Frohlich, 2002)
[18] (Downing, 2002)
[19] (Angeles, 2000)

Table 4.6: Performance impact of main integration technologies (continued)

Type of digital technology	Benefits	Drawbacks
CRM system	Higher customer satisfaction[3,4] Increased customer loyalty[3,4] Increased financial performance[4] Increased sales[3,4] Less errors[1,2] Less paperwork[1,2] Smaller sales force (supplier)[1,2]	
SCM system	Improved communication[5] Improved financial performance[4] Improved inventory visibility[5] Improved supplier reliability[5] Increased bargaining power (buyer)[6] Increased competitive performance (supplier)[6] Increased financial performance[4] Reduced cost[5] Reduced imitation risk (supplier)[6] Reduced uncertainty[4] Time savings[5]	Increased effort (supplier)[6] Increased relationship specific investment (supplier)[6] Less bargaining power (supplier)[6]

[1] (Johnston & Vitale, 1988)
[2] (Weill & Vitale, 2001)
[3] (Ariely, 2000)
[4] (Barua et al., 2004)
[5] (Frohlich & Westbrook, 2002)
[6] (Subramani, 2004)

4.1.6 Digital technologies in general

In Table 4.7, the performance impact of web-enabled technologies is depicted. It is remarkable how many papers discuss the performance impact, while less research can be found on the type of digital technologies used. Harland et al. (2007) find several potential barriers to the adoption of digital technologies. However, as already mentioned, digital technologies can create and sustain competitive and strategic advantage. This makes it questionable that barriers such as lack of awareness of possible benefits or lack of strategic alignment are still significant. Most likely companies' perceptions are changed by now, and nearly all have accepted the benefits of any form of digital technology.

Furthermore, Harland et al. (2007) state that larger downstream firms make more use of digital technologies than upstream SMEs; while Zhu and Kraemer (2005) discover the opposite, due to structural inertia of the larger firm. Since larger firms have more connections with other firms, and thus can achieve economies of scale, employing digital technologies will most likely be higher. There is also a higher chance of justification of the investment(s).

Unlike most studies available in the literature, N. G. Carr (2003) argues that IT doesn't make a difference. He claims that IT cannot create or sustain a competitive advantage since it is widely available to nearly all companies in today's business world. There is much research to be found on the so-called **IT paradox**. However, this dissertation does claim that IT can improve performance by a considerable amount, which is supported by all the potential benefits (Table 4.7).

Most of the time, companies use a combination of different digital technologies instead of focusing on just one. Often a digital technology interacts or is complemented by other tools. For example, websites, electronic marketplaces, web-based procurement systems all provide online catalogs. Likewise, e-marketplaces and web-based procurement systems also offer auction capabilities and electronic requirement determination tools.

Finally, most research studies are based on underlying theories. Some theories are used many times, such as the Resource Based View (RBV), the relational view of the firm, and Transaction Cost Economics/Analysis (TCE/TCA).

Table 4.7: Performance impact of digital technologies in general

Benefits	Drawbacks
Advanced customization[2,3]	Asset-specific investment[8,10]
Advanced innovativeness[17]	Coordination difficulties (inter-firm)[18]
Better information access and sharing[3,6]	Data confidentiality issues[11]
Better matching[2]	Data quality and flow issues[18]
Better (systems) quality[1,17]	Difficulty managing new processes[18]
Easier collaboration[6]	Lower search cost seller)[1]
Elimination of non-value-adding activities[12]	Need for effective change management[18]
Faster decision making[7]	Opportunism[11]
Improved coordination[12,15,16]	Process restructuring[10]
Improved employee satisfaction[15,16]	Scalability issues[18]
Improved inventory control (seller)[3]	
Increased efficiency[1,2,3,8]	
Increased flexibility[3,4]	
Increased number of alternatives[1]	
Increased sales (seller)[2]	
Information transparency[11]	
Lower prices[1]	
Lower costs (advertising, coordination, communication, information, processing, search)[1,5,9,12,13,14]	
Reduced uncertainty[12]	
Smaller batch size (indirectly)[7]	
Strategic sourcing opportunity (seller)[2]	
Synergy[15,16]	
Time savings (buyer and seller)[1,2,7,12]	

[1] (Mishra et al., 2007)
[2] (Zhu & Kraemer, 2005)
[3] (Lederer et al., 2001)
[4] (H. L. Lee & Whang, 2004)
[5] (Aral et al., 2017)
[6] (Devaraj et al., 2007)
[7] (Cachon & Fisher, 2000)
[8] (R. Klein & Rai, 2009)
[9] (Chopra, Dougan, & Taylor, 2001)
[10] (Rosenzweig, 2009)
[11] (Zhu, 2004)
[12] (Frohlich, 2002)
[13] (Malone et al., 1987)
[14] (Clemons et al., 1993)
[15] (Standing & Lin, 2007)
[16] (Delone & Mclean, 2004)
[17] (Overby & Min, 2001)
[18] (Barratt & Oliveira, 2001)

Chapter 5

Conclusion

5.1 Context

This master dissertation is a blend of buyer-supplier relationships and digital technologies. It combines the two to investigate the potential impact digital technologies can have on the interaction between a buyer and a supplier firm. Do they make effective use of digitization, or are they better off? Furthermore, which specific technologies are applied and to what ends? This thesis gives answers on all of the questions above, with the e-business process framework as a guideline.

5.2 Final answers to the research questions

The following research questions were stated in Chapter one of this work:

- What is the state of the literature on the technology use within and across companies in each of the e-business processes of the framework?
- What is the performance impact of the main digital technologies found in the sub-processes?

The answer to the main research question can be found in Table 4.1. This table provides the reader with a complete overview of all digital technologies used within and across companies. As can be seen, there is an abundance of digital technologies available to be employed in each process. Whether the company wants to facilitate transactions, make better business decisions, or integrate their processes with partners, digital technologies create value along the way.

Previous literature has tried to give an indication of the digital technology use in organizations, and has provided extensive research on all topics related to e-business. However, few - if any - give a complete overview of all the technologies existing in today's market. Rather, they tend to focus on a few particular technologies and discuss potential performance impacts on the organization and its environment.

The benefits and drawbacks of the main digital technologies are shown in Table 4.2 to 4.6. These are CPFR, data standards and inter-organizational business process standards, electronic catalogs, electronic marketplaces, mobile applications, online auctions, web-based EDI, web-based IOS (including CRM and SCM systems), web-based procurement systems, and websites. Next to that, the performance impact of digital technologies as a construct is shown in Table 4.7.

One thing that is particularly clear is the fact that companies that are not revolutionizing their businesses by means of digital technology are at a significant competitive disadvantage. Digital technologies have an enormous positive influence on all of the processes: trade, decision support and integration. The business landscape is not the same as it was before.

5.3 Methodology

The master dissertation started off with an investigation of potential relevant papers in both technological and economic journals. The papers are aggregated into a table according to the journal to which the respective paper belongs. Table 7.1 in the Appendix gives an overview of the investigated papers, which shape the foundation for the literature review.

5.4 Limitations and future directions

This thesis has several limitations. First, the e-business process framework is not always applicable, in that some technologies overlap boundaries of the different processes and sub-processes. Perhaps the distinction between search and valuation is not really useful, since the price can often be discovered in the search process. Next to that, the same digital technologies are often part of both processes. Thus, a recommendation is made to the authors to consider the possibility to merge them into one construct. Configuration and collaboration could also be combined, as collaboration between the buyer and supplier is necessary in order to configure the products/services.

Furthermore, knowing to which process the digital technology belonged is a challenge from time to time. For example, there is a thin line between collaboration and integration, since integration requires extensive collaboration. Hence, it is possible that the reader has a different point of view on the categorization provided in this work.

Third, and possibly the most significant limitation, the literature review is based on papers that are published a relatively long time ago. There seems to be a considerable time lag between the literature and reality. Next to that, every now and then there is a time lag between when the paper was submitted and when it was published.

Fourth, it is possible that there are digital technologies to be found in reality that are not classified in one or more of the e-business processes. This dissertation tries to give a complete overview, however, it is possible that the list is not entirely exhaustive.

Furthermore, some topics are not discussed in depth due to their large scope.

Finally, no distinction is made between products and services. The dissertation mostly focuses on products, since few studies are to be found investigating technology use in services.

There are numerous interesting topics for future research. A complete list can be found below.

- Are online auctions damaging the long-term buyer-supplier relationship?
- Investigation of business intelligence technologies at a higher level of detail.
- Investigation of digital technology use in integration by means of extending the buyer-supplier dyad to more members. After all, the more participants, the more benefits can be reached from the technologies.
- Investigation of the adoption of online payment instruments. Is there a change for the better?
- Investigation of the barriers to digital technology adoption. Are larger firms adopting digital technologies at a higher rate than SMEs?
- Investigation of the use of and trust in machine intermediaries, such as intelligent agents and shopbots.
- Is there already a common digital tool for product authentication? And how much are digital technologies used in all authentication mechanisms?
- To what extent are digital technologies used in the service sector?
- To what extent are mobile applications used for complex business tasks and what is the perception of employees?

- To what extent can social media and other web 2.0 technologies be used in business interactions?

This master thesis can serve as a kind of guideline for dissertations of future master students, in that the digital technologies mentioned in each and all of the e-business processes can be used in setting up clear, well-structured and focused questions for interview-related purposes.

5.5 Final remarks

Some of these technologies seem all too common in today's world, yet not so many years ago they were disrupting the business landscape. To some of us, e-mail, web-based conferencing, and so forth may seem self-evident/obvious ways of communicating. This master dissertation tries - to the best of my knowledge - to 'draw the whole picture' of existing digital technologies in the business world as we know it today.

Companies shouldn't stick to old ways of conducting business, but should recognize the potential value new digital technologies could bring for their company and their partners, thereby overcoming internal/external barriers to adoption. Out with the old, in with the new. Next to that, companies continuously need to reinvent themselves in order to stay ahead of the competitors. The quest for digital technologies continues...

Chapter 6

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Chapter 7

Appendix

Table 7.1: List of papers and corresponding journals

Reference -Journal	Title	TR	DS	INT	Sub-processes
(Chaudhuri et al., 2011) -CACM	An overview of business intelligence technology		X		Business intelligence
(Glushko et al., 1999) -CACM	An XML framework for agent-based e-commerce	X		X	Search Data integration
(Basu & Muylle, 2003a) -CACM	Authentication in e-commerce	X			Authentication
(Andriole, 2010) -CACM	Business impact of web 2.0 technologies		X		Collaboration
(Malone et al., 1987) -CACM	Electronic markets and electronic hierarchies	X	X	X	Search Payment Configuration Collaboration Data integration Application integration
(Ellis et al., 1991) -CACM	Groupware: some issues and experiences		X		Collaboration

Reference -Journal	Title	TR	DS	INT	Sub-processes
(Kumar, 2001) -CACM	Technology for supporting supply chain management			X	Data integration Application integration
(Vakharia, 2002) -DS	E-Business and supply chain management			X	Application integration
(Frohlich, 2002) -DS	E-Integration in the supply chain: barriers and performance			X	Data integration Application integration
(Saeed et al., 2005) -DS	Examining the impact of inter-organizational systems on process efficiency and sourcing leverage in buyer-supplier dyads	X		X	Search Application integration
(Kendall, 1997) -DS	The significance of information systems research on emerging technologies: seven information technologies that promise to improve managerial effectiveness		X		Collaboration
(Yao et al., 2007) -DSS	An inter-organizational perspective on the use of electronically-enabled supply chains			X	Application integration
(Strader & Shaw, 1997) -DSS	Characteristics of electronic markets	X			Search Authentication Valuation
(M. Chen et al., 2007) -DSS	Empowering collaborative commerce with Web services enabled business process management systems		X	X	Collaboration Data integration Application integration
(Bajwa et al., 1998) -DSS	Key antecedents of executive information system success: a path analytic approach		X		Collaboration
(Muylle & Basu, 2008) -DSS	Online support for business processes by electronic intermediaries	X	X	X	All sub-processes
(Basu & Muylle, 2003b) -DSS	Online support for commerce processes by web retailers	X			Search Authentication Valuation Payment Logistics
(Meire et al., 2017) -DSS	The added value of social media data in B2B customer acquisition systems: A real-life experiment		X		Business intelligence

Reference -Journal	Title	TR	DS	INT	Sub-processes
(Basu & Muylle, 2011) -ECRA	Assessing and enhancing e-business processes	X	X	X	All sub-processes
(Gunasekaran & Ngai, 2004) -EJOR	Information systems in supply chain integration and management	X		X	Logistics Data integration Application integration
(Kaplan & Sawhney, 2000) -HBR	E-hubs: the new B2B marketplaces	X			Search
(A. McAfee & Brynjolfsson, 2008) -HBR	Investing in the IT that makes a competitive difference		X		Configuration Collaboration
(Browne & Zhang, 1999) -IJAMS	Extended and virtual enterprises - similarities and differences			X	Data and Application integration
(Chandrasekar & Shaw, 2002) -IJEC	A study of the value and impact of B2B e-commerce: the case of web-based procurement	X	X	X	Search Configuration Application integration
(Ranganathan et al., 2004) -IJEC	Assimilation and diffusion of web technologies in supply-chain management: an examination of key drivers and performance impacts			X	Data integration Application integration
(Qizhi & Kauffman, 2002) -IJEC	Business models for internet-based B2B electronic markets	X	X	X	Search Valuation Payment Logistics Business Intelligence Data integration Application integration
(Kauffman & Walden, 2001) -IJEC	Economics and electronic commerce: survey and directions for research	X		X	Search Authentication Valuation Payment Data integration

Reference -Journal	Title	TR	DS	INT	Sub-processes
(Vladimir, 1996) -IJEC	Electronic commerce: structures and issues	X	X	X	Search Authentication Payment Collaboration Application integration
(Delone & Mclean, 2004) -IJEC	Measuring e-commerce success: Applying the DeLone and McLean information systems success model	X	X	X	All sub-processes (general)
(Standing & Lin, 2007) -IJEC	Organizational evaluation of the benefits, constraints, and satisfaction of business-to-business electronic commerce	X	X	X	All sub-processes (general)
(Chircu & Kauffman, 2000) -IJEC	Reintermediation strategies in business-to-business electronic commerce	X		X	Search Authentication Valuation Logistics Data integration
(Gebauer & Shaw, 2004) -IJEC	Success factors and impacts of mobile business applications: results from a mobile e-procurement study	X	X		Authentication Payment Configuration
(Lederer et al., 2001) -IJEC	The search for strategic advantage from the World Wide Web	X			Search
(Vanpoucke et al., 2017) -IJOPM	Leveraging the impact of supply chain integration through information technology			X	Data integration
(Clarke, 1998) -IJPDLM	Virtual logistics: An introduction and overview of the concepts	X			Logistics
(Lancioni et al., 2000) -IMM	The role of the Internet in Supply Chain Management	X			Logistics
(Rajkumar, 2001) -ISM	E-procurement: business and technical issues	X			Search
(Venkatesh & Bala, 2012) -ISR	Adoption and impacts of interorganizational business process standards: Role of partnering synergy		X	X	Data and Application integration

Reference -Journal	**Title**	**TR**	**DS**	**INT**	**Sub-processes**
(Mishra et al., 2007) -ISR	Antecedents and consequences of internet use in procurement: an empirical investigation of US manufacturing firms	X		X	Search Data integration
(Bala & Venkatesh, 2007) -ISR	Assimilation of inter-organizational business process standards			X	Data and Application integration
(Ray et al., 2009) -ISR	Competitive environment and the relationship between IT and vertical integration			X	Application integration
(Sankaranarayanan & Sundararajan, 2010) -ISR	Electronic markets, search costs, and firm boundaries	X		X	Search Application integration
(Saraf et al., 2007) -ISR	IS application capabilities and relational value in interfirm partnerships			X	Data and Application integration
(Malhotra et al., 2007) -ISR	Leveraging standard electronic business interfaces to enable adaptive supply chain partnerships		X	X	Business Intelligence Data integration
(Zhu & Kraemer, 2005) -ISR	Post-adoption variations in usage and value of e-business by organizations: cross-country evidence from the retail industry	X	X	X	All sub-processes (general)
(Banker, Kalvenes, & Patterson, 2006) -ISR	Research Note—Information Technology, Contract Completeness, and Buyer-Supplier Relationships	X	X	X	All sub-processes (general)
(Rai & Tang, 2013) -ISR	Research commentary—information technology-enabled business models: a conceptual framework and a coevolution perspective for future research		X		Collaboration
(Dong et al., 2009) -ISR	Research note—information technology in supply chains: The value of it-enabled resources under competition			X	Data integration
(Mishra & Agarwal, 2010) -ISR	Technological frames, organizational capabilities, and IT use: an empirical investigation of electronic procurement	X	X		Search Business Intelligence
(Ghose et al., 2007) -ISR	The impact of Internet referral services on a supply chain	X	X		Valuation Collaboration

Reference -Journal	**Title**	**TR**	**DS**	**INT**	**Sub-processes**
(Ghose & Yao, 2011) -ISR	Using transaction prices to re-examine price dispersion in electronic markets	X			Valuation
(Palmer, 2002) -ISR	Website usability, design, and performance metrics	X			Search
(Daniel et al., 2004) -JEIM	Exploring the role of third parties in inter-organizational Web service adoption			X	Data and Application integration
(Yoo et al., 2002) -JMIS	A model of neutral B2B intermediaries	X			Search Valuation
(Hong et al., 2002) -JMIS	Determinants of user acceptance of digital libraries: an empirical examination of individual differences and system characteristics	X			Search
(Son & Benbasat, 2007) -JMIS	Organizational buyers' adoption and use of B2B electronic marketplaces: efficiency-and legitimacy-oriented perspectives	X			All sub-processes (general)
(Clemons et al., 1993) -JMIS	The impact of information technology on the organization of economic activity: the "move to the middle" hypothesis		X	X	Collaboration Data and Application integration
(Grover & Saeed, 2007) -JMIS	The impact of product, market, and relationship characteristics on inter-organizational system integration in manufacturer-supplier dyads			X	Application integration
(Cannon & Perreault Jr, 1999) -JMR	Buyer-seller relationships in business markets	X	X	X	All sub-processes (general)
(Ansari & Mela, 2003) -JMR	E-Customization		X		Configuration
(Rosenzweig, 2009) -JOM	A contingent view of e-collaboration and performance in manufacturing		X		Collaboration

Reference -Journal	**Title**	**TR**	**DS**	**INT**	**Sub-processes**
(Sanders, 2007) -JOM	An empirical study of the impact of e-business technologies on organizational collaboration and performance		X	(X)	Collaboration
(Harland et al., 2007) -JOM	Barriers to supply chain information integration: SMEs adrift of eLands	X		X	Search Data integration
(Rosenzweig & Roth, 2007) -JOM	B2B seller competence: construct development and measurement using a supply chain strategy lens	X	X		Logistics Collaboration
(R. Klein, 2007) -JOM	Customization and real time information access in integrated eBusiness supply chain relationships			X	Data integration
(Frohlich & Westbrook, 2002) -JOM	Demand chain management in manufacturing and services: web-based integration, drivers and performance			X	Application integration
(Devaraj et al., 2007) -JOM	Impact of eBusiness technologies on operational performance: the role of production information integration in the supply chain		X	X	Collaboration Data integration
(A. S. Carr & Pearson, 1999) -JOM	Strategically managed buyer-supplier relationships and performance outcomes	X	X		Authentication Collaboration
(Power & Singh, 2007) -JOM	The e-integration dilemma: The linkages between Internet technology application, trading partner relationships and structural change		X	X	Collaboration Data integration Application integration
(Xue et al., 2013) -JOM	The impact of supply-side electronic integration on customer service performance			X	Application integration
(Benton & Maloni, 2005) -JOM	The influence of power driven buyer/seller relationships on supply chain satisfaction			X	Data and Application integration (general)
(I. J. Chen & Paulraj, 2004) -JOM	Towards a theory of supply chain management: the constructs and measurements		X		Collaboration

Reference -Journal	Title	TR	DS	INT	Sub-processes
(P. F. Johnson, Klassen, Leenders, & Awaysheh, 2007) -JOM	Utilizing e-business technologies in supply chains: the impact of firm characteristics and teams	X	X	X	All sub-processes (general)
(Bhatt & Emdad, 2001) -LIM	An analysis of the virtual value chain in electronic commerce	X	X	X	All sub-processes (general)
(Alshawi, 2001) -LIM	Logistics in the Internet age: towards a holistic information and processes picture	X	X		Logistics Configuration Collaboration
(Desanctis & Gallupe, 1987) - MaSc	A foundation for the study of group decision support systems		X		Collaboration
(Kalvenes & Basu, 2006) -MaSc	Design of robust business-to-business electronic marketplaces with guaranteed privacy	X			All trade processes
(Yoo, Choudhary, & Mukhopadhyay, 2007) -MaSc	Electronic B2B marketplaces with different ownership structures	X	X	X	All sub-processes (general)
(Aral et al., 2017) -MaSc	Information technology, repeated contracts, and the number of suppliers	X			Search
(Zhu, 2004) -MaSc	Information transparency of business-to-business electronic markets: A game-theoretic analysis	X			Search Valuation
(Pinker et al., 2003) -MaSc	Managing online auctions: Current business and research issues	X			Search Valuation
(Devaraj & Kohli, 2003) -MaSc	Performance impacts of information technology: is actual usage the missing link?	X	X	X	All sub-processes (general)
(Bakos, 1997) -MaSc	Reducing buyer search costs: Implications for electronic marketplaces	X			Search Valuation
(Mukhopadhyay & Kekre, 2002) -MaSc	Strategic and operational benefits of electronic integration in B2B procurement processes			X	Application integration

Reference -Journal	**Title**	**TR**	**DS**	**INT**	**Sub-processes**
(Aviv, 2001) -MaSc	The effect of collaborative forecasting on supply chain performance		X		Collaboration
(Dellarocas, 2003) -MaSc	The digitization of word of mouth: promise and challenges of online feedback mechanisms	X			Authentication
(Barua et al., 2004) -MISQ	An empirical investigation of Net-enabled business value		X	X	Configuration Collaboration Application integration
(Soh et al., 2006) -MISQ	Electronic marketplaces and price transparency: strategy, information technology, and success	X			Search Valuation
(Ba & Pavlou, 2002) -MISQ	Evidence of the effect of trust building technology in electronic markets: Price premiums and buyer behavior	X			Authentication Valuation
(Rai et al., 2009) -MISQ	How CIOs can align IT capabilities for supply chain relationships		X		Collaboration Business Intelligence
(Subramani, 2004) -MISQ	How do suppliers benefit from information technology use in supply chain relationships?	X		X	Payment Logistics Application integration
(R. Klein & Rai, 2009) -MISQ	Interfirm strategic information flows in logistics supply chain relationships	X	X		Logistics Collaboration
(Sambamurthy, Bharadwaj, & Grover, 2003) -MISQ	Shaping agility through digital options: reconceptualizing the role of information technology in contemporary firms	X	X	X	All sub-processes (general)
(Goodhue et al., 1992) -MISQ	The impact of data integration on the costs and benefits of information systems			X	Data integration
(Pavlou et al., 2007) -MISQ	Understanding and mitigating uncertainty in online exchange relationships: A principal-agent perspective	X			Search Authentication Payment
(Tsikriktsis et al., 2004) -POMS	Adoption of e-processes by service firms: an empirical study of antecedents	X	X	X	Search Configuration Application integration

Reference -Journal	Title	TR	DS	INT	Sub-processes
(Ba & Johansson, 2008) -POMS	An exploratory study of the impact of e-service process on online customer satisfaction	X			All sub-processes (general) Focus on search
(Boyer & Olson, 2002) -POMS	Drivers of Internet purchasing success	X			Search
(Gupta et al., 2009) -POMS	E-Business: A review of research published in Production and Operations Management (1992-2008)	X	X		Valuation Logistics Configuration Collaboration
(M. Johnson & Whang, 2002) -POMS	E-business and supply chain management: an overview and framework	X	X		Search Configuration Collaboration
(Oliveira & Roth, 2012) -POMS	The influence of service orientation on B2B e-service capabilities: an empirical investigation	X			All sub-processes (general) Focus on search
(H. L. Lee & Whang, 2004) -Springer	E-business and supply chain integration		(X)	X	Data and Application integration
(Basu & Muylle, 1999) -WECWIS	Customization in online trade processes	X			All trade sub-processes