Unpeeling the layers of the digital divide: category thresholds and relationships within composite indices

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Title

Unpeeling the layers of the digital divide: category thresholds and relationships within composite indices

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Introduction

The birth of the Information Society can be dated as remotely as one might like to, from back to 1850, as a part of the Industrial Revolution, until somewhere in the twentieth century, depending on who is claiming to be his father: Alan Turing and the Computer Science, John Vincent Atanasoff and the digital computer, or Sir Vinton Gray Cerf and the TCP/IP protocols.

Notwithstanding, for most human beings, the Information Society – if ever called this name at home – begins around 1994-1995, when the Internet becomes popular due to the release of Netscape Navigator (Berners-Lee, 2000) and the mobile phone becomes (a) truly mobile and (b) less than a luxury.

On 1994, as a report to backup the World Telecommunication Development Conference that took place that year, the first World Telecommunication Development Report is published by the International Telecommunication Union. Two years later, 1996, Simon Moores coins the term "Digital Divide". Although he was talking about the digital divide *within* rich countries among different strata, the concept spreads to denote unbalances in the adoption of Information and Communication Technologies *among* different countries.

A decade since, buzzwords have spread exponentially and so have telecommunication reports, indices and rankings, all of them to try and name and measure this so called digital divide – or digital development, if taken assertively.

Nevertheless, the international community still believes[1] that there is an important lack of tools to measure the development of the Information Society and, within these existing tools, a lot of work needs to be done for their improvement.

The goal of this research project is to add reflection and knowledge to this commitment. We believe there is still an unexplored point of view in measuring the Information Society which goes from inside-out instead of outside-in. In other words, the main indices and/or reports focus either in technology penetration or in the general snapshot of the Information Society "as is". There is, notwithstanding, a third approach that would deal with working *only* with digital-related indicators and indices, thus including some aspects not taken into account by the technology penetration approach (i.e. informational literacy), and putting aside some "real economy" or "analogue society" indicators not strictly related to the digital paradigm[2].

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[1] See, as the clearest example in this issue, Barzilai-Nahon, K. (2006). Other examples are most publications concerning assessment and measuring tools.
[2] By these we mean, for instance, GDP growth. This indicator is structurally related to one economy's performance measuring and actually includes, by construction, the performance of the ICT sector. But, on the other hand, it also includes the performance of the agricultural sector, which by any means is a digital issue (leaving asside changes in its productivity thanks to the use of ICTs) such as the cost of connectivity or the level of informational literacy.

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This procedure should be able to provide, at least, two kinds of analyses:

1. To compare only-digital indicators with non-digital indicators, especially when aggregated by categories at the index vs. index level. This should provide hints on whether it is possible to leapfrog development by means of ICTs (Figure 1).
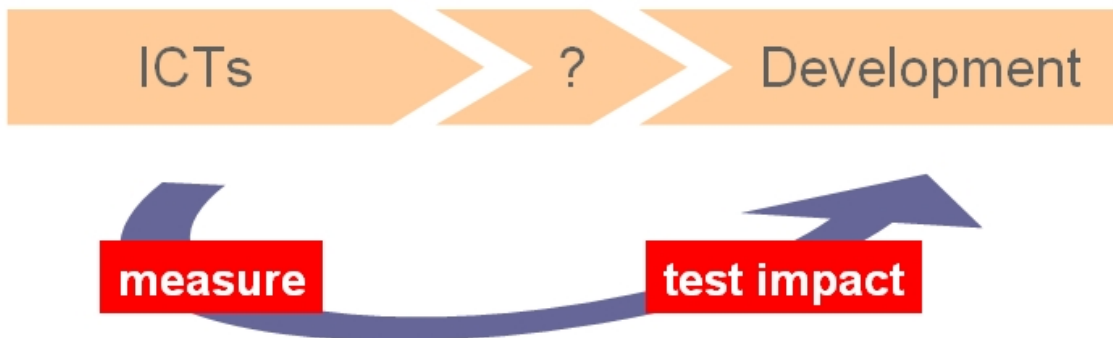
Figure 1: Impact of ICTs in Development

The relevant question here would be whether ICTs have an impact on Development.

2. To compare only-digital indicators among themselves, one by one or grouped according to predefined categories. This should provide hints on whether it is possible to leapfrog the digital development itself and how ICT policies should be stressed to get the optimal results (Figure 2).

Figure 2: Impact of Public Policies to promote the Information Society

In this case, we want to know the impact of sets of policies to bridge the digital divide and see how the Information Society develops accordingly.

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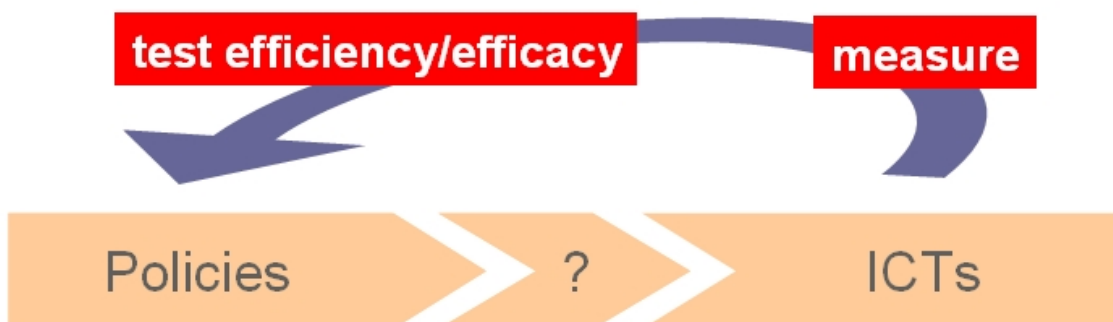Doctorate in the Information Society – PhD Thesis: Project

Keywords

e-readiness, infostate, digital divide, measuring ICT, composite index, ICT4D, infrastructure, capacity building, access, informational literacy

Justification

> "the notion of "access" has traditionally meant different things in broadcasting and in telecommunications. In the broadcasting model, emphasis is placed on the active receiver, on free choice, and access refers to the entire range of products on offer. In the telecommunications model, emphasis is on the sender, on the capacity to get one's messages out, and access refers to the means of communication"[3]

While Marc Raboy was talking in this 1998[4] text – or back in 1995[5] – mainly communications in general, and about mass media in concrete, the statement does apply to Information and Communication Technologies nowadays. Nevertheless, access to the Information Society (its content, its services) is usually described not by dealing with access itself, but by the lack of it, namely, the Digital Divide.

The Digital Divide has been defined in many ways, but most of them can be grouped in two main categories:

- The difference among the *haves* and *have nots* in the Information Society.

- The difference among those who can *access* the Information Society and those who cannot.

We can easily see that these two main categories almost perfectly match the two models describes by Raboy: the "haves and have nots" approach stresses the point of view of the telecommunications model, where people have or have not (physical) means to communicate; the "access" approach being more similar to the broadcasting model, where the stress is put on the user and his ability to access the goods the Information Society can offer.

Measuring this access – or, in negative terms, this digital divide – requires delimiting what is to be *had* or to be *accessed* when one considers a person or a community to be on each side of this divide. Of course, a previous decision is to be made too: what will be the approach, the methodological framework the measuring will be grounded on. In other words, we think that there are two (main) ways of understanding the digital divide that have influenced the design of the tools to measure the Information Society and the Digital Divide. Thus, two groups of indices have appeared depending on the methodological framework chosen: we call them the Telecomm approach, keeping the

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[3] Raboy (1998), p. 224
[4] Op. Cit.
[5] Raboy (1995)

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same name than Raboy, and the e-Readiness approach, which would work the same
way that Raboy's Broadcasting model does.

The Telecomm approach

This group of indices comes from the point of view that the digital divide is a matter of
having or not having computers and/or connectivity, say, telecommunications
infrastructure.

Indices such as the Information Society Index (ISI), infoDev's Information Infrastructure
Indicators (III) or ITU's Digital Access Index (DAI) belong clearly to this group, as can
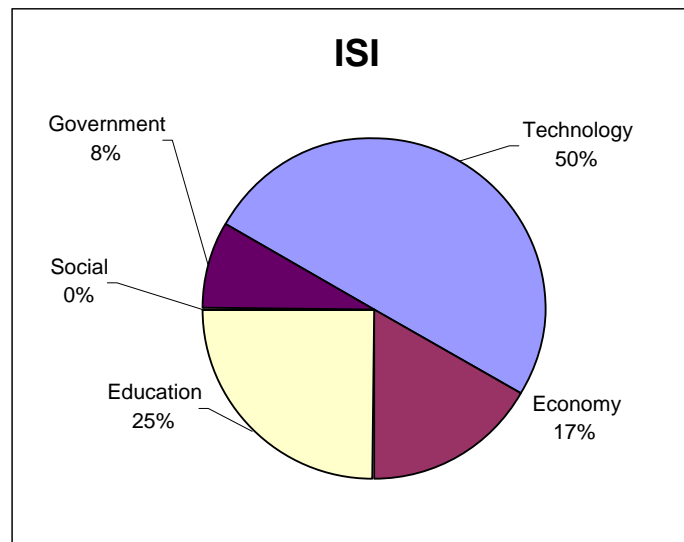bee seen Figure 3, Figure 4 and Figure 5:

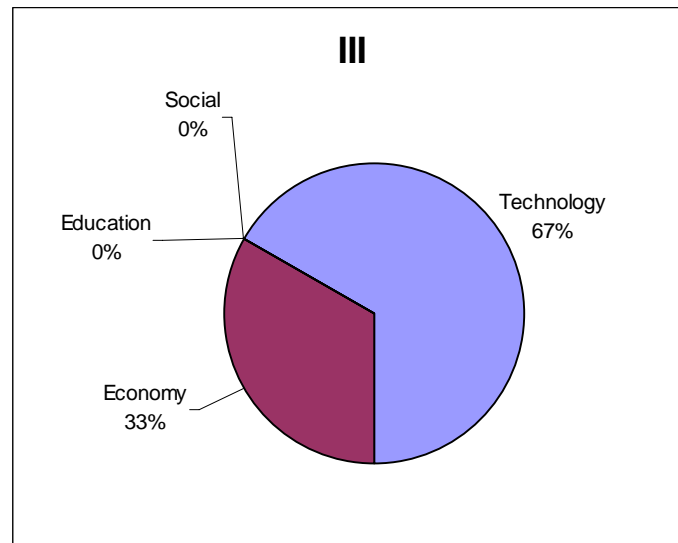**Figure 3: ISI distribution in categories after Bridges.org (2005a)**

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Figure 4: III distribution in categories after Bridges.org (2005a)
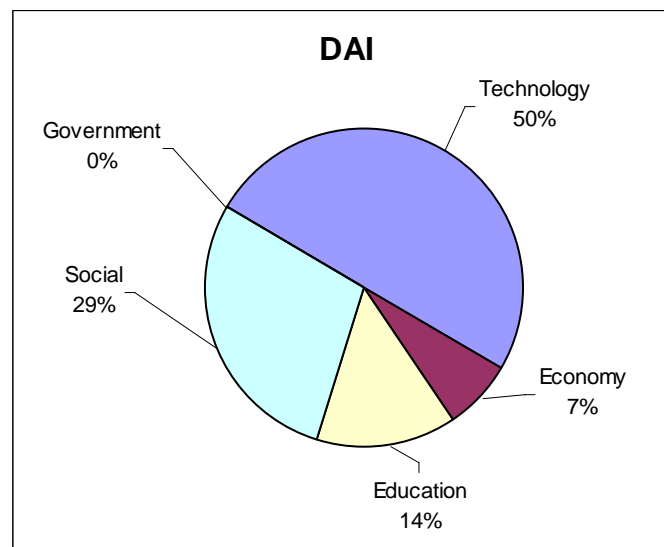
Figure 5: DAI distribution in categories after Bridges.org (2005a)

This is cleary a strong bias towards technology and/or infrastructure, with at least 50% of the total weight in the most even weighted case. Education or the Legal Framework are sometimes not even considered.

It is our belief that while this approach can measure some impact of ICT infrastructures in development (as some authors have been doing for the last years measuring i.e. the impact of ICT investment in GDP) it cannot explain whether public policies to foster the Information Society are working. For example, we think that it might it be possible that capacity building and content and services development could be increasing

exponentially due to correct policies, while such an improvement would not appear in infrastructure biased indices that, above all, focus on hardware and connectivity issues.

The e-Readiness approach

If the digital divide is understood not in terms of infrastructure property or existence but in terms of access to the Information Society (i.e. digital content and services) the indices change dramatically and become more balanced. Being e-readiness the ability of one region to benefit from the Information Society, these indices try to measure its readiness to enter the digital paradigm, by mixing some indicators in the field of ICTs but also from other fields from human development in general. Three of these indices are the World Economic Forum Networked Readiness Index (NRI), ITU's World Telecommunication Indicators (WTI) and The Economist Intelligence Unit Readiness Rankings (EUI).

Nevertheless, as we have previously stated, this approach is, in our opinion, too comprehensive to discriminate, from the index, what really is the state of the *digital development in itself*, regardless of the "general" development of the region. For instance, a high degree of digital literacy in a poor country could output the same result as low literacy levels with high GDP, since both indicators take part in the index.

We can see in Figure 6, Figure 7 and Figure 8 that between 16 to 20% of the indicators do not measure to the "digital" realities:
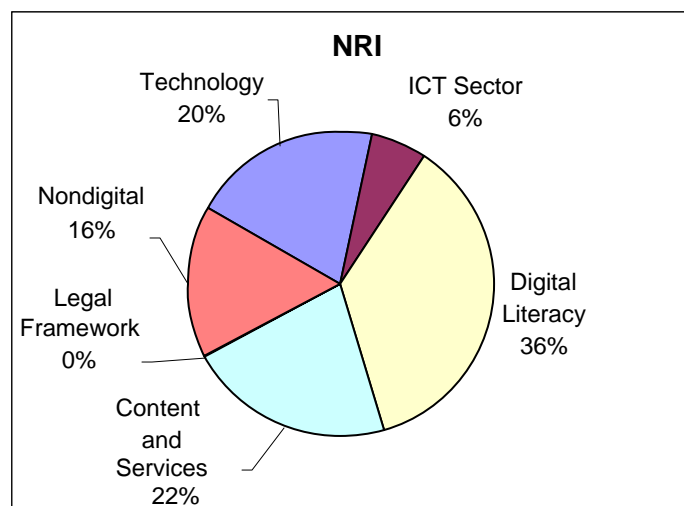
Figure 6: NRI distribution in digital categories, with Bridges.org (2005a) data
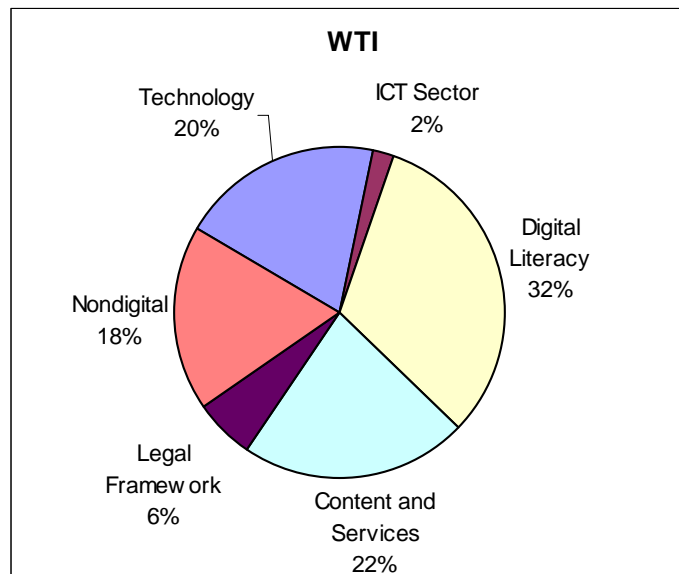
Figure 7: WTI distribution in digital categories, with Bridges.org (2005a) data
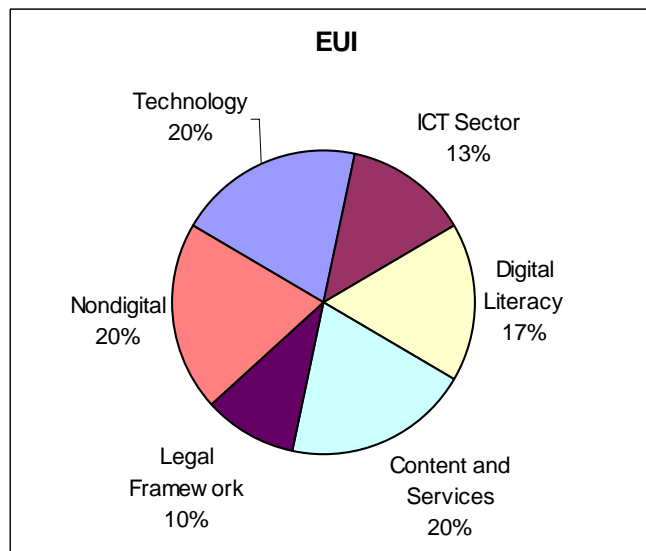
Figure 8: EUI distribution in digital categories, with Bridges.org (2005a) data

These results do look far more balanced than the Telecomm approach, however some "noise" is added through the Nondigital indicators, but also half the other indicators do need reshaping to fit a correct "natural transition" from infrastructure to literacy to content and services, taking into account the accompanying measures of ICT Sector quality and Legal Framework[6].

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[6] See next section and Figure 9 for more details.

We think that this "noise" makes impossible to exactly know whether ICTs are affecting a society's general development, because "analogue economy" indicators might carry most of the weight that explains this development[7]. On the other hand, these indices are much more sensible than the telecomm approach model at explaining the impact of policies in the development of an Information Society.

The Digital Development approach

Thus, we will look at what we could call the Digital Development approach, which means going further than the Telecomm Approach – i.e. include more than "just" infrastructure in the measuring – but stopping before the e-Readiness Approach – i.e. excluding everything that is not *strictly* digital.

Our only-digital approach, as can be seen, does not fit the two former classifications, as there is no way, just by looking at the categories, to know whether an i.e. Education indicator refers to Primary Education or Digital Literacy. A preliminary bibliographic comparative research[8] suggests that we could see these indicators grouped according to these categories:

- Technology
- ICT Sector
- Digital Literacy
- Content and Services
- Legal Framework (ICT Sector regulation, digital content and services regulation)

The group of indicators, in a sort of a timely sequence, could look this way:

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[7] Following the previous example, GDP growth will reflect changes in the agricultural sector growth. An e-readiness indicator such as the ones presented in this section will change when the agricultural sector performance improves through changes in the nondigital indicators such as GCP, even if this growth is in no way related to the digital economy.

[8] While there is no such a classification the way it is presented here in any of the references consulted, we have worked upont the findings, proposals and models of authors like Barzilai-Nahon, K. (2006), Bridges.org (2005a), CSPP (2000), Economic Commssion for Africa (2003), Economist Intelligence Unit (2001-2006), Harvard University (Ed.) (2000), Hilbert, M. R. & Katz, J. (2003), International Telecommunication Union (2005-2006), SIBIS Consortium. (2003c) and World Economic Forum (2002-2006) among many others.
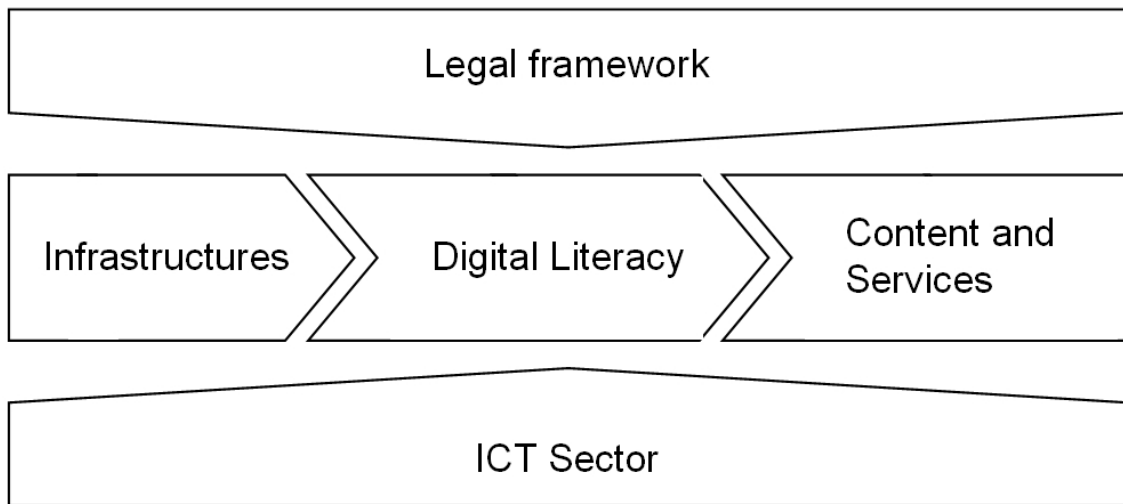
Figure 9: Interdependence of Digital Development Indicators

Purpose

The purpose of this research is triple:

- To build a composite Digital Development Index with two main characteristics:

  - o It would include digital-only indices and/or indicators

  - o It would be based on existing indices and/or indicators and, when not available, proxies from already existing indicators. For instance, digital literacy should be spanned into different categories (basic, intermediate, advanced). If "advanced digital literacy" is not already measured, the number of blogs per country could be one of these proxies to be used. Same with intensity of use and number of domains under national ccTLD.

- To study the relationships among the five different groups of digital-only indicators, namely Technology, ICT Sector, Digital Literacy, Content and Services and Legal Framework.

- To study the relationship among the Digital Development Index – a digital-only indicators composite index – with other Development Indices that do not include digital indicators – i.e. the Human Development Index, life expectance, the Gross Domestic Product, the Gini coefficient, literacy rate, labour productivity, etc.

This work should help to answer these

Research Questions

1. What kind of relationships exist among the categories used in composite indices, such as the proposed Digital Development Index? For instance:

   1.1. Is there a maximum amount of computers/person (maximum threshold) so that an increase in computers/person does not affect the digital development index if, i.e., digital literacy does not increase too?

   1.2. Is there a minimum amount of computers/person (minimum threshold) so that an increase in digital literacy does not affect the Digital Development Index if, i.e., computers/person does not increase too?

   1.3. Is the development of the ICT Sector independent from the Legal Framework?

   1.4. Is the existence of Content and Services independent from the Digital Literacy level?

   1.5. Is there anything such an e-Awareness? Is the Legal Framework dependent from the Digital Literacy level?

   1.6. etc.

2. Is it possible to leapfrog digital development? Is the development of the Information Society somehow *nonlinear*? In other words, is digital content and services (the *raison d'être* of the Information Society) independent from

   2.1. Infrastructures

   2.2. Digital literacy

   2.3. ICT Sector

      2.3.1. so we can expect to find experiences such as India's (with relatively few infrastructure) or Blangladesh's (with Information Society services mostly based on mobile phones) to replicate overpassing prior stages?

3. Is it possible to leapfrog development with the help of ICTs?

   3.1. Is it the ICT Sector a development locomotive? In other words, is the ICT Sector related to other non-digital development indices and/or indicators?

   3.2. Is there a relationship between the Digital Development Index and other non-digital development indices and/or indicators?

4. In addition to the possible answers to the previous questions, this research project could bring the following outputs:

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5. Relative weight of the different aspects of the Digital Development Index (Technology, ICT Sector, Digital Literacy, Content and Services, Legal Framework), so better indices can be built upon.

6. Guidelines for policy makers on what aspect (Technology, ICT Sector, Digital Literacy, Content and Services, Legal Framework) should be reinforced in an Information and Communication Technologies for Development (ICT4D) strategy to bridge the digital divide depending on the state of development of each one.

Methodology

Theoretical and conceptual basis

What's the Digital Divide: mapping the Information Society

We believe that, prior to any work about measuring the Information Society, we should master the concepts and, most especial, the main components or categories that usually define both the measuring and the public policies aiming to promote this Information Society.[9]

Our approach will not be that of the theoretical definitions ("what is the Information Society") but the one about practical definitions ("what means being in the Information Society"), focusing in those authors that have studied this field from the point of view of what is lacking to achieve or to catch up with the Information Society, namely, what is the Digital Divide and, indeed, which are the Digital Divide*s* that build it up.

The following points should be deeply analyzed:

- Deep analysis of the different conceptions and approaches of the Digital Divide

- The different infrastructural components to access the Information Society:

  o Hardware
  o Software
  o Connectivity

- Definition of Digital Literacy and its different levels

- Portfolio of digital content and services:

  o Locally relevant digital content as commodity
  o Locally relevant digital content as capital (i.e. research papers)

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[9] We do not want to analyze specific public policies, but just what concepts, fields, are usually taken into account.

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- - e-Business
  - Pubic e-Services (i.e. e-Health, e-Government, etc.)

- Identification of relevant and/or kinds of regulation in the development of the Information Society

  - ICT Sector regulation
  - Intellectual Property Rights
  - e-Commerce regulation
  - Data and security
  - Access/Censorship
  - Education and ICTs, e-Learning
  - e-Inclusion policies
  - ICT4D policies

We will not pretend to try and define concepts that will work for either all regions and all times, but take a snapshot of reality at a given moment. While we may lose some information in doing so, it is our aim to stress the relationships among layers or categories within the same country of within the same year, and not among countries or across years. Of course, all indices and indicators chosen should be easily subject to change and update by their equivalent along time or across countries, but not as a part of this research but as an update (if any) to it.

How has the Information Society / Digital Divide been measured

Although there have been some interesting studies that have analyzed most part of the existing indices so far (Sciadas, 2004a; Bridges, 2005a) a review of other literature regarding description and analysis of indices should be performed. This first step in reviewing the work and literature in the field of measuring the Information Society should lead us to find:
   a) if our assumption of two existing categories of indices or approaches in conceptualizing the digital divide is correct, and
   b) what are the existing live indices nowadays, meaning by "live" that they have a past history and are intended to be continued in the future, thus discarding those one-time or one-survey-built-upon indices.

Once the live indices have been chosen, an a categorization has been accomplished, these indices would be tested to demonstrate – or invalidate – that, according to their category, they can or cannot explain one economy's development or the impact of public policies to foster the Information Society.

Applied work

Building up the index

As stated in the previous section, the following work in the field of ICT indicators will be carried out:

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▪ Identification of the critical indicators of Digital Divide. Choice of one (or more) existing index as a framework and basis and adding up the lacking indicators from other indices or other data providers, according to the indices analysis previously mentioned.

▪ Elaboration of the proxies for those indicators not already provided.

▪ Elaboration of the proposed composite index[10] with the selected indices and indicators, including theoretical approach explaining the weights chosen for each component index as contribution to the final index.

The philosophy underlying behind our work is not to begin from scratch – even if it implied an analysis of previous work – but to build upon already existing tools and, most important, to build upon consensus. Thus, our starting point in this issue will surely be the two most relevant indices – corresponding with the two previously mentioned approaches – at this time. On one hand, and from the Telecomm approach, we will analyze the Digital Opportunity Index (DOI)[11], based on the ICT Core Indicators[12] and fostered by the International Telecommunications Union and the Partnership on Measuring ICT for Development. As can be seen in Figure 10, it is clearly devoted to infrastructures measuring:
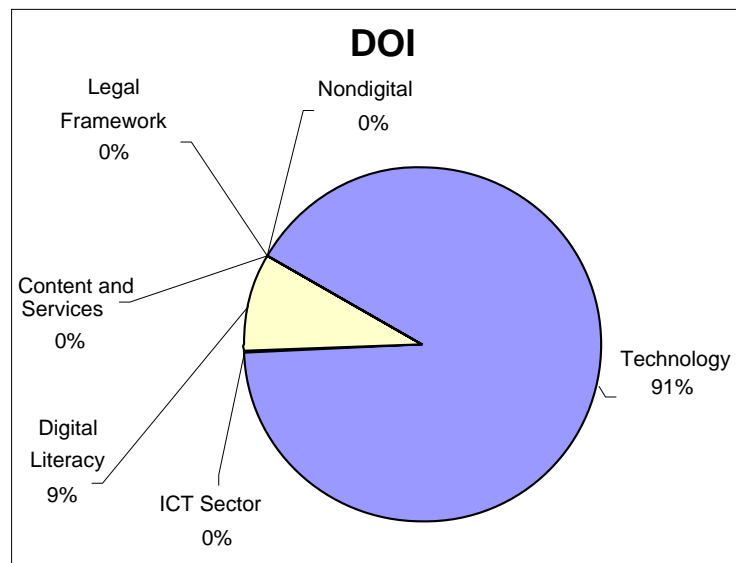
Figure 10: DOI distribution in only digital categories

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[10] Most of the researches listed in the bibliography on e-readiness indicators and measns to measure the information society usually include the way the indices are built. Nevertheless, and depending on the degree of completion of the live index to be taken as basis, further bibliography on index construction will be consulted.
[11] International Telecommunication Union (2006b)
[12] Partnership on Measuring ICT for Development (2006)

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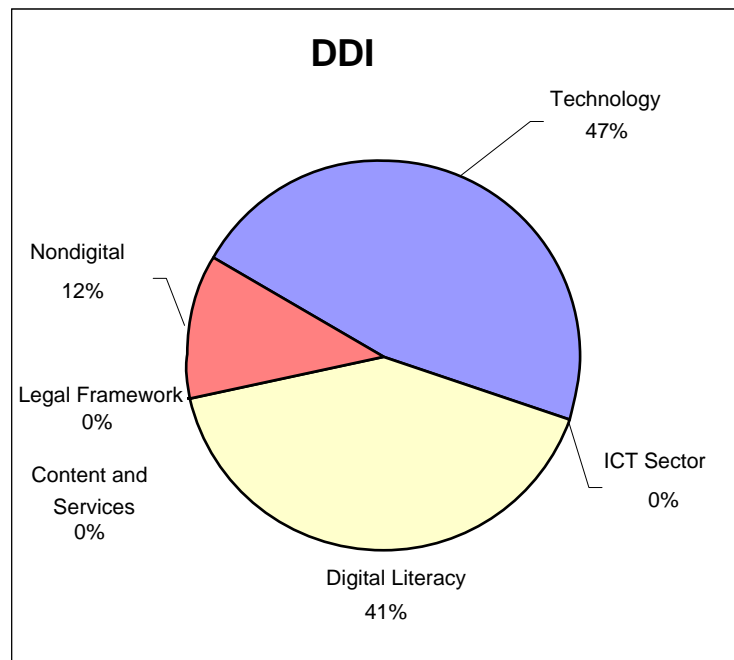
Figure 11: DDI distribution in only digital categories

On the other hand, and from the e-Readiness approach, we will analyze the Digital Divide Index (DDI)[13], developed by Orbicom[14] and recently used by UNCTAD to base on it their last Information Economy Report[15]. Figure 11 shows how the DDI is more balanced while having, still, important lacks such as the legal framework, the digital content or the ICT Sector, while including non-digital data that, in our opinion, weaken the strength of the Index for some determinate uses.

Those two indices are placed in just opposite points of view or approaches, being one of the cores of this work to make ends meet and fill in the gaps that these two indices – and their respective "families" – leave blank.

Activities to carry on will include:

▪ Analysis of the existing indicators, indices and assessments in the field of Telecommunications Development and e-Readiness.

▪ Detection of live indices and testing against development and policy indicators/indices.

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[13] Also known as Orbicom Index or Infostate Index
[14] Sciadas (2003) and Sciadas (2005)
[15] UNCTAD (2006b)

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Conclusions and relevant advice

Once the index is built, its capability to answer the *Research Questions* stated in the *Purpose* section would be tested both qualitatively and quantitatively/statistically, being some of the expected outputs the following

- Statistical work with the index and other analogue indices and indicators to test the power of the index to explain one economy's development. To do this, and due to serious lack of available data at the micro level, the proposed departure point will be analyzing all countries – according to UN definitions – for all years available, never going back further than 1994, as stated in the introductory section. Depending, then, on data constraints, the model will be adjusted to provide the strongest statistical explanation, either setting aside countries with insurmountable data deficits, either abandoning testing lines among indicators because of truncated temporal series.

- Statistical work with indicators and categories to test correlations among different categories of the index, trying to find trends, threshold values in a category that block or allow another category's evolution, etc. Econometrical methods will be used to see (a) in what degree a model explains reality, (b) two indices and/or indicators have a relationship and what is it, (c) test if supposed similar indices and/or indicators have a strong correlation and (d) see, in correlated indices and/or indicators, what are their similarities and differences and how can they be explained (see, as a simplest example, Figure 12)

- Degree of replicability of the index built and the conclusions found.

- Guidelines for policy makers in the field of ICT adoption promotion and digital divide bridging.
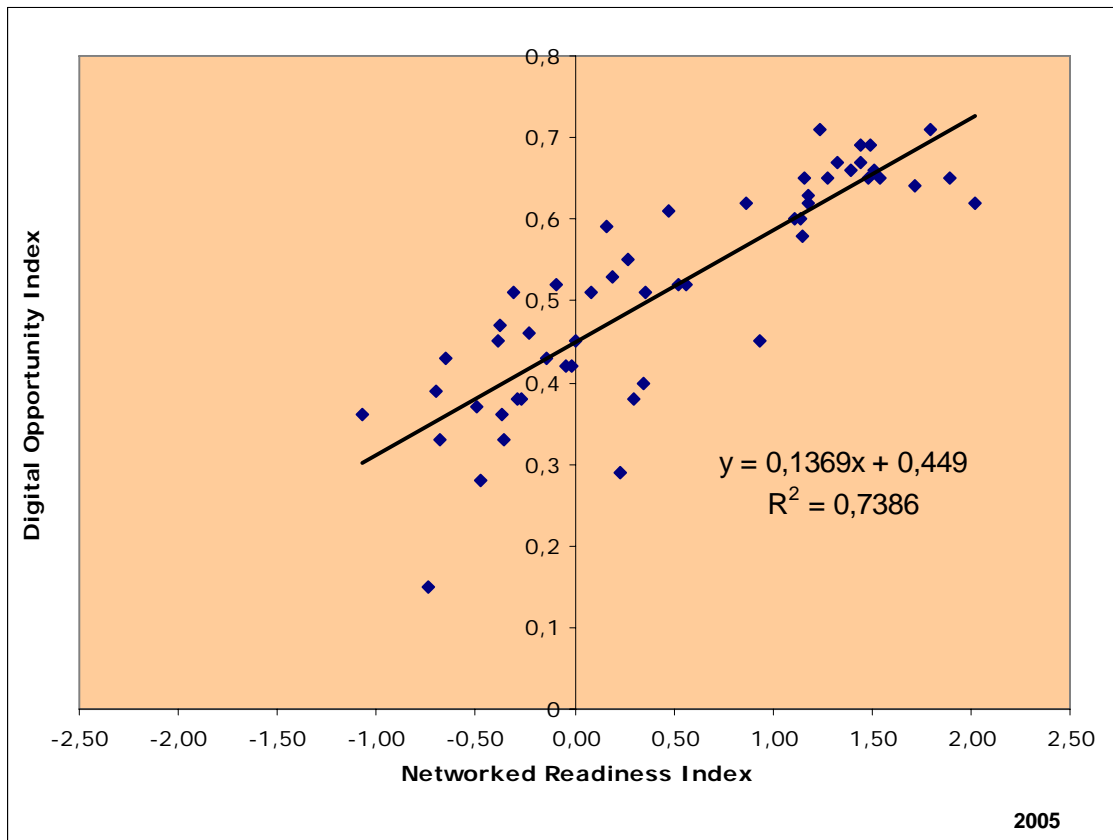
Figure 12: Comparison: DOI (Telecomm approach) vs. NRI (e-Readiness approach) for year 2005. Data from International Telecommunication Union (2006d) and World Economic Forum (2006).

Schedule

Title	Jan 2006	Feb 2006	Mar 2006	Apr 2006	May 2006	Jun 2006	Jul 2006	Aug 2006	Sep 2006	Oct 2006	Nov 2006	Dec 2006	Jan 2007	Feb 2007	Mar 2007	Apr 2007	May 2007	Jun 2007	Jul 2007	Aug 2007	Sep 2007	Oct 2007	Nov 2007	Dec 2007	Jan 2008	Feb 2008	Mar 2008	Apr 2008	May 2008	Jun 2008
Bibliographic revision on the concept of the Digital Divide	▓	▓	▓	▓	▓	▓	▓	▓	▓	▓	▓	▓																		
Stablishing of categories							▓																							
Definition of main components for categories											▓	▓																		
Analysis of Information Society indicators								▓	▓	▓						▓	▓													
Detection of live indices									▓	▓						▓														
Identification of critical indicators												▓	▓	▓	▓	▓														
Choice of proxies														▓	▓															
Elaboration of the index															▓	▓	▓	▓												
Statistical work with digital index vs. analogue indicators																		▓	▓	▓	▓	▓	▓	▓						
Statistical work within digital index categories																		▓	▓	▓	▓	▓	▓	▓						
Conclusions																								▓	▓	▓	▓	▓	▓	▓

Table 1: Schedule of work packages and deliverables

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