

Underpinning the E-Business Framework: Defining E-Business Concepts and Classifying E-Business Indicators

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This article describes intermediate results of the CBS/VU project “E-business, ICT and Statistics.” The main result is a methodology for classifying indicators used to measure e-commerce and e-business. This methodology, the e-business effect matrix, consolidates developments around the widely used OECD framework of readiness, intensity and impact. The proposed framework visualizes the whole spectrum of e-business effects and can thus be used to categorize e-business indicators.

Furthermore, this article combines material on e-business and e-commerce definitions from statistical and scientific sources into a framework for defining e-business. This framework conceptually distinguishes e-commerce from e-business and can be used in discussions on standardization of definitions used to inquire e-business.

Key words: E-commerce; E-business; business processes; organisation structures; efficiency; productivity.

1. Introduction

Companies use Information and Communication Technologies (ICT) more often and more intensely than before. ICT supports traditional business processes and can be a source of new ones. Measuring new phenomena like ICT developments generally leads to research questions like “what will be the impact” and “what should be measured?” This article discusses the measurement of e-commerce and e-business by National Statistical Institutes (NSIs). Section 2 discusses how NSIs measure and define e-commerce and e-business in practise. Section 3 presents a conceptual framework of these definitions as well as a methodology for classifying indicators. Conclusions are presented in Section 4.

Systems for knowledge and supply chain management are examples of e-business systems. EDI is an e-business system that has been around for almost 30 years. It mainly standardizes the transfer of routine business documents between companies. Over the last 10 years the Internet has increased the possibilities and the visibility of e-commerce and e-business enormously. Although universities and National Statistical Institutes (NSIs) have completed a lot of research on this topic, important research questions remain unanswered. Conceptually and scientifically, the phenomenon of e-business is not fully understood yet. This black box situation is partly caused by the fact that technical systems

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can hardly be seen as stand-alone influences. ICT is often seen as a general-purpose technology (Bresnahan and Trajtenberg 1995) that can be applied in many different ways. This complex nature complicates the measurement of the effects of ICT on for instance business processes. This article focuses exclusively on ICT indicators measured by NSIs. These indicators are used for instance when studying linkages between firm ICT capital and firm performance (see e.g., OECD 2004; United Nations - UNCTAD 2003a).

In collaboration with the Vrije Universiteit Amsterdam, Statistics Netherlands (Centraal Bureau voor de Statistiek) operates a research project on measuring e-business. This project is called “E-Business, ICT and Statistics” and aims to provide a scientific basis for measuring the effects of e-business on companies. Therefore a conceptual model is being built that describes the influence of ICT and e-business on established company processes, both inside and between companies, including the important service sector (Keller, Bartelsman, and Klomp 2001). The effects of e-business on companies go beyond technical effects, which explain our emphasis on processes. Furthermore, we emphasize the service sector since this project has to cover all businesses and sectors, whereas much research so far is aimed at specific markets and industries, mostly not including services. Our research plan is built up out of several phases (Table 1.1). Phase 1 mainly consists of gathering knowledge from literature and interviews. We are currently at the beginning of phase 3, which mainly consists of gathering quantitative data on the new indicators developed. Therefore, Statistics Netherlands has sent a questionnaire to approximately a thousand Dutch companies in April 2005. Data from this questionnaire will be linked with existing data on e.g., ICT investment and firm productivity. Conclusions will be drawn in phase 4.

2. Defining and Measuring E-Commerce and E-Business in Practise

2.1. Overview

This article discusses e-commerce and e-business definitions. When we talk about e-commerce and e-business, we refer to the following concepts:

- Electronic Commerce (e-commerce) is the sale or purchase of goods or services, whether between businesses, households, individuals, governments, and other public or private organisations, conducted over computer-mediated networks. The goods and services are ordered over those networks, but the payment and the ultimate delivery of the good or service may be conducted on or off-line (after a broad definition of e-commerce transactions (OECD 2001)).

Table 1.1. Research plan

Phase	Main phase outcome
1. Theory	Literature review, theoretical model, conceptual model and measurement model
2. Case studies	Improved measurement model
3. Test survey	Business process based ICT indicators linked with ICT-investment and productivity data
4. Analysis and final report	End results

- Electronic Business (e-business) is any process that a business organization conducts over computer-mediated network channels (Atroscopic, Gates, and Jarmin 2000).

Thus we see e-commerce as a subset of e-business. Statistical institutes generally agree on e-commerce concepts, which are discussed in detail in this section. Concerning e-business broadly accepted concepts do not exist yet. Many actors including the OECD Working Party on Indicators for the Information Society (WPIIS) currently work on new concepts and definitions.

This article focuses on ICT usage of companies. Measuring ICT usage of for instance households and government (e-government) is beyond the scope of this article. Between 1995 and 2000, many developed countries started to measure aspects of e-commerce and e-business. NSIs provide part of the statistics scientists, policy makers and companies are in demand of. Statistics Netherlands was one of the pioneers in these matters and has measured ICT usage since the early 1980s. For this research, we have analyzed more recent (mostly from 2000 and on) work organizations involved in measuring e-business, such as Eurostat, the OECD, Statistics Netherlands and other conducted by NSIs.

Eurostat and the OECD publish model questionnaires on ICT usage by enterprises (Eurostat 2004). These questionnaires focus more and more on e-business. As the European statistical office, Eurostat co-ordinates the ICT usage surveys of participating countries (Community E-business Survey Initiative). Furthermore, the European Union conducts sectoral e-business surveys (e-business watch) to improve knowledge on the impact of e-business on industrial sectors (European Union 2004). Statistics Netherlands conducts an annual inquiry on ICT usage (CBS 2003), which is sent to approximately 14,000 companies. When possible this survey follows Eurostat and OECD standards.

2.2. *Classifying indicators*

In 1999 the OECD proposed the following framework for classifying indicators (Colecchia 1999):

1. **Readiness indicators** describe the technical, commercial and social infrastructures that are necessary to support e-commerce.
2. **Intensity indicators** describe the usage, volume, value and nature of electronic transactions (aiming to identify who is taking advantage of e-commerce opportunities and who is not, and to identify leading sectors and applications).
3. **Impact indicators** describe the differences made by e-commerce in terms of efficiency and/or the creation of new sources of wealth.

This conceptual framework has evolved into the current standard for classifying e-business indicators and is widely used, for instance by Eurostat (Deiss 2002) and in the OECD Technology Outlook (OECD 2002). Impact is often interpreted in a 'positive' way (e.g., increasing profits, increasing learning possibilities). We note that 'negative' impacts are also feasible (e.g., creation of dominant positions in a supply chain and possible abuse thereof, and excessive disruption of workers/firms (churning)). An analysis from NSI publications and questionnaires from Australia, Canada, Netherlands, Japan, Singapore, UK, U.S.A, and the five Nordic countries from the period 2000 – 2004 leads to the following general observations:

- Most NSI questionnaires follow - to a large extent – the model questionnaires.
- NSIs use the framework of readiness, intensity and impact either directly or indirectly to structure their e-commerce questionnaires and publications (see e.g., Infocomm Development Authority of Singapore 2002; Office for National Statistics 2003; Statistics Norway 2002; United States Department of Commerce - Economics and Statistics Administration 2003).
- In general, the term readiness has been given a very technical interpretation ignoring social and commercial aspects (see e.g., Deiss 2002).

Questionnaires contain more questions on readiness and intensity than on impact (Deiss 2002; United Nations - UNCTAD 2003b). Questions on intensity are more or less limited to the volumes of e-sales and e-procurement. This seems logical since the adoption of new technologies like e-commerce often follows an S-curve indicating that at first new technologies experience a slow adoption, followed by a period in which the new technologies are massively adapted and concluded with a slow saturation process (Nolan 1973). After the slow adoption period, data on intensities becomes increasingly interesting. ICT impacts are diverse and relate to for instance productivity and profit. For instance, the OECD proposes that such impacts be examined analytically, as opposed to measured directly. Therefore no specific impact questions are included in ICT questionnaires (OECD 2003). Instead impacts are analyzed by linking various data sets.

Again focussing solely on companies, we will analyze the OECD classification in further detail. The current OECD classification cannot unambiguously classify all existing indicators. Indicators on topics like perceived benefits and encountered barriers can be related to either readiness or intensity or impact. An extension of the OECD framework for classifying indicators with a “mindset category” seems possible. *Mindset indicators* describe the way e-business decision makers and/or users think about e-business. Some mindsets represent general thoughts on how e-business works, whereas other mindsets are more directly correlated with decision-making. Analyzing the questionnaires mentioned earlier, three kinds of mindset indicators emerge:

1. **Planning.** Mindset indicators on planning describe company plans to buy or implement certain e-business features.
Example: intentions to buy certain applications.
2. **Motives.** Mindset indicators on motives describe the benefits a company expects to perceive from buying and/or implementing certain e-business features.
Example: reasons for introducing certain technologies (e.g., higher efficiency)
3. **Barriers.** Mindset indicators on barriers describe reasons why a company does not implement (aspects of) e-business.
Example: lack of standardization, absence of trust.

Mindsets can be seen as independent research topics. On the macro level, policy measures may be based on company mindsets. On the micro level, differences between company and employee mindsets may affect change management. Another field of research is to relate mindsets with actual observed changes.

2.3. Defining e-commerce and e-business

NSIs use slightly different definitions of e-commerce. The previous mentioned paper of Colecchia describes three elements on which e-commerce definitions differ (Colecchia 1999, p. 6). Table 2.1 summarizes these elements. Compared with Table 2.1, our analysis of the NSI questionnaires and publications mentioned above discloses no further elements of difference.

E-business is not limited to procurement and sales activities. Our analysis of the NSI questionnaires shows that the element of activities contains subelements. All activities used for defining e-business can be classified into one of the following three groups:

1. **External versus internal.** Some definitions limit e-business to communication that crosses company boundaries (external). Other definitions also take internal communication into account.
2. **Processes.** Most definitions limit e-business to specified processes. Examples of processes used in e-business questionnaire definitions are transacting, collaborating and inventory management. These processes can be seen as extensions of the broad set of activities as defined by Colecchia.
3. **Phases of trade cycle.** Most definitions limit e-business to the automation of certain aspects of the trade cycle. Aspects used for limitation are e.g., order, payment, delivery, settlement, and invoice. The phases of the trade cycle can be seen as extensions of the narrow set of activities as defined by Colecchia.

In line with the Eurostat and OECD model questionnaires, Statistics Netherlands has adapted the nowadays widely accepted view that e-commerce has to do with transactions where the ordering is done electronically and the payment and delivery may be conducted offline. On lower levels of the definition of e-commerce, many technical differences between national and model questionnaires can be found. For instance, Statistics Netherlands gathers motives for network usage combining IP and non-IP networks whereas the Eurostat and OECD model questionnaires gather information on motives solely for IP-based networks.

Table 2.1 distinguishes activities, applications and communication networks. To define e-business and e-commerce conceptually, we argue that activities are a better starting point to base definitions upon than application or (technical) network characteristics, since

Table 2.1. Differences in e-commerce definitions

Element	Indication of spread
Activities	Narrow (looking at specific activities such as only retailing or electronic delivery) or broader (including most different layers of economic activity such as collaborative design, transport, advertising and more)
Network type/protocol	All possibilities, e.g., Web, EDI, and Minitel
Ownership network	All possible types of networks, e.g., open, closed, (non-)proprietary

general company activities are more stable than technological aspects of e-business. Technical components could however be needed when a definition has to be operationalized into survey questions. Also, the current divide between e-commerce and e-business is activity based with e-commerce being restricted to the activities of buying and selling. Thus general descriptions of company activities such as those of Porter's value chain model (Porter 2001) or those used by business software vendors (Markus and Tanis 2000) seem to be a good basis for e-commerce and e-business definitions. These viewpoints are supported by recent OECD work on the addition of an e-business module to their model questionnaire. In the process of developing the e-business 'model questions' the OECD identified the following processes as of common interest (Wyckoff 2003):

- Customer acquisition and retention;
- E-commerce;
- Finance, budget and account management;
- Human resource management;
- Product design and development;
- Order fulfillment and order tracking;
- Logistics (inbound and outbound) and inventory control;
- Product service and support;
- Knowledge management.

3. Frameworks for Defining and Categorizing E-Commerce and E-Business

3.1. Overview

This section discusses the definition and categorization of e-commerce and e-business indicators from a scientific perspective. Section 3.1 presents the concepts that, in our view, should be part of e-commerce and e-business definitions. The definitions presented at the beginning of Section 2 meet these conceptual demands of Table 3.1. Section 3.3 discusses the categorization of e-business indicators.

Table 3.1. Conceptually defining e-commerce and e-business

Elements of difference		E-Commerce	E-Business
Activity	internal	no	yes
	external	yes	yes
	process	transactions (buying and selling)	interactions
	phase of trade cycle	order	no restrictions
Network type / standard (internet, EDI, other)		no restrictions	no restrictions
Ownership of network (publicly owned, privately owned, other)		no restrictions	no restrictions

3.2. Definitions

Many scientific papers discuss minor aspects of e-business such as organizational learning (Tippins and Sohi 2003) or logistics (Lewis 2001) and thus avoid defining e-business as a whole. Other papers define e-business in very specific contexts such as the concept of supply chain integration, which in this case has led to the following definition of e-business: “the planning and execution of the front-end and back-end operations in a supply chain using the Internet” (Lee and Whang 2001). A paper on e-commerce metrics defines e-commerce (more broadly than we do) as “business activities conducted over the Internet” (Zhu and Kraemer 2002). Summarizing scientific literature Chaffey notes that the viewpoint where e-commerce is a subset of e-business is most realistic (Chaffey 2002).

One of the conclusions of a study of literature on e-commerce is that e-commerce has different valid definitions depending on the perspective taken (Pires and Aisbett 2002). This study uses four perspectives on e-commerce (set by Kalakota and Whinston 1997). Turban (2002) describe these four perspectives as follows:

- From a communications perspective, e-commerce is the delivery of goods, services, information, or payments over computer networks or by any other electronic means.
- From a business process perspective, e-commerce is the application of technology towards the automation of business transactions and workflow.
- From a service perspective, e-commerce is a tool that addresses the desire of firms, consumers and management to cut service costs while improving the quality of goods and increasing the speed of service delivery.
- From an online perspective, e-commerce provides the capability of buying and selling products and information on the Internet and other online services.

The above list of perspectives and descriptions is not considered to be limitative or complete. However, the perspectives do show the broadness of our work field. This research project has the very broad perspective of National Statistical Institutes. We want to define e-commerce and e-business as whole phenomena in their complete context. We do not want to define them in a specific project context. Given these assumptions, logical starting points for defining e-commerce and e-business are general business activities. Many different definitions of e-commerce and e-business exist. E-commerce is mostly defined using an electronic trade concept. Thus the scope of e-commerce is external and limited to transactions with suppliers and customers not belonging to the own company. This excludes internal transactions between for instance departments from e-commerce. E-business is often seen to go beyond the external concept of trade and also include for instance internal collaboration. Many elements of difference between e-commerce and e-business have been brought up. The element of difference of activities seems most suited and sufficient to conceptually separate e-commerce from e-business. Technical components could however be needed when a definition has to be operationalized into survey questions.

The above reasoning can be summarized in a table using the concepts of transactions and interactions:

- A **transaction** is a special kind of interaction, namely (structured) communication that leads to the transfer of information, goods and/or services of some value.

- An **interaction** is defined as the exchange of information, goods and services between two or more entities. Sometimes the word “interaction” will be denoted as (economic) activity. Transactions are a subset of interactions. Examples of interactions that are not transactions are collaboration (e.g., codesign), servicing customers, R&D, and document or knowledge management.
- **E-commerce** can be defined as the whole of transactions conducted between entities using digital communication of which the order is placed electronically. Some people use a narrower definition of e-commerce, which is limited to e-sales and excludes e-procurement. However, in this article e-commerce implies e-sales and e-procurements. Other current definitions go beyond this definition of e-commerce. They include for instance servicing customers, collaborating with business partners and conducting electronic transactions and interactions within organizations (Turban et al. 2002). We consider these aspects to be e-business rather than e-commerce, because they go beyond basic trade.
- **E-business** can be defined as business of which a part of the process is done using digital communication. So e-business does not only include transactions but also collaborative activities and other e-interactions. And where e-commerce is limited to placing an order electronically, e-business is not.

Table 3.1 summarizes definition components.

Related to these definitions, the following terms are defined:

- **Communication** is the exchange of information between two or more entities.
- In practise, most **entities** coincide with normal companies. Statistically, most entities coincide with statistical units. However, other examples of entities are enterprise groups, companies and company parts. Issues related to the construction of statistical units are beyond the scope of this article.
- **Digital communication** is communication using digital channels, i.e., transferring bits on channels (between entities).
- A **channel** is a means along which two or more entities can perform interactions. Examples of channels are the Internet, a shop, a telephone and the traditional mail system.
- A **business process** (function) is a group of activities that together support one aspect of the furthering of the mission of the enterprise (Martin 1990). For instance primary business processes like procurement, production and sales and secondary business processes like HRM and accounting may be distinguished.

The definitions presented at the beginning of Section 2 meet the conceptual demands of Table 3.1. This article opts for a conceptual distinction, not for one specific formulation of e-commerce or e-business definitions.

3.3. Classification: E-Business effect matrix

Chapter 2 describes the OECD classification of readiness, intensity and impact. In addition to this classification we present a tool that categorizes the effects of e-business on companies. Chapter 2 describes the current situation regarding measuring e-business. The spread of indicators over the three OECD categories is not in equilibrium (likely to be

caused by the fact that adoption of new technologies is S-curved) and the readiness category has been given a very technical interpretation. On the other hand, research attention is moving from technical e-business systems towards the consequences of having those systems (Deiss 2002). Two kinds of e-business impacts become visible:

1. An impact that focuses on the consequences of e-business and ICT on processes, organization structures, and communication.
2. An impact that focuses on business and strategy measures like effectiveness (profit), efficiency (costs) and customer satisfaction.

There is a clear tension between the current NSI measures and the scientific and political interests. Current available measures' technological orientation lags behind the demand for process and business effect measures of e-business. As a first step to release this tension, we present a tool can be used to classify e-business measures and indicators.

E-business is a phenomenon that provides companies with new technological possibilities. These new technologies are related to for instance new possibilities to construct information flows and business processes, which in turn are related to business outcomes. This leads to three e-business effects:

- Effects on business. On the company level, e-business usage may affect business outcomes such as products and services on the one hand and firm performance measures such as sales, costs, customer satisfaction and productivity on the other hand. We pack these effects together under the term "effects on businesses."
- Effects on processes. We consider E-business to affect among other things a) organizational structures - a collection of elements and the set of relationships that connect them (Monge and Eisenberg 1987) where elements are for instance persons, business units or whole companies, b) business processes - primary business processes like production, secondary business processes like knowledge management and information (workflow) processes about how and when information and records are moved, c) business rules - rules that state and make explicit the actions that should be taken in processes, and d) semantics – the "language" in which information and records are stored.
- Effects on technology. We consider technology use on the topics of a) infrastructure (hardware and networks), b) middleware (software to support business processes like operating systems, databases, web servers and application servers, and c) applications (software to conduct business processes such as administration, finance, and procurement).

The e-business effects can be measured in different ways. We distinguish three dimensions where information on e-business can be gained:

- Mindset. Mindset indicators describe the way e-business decision makers and/or users think about e-business (see Section 2).
- Occurrence. Questions on the actual presence and magnitudes of e-business effects.
- Value. Questions on the financial consequences of the e-business effects.

Thus technological, process and business effects can be measured in terms of three different dimensions: mindset, occurrence, and value. This leads to a matrix structure

(Table 3.2), which we name the “E-Business Effect Matrix.” Joining three effects and three dimensions leads to nine different classes of indicators.

In case studies conducted at 19 larger (more than 100 employees) Dutch companies from four sectors (manufacturing, banking and insurance, publishing, retail), we tested an e-business measurement instrument. This instrument measures “occurrence indicators” concerning technological, process and business characteristics on different organizational levels. Initial qualitative results indicate companies are able to report on different e-business aspects (e.g., standardization of data semantics, process, etc.).

In general, the E-Business Effect Matrix has two major applications:

1. It can be used to relate e-business effects and indicators. Since possibilities to change processes and business performance are related to technological possibilities, the matrix can be used to show that technological, process and business effects are related. The matrix does not show the beginning, the route and the end of causal relationships (which are likely to have a dynamic and iterative character). A demand for innovative processes or business models may pull technology into the organization, or technology may be pushed into the organization, resulting in a need to use it. Also, the combination of the nine matrix cells can be seen as a situation where technologies are used in a certain way (company or sector configuration).
2. It can be used to classify e-business indicators. The matrix joins different e-business effects with different dimensions of those effects leading to an overview of measurement areas.

To conclude this article we present an E-Business Effect Matrix with conceptual descriptions of the nine categories (Table 3.3) and an E-Business Effect Matrix with arbitrarily chosen examples of rough expressions of indicators and/or questions that could be placed in the different cells (Table 3.4).

E-business indicators are used in many fields of research. For example, indicators describing market expansion (mindset - business) or broadband rollout (technology occurrence) can be used in strategy related research. Indicators describing decentralization of work processes (occurrence – processes) can for instance be found in research of Bresnahan and others who find that increases in a firm’s IT capital stock are associated with the greatest increases in output in firms, which also have high levels of human capital or decentralized work organizations, or both (Bresnahan, Brynjolfsson, and Hitt 1999). Numerous process indicators are used in research describing for instance (dis)intermediation (e.g., Nissen 2000) and network hierarchies (e.g., Bakos and Brynjolfsson 1997).

Table 3.2. *E-Business effect matrix*

Effects of e-business on companies		Dimension of effect		
		Mindset	Occurrence	Value
Kind of effect on	Technology Processes Business			

Table 3.3. Categories of e-business indicators

Effects of e-business on companies		Dimension of effect		
		Mindset	Occurrence	Value
Kind of effect on	Technology	Thoughts on technical aspects of e-business systems	Presence and level of usage of e-business systems	Costs of e-business systems (hardware, software, networks)
	Processes	Thoughts concerning e-business systems effects on processes and/or organizational structures	Presence and level of usage of new processes and/or new organisational structures	Costs of new processes and/or organizational redesign correlated with e-business systems
	Business	Thoughts on effects of e-business on the business as a whole	Presence and level of effects of e-business on the business as a whole	Financial consequences of e-business on the business as a whole

Table 3.4. Arbitrarily chosen examples of e-business questions and/or indicators

Effects of e-business on companies		Dimension of effect		
		Mindset	Occurrence	Value
Kind of effect on	Technology	Security concerns (e.g., viruses) as barriers to usage	Standardisation of databases	Costs of internet access
	Processes	Expectations of electronic supply chain management	Reduction of time between order and delivery	Costs of knowledge management training sessions
	Business	Difficulty to recruit qualified ICT personnel	Level of management commitment	Total cost of ownership

4. Conclusions

E-Business is a relatively new phenomenon. Investigating and measuring its impact on processes both inside and outside the company is a challenge.

Concerning the definitions of e-commerce and e-business, we found that these concepts have been defined in many ways depending on the situation and perspective taken. This article combines many different definitions stemming from National Statistical Institutes and scientists into one conceptual framework. This framework of definitions demarcates the boundaries between e-commerce and e-business and can be used in discussions on the standardization of the definitions of e-business and e-commerce.

Concerning the classification of e-business indicators we see that the widely used OECD framework of readiness, intensity and impact has been very useful to describe the role of e-business in our society and economy. However, the insights regarding the different effects of e-business on companies are becoming more and more mature. We presented a tool that combines the new insights in a matrix: the E-Business Effect Matrix. This matrix considers three effects of e-business on technology, processes and business of companies. Each effect can be expressed in terms of three different dimensions. This classification will serve as a structure for the remaining work of our research project.

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