

# Synthetic Indicators for Measuring e-Business: A Target Approach

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The quantitative approach, by defining appropriate synthetic indicators, to a qualitative description of targets concerning the development of e-business and the settlement of a general framework for the detailed socioeconomic analysis of changes promoted by the intensive use of ICTs, are the two main elements of originality of the paper.

The target description is founded on the e-Europe Action Plans, where targets are proposed to make of Europe “the most competitive and dynamic economy in the information and communication society”. For the definition of synthetic indicators, indicators from different European projects are classified into three different levels of concretisation, covering information about changes in demand and supply, and the internal organisation and business strategy. These synthetic indicators built on the idea of “importance” of an indicator in the description of each level of concretisation. With these indicators and using data from those European projects and from other regional projects, static analysis is developed for comparing different regional and national realities concerning the development of e-business.

- synthetic indicators
- e-measurement
- measurement theory
- e-business
- e-commerce
- value chain
- e-Europe action plans
- network-firm
- e-business w@tch
- regional-IST

## 1

### Introduction

The e-Europe Action Plans [6, 7] propose some targets with the objective to make of Europe “the most competitive and dynamic economy in the information and communication society”. This simple statement entails a more complex situation, affecting not just the economy of the EU, but also the European society as a whole.

Furthermore, for measuring the final achievement of the general targets, some associated indicators are also proposed (eEurope2005: Benchmarking Indicators). In addition to the general guidelines stated at European level, all member states and, more concretely, most of the regions in those states, have their own targets and subtargets considered by regional and national policy makers. Although these regional targets follow the main ideas of what is depicted in all e-Europe action plans, they take into account the particular situation in each region (socially, economically, politically, etc.) and design concrete actions that can drive to a developed information and communication society.

While this strategic goal is defined taking into account all possible external challenges (namely globalisation), it is important to bear in mind that there are important internal constraints, related to the social aspects and to significant economic diversities among all Member States. For this reason the main target, stated before, has to be split into more detailed targets and associated subtargets. Thus, as it was stated in the European Council Meeting that took place in Lisbon (March, 2000), several different targets, with more concrete goals to be achieved (subtargets), have to be considered for managing Europe towards a knowledge-based economy.

Since the evolution towards a knowledge-based economy is a dynamic process, which highly depends on changes in external challenges affecting the economy and, more generally, the society, all initial goals and objectives have to be continuously reformulated, reconsidered and enlarged. From the conclusions of subsequent meetings of the European Council (Barcelona, March 2002, and Sevilla, June 2002), it is understood that all previous targets has to be beard in mind and reinforced by all Member States.

The development of a knowledge based economy will be possible just in the case where all agents involved (firms, public administrations and consumers) actively participate, playing their appropriate role. For this to happen it is necessary to set an adequate framework for pro-

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moting services (demand side) and infrastructure (offer side) to create a positive dynamic for a compensated and equilibrated development of all elements associated with the participation of the economic agents in productivity and growth. In other words, these services and infrastructures have necessarily to create new markets, reduce costs and increase productivity of the whole economy.

In a complex and decentralised policy setting, to move so many actors in a common direction requires clear targets, which will allow monitoring and benchmarking best practices. Precisely, for this purpose it comes up the necessity of establishing, where appropriate, quantitative and qualitative indicators. Indicators are important to inform policy-makers whether they are on the right track towards the development of a knowledge-based economy, and to what extent they are not. Furthermore, developing a complete set of indicators, with more up-to-date data, is important to design appropriate policies at every level and to set adequate adjustments when necessary.

In this paper we focus on those targets that refer to the development of the e-business. We will set a general framework which will permit to understand what has to be considered for studying the effect of Information and Communication Technologies (ICT) on the evolution of business. This framework will be used to establish the appropriate indicators for measuring e-business, according to the initially given targets and subtargets by both, e-Europe and regional/national policy makers.

For a complete analysis of the transformation of enterprises, which in turn constitute the economic agent that has experienced the most important changes by the irruption of ICTs and the relevant presence of knowledge, indicators will be classified according to different criteria. These criteria, which will be broadly explained in later sections, are directed to have an idea of how changes are affecting *demand* and *supply*, the internal *organisation* and business *strategies*.

For comparing results on the situation of e-business between different realities it will be proposed different *synthetic indicators*, which will capture all aspects related to e-business measurement, accordingly to different classification criteria. With these indicators, static and dynamic analysis could be easily developed.

This paper is organized as follows.

**Section 2** focuses on the description of the general framework for the analysis of e-business. It is given the definition of what it is commonly understood by e-business. This definition and what it implies for the rest of the work is also considered in this part. Some macroeconomic and microeconomic concepts on the so called new economy or knowledge economy are also given and analysed in order to have a clear approach to what implies the intensive use of ICTs and the changes it involves, not just in all functional areas of an enterprise, but also in the interaction between firms and economic agents with whom it interacts. Concepts like *network-firm*, *value chain* and *digital technologies* will be central issues in this section.

**Section 3** is the most important part of this paper. Apart from establishing a general methodology that can be used for the appropriate identification of indicators, it also

Figure 1. Relationship between targets and indicators

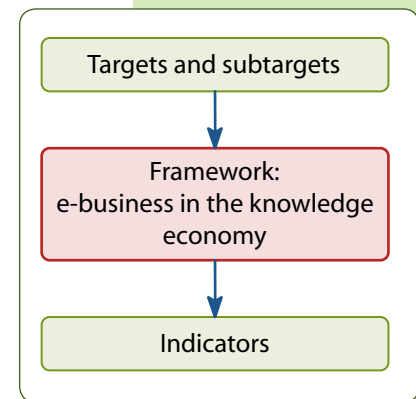
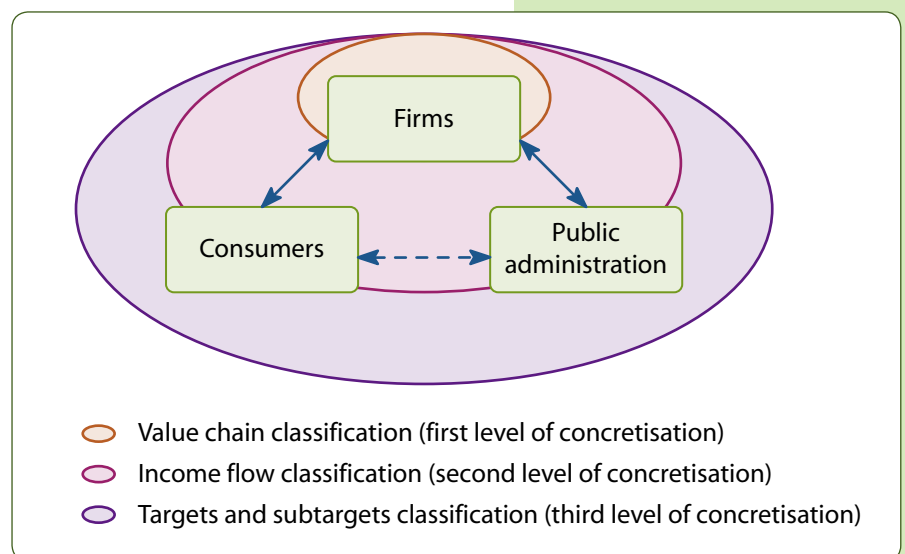


Figure 2. Classification criteria (levels of concretisation)



proposes *synthetic indicators* which will permit to capture the evolution of all elements related to the analysis of e-business. A classification criterion is selected for the organization of all e-business indicators and for the construction of synthetic indicators. In this paper we propose three different possibilities: *value chain* classification, *income flow* classification, and, the last one, *targets* and *subtargets* classification.

**Section 4** will focus on the results of an application of the theoretical framework that has been depicted in previous sections. The concrete application mainly refers to the measurement of a concrete subtarget, "Increase proportion of B2B and B2C", by the computation of the synthetic indicator associated to the third level of concretisation. This measurement is done for different regions and countries, in order to have a benchmarking approach to the final achievement of the target. The selection of regions and countries has been done according to data availability from 3 different projects: the *Regional-IST* project ([www.regional-ist.org](http://www.regional-ist.org)), the *e-Business watch* project ([www.ebusiness-watch.org](http://www.ebusiness-watch.org)) and the *Projecte Internet Catalunya (PIC)* ([www.uoc.edu](http://www.uoc.edu)).

Finally, this paper ends with the summary of main conclusions and with the bibliographic references considered throughout the research work.

## 2 e-Business in the knowledge economy

Transition towards a knowledge-based economy involves a fundamental structural change, led by scientific and industrial research, which have to be consistent with own values and concepts of society. Although these structural changes takes place since the fourth quarter of 20th century, nowadays the intensive use of ICTs for the (efficient) creation, diffusion and exploitation of new knowledge has produced remarkable changes, increasing productive capacity in the economy [12] and a widespread impact on almost all aspects of society [14, 16, 17]. ICTs have a horizontal effect on many industrial sectors, from services to manufacturing. This horizontal effect has significant impact on the society, and defines a new framework that is commonly known as Information and Communication Society.

E-Business can be defined as those business activities carried out via digital data networks and organised in networks. As it is mentioned in [2], e-business is those productive activities whose key operations (such as management, financing, innovation, production, distribution, sales and relations between employees and clients) take place within and through the Internet, or other information technology nets.

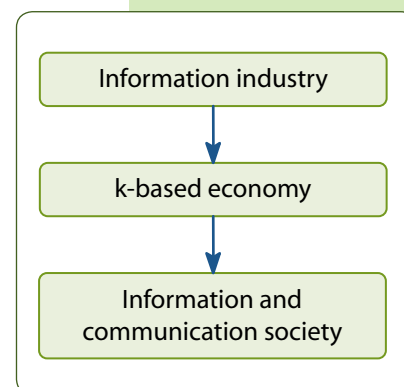
Going from the general framework depicted by targets and subtargets to the concrete measure of changes in the organisation and the strategy of firm, we propose next different levels of concretisation.

### 2.1 First level of concretisation: Business organisation and strategy. Network firms

In this first level of concretisation we are centred in the idea of firm. With no doubt, the economic agent that has experienced the most important changes by the irruption of ICTs and the relevant presence of knowledge is the firm. This important process of transformation, which implies changes in two basic inputs of business activities (labour and capital), as well as in production and organisation, can be summarised through the combination of two concepts: *network-firm* and *e-business*. The intensive and regular use of ICTs in both, the organisation and the strategy of firms, leads the firms to a new way of doing business (e-business) and to a new strategic and organisational model (network-firm).

On one hand, *network-firm* is commonly accepted as the concept that refers to the strategic and organisational model based on the decentralisation of the different business lines of a firm in networks. In [2] it can be read that the concept, network-firm, defines the way in which a firm

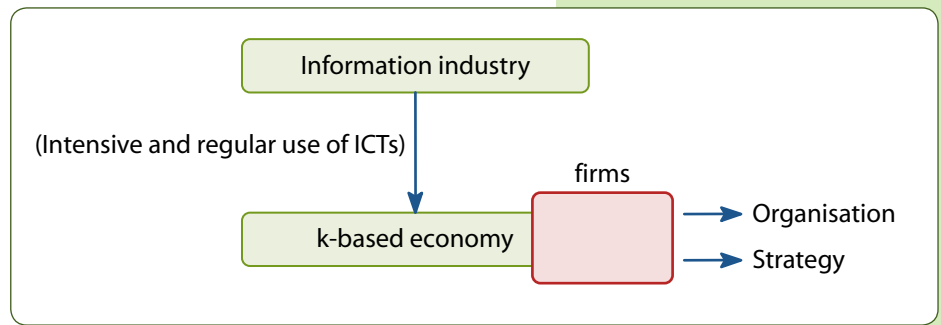
Figure 3. Impact of ICTs



organises its business projects as a result of the co-operation between different components of diverse firms, working in networks for all the project period.

For an appropriate measurement of e-business, we have to put an eye on the idea of firm, analysing all the elements in the value chain of the business activity (as these elements determine the *organisation* of a firm), and the competitive forces, as determinants of the *business strategy*. A *firm* can be defined as a set of resources organised with the objective of achieving, assuming a certain risk, a concrete strategy which leads up to getting profits.

Figure 4. Impact of ICTs



*Business organisation* builds on the work division in units and on the co-ordination among them. The *value chain model* permits a systematic analysis of all primary (operation activities and, marketing and after-sales services) and support activities (the infrastructure of a firm, the human resources administration, and innovation), and their interactions through the added value they generate.

*Business strategy* drives the business organisation in the long term, adjusting resources and capabilities available in the environment. The value chain model allows studying the competitive forces that determine the outstanding factors in the setting of business strategy.

Summarising, the existence of network-firms implies the rupture of the basic principles in business organisation and in business strategy. ICTs transform the design of workplaces and the relationships between the different components of business activity (functional areas and processes). In the network-firm, work division is built on knowledge division: workplaces are designed to make human factor an active part of its own activity. Thus, decision-makers in firms have to consider the decentralised knowledge to state their strategic design. With this value chain approach, we will have a general setup which will be considered to determine appropriate indicators for studying the characteristic intangible elements of the knowledge-based economy affecting business transformation, such as flexibility, cultural change, new division of work and decision taking.

## 2.2 Second level of concretisation: networks of firms, public administration and consumers

With this second level of concretisation, it is possible to analyse the interaction that there exists between each of the three agents involved in the measurement of e-business: the households (consumers), the enterprises and public administrations. We move from the insight study of a firm (organisation and strategy) to the outside relationships of a firm. This analysis follows the well-known *circular income flow model* that differentiates the supply and the demand side of the different interactions that might appear among the involved agents. (The original circular income flow model also includes a fourth agent, the foreign sector; for the purpose of our analysis its exclusion does not change the results of our study.) We focus on how ICTs have transformed the way by which firms interact with other firms, with consumers and with public administrations. All these relationships have suffered a deep transformation due to the appearance and inclusion of ICTs not only at the economic level but also at the social one. This implies large amount of knowledge to be managed by the intensive use of TIC [14].

Among all economic agents and the digital interchanges that can be built between them, in the second level of concretisation we focus on those e-Business indicators describing supply and demand between companies-individuals, between firms, and between firms and public administrations.

The *supply side* of firm's interaction, when considering the intensive usage of ICTs for the basic setting of the transactions, can be classified into three different groups. Firms can supply to public administrations, B2G (*e-procurement*) and to, both, consumers (B2C), and other firms

(B2B). Business done over digital data networks (for example, Internet or EDI), selling goods and services, between firms and consumers is named *e-commerce*. On the other hand, concerning the *demand side* of firms, the relationship can be established with the public administrations, G2B, mainly to get information; with other firms B2B, but also with consumers, C2B (consumers provide firms with, for example, labour force).

### 2.3 Third level of concretisation: European, regional and local targets and subtargets

For an appropriate measurement of e-business it has to be considered the particular socio-economic context in which firms carry out their business. Policy makers, at different levels, take into account these particularities when defining the general targets, and their concrete subtargets that will determine the strategy either at national, regional or local level. We are not just interested in describing a methodology for measuring e-business; we are interested in describing a general framework for measuring e-business in a concrete context, for example, a country or a region. For doing so, the starting point for measuring e-business is determined by the set of targets and subtargets, established by policy makers and linked to a concrete socio-economic situation.

Once this third level of concretisation is established, and bearing in mind the other two levels of concretisation, it can be easily described *what* has to be measured. In next section it will be shown *how* to measure what has to be measured. In other words, lists of indicators and synthetic indicators will be proposed for measuring the different levels of concretisation, taking into account the availability, the suitability, and the homogeneity of data, and particular differences between regions or countries.

## 3 Indicators for measuring e-business targets

The importance of the target-approach for measuring e-business consists of two facts. First of all, policy makers in a concrete region or country establish targets and subtargets, taking into account what are the specific needs for an adequate development of the Information and Communication Society. Secondly, since economic reality is dynamic, the final analysis of the degree of achievement of the targets could be used to redefine policies, to reinforce the initial ones or, if it is the case, to set new targets and subtargets to correctly direct policies towards e-Europe guidelines.

Therefore, the main issue is to identify e-business indicators, together with the current indicators promoted by e-Europe, so that the objectives of both, e-Europe and policy makers in the members states can be measured. The set of indicators is established according to the three different levels of concretisation, in order to capture the important process of transformation due to the use of ICTs which changes firms and their environment.

### 3.1 List of indicators and the Regional-IST project

The list of indicators we will consider in this paper comes from previous work done by the authors as participants in the European project *Regional-IST*, developing the work-package devoted to the measurement of e-business. The project, which is included in the Information Society Technologies Programme-IST of the European Commission, focuses on the implementation of e-government and e-business in the European regions (the consortium of the Regional-IST project consists of 7 official institutions grouped around 5 countries).

Since the Regional-IST project builds its set of indicators following studies commissioned by official bodies, along with e-Europe targets and subtargets, we consider it as the starting point of the research line we present in this paper. In further research, the set of indicators will be necessarily modified and updated according to the evolution of e-business and its particularities depending on its implementation in concrete regions or countries.

The first list of proposed indicators cover a big variety of business activities, such as, infrastructure availability and accessibility (networks, broadband, equipment, secure servers, etc.), e-

**Table 1.** Number of indicators according to the first level of concretisation  
**Source:** own elaboration

Value chain element		Number of Indicators
<b>Support activities</b>	Technologic infrastructures	20
	Human resources	9
	Innovation	4
<b>Organization</b>	• Supply	10
	• Production	5
	• Distribution	2
	• Marketing and sales	10
	• After-sales services	2
<b>Basic activities</b>	Marketing and after-sales services	2
	Business environment and strategy	7
<b>Strategy</b>	Business environment and strategy	7

commerce, integrated management systems, extranet/intranet usage, online retailers, etc. They also cover other aspects related to the organisation and the strategy of firms. It will be also possible to have information on ICT investment and production, and on the skills of workers with respect to the information and communication technologies (e-skills). The first list of indicators used to capture information concerning e-business contains about 80 indicators ([www.uoc.edu](http://www.uoc.edu)).

Now, our work flows to the classification of these indicators according to the three levels of concretisation. We can reorganise the previous list of indicators according to the value chain (first level), to the demand and supply of firms (second level) and to the e-business targets and subtargets (third level).

### 3.2 Classification of indicators

i. First level of concretisation

First of all we classify the indicators for having a description of the first level of concretisation, which corresponds to the value chain analysis. By placing the number of indicators that can be used for measuring a concrete business activity, we have Table I. A closer look to this table gives us an idea of the *complexity* in measuring a concrete business activity as well as information about the *importance* of a particular indicator. The total number of indicators that are used for describing an activity can be seen as an index of complexity for its measurement. Hence, the technologic infrastructure of a firm, with 20 indicators, seems to be complex to be measured. On the other hand, after-sales services have only 2 indicators associated to its measurement. In consequence, it is the less complex business activity to be measured. (The level of complexity directly depends on the list of indicators, since one can always add more (and more) indicators to have more information about a certain item.)

ii. Second level of concretisation

The second level of concretisation focuses on the relationship between firms and the other agents which define the circular income flow model, this is, consumers, public administrations and other firms. To analyse the interaction that there exists between each of them, for an adequate e-business measurement, it is necessary to have indicators associated to consumers and to public administrations. In this sense, it will be considered the list of indicators in the Regional-IST project ([www.uoc.edu](http://www.uoc.edu)) concerning population, "Regional-IST population indicators Second round 2003-4" and public administrations, "Regional-IST e-Government indicators Second round 2003-4". This new two lists will be centred on the description of some characteristics associated to the demand side of the different interactions.

iii. Third level of concretisation

As already mentioned, the main purpose of this paper is the creation and development of a set of indicators with the aim of quantitatively measure the achievement of certain

targets, with respect to e-business, according to the e-Europe action plans [6, 7].

In this third level of concretisation, the list of main e-Europe targets is given. In order to have a complete description of the evolution and the degree of achievement of this targets and subtargets, indicators given in the two previous levels of concretisation are associated to each of them.

The previous table allocates the supply side indicators to the different subtargets. As it can be observed, the great majority of the subtargets have at least one indicator assigned. These indicators capture some critical information related to it and therefore, they allow to easily assessing the achievement of the subtarget. The target to which the greater number of indicators is associated is "Increase e-business". There are 15 indicators that can be used to measure the achievement of the target, in other words, to see if there has been an effective increase of e-business. On the other hand we found the target "Establish e-business support networks", with just two indicators associated to it. Finally it has to be said that some e-Europe targets such as "Stimulate broadband content, services and applications" and "Enable m-commerce" are not included in this paper approach. It is left for further research to consider what type of indicators have to be associated to these (and other possible new added) targets.

The same has been done for the demand side indicators (consumers and public administrations). There is a target that has significantly more indicators associated to it than the other ones. Concretely, for measuring the target "Increase the number of citizens connected to the Internet" there are 6 indicators that, altogether, define the final achievement of it. Most of the remaining targets have 1 or 2 indicators.

### 3.3 Synthetic indicators and the levels of concretisation

In this subsection we will set a general methodology for defining synthetic indicators associated to the different levels of concretisation. Many decision makers and experts are quite concerned about the emergence of a large amount of data related to ICTs, to the use of ICTs and to the transformations that this use implies. What synthetic indicators pretend is to explain complex situations with just "one number", providing the "big picture" so as to avoid the fuzziness of large amounts of data [1, 8]. Nevertheless, the idea of a single synthetic indicator may invite one to draw simplistic policy conclusions. It is important to find the balance between the need of having high levels of aggregation with the concrete information that disaggregate values draw [20]. Hence, it is of great relevance to define sets of synthetic indicators according to the multidimensionality (level of concretisation) of the analysis.

**Table 2.** List of subtargets and associated indicators (supply side)  
**Source:** Regional-IST (www.regional-ist.org) and e-Europe Action Plans [6, 7]

#### Establish e-business support networks (geographical and sectoral clusters of companies working online)

- Percentage of firms interacting with local or central government using ICTs
- Percentage of firms using ICT for external growth

#### Increase consumer confidence in e-commerce by using secure transaction servers

- Percentage of firms with a security policy concerning the Internet
- Enterprises with firewalls
- Enterprises with antiviruses
- Percentage of firms with a security policy concerning data privacy
- Use of e-signature or certification
- Enterprises selling goods or services online

#### Increase e-business, i.e. every business activity carried out via digital data networks and organised in networks

- Enterprises with intranet
- Enterprises with extranet
- Enterprises with own website
- Enterprises with specific informatic systems
- Percentage of workforce doing telework / e-work
- Percentage of firms with software maintenance outsourcing
- Enterprises with B2G (interacting with governments using ICT)
- Enterprises selling goods or services online
- Enterprises purchasing goods or services online
- Number of companies using Internet for payments
- Percentage of firms organised by products and services
- Percentage of workforce with (at least) basic ICT training
- Percentage of firms using ICT for individualised relationships with clients
- Percentage of firms using ICT for internal growth
- Percentage of firms using ICT to organise sales through a net of distributors

#### Increase proportion of B2B and B2C transactions taking place over the Internet.

- Enterprises connected to Internet
- Enterprises with own website
- Enterprises with Internet security police
- Enterprises selling goods or services online
- Enterprises purchasing goods or services online
- Share of electronic selling over total revenues
- Enterprises with EDI

#### Increase the number of enterprises connected to the Internet.

- Enterprises connected to Internet
- Percentage of PCs that support Internet connection
- Enterprises with PC
- Enterprises with e-mail
- Enterprises with LAN
- Enterprises with intranet
- Percentage of firms/ SMEs with website
- Workforce using regularly PC for work
- Workforce using regularly Internet for work
- Enterprises using internet for payments

The key point in the definition of synthetic indicators lays in the selection of indicators and in how to weigh these indicators. The selection of weights has to be made taking into account several different conditions. Since from the target measurement approach we want to evaluate "policy" performance, the weights should preferably reflect policy priorities. But, it is hardly difficult to set, *a priori*, appropriate weights. For the purposes of this paper we will adopt a weighting procedure that builds on the idea of "importance of an indicator", already explained in previous subsections.

i. Construction of synthetic indicators

Composite or synthetic indicators are based on indicators which data is presented through different units of measurement. To avoid these differences, and since in next section we will apply the methodology to the data obtained for different regions and countries in Europe, we will consider the static normalization method, taking as reference values the mean of the EU-5 (EU-5 refers to the following countries: Germany, Spain, France, Italy and the United Kingdom).

Similarly to what has been considered by the DG-RTD of the European Commission, for the construction of indexes about "Investment in the knowledge based economy" and "Performance in the knowledge based economy", the process we will consider in this paper for the aggregation of indicators is based in the weighted average of the values of the indicators [15].

Hence, the central issue here pertains to the specification of the weights. There are a great variety of methods. Many of them are either arbitrary or unreliable [4]. For the purpose of this paper, and as a first step, we describe a very simple method which will be applied in all three levels of concretisation. It is based on the idea of the "importance" of an indicator: *the weight associated to an indicator is given by the number of times the indicator is used for describing different elements referred to a certain level of concretisation.*

For example, indicator "Enterprises with own website" is used in the third level of concretisation for four different elements (targets): "Increase e-business", "Increase proportion of B2B and B2C", "Increase the number of enterprises connected to the Internet", and "Stimulate the development and use of digital content". Hence, the associated weight, relative to the third level of concretisation, is 4.

If we refer to each level of concretisation with I, II, and III respectively, we can write the corresponding synthetic indicators for a concrete period of time *t* and a country (or region) *j* as follows, in Table 4. Letters *F*, *C* and *P*, refer to firm's indicators, consumer's indicators and public administration *s* indicators, respectively.

As it can be seen, the synthetic indicator for the third level of concretisation summarizes, in some sense, the

**Make ICT and software-related industries an important sector in the economy.**

- Business expenditure in R&D (global)
- Enterprises with specific informatic systems
- Enterprises with informatic maintenance outsourcing
- Percentage of firms providing ICT training for the employees
- Percentage of workforce with (at least) basic ICT training
- Growth rate (revenues) of ICT companies
- Business investment in ICT
- Number of ICT enterprises
- ICT market value
- Turnover of ICT enterprises
- Number of employees in ICT companies

**Stimulate the development and use of digital content.**

- Enterprises connected to Internet
- Enterprises with PC
- Enterprises with e-mail
- Enterprises with own website

**Table 3.** List of subtargets and associated indicators (demand side)  
**Source:** Regional-IST (www.regional-ist.org) and e-Europe Action Plans [6, 7]

**A secure internet**

- Number of secure servers (SSL) per one million inhabitants
- Percentage of Internet users experiencing security problems

**Accelerate e-business and e-commerce**

- Purpose of use of the Internet (of regular users)

**Enable Internet access for everyone**

- Percentage of households with computer
- Percentage of population who uses PC
- Percentage of population with mobile phone
- Place of access to the Internet (of regular users)

**Increase consumer confidence in e-commerce by using secure transaction servers**

- Number of secure servers (SSL) per one million inhabitants

**Increase the number of citizens connected to the Internet**

- Percentage of households with computer
- Percentage of households with flat-rate Internet access
- Percentage of households with Internet access
- Percentage of population who have used the Internet
- Percentage of population who regularly uses the Internet
- Type of use of the Internet (of regular users)

**Make broadband the dominant access technology**

- Percentage of households with flat-rate Internet access
- Percentage of households with high-speed Internet access

**Set up Public Internet Access Points (PIAPs) in public spaces**

- Total number of Public Internet Access Points (centres)

**Stimulate the development and use of digital content**

- Purpose of use of the Internet (of regular users)

**Use signature cards and secure card terminals**

- Percentage of population with signature cards

Table 4.

Synthetic indicators and levels of concretisation

Source: own elaboration

Level of concretization	Synthetic indicator
First level (value chain)	$SI_j^{t,I} = \frac{\sum_{i=1}^{70} w_{F_i}^I \cdot \check{F}_{ij}^t}{\sum_{i=1}^{70} w_i^I}$
Second level (consumers and public administration)	$SI_j^{t,II} = \frac{\sum_{i=1}^{15} w_{C_i}^{II} \cdot \check{C}_{ij}^t + \sum_{i=1}^{29} w_{P_i}^{II} \cdot \check{P}_{ij}^t}{\sum_{i=1}^{15} w_{C_i}^{II} + \sum_{i=1}^{29} w_{P_i}^{II}}$
Third level (targets and subtargets)	$SI_j^{t,III} = \frac{\sum_{i=1}^{70} w_{F_i}^{III} \cdot \check{F}_{ij}^t + \sum_{i=1}^{15} w_{C_i}^{III} \cdot \check{C}_{ij}^t + \sum_{i=1}^{29} w_{P_i}^{III} \cdot \check{P}_{ij}^t}{\sum_{i=1}^{70} w_{F_i}^{III} + \sum_{i=1}^{15} w_{C_i}^{III} + \sum_{i=1}^{29} w_{P_i}^{III}}$

information of the previous two, since in this one the three types of indicators, associated to firms, to consumers and to public administrations are used. Nevertheless, since the weights for each level are not necessarily the same, there can be a lost of information. Moreover, maybe we can have an excessive simplified description of reality due to the fact that for the measurement of targets (and subtargets) a reduced subset of the initially given indicators is considered. Hence, we find hardly convenient to bear in mind all three synthetic indicators. However, considering the objectives of the paper, in next section we will just focus in the third level of concretisation.

# 4

## Application: Measuring the target "Increase proportion of B2B and B2C"

### 4.1 Data sources, targets and indicators

Considering the main objectives of the paper, in this section we will focus on the application of the previous reasonings and methodology to the measurement of e-business targets, in the third level of concretisation, using the corresponding synthetic indicators and the data from two European projects, the Regional-IST project and the e-Business w@tch project, and a Catalan project, the PIC-project. All data used in this section comes from surveys carried out during year 2003.

On one hand from the e-business w@tch project we will get data at national level, for countries in the enlarged European Union (Germany, Spain, France, Italy, United Kingdom, Estonia, and Poland). On the other hand, for having additional information on other European countries and a more detailed insight of what is the effect of ICTs in companies' performance and competitiveness at regional level (Catalonia (ES), Baden-Württemberg (DE), Piedmont (IT), Portugal, and Hungary), we will use data from the Regional-IST project and the PIC project.

By its particular interest and relevance among the remaining subtargets for the e-business measurement, we will study the target "Increase proportion of B2B and B2C", which has 7 associated indicators. It is left for further research a more in deep analysis of the remaining targets. Due to data availability, in

Table 5.

Percentage of firms doing e-commerce

Source: For Catalonia, the PIC-project, for Baden-Württemberg, Piedmont, Portugal and Hungary, the Regional-IST project, and for the rest, the e-business w@tch project

Regions / Countries	% of firms
Catalonia (ES)	12.2
Baden-Württemberg (DE)	22.0
Piedmont (IT)	13.0
Portugal	13.5
Hungary	13.4
Germany	13.2
Spain	8.9
France	5.4
Italy	9.8
United Kingdom	10.4
Estonia	6.9
Poland	10.0

this section a particular use of the expressions of the synthetic indicator for the third level of concretisation will be considered.

### 4.2 Results

The situation of e-commerce is quite similar in the different countries/regions considered in the paper. Taking into account indicator "Enterprises selling goods and services online", there are similar figures between them. Around 10% of firms in Europe carry out ecommerce (EU5 9.5%). Above all, it has to be mentioned the case of France, with just 5.4% of firms with e-commerce, and the opposite situation represented by Baden-Württemberg, where we can find that 22.0% of firms are doing e-commerce.

It becomes clear that the development of e-commerce in Europe is still at the very beginning. This conclusion can be reinforced by analyzing, in more detail, what is the weight that represents the e-commerce over total sales of a firm. The great majority of firms carry out less than 5% of its sales through the e-commerce (between 52.5% in Spain and 31.6% in Italy). Nevertheless, it has to be noted the special case of the United Kingdom, where 23.0% of firms obtain more than 50.0% of their sales from e-commerce. It is, in fact, the highest percentage (followed by Italy) between all considered cases.

To complete the picture, that is given by the direct observation of some figures, and in order to give a single comparable figure corresponding to the measure of the achievement of the target in different regions/countries, we will use the synthetic indicator associated to this target, following the general methodology developed in previous sections and according to the established general framework. In Table VII there is the list of indicators associated to the target, accordingly with the information in the Regional-IST project.

Indicators associated to the target cover information about the main aspects associated to the development of e-commerce. Equipment ( $F_1$ ,  $F_{10}$ , and  $F_{41}$ ) and security ( $F_{13}$ ) give important information for complementing the information coming from the more usually indicators considered for the measurement of B2C and B2B (i.e.,  $F_{13}$ ,  $F_{31}$ , and  $F_{36}$ ).

Now, from **Table 4**, for each country or region, we have to compute the following expression:

$$SI_j^{t,III} = \frac{\sum_{i=1}^{70} w_{F_i}^{III} \cdot \check{F}_{ij}^t + \sum_{i=1}^{15} w_{C_i}^{III} \cdot \check{C}_{ij}^t + \sum_{i=1}^{29} w_{P_i}^{III} \cdot \check{P}_{ij}^t}{\sum_{i=1}^{70} w_{F_i}^{III} + \sum_{i=1}^{15} w_{C_i}^{III} + \sum_{i=1}^{29} w_{P_i}^{III}}$$

where  $t = 2003$  and  $j = \{\text{Catalonia, Baden-Württemberg, Piedmont, Portugal, Hungary, Germany, Spain, France, Italy, United Kingdom, Estonia, Poland}\}$ .

We will restrict the previous expression to the information on firms, since only these indicators are used for the description of targets in the supply side (and not used in the demand side). Hence, the expression for the synthetic indicator can be reduced to:

**Table 6.**

Percentage of e-commerce over total sales (percentage of firms)

Source: e-Business w@tch project

Countries	> 50%	26-59%	11-25%	5-10%	< 5%
EU5	9,5	12,3	11,2	25,1	41,9
Germany	4,4	6,8	7,4	32,6	48,7
Spain	1,2	28,5	8,7	9,2	52,5
France	7,5	4,0	25,2	20,1	43,2
Italy	12,2	11,2	7,2	37,8	31,6
United Kingdom	23,0	11,0	17,9	9,4	38,7

**Table 7.**

Indicators (F) and weights (w) associated to the target

Source: Regional-IST project (www.regional-ist.org)

#### Increase proportion of B2B and B2C transactions taking place over the Internet

$F_1$ : Enterprises connected to Internet	$wF_1 = 3$
$F_{10}$ : Enterprises with own website	$wF_{10} = 4$
$F_{13}$ : Enterprises with Internet security police	$wF_{13} = 2$
$F_{30}$ : Enterprises selling goods or services online	$wF_{30} = 3$
$F_{31}$ : Enterprises purchasing goods or services online	$wF_{31} = 2$
$F_{36}$ : Share of electronic selling over total revenues	$wF_{36} = 1$
$F_{41}$ : Enterprises with EDI	$wF_{41} = 1$

$$SI_j^{t,III} ("Increase B2B and B2C") = \frac{3 \cdot \check{F}_{1j}^t + 4 \cdot \check{F}_{10j}^t + 2 \cdot \check{F}_{13j}^t + 3 \cdot \check{F}_{30j}^t + 2 \cdot \check{F}_{31j}^t + 1 \cdot \check{F}_{36j}^t + 1 \cdot \check{F}_{41j}^t}{\sum_{i=1}^{70} w_{F_i}^{III}}$$

Now, since 54 times indicators have been associated to targets of the supply side (see **Table 2**), the expression for the synthetic indicator can be finally written as follows:

$$SI_j^{t,III} ("") = \frac{3 \cdot \check{F}_{1j}^t + 4 \cdot \check{F}_{10j}^t + 2 \cdot \check{F}_{13j}^t + 3 \cdot \check{F}_{30j}^t + 2 \cdot \check{F}_{31j}^t + 1 \cdot \check{F}_{36j}^t + 1 \cdot \check{F}_{41j}^t}{54}$$

With the corresponding computations (see the **Annex** for details), the synthetic indicator of the target for each analysed country and region shows that the situation in Europe, both at national and regional level, is quite similar. This fact reinforces what was already considered with the initial analysis of just two indicators, the percentage of firms doing e-commerce and the percentage of e-commerce over total sales. Nevertheless, it has to be said that Catalonia and Piedmont have the highest value (0.43 and 0.47, respectively), clearly above the EU5 mean, with a value of 0.30. Although differences are not so relevant, at the opposite side, we find Portugal and France, which obtain the lowest score (0.26 and 0.25), below the result for the aggregated EU5.

Finally, it has to be mentioned that this result has to be combined in further research with those corresponding with the remaining targets and subtargets. That combination will give the "big picture" of the situation of e-business in different regions and countries. Furthermore, in this future research, when data for other years will be available, it will be possible to do a dynamic analysis of the target, studying its performance across time.

# 5

## Conclusions

The main contribution of the paper is the proposed methodology for the measurement of e-business. This proposed methodology establishes three different levels of concretisation, to which indicators and synthetic indicators are associated. According to the theoretical framework stated in **Section 2**, these levels of concretisation measure specific aspects related to e-business, from a narrow approach to a broad approach. The first level of concretisation corresponds to the value chain analysis, which provides an in deep description of the business activities. This level of concretisation permits to analyse the changes that the use of Information and Communication Technologies involve in both, the organisation and strategy of a firm. The second level of concretisation focuses on the relationship between firms and the other agents of the economic activity, this is consumers, public administrations and other firms. The way that interaction between all of them (supply and demand) is modified by the intensive use of ICT is captured in this second level.

Finally, the third level represents the broad approach to the measurement of e-business. Since for an appropriate measurement of e-business it has to be also considered the particular socio-economic context in which firms carry out their business, policy makers determine general targets which will define the strategy either at national, regional or local level. In this level of concretisation it is establish the basis for the analysis of some common targets, proposed by the European Union. Although all levels of concretisation are important for an appropriate e-business measurement, it is of special interest in this paper to analyze the measurement of e-business targets.

Once the three levels of concretisation are well defined, results from the European project Regional-IST are used to associate indicators to each level. All these indicators give information about the value chain activities (primary and support activities), about the demand and the supply side of firms and, finally, about the targets and subtargets established in different

**Table 8.** Synthetic indicator for each region and country  
**Source:** own elaboration  
 \* Year 2002

Regions/Countries	Synthetic indicator (SI)
Catalonia (ES)	0.43
Baden-Württemberg (DE)*	—
Piedmont (IT)	0.47
Portugal	0.26
Hungary	0.30
Germany	0.33
Spain	0.28
France	0.25
Italy	0.30
United Kingdom	0.34
Estonia	0.28
Poland	0.29

e-Europe action plans. For summarizing all this big amount of information (more than 100 indicators are considered) in few figures, the proposed methodology defines synthetic indicators for each level of concretisation.

The normalization and aggregation processes for the construction of these indicators are also explained in the paper. Similarly to the construction of some indexes by the European Commission, such as "Performance in the knowledge based economy", it is used the weighted average method of the values of the indicators. The selection of weights is done according to the idea of "importance of an indicator": the more an indicator is used for describing the e-business development, the more important it is compared to others.

Last part of the paper is devoted to the application of the general methodology to the third level of concretisation, by measuring the target "Increase proportion of B2B and B2C" with the corresponding synthetic indicator. For this application, it is used data from two European projects, the Regional-IST project and the e-Business w@tch project, and a Catalan project, the PIC-project.

With the corresponding data we construct synthetic indicators for some regions and countries (Catalonia, Piedmont, Portugal, Hungary, Germany, Spain, France, Italy, UK, Estonia, and Poland) which permit both, to measure the target "Increase proportion of B2B and B2C" in each case and to compare it between them. With regard to that, it can be said that the situation of e-commerce is quite similar in the different countries/regions considered in the paper. All synthetic indicators, in all cases, have figures which are really closer to the European mean (EU5) 0.30. And it becomes clear that the development of e-commerce in Europe is still at the very beginning, since the synthetic indicators reflect a situation where just 9.5% of firms in Europe is doing e-commerce, and the great majority of firms carry out less than 5% of its sales through the e-commerce.

## ANNEX: Synthetic indicator computations

In this Annex, we show the set of steps followed for the computation of the synthetic indicator associated to the measurement of the target "Increase proportion of B2B and B2C".

### Data

First of all, it is shown the table with data for the associated indicators, and for all regions and countries considered in the paper. Data for Catalonia (CAT) comes from both, the PIC project and the Regional IST project. Data for Baden-Württemberg (B-W), Portugal (PT), Piedmont (PIE), and Hungary (HU) are obtained from the Regional-IST project. Finally, for Germany (DE), Spain (ES), France (FR), Italy (IT), United Kingdom (UK), Estonia (EE), and Poland (PL) it is used the e-Business w@tch project. Due to source availability, Baden-Württemberg is not considered in the analysis. Data for only 3 out of 7 indicators is obtained.

F	w	CAT	B-W	PT	PIE	HU	EU-5	DE	ES	FR	IT	UK	EE	PL
F <sub>1</sub>	3	90.8	?	70.0	98.7	84.0	76.2	79.8	74.0	60.9	85.5	74.9	88.7	66.0
F <sub>10</sub>	4	46.1	48.0*	25.8	72.0	45.6	35.5	44.5	29.8	28.9	33.7	43.5	49.5	44.9
F <sub>13</sub>	2	90.7	?	70.8	83.2	18.5	46.3	34.9	61.7	46.0	48.9	42.5	29.4	32.5
F <sub>30</sub>	3	12.2	22.0*	13.5	13.0	13.4	9.5	13.2	8.9	5.4	9.8	10.4	6.9	10.0
F <sub>31</sub>	2	21.2	37.0*	10.7	43.1	17.4	31.1	39.2	19.9	26.9	27.3	48.0	27.7	11.8
F <sub>36</sub>	1	13.1	?	1.0	14.8	12.3	14.4	9.8	15.0	12.4	15.3	20.6	11.8	21.2
F <sub>41</sub>	1	23.5	?	2.6	10.0	3.1	5.2	3.5	6.3	7.1	5.0	3.8	0.5	5.6

It is used the value for EU-5 as the reference for all values and countries. F is obtained dividing the initial value of the indicator by the European mean.

## REFERENCES

- Atkinson A., Cantillon B., Marlier, E., Nolan, B. (2002), *Social Indicators: The EU and Social Inclusion*. Oxford University Press, Oxford.
- Castells, M. (2001), *La galaxia internet. Reflexiones sobre Internet, empresa y sociedad*. Editorial Plaza&Janés, Madrid.
- Cherchye, L. (2001), 'Using data envelopment analysis to assess macroeconomic policy performance', *Applied economics*, 33, pp. 407-416.
- Cox, D., Fitzpatrick, R., Fletcher, A., Gore, S., Spiegelhalter, D., Jones, D., (1992), 'Quality-of-life assessment: can we keep it simple?', *J.R. Statist. Soc.*, 155 (3), pp. 353-393.
- European Commission (2003), *Third European Report on Science & Technology Indicators*, EUR20025 EN Studies, Directorate-General for Research, Information and Communication Unit, Brussels.
- Europe's Information Society (2002), *e-Europe 2005: an information society for all*, [europa.eu.int](http://europa.eu.int).
- Europe's Information Society (2000), *e-Europe 2002 action plan*, [europa.eu.int](http://europa.eu.int).
- Hills J. (2002), 'Comprehensibility and balance: the case for putting indicators in baskets', *Politica Economica*, 18, pp. 95-98.
- Huggins R. (2003), 'Creating a UK competitive index: regional and local benchmarking', *Regional Studies*, 37, pp. 89-96.
- Krantz D.H., Luce R.D., Suppes P., Tversky A. (1971), *Foundations of measurement*, vol. 1 'Additive and polynomial representations', Academic Press, New York.
- Lovell C.A.K., Pastor J.T., Turner J.A. (1995), 'Measuring macroeconomic performance in the OCDE: a comparison of European and non-European countries', *European Journal of Operational Research*, 87, pp. 507-518.
- Lundvall B.A., Johnson B. (1994), 'The learning economy', *Journal of Industry Studies*, 1(2), pp. 23-42.
- Porter M., (1985), *Competitive Advantage. Creating and Sustaining Superior Performance*, The Free Press, New York.
- Rodrigues M.J. (2002), 'For a European Strategy at the turn of the century'. In: Rodrigues M.J. (ed) (2002), *The New Knowledge Economy in Europe. A Strategy for International Competitiveness and Social Cohesion*, Edward Elgar Publishing, Cheltenham and Northampton, Massachusetts.

F	w	CAT	B-W	PT	PIE	HU	EU-5	DE	ES	FR	IT	UK	EE	PL
F <sub>1</sub>	3	1.2	-	0.9	1.3	1.1	1.0	1.0	1.0	0.8	1.1	1.0	1.2	0.9
F <sub>10</sub>	4	1.3	-	0.7	2.0	1.3	1.0	1.3	0.8	0.8	0.9	1.2	1.4	1.3
F <sub>13</sub>	2	2.0	-	1.5	1.8	0.4	1.0	0.8	1.3	1.0	1.1	0.9	0.6	0.7
F <sub>30</sub>	3	1.3	-	1.4	1.4	1.4	1.0	1.4	0.9	0.6	1.0	1.1	0.7	1.1
F <sub>31</sub>	2	0.7	-	0.3	1.4	0.6	1.0	1.3	0.6	0.9	0.9	1.5	0.9	0.4
F <sub>36</sub>	1	0.9	-	0.1	1.0	0.9	1.0	0.7	1.0	0.9	1.1	1.4	0.8	1.5
F <sub>41</sub>	1	4.5	-	0.5	1.9	0.6	1.0	0.7	1.2	1.4	1.0	0.7	0.1	1.1

Next step is for multiplying the importance of each indicator (the weight *w*) by the value of the normalized indicator.

w·F	CAT	B-W	PT	PIE	HU	EU-5	DE	ES	FR	IT	UK	EE	PL
3·F <sub>1</sub>	3.6	-	2.8	3.9	3.3	3.0	3.1	2.9	2.4	3.4	2.9	3.5	2.6
4·F <sub>10</sub>	5.2	-	2.9	8.1	5.1	4.0	5.0	3.4	3.3	3.8	4.9	5.6	5.1
2·F <sub>13</sub>	3.9	-	3.1	3.6	0.8	2.0	1.5	2.7	2.0	2.1	1.8	1.3	1.4
3·F <sub>30</sub>	3.9	-	4.3	4.1	4.2	3.0	4.2	2.8	1.7	3.1	3.3	2.2	3.2
2·F <sub>31</sub>	1.4	-	0.7	2.8	1.1	2.0	2.5	1.3	1.7	1.8	3.1	1.8	0.8
1·F <sub>36</sub>	0.9	-	0.1	1.0	0.9	1.0	0.7	1.0	0.9	1.1	1.4	0.8	1.5
1·F <sub>41</sub>	4.5	-	0.5	1.9	0.6	1.0	0.7	1.2	1.4	1.0	0.7	0.1	1.1
<b>SUM</b>	<b>23.33</b>	<b>-</b>	<b>14.24</b>	<b>25.42</b>	<b>16.05</b>	<b>16.00</b>	<b>17.71</b>	<b>15.28</b>	<b>13.30</b>	<b>16.15</b>	<b>18.22</b>	<b>15.22</b>	<b>15.53</b>

Finally, the synthetic indicator is computed dividing the sum of weighted and normalized indicators by the total number of indicators that are used in the supply side of the third level of concretisation.

	CAT	B-W	PT	PIE	HU	EU-5	DE	ES	FR	IT	UK	EE	PL
<b>SUM/54</b>	<b>0.43</b>	<b>-</b>	<b>0.26</b>	<b>0.47</b>	<b>0.30</b>	<b>0.30</b>	<b>0.33</b>	<b>0.28</b>	<b>0.25</b>	<b>0.30</b>	<b>0.34</b>	<b>0.28</b>	<b>0.29</b>

15. Saisana M., Tarantola S. (2002), 'State-of-the-art report on current methodologies and practices for composite indicator development', *EUR 20408 EN Report*, European Commission, JRC, Ispra, Italy.
16. Soete L. (2002), 'The challenges and the potential of the knowledge-based economy in a globalised world'. In: Rodrigues M.J. (ed.) (2002), *The New Knowledge Economy in Europe. A Strategy for International Competitiveness and Social Cohesion*, Edward Elgar Publishing, Cheltenham and Northampton, Massachusetts.
17. Viginier P., et al. (2002), *La France dans l'économie du savoir: pour une dynamique collective*, Commissariat Général du Plan, Paris.
18. Vilaseca J. (2002), 'Hacia una economía del conocimiento. Introducción', *Revista de Economía Mundial*, 7, pp. 3-7.
19. Vilaseca J., Torrent J. (2002), 'Midiendo la economía digital: una aproximación metodológica a un indicador de demanda del sector TIC para EE.UU', *Revista de Economía Mundial*, 6, pp. 159-173.
20. Wall R., Ostertag K., Block N. (1995), *Synopsis of selected indicator systems for sustainable development*, Report for the research project: Further development of indicator systems for reporting on the environment, of the Federal Ministry of the Environment, Fraunhofer Institute for Systems and Innovation Research, Karlsruhe.