

Measuring the Diffusion of e-Business in the Information Society

Jose L. SALMERON*
Victor A. BANULS*

In this paper a review of the e-business indicators used in the last supranational benchmarking exercises is done. This contribution aims to bring a framework from researchers and practitioner in the e-business measurement field. Moreover several challenges from the e-business measurement research agenda are proposed. Basically these challenges would be resumed in (1) spreading the use of the e-business indicators (2) extending the set of e-business dimensions covered by the indicators (3) spreading the existing methodologies among the research networks in order to set standards (4) integrating the advances in related scientific areas like Policy Analysis and Technology Foresight in the e-business measurement field.

- information and communication technologies
- benchmarking
- e-business measurement
- technology foresight
- policy analysis

1

Introduction

Information and Communication Technologies (ICT) are generally recognised as a key factor contributing to national productivity and growth [1, 2]. Due that relevance, several supranational initiatives have been carried out in order to measure ICT diffusion [3, 4, 5, 6, 7, 8, 9].

As a result of these initiatives, numerous indicators for measuring the ICT diffusion have been developed. These efforts aim to bring to researchers and practitioners an adequate data basis for the analysis of the Information Society. This work is focused on reviewing and analyzing these indicators in a specific cluster of the Information Society: the e-business.

The e-business relevance in the Information Society development has been widely debated in academic and non-academic forums. These debates have rotated from the optimism of the end of 90's to the criticism of the last years. This criticism arises mainly from the collapse of the 'firms.com' in the middle of the new millennium's euphoria. A post hoc analysis of the collapse of the 'firms.com' put on relevance the complexity of the lack of tools for monitoring the e-business phenomena.

In an effort to avoid this lack, ICT researchers and practitioners have been building a set of measures and methodologies to monitor e-business developments in the last years. In this work the authors analyse these developments. This contribution aims to bring a framework from researchers and practitioners in the e-business measurement field.

In the second section, ICT measurement framework, the sample of the activities included in the review is defined. In the third section, indicators used in the ICT benchmarking activities of the sample are analysed. Finally, trends and research lines in e-business measurement are discussed.

2

The ICT Measurement Framework

The indicators of ICT diffusion are mainly used as inputs in supranational benchmarking processes. It is for that reason that the ICT benchmarking processes would be considered the framework of ICT measurement in general (and for e-business measurement in particular). ICT benchmarking processes allow comparisons between countries and indicate how well countries are doing compared to others in terms of adaptation, mastery and development. Comparison with better-performing countries helps identify policies for further improvement and progression [10].

* University Pablo de Olavide at Seville (Spain)

The main international ICT benchmarking initiatives have been carried on the European Union - European Survey of Information Society (ESIS) [3], Statistical Indicators Benchmarking the Information Society (SIBIS) [4], Benchmarking the Information Society (BISER) [5], European regions UNDER way towards STANDard indicators for benchmarking Information Society (UNDERSTAND) [6], The European e-Business Report, [7], but also in other supranational institutions as the United Nations (UN) [10], WorldBank – Knowledge Assessment Methodology (KAM) [11], Organization for Economic Cooperation and Development (OECD) – OECD Key ICT indicators [8] and International Telecommunication Union (ITU) [9] (see more national and supranational ICT benchmarking initiatives in [12]).

In this section a sample of the main international ICT benchmarking activities around the world are briefly described. We present these activities grouped by the supranational entity in which have been developed.

2.1 Organization for Economic Cooperation and Development

OECD ITC Key Indicators. Systematic efforts to address the policy challenges posed by the Information Society began at the OECD in the 80's. Over the next two decades, OECD acted as a forum where OECD's member countries met to analyse and discuss policy issues, develop recommendations on best practice policies on such matters as liberalisation in the area of telecommunications and to formulate guidelines that would provide some co-ordination and coherence in national policies which are inherently international in nature [13].

One of the most useful tools for monitoring these policies is the set of OECD ICT indicators. The actual 15 ICT indicators are drawn from various publications and databases produced by the OECD's Directorate for Science Technology and Industry, mainly the OECD Communications Outlook [14].

These indicators cover several clusters of the Information Society of the OECD countries like citizens (i.e. mobile, Internet, Broadband and Cable TV subscribers) business (i.e. Internet access and use in business) and Research and Development (R&D) networks (see the whole list in [8]).

2.2 European Union

ESIS project. In 1997, the European Commission set up a survey of European Information Society Projects and Actions, the ESIS. This project covered the 15 European Union (EU) Member States until January 1999. At this date, ESIS was further extended to 25 Central and Eastern European and Mediterranean countries to run until January 2001. The aim of this project was to provide up-to-date and relevant information that would support the existing reports and databases [3].

The ESIS indicators were divided in telecommunication market (2 indicators), telephone lines (3 indicators), telecommunication equipment (2 indicators), voice communications prices and Personal Computers (PCs) (2 indicators), Internet (5 indicators), e-commerce (3 indicators) and television (2 indicators).

e-Business W@tch. The European Commission, Enterprise Directorate General, launched the e-Business W@tch to monitor the growing maturity of electronic business across different sectors of the economy in the enlarged European Union [7]. Since 2001 the e-Business W@tch has analysed e-business development and impact in 17 manufacturing, financial and service sectors [7].

The e-business watch is mainly composed of a set of 16 ICT and e-business indicators that are organised into four modules: ICT infrastructure of the enterprise (4 indicators), internal business process automation (4 indicators), procurement and supply chain integration (4 indicators) and electronic marketing and sales (4 indicators).

Other methodological contribution of the e-Business W@tch is the benchmarking index called "E-Business Index". The Index is composed of two sub-indices: (1) ICT infrastructure diffusion (5 component indicators), and (2) ICT use for e-business (6 component indicators).

New eEurope Indicator Handbook. The New eEurope Indicator Handbook was prepared in the context of the Statistical Indicators Benchmarking the Information Society Project (SIBIS). The aim of the SIBIS project was to contribute to a better understanding of how to apply benchmarking in the different areas and to bring together information on the current state in indicator development from a broad variety of sources on a broad range of topics [4].

The indicators included SIBIS project from a large variety of sources (such as Eurostat, the Eurobarometers, BISER, OECD, e-W@tch, to name a few). The SIBIS indicators are divided in three main categories: general access and use factors, Internet access and use and on-line purposes. The general access and use factors category is divided in internet readiness (13 indicators) and digital divide (10 indicators). The Internet access and use category is divided in information security (14 indicators), perceptions as possible access barriers (9 indicators), and digital literacy, learning and training (22 indicators). The on-line purposes category is divided in e-commerce (12 indicators), e-work (14 indicators), e-science (21 indicators), e-government (13 indicators), and e-health (4 indicators).

BISER. BISER (Benchmarking the Information Society) is a research project supported by the EU which developed and piloted indicators for measuring Information Society development at the regional level [5].

BISER key indicators were selected using quality criteria for benchmarking, namely political relevance and completeness, and validity which includes the feasibility of statistical concepts and methods to be applied in different cultural contexts [15]. The 20 BISER key indicators are divided in two categories: population (11 indicators) and establishment (9 indicators).

2.3 International Telecommunication Union

Telecommunication Indicators Handbook. The purpose of the ITU Telecommunications Handbook is to identify and define the most important indicators which are useful for analyzing the public telecommunication sector. The term 'public telecommunication sector' refers to the telecommunications infrastructure and services provided on this infrastructure for the public at large [9].

The indicators are classified into different areas that provide a broad view of the public telecommunication sector: telephone network size and dimension (6 indicators), enhanced and other services (7 indicators), quality of service (7 indicators), traffic (7 indicators), tariffs (7 indicators), staff (1 indicator), revenue and costs (17 indicators), and investment (4 indicators).

World Telecommunication Development Report. The World Telecommunication Development Report was coordinated by the ITU's Telecommunication Development Bureau. This report examines the specific issue of measuring access to ICTs [16].

One of the main contributions of this work is the ITU's "Digital Access Index" (DAI). The goal of the DAI is to measure the overall ability of individuals in a country to access and use new ICTs. The categories of the DAI are infrastructure (2 component indicators), affordability (1 component indicator), knowledge (2 component indicators), quality (4 component indicators) and usage (1 component indicator). In the 2003 edition the DAI had been calculated for 178 economies (see the whole set of data [16]).

2.4 World Bank

Knowledge for Development program. The Knowledge for Development (K4D) program helps developing countries to make more effective use of knowledge for their overall economic and social development [11].

As part of its toolkit, the K4D program uses a knowledge assessment methodology (KAM) that helps to benchmark how an economy compares with its neighbours, competitors, or others it wishes to emulate. The comparison is undertaken for a group of 128 countries which includes most of the developed OECD economies and over 90 developing countries.

The indicators used in the basic scorecard of the KAM are performance indicators, economic incentive and institutional regime, education and human resources, innovation system and information infrastructure. Due the scope of our study, we will be focused on the last category. In this category three component indicators are used for this plank of the knowledge-based economy (telephones per 1, 000 population, computers per 1, 000 population, and Internet users per 10, 000 population).

2.5 United Nations

The Digital Divide: ICT Development Indices. The UN Digital Divide Report has two main goals: (1) monitoring and assessing the international digital divide and its implications; and (2) evaluating ICT development using a range of indicators to benchmark connectivity, access, ICT policy and overall ICT diffusion in a cross-country analysis of a total of 165 countries [10].

The UN Digital Divide Report indicators are divided in three categories: connectivity (4 indicators), access (4 indicators), and policy (3 indicators).

2.6 Others

The Global Information Technology Report. The Global Information Technology Report (GIRT) is a special project within the framework of the Global Competitiveness Programme. The GIRT is the result of collaboration between the World Economic Forum, the World Bank, and INSEAD, France. One of the main contributions of this report is The Networked Readiness Index (NRI). The NRI is defined as the degree of preparation of a nation or community to participate in and benefit from information ICT development [17]. A number of 102 countries were considered in the 2004 edition of the GIRT. Data were extracted from different sources (mainly from the ITU, and the World Economic Forum).

The main components of the index are three: environment, readiness and usage. The environment component is divided in three subcomponents: market (9 indicators), policy and regulatory (8 indicators), and infrastructure (5 indicators). The readiness component is divided in three subcomponents: individual (10 indicators), business (6 indicators), and government (3 indicators). The usage component is divided in three subcomponents: individual (4 indicators), business (3 indicators), and government (2 indicators).

Monitoring the Digital Divide. Monitoring the digital divide was an ORBICOM-CIDAS project aimed to make a contribution by developing a methodological to (1) quantify the Digital Divide, (2) compare across countries at given point in time, and (3) compare within countries over time [18].

The main contribution of this project is the index "Infoestate", which has two components that are Infodensity and Info-use. Infodensity refers to the ICT capital and labour stocks and their role in the productive capacity of the economy. It includes ICT networks (3 component indicators), as well as ICT skills (2 component indicators). Info-use refers to the uptake of various ICTs by households, business and governments (5 component indicators), and the intensity of their actual use (2 component indicators).

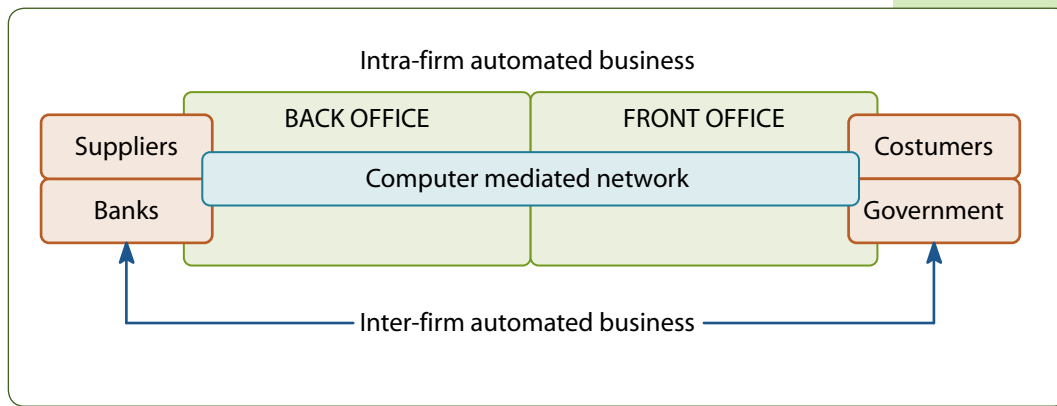
3

E-business Measurement Indicators

Once analysed the ICT measurement framework, we are going to analyse the most spread e-business indicators in the sample. But first we are going to determine the scope of the analysis. This delimitation of the scope will be given by the e-business definition.

OECD [2] defines e-business as "automated business processes (both intra and inter-firm) over computer mediated networks". That is, the scope of the e-business is wider than commercial transactions between companies and their customers. E-business also includes intra-firm processes support, like workflow or e-training, and automated relationships with stakeholders like suppliers, costumers, banks or government. Following this definition, the e-business diffusion

Figure 1. e-Business dimensions



may be measured in three dimensions: (1) intra-firm automated business processes (2) inter-firm automated business processes (3) computer mediated network infrastructure (Figure 1).

It can be seen in Table 1 that the main efforts of researchers have been aimed at measuring the extent of inter-firm automated business process (see the whole list in Appendix).

These indicators are mainly focused in the measurement of the automated process with the integration of external stakeholders that shape the value chain, as suppliers and costumers.

Secondly, e-business indicators have been aimed at measuring the extent of computer mediated network infrastructure into firms, mainly Internet access and computer infrastructure and web site.

Finally, the e-business indicators aimed at measuring the intra-firm automated business processes and have been mainly focused in the study of the relationships with employers and operational process support.

Analysing the e-business indicators, it might be pointed out three key issues. The first is the existence of geographical differences for the availability of data. In spite of the global relevance of ICT benchmarking indicators, the e-business indicators have been mainly developed in the EU context. This would be mainly due to the (1) high priority of the European directives to the e-business development and (2) to the necessity of indicators to measure the digital divide between the nations that compose the EU.

The second key issue is the increase in the accuracy of the e-business measurement over the time line. From the initial initiatives, which were only focused in measuring the e-commerce extension, a wide range of indicators to measure other e-business dimension has been developed.

Table 1. e-Business indicators distribution and focus

Scope	Project	Computer mediated network infrastructure	Inter-firm automated business processes	Intra-firm automated business processes
Global	OECD ICT Key Indicators	1	1	0
	GIRT	2	0	0
European Union	ESIS project	0	3	0
	e-Business W@tch	5	8	3
	New eEurope Indicator Handbook	1	13	4
	BISER	5	2	3
Total (rate)		27%	53%	20%

The last key issue is the lack of conceptual and methodological standards for measuring the e-business diffusion. Different indicators with different measures are used to estimate the same. Notwithstanding, the last e-benchmarking initiatives have been focused to cover this lack of standardization.

4

What is next?

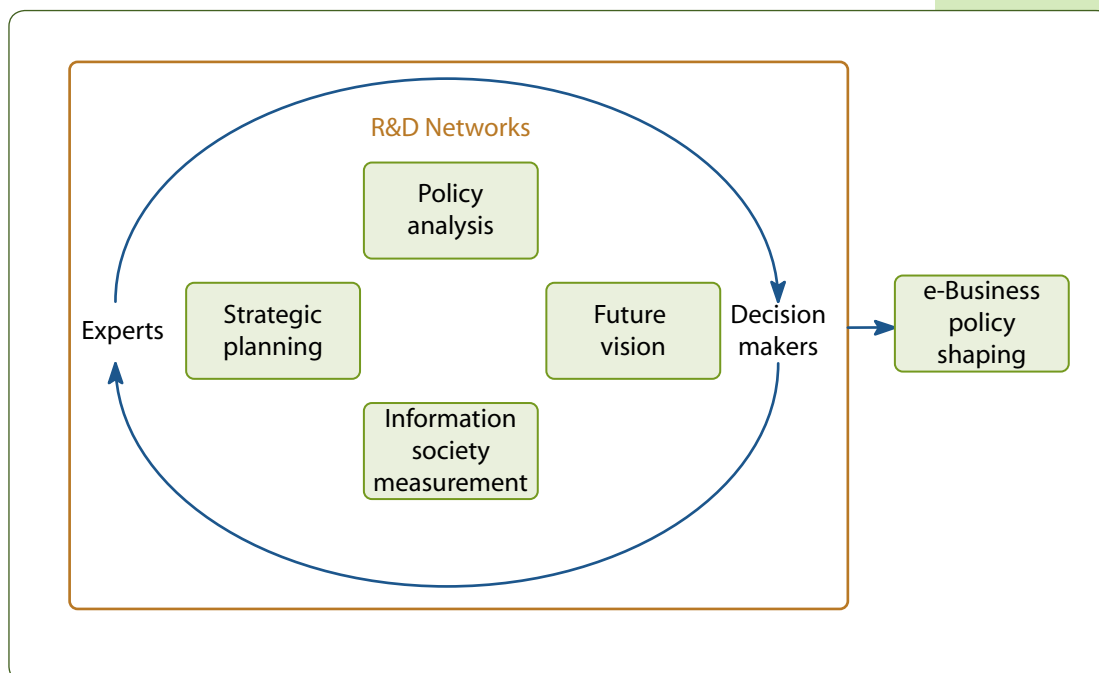
From the discussion and analysis of the actual e-business measurement indicators done in this work, it can be detected some potential challenges to be included in the national and supra-national research agendas in the next years. These challenges can be resumed in (1) spreading the use of the e-business indicators; (2) extending the set of e-business dimensions covered by the indicators; (3) spreading the existing methodologies among the research networks in order to set standards.

Moreover to the specific challenges for the e-business research agenda, a last and maybe most important challenge for the Information Society measurement is the (4) integration of this field with other related scientific areas like Policy Analysis and Technology Foresight. This necessity arises from the synergic benefits of sharing knowledge among those R&D networks.

A first benefit from the shared knowledge between those scientific fields would be the development of integrated policy analysis tools based on Information Society measurement. With these tools policy makers would have, moreover of the diffusion measures, indicators of the impact of each Information Society cluster in the national development.

Secondly, actual Information Society measurement would be used as an input of Technology Foresight processes. Technology Foresight orientates towards the longer-term future of science, technology, economy and society, with the aim of identifying the areas of strategic research and the emerging generic technologies likely to yield the greatest economic and social benefits [19]. The integration of Information Society measurement in the Technology Foresight process would improve research in both disciplines. On one hand, the e-business diffusion indicators would bring to Technology Foresight a snapshot about the current state of the Information Society. On the other hand, Technology Foresight processes would bring to the Information Society measurement field a reference about the critical technologies and future trends that should be measured.

Figure 2. Extended foresight networks



Finally, a third benefit of the integration of those scientific fields would be motivated by the synergic effect of the extension of the current R&D networks. Actually, foresight networks arise from a convergence of trends underlying recent developments in the fields of policy analysis, strategic planning, and future studies [20]. This mode of long-range thinking systematically disseminates information about projected future scenarios and develops strategic visions into R&D networks. Including Information Society Measurement as an input of this foresight process, foresight networks would be improved (Figure 2).

Specifically, this extended foresight networks would be useful mainly in developing countries. With this policy intelligence tool, public decision makers would have a measure of the evolution of the digital divide in the time horizon. Moreover, they would be able to create R&D networks between actors involved in the extended foresight process. This extension of the foresight process would integrate, moreover of the actual actors and processes involved in it [19], R&D efforts and components of the current supranational projects focused in the Information Society measurement.

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Conclusions

In the last years, the demand of indicators about how economy and society are affected by e-business development has been growing continuously. This necessity has been covered by numerous supranational initiatives which orientate how to measure the international digital divide at any level. In this paper, the last developments of e-business indicators in supranational initiatives have been analysed.

A first conclusion of this analysis is that the main efforts of researchers have been aimed at measuring the extent of inter-firm automated business processes. A second conclusion is that the existing e-business measurement indicators should be extended and spread into the world scientific community in order to set robust standards. Finally, the integration of the Information Society measurement techniques and data with other close research areas, like Policy Analysis and Technology Foresight, has been proposed. This integration is aimed at improving e-business policy shaping by the measuring of its potential implications.

Appendix: e-Business indicators

The ICT initiatives of the sample without e-business indicators have not been included in this appendix.

Project	Category	e-business Indicators
OECD ITC Key Indicators	N/A	<ul style="list-style-type: none"> Internet penetration by size class. Percentage of businesses with ten or more employees using the Internet. Businesses using the Internet and businesses receiving orders over the Internet.
ESIS project	e-commerce	<ul style="list-style-type: none"> E-commerce market overview E-commerce market per country Internet users propensity to purchase on Internet

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e-Business watch	ICT infrastructure of the enterprise	<ul style="list-style-type: none"> • Enterprises connecting computers with a LAN • Internet connectivity index • Remote access to the company network • Wireless access to the company network
	Internal business process automation	<ul style="list-style-type: none"> • Use of an intranet • Use of online technology to track working hours / production time • Use of ERP systems • Impact of e-business on internal work processes (index)
	Procurement and supply chain integration	<ul style="list-style-type: none"> • Enterprises purchasing at least 5% of their supplies online • Use of SCM systems • Integration of the IT system with that of a supplier • Electronic exchange of documents
	Electronic marketing and sales	<ul style="list-style-type: none"> • Enterprises maintaining a website with a content management system with suppliers • Use of CRM software systems • Enterprises selling at least 5% of their goods and services online • Enterprises with an online sales system offering the capability of secure transactions
New eEurope Indicator Handbook	Business readiness	<ul style="list-style-type: none"> • Multiple computer network presence within enterprises (Internet, Extranet, Intranet, EDI over IP)
	Skill acquisition	<ul style="list-style-type: none"> • Use of e-learning tools for work-related learning • Use of the Internet for learning • Establishments using an Intranet for staff training • Establishments supporting ICT-related self-learning of their staff • Share of establishments giving staff access to Internet
	General e-Commerce indicators	<ul style="list-style-type: none"> • Share of establishments involved in 'All round e-commerce' • Share of businesses selling on-line • Share of businesses participating in e-marketplaces • Barriers to on-line selling • Barriers to on-line purchasing
	B2C	<ul style="list-style-type: none"> • Internet usage for on-line banking • Usage of mobile phones for e-commerce • Businesses' sales to consumers
	B2B	<ul style="list-style-type: none"> • Share of businesses procuring on-line • Businesses' sales to businesses • Self-assessed impacts of on-line sales • Self assessed impacts of on-line purchases
BISER	Establishment-side indicators	<ul style="list-style-type: none"> • Broadband Internet availability and access (establishments) • Establishments with an internal computer network • Establishments with a website • Establishments with at least 10% of sales conducted online • Participation in electronically integrated supply chains • IP-supported process and product innovation • Establishments providing ICT training for their staff • More than 25% of staff need Internet skills
GIRT	Usage Business Readiness	<ul style="list-style-type: none"> • Computers installed in businesses • Firm-level technology absorption

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