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Underpinning the eBusiness Framework - Defining eBusiness Concepts and Classifying eBusiness Indicators

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Abstract

This paper presents a framework for the classification of indicators used to measure e-commerce and e-business. This framework is presented in the so-called E-Business Effect Matrix. It consolidates developments around the widely used OECD framework of readiness, intensity and impact on the company level. The E-Business Effect Matrix visualizes the whole spectrum of e-business effects. It relates e-business techniques with business processes, organizational structures, and business performance for three different dimensions and thereby structures the research fields of 'ICT & Statistics' and 'E-business Effects'.

Furthermore, this paper combines material on e-business definitions from statistical and scientific sources into a framework for defining e-business. This framework distinguishes e-commerce from e-business and can be used in discussions on standardization of the definitions national statistical institutes (NSIs) use to inquire e-business.

1. Introduction

In collaboration with the *Vrije Universiteit Amsterdam*, Statistics Netherlands (*Centraal Bureau voor de Statistiek*) operates a research project on measuring e-business called 'E-Business, ICT and Statistics'. The research question of this project is 'How does applying e-business influence business processes, organizational structures and business performance?'. This paper discusses one of the first project outcomes namely a framework for classifying e-business indicators. The framework is presented in the E-Business Effect Matrix. This matrix can be seen as consolidating the developments around the widely used OECD framework of readiness, intensity and impact on the company level.

In order to build the E-Business Effect Matrix, work from both statistical organizations and scientists has been analyzed. Section two discusses the work of NSIs, Eurostat and the OECD on classification and definition issues. Section three first discusses e-business

definitions from a scientific viewpoint and then combines section two with the scientific sources into a conceptual framework for defining e-business. Section four first sketches the current situation around the OECD classifications of readiness, intensity and impact (applied to companies) and thereafter presents the E-Business Effect Matrix.

The work presented in this paper belongs to the research fields of 'ICT & Statistics' and 'E-business Effects'. Our arguments are drawn from both research fields.

2. Measuring eBusiness by Statistical Institutes

Between 1995 and 2000, many developed countries started to measure aspects of E-business. NSIs (national statistical institutes) provide part of the statistics that scientists, policy makers and companies are in demand of. Both Eurostat and the OECD publish model questionnaires on ICT usage by enterprises. These questionnaires focus more and more on e-business. Eurostat and the OECD also work on definitions and classifications related to e-commerce and e-business. As the European statistical office, Eurostat coordinates surveys on ICT usage of participating countries. Statistics Netherlands (CBS) also has an annual inquiry on ICT, which is sent to approximately 14 thousand companies. The CBS tries to work according to Eurostat and OECD standards.

Classifying indicators

In 1999 the OECD has proposed the following framework for classifying indicators (Colecchia, December 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.
3. **Impact indicators** describe the differences made by e-commerce in terms of efficiency and/or the creation of new sources of wealth.¹

The OECD classification is not only applied to companies, but also to households and governments. Focusing solely on companies, we will analyze the OECD classification in further detail. The OECD framework has evolved into the current standard for classifying e-commerce indicators and is widely used, for instance by Eurostat (Deiss, August 2002), NSIs and in the OECD 2002 Technology Outlook (OECD, 2002). Analyzing NSI questionnaires and publications from Australia, Canada, Netherlands, Singapore, the UK, the US and five Scandinavian countries², some comments on this classification can be made:

- NSIs use the framework of readiness, intensity and impact either directly or indirectly to structure their e-commerce questionnaires and publications.
- The term readiness has been given a very technical interpretation ignoring social and commercial aspects (see also Deiss, August 2002).

¹ Impact is often interpreted in a 'positive' way (e.g. increasing profits, increasing learning possibilities). However, 'negative' impacts are also feasible (e.g. creation of dominant positions in supply chain and possible abuse thereof, excessive disruption of workers/firms).

² (Australian Bureau of Statistics, May 2001; CBS, 2002, May 2002; Infocomm Development Authority of Singapore, March 2002; Office for National Statistics (UK), 2001; Statistics Canada, October 2000; Statistics Norway, April 2002; United States Department of Commerce' Economics and Statistics Administration' U.S. Census Bureau, August 2001, March 18 2002)

- Current e-commerce questionnaires contain more questions on readiness and intensity than on impact (see also Deiss, August 2002). Most questionnaires contain a broad spectrum of questions on readiness, while questions on intensity are more or less limited to 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 adopted and concluded with a slow saturation process.

The current OECD classification cannot unambiguously classify all 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 decision-makers and/or users of e-business 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 categories of mindset indicators emerge:

1. **Planning.** Mindset indicators on planning describe company plans to buy or implement certain e-business features.
Example: systems and/or automated business processes that are going to be used.
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. better efficiency / consumer response).
3. **Barriers.** Mindset indicators on barriers describe reasons why a company does not implement (aspects of) e-business.
Example: lack of standardization or trust.

Mindset indicators 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 hinder processes of change. Another research direction is to relate mindsets with actual observed changes.

Defining e-commerce and e-business statistically

Most NSIs use slightly different definitions of e-commerce³. The previous mentioned paper of Colecchia describes three elements on which e-commerce definitions differ (Colecchia, December 1999, p6). Table 2.1 summarizes these elements.

³ Most statistical organisations involved in measuring e-business do not explicitly distinguish between e-commerce and e-business. They mostly speak of e-commerce, also when referring to what we would call e-business. Therefore, section 2 speaks of e-commerce when discussing a source that does so. When no source is cited we will use the terms e-commerce and e-business in accordance with the definitions provided in section 3.

Table 2.1: Elements of 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

Compared to table 2.1, our analysis of the NSI questionnaires and publications mentioned above discloses no further elements of difference. However, our analysis of NSI questionnaires shows that the element ‘activities’ contains sub-elements, namely:

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

The definitions of e-commerce used by Eurostat and the OECD are given in table 2.2. The US Census Bureau explicitly distinguishes between e-commerce and e-business, which gives us a reason to include their definitions in table 2.2. Many comments on the presented definitions can be made. We restrict ourselves to noting that:

- E-commerce is limited to transacting (buying and selling) whereas e-business describes a broader concept, including for instance inventory management and production control. Also, the view that e-commerce has to do with transactions where the ordering is done electronically and the payment and delivery may be conducted offline is nowadays widely accepted, for instance by Statistics Netherlands (CBS, May 2002).
- Small differences between definitions exist. These differences may hinder country comparison, since questionnaires are mostly based on definitions. For instance, Statistics Netherlands gathers motives (mindset indicators) for using networks combining IP and non-IP networks. Eurostat and OECD model questionnaires advise to gather information on motives solely for IP-based networks. Besides, some differences lead to a sort of vagueness. For instance, Eurostat speaks of ‘non-interactive emails’, whereas it could be said that all e-mails are interactive. The Eurostat model questionnaire excludes orders via manually typed e-mails from e-commerce. However, other interpretations of the word interactive may lead to different conclusions, for instance to a distinction between non-structured e-mails and structured e-mails. Structured e-mails have fixed syntaxes and semantics and can therefore be processed automatically.

Table 2.2: Definitions

Organization	Definition
Eurostat (Eurostat, October 2001)	Electronic Commerce: “Transactions conducted over Internet Protocol-based networks and over other computer-mediated networks. The goods and services are ordered over those networks, but the payment and the ultimate delivery may be conducted on-line or off-line. Orders received via telephone, facsimile and non-interactive e-mails are not counted as electronic commerce.”
OECD (OECD, February 2002, November 2001)	“Electronic commerce refers generally to all forms of transactions relating to commercial activities, including both organizations and individuals, that are based upon the processing and transmission of digitized data, including text, sound and visual images.” The OECD also distinguishes transactions over computer mediated networks (broad) from Internet transactions (narrow).
U.S. Census Bureau (U.S. Census Bureau, June 2000; United Nations - Statistical Division, October 2000)	<p>“E-commerce is any transaction completed over a computer-mediated network that transfers ownership of, or rights to use, goods or services. Transactions occur within selected electronic business processes. Transactions are completed when the agreement between buyer and seller to transfer the ownership or rights to use goods or services occurs over computer-mediated networks. Only priced transactions will be measured.”</p> <p>“E-business is any process that a business organization conducts over computer-mediated network channels. Business organizations include any for-profit, governmental, or nonprofit entity. Examples of these processes are on-line purchasing, on-line sales, on-line logistics, customer support, employee training and recruiting, and vendor-managed inventory, production design and control.”</p>

3. Defining eBusiness

Many scientific papers discuss small aspects of e-business such as e-catalogs (Baron, Shaw et al., 2000) or procurement (Cox, 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 & Whang, November 2001). A paper on e-commerce metrics defines e-commerce as “business activities conducted over the Internet” (Zhu & Kraemer, 2002). Turban gives the following definitions of e-business and e-commerce (Turban, 2002):

- “E-commerce is an emerging concept that describes the process of buying, selling, or exchanging products, services and information via computer networks, including the Internet.”
- “E-business refers to a broader definition of E-commerce, not just the buying and selling of goods and services, but also servicing customers, collaborating with business partners, and conducting electronic transactions within an organization.”

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 & Aisbett, August 2002). This study uses four perspectives on e-commerce (set by Kalakota & Whinston, 1997). Turban (Turban, 2002) describes 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 mentioned perspectives and definitions are not considered to be complete or accurate. However, they do show the broadness of our work field. Most scientific definitions are so focused on one particular aspect of company automation that they lack the generality needed by NSIs. NSI definitions have been discussed in section 2. Based on both statistical and scientific sources we will provide starting points for standardizing e-business definitions. We will summarize statistical and scientific sources into a framework of definitions that demarcates the boundaries between e-commerce and e-business. We aim at distinguishing e-commerce from e-business rather than at giving full descriptions of the two areas. Our definitions will be described in text and illustrated in a table. They suffer the usual weaknesses associated with generality, like lack of specificity and low richness of detail. However, they give insight and may support the process of standardization.

Summarizing our sources into a framework of definitions, the following assumptions have been made:

- E-commerce is a subset of e-business. E-commerce is defined using the concept of trade. E-business is seen to go beyond trade and to include other business processes as well.
- Table 2.1 distinguishes activities, applications and communication networks. However, in our view the type of network (EDI, Internet, other) and the ownership structures (privately owned, public good, other) have no fundamental impact on the activities taking place. Activities and processes provide a firmer basis to define e-business than the technology used⁴.
- Kalakota & Whinston describe the service perspective. Service is only one of the aspects that can be improved by e-business. Such aspects should not be included in definitions.

Given these assumptions, definitions of e-commerce and e-business can be constructed in the following way:

- 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

⁴ Internet and other computer mediated networks may be measured separately, but this does not influence e-business and e-commerce definitions

interactions that are no transactions are collaboration (e.g. co-design), servicing customers, R&D, and document or knowledge management.

- E-commerce is 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 paper e-commerce implies e-sales and e-procurements. Other 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, 2002). We consider these aspects to be e-business rather than e-commerce, because they go beyond trade.
- E-business is 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. Where e-commerce is limited to placing an order electronically, e-business is not.

Table 3.1 gives a summarization of these definitions.

Table 3.1: Defining eCommerce and e-Business

Elements of difference		e-commerce	e-business
Activity	Internal	no	yes
	External	yes	yes
	Process	transactions	interactions
	phase of trade cycle	order	no restrictions
Network type / protocol (Internet, EDI, other)		no restrictions	no restrictions
Ownership of network (publicly owned, privately owned, other)		no restrictions	no restrictions

Related to these definitions, the following terms are defined:

- **Communication** is the exchange of information between two or more entities.
- **Digital communication** is communication using digital channels (transferring bits on channels).
- An **entity** is an economic agent. As entities we discern companies, governments and consumers.
- 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.
- An **enterprise function** is a group of activities that together supports one aspect of the furthering of the mission of the enterprise. **Processes** are specified activities in enterprises that are executed repeatedly (Martin, 1990). We use the term **business process** interchangeably for business functions and processes.

4. The eBusiness Effect Matrix

This section first sketches the current situation around the OECD classifications of readiness, intensity and impact (applied to companies) and thereafter the E-Business Effect Matrix is presented.

Classifying e-business indicators nowadays

Section 2 describes the current OECD classification tool of readiness, intensity and impact. 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, August 2002). Two kinds of e-business impacts become visible:

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

There is a clear tension between the current NSI measures and the scientific and political interests. As a first step to release this tension, we present a tool that gives an overview of the different impacts e-business has on companies. This tool can be used to classify e-business measures and indicators, thereby providing insight in possible new areas of measurement and/or research.

The eBusiness Effect Matrix

E-Business provides companies with new opportunities. Technological opportunities are the most visible. Related to technological possibilities are possibilities to change business processes and business performance. Thus, e-business has three effects on companies:

- Effects on technology. We consider technology use on the topics of a) infrastructure (hardware and networks), b) middleware (primarily application and integration servers, also other supporting software like operating systems), and c) applications (software to conduct business processes like administration, finance, and procurement).
- Effects on processes. We consider E-business to affect among others a) organizational structures - a collection of elements and the set of relationships that connect them (Monge & Eisenberg, 1987) where elements are for instance persons, business units or whole companies, b) business processes - primary business processes such as production and secondary business processes such as knowledge management and information (workflow) processes on how and when information and records are moved, c) business rules - rules that state and explicit the actions that should be taken in processes, and d) semantics - 'language' in which information and records are kept. We pack these effects together under the term 'effects of e-business on processes'.
- Effects on business performance. The effects of e-business are also seen on a strategic level affecting company relations (stakeholders, employees, customers, suppliers, governments and others), the products and services a company makes, and the whole business model. This also includes measures of effectiveness (sales), efficiency (costs) and customer satisfaction. We pack these effects together under the term 'effects of e-business on businesses'.

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

- **Mindsets.** Mindsets include company thoughts on e-business plans, motives, and barriers (see section 2).
- **Occurrence.** Questions on the actual presence and magnitudes of e-business effects. The occurrence category consists of, and may be split into, the OECD readiness and intensity categories.
- **Value.** Questions on the financial consequences of the e-business effects.

Technology, processes and business performance can be seen as collections of areas that are affected by e-business. Those effects can be measured in terms of three different dimensions. Doing so, we obtain a matrix structure (table 4.1), which we name the ‘E-Business Effect Matrix’. The join of the three effects and three dimensions leads to nine different classes of indicators.

Table 4.1: eBusiness Effect Matrix

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

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, processional and business effects are related. The matrix does not show the beginning, the route and the end of causal relations⁵. 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 three rows 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 the areas of measurement.

To conclude this section we present an E-Business Effect Matrix with conceptual descriptions of the nine categories (table 4.2) 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 4.3).

⁵ Causal relations inside the E-business Effect Matrix are likely to have a dynamic and iterative character.

Table 4.2: *Conceptual Categories of Indicators*

Effects of e-business on companies		Dimension of effect		
		Mindset	Occurrence	Value
Effects of E-business on	Technology	thoughts on technical aspects of e-business systems	presence and usage levels of e-business systems	costs of e-business systems (hardware, software, networks)
	Processes	thoughts on effects of e-business systems on processes and/or organizational structures	presence and usage levels of different processes and/or new organizational structures	costs of altering processes and/or organizational redesign correlated with e-business systems
	Business	thoughts on the effects of e-business on efficiency, effectiveness and customer satisfaction	presence and level of changes in efficiency, effectiveness, customer satisfaction due to e-business	financial consequences of e-business due to changes in efficiency, effectiveness, and customer satisfaction

Table 4.3: *Arbitrarily Chosen Examples of e-Business Questions and/or Indicators*

Effects of e-business on companies		Dimension of effect		
		Mindset	Occurrence	Value
Effects of E-business on	Technology	barriers related to e-procurement	presence of Internet connection	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	plans forecasting the effect of Internet sales on efficiency	number of new or retained customers due to e-procurement	e-business effects on profit (ROI of e-business usage)

5. Conclusions

The widely used OECD framework of readiness, intensity and impact has been very useful in describing the role of e-business in our society and economy. However, insights in the different effects of e-business on companies have become more and more mature. In this paper we presented a tool, the E-Business Effect Matrix, which combines the new insights. This matrix considers three effects of e-business on companies: effects on technology, on processes and on business performance. Each effect is expressed in terms of three different dimensions: mindset, occurrence and value.

The terms ‘e-commerce’ and ‘e-business’ have previously been defined in many ways, depending on the situation and perspective taken. This paper combines many different definitions from National Statistical Institutes (NSIs) and scientific authors into one conceptual framework. This framework of definitions demarcates the boundaries between e-commerce and e-business and may be used in discussions on the standardization of the definitions of e-business and e-commerce.

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