MONITORING THE DIGITAL DIVIDE
OBSERVATOIRE DE LA FRACTURE NUMÉRIQUE

George Sciadas

in collaboration with the Orbicom Network
en collaboration avec le réseau Orbicom

An ORBICOM-CIDA Project ***un project Orbicom-ACDI***

ISBN 2-922651-01-0

Legal Deposit:
Bibliothèque nationale du Québec 2002
National Library of Canada 2002

Research report editing: George Sciadas
The report is written in the author’s language.
Le rapport est rédigé dans la langue de l’auteur

TABLE OF CONTENTS

PREFACE . . . iv
PRÉFACE . . . v

FOREWORD . . . vi
AVANT-PROPOS . . . vii

ABSTRACT . . . viii
RÉSUMÉ . . . x

EXECUTIVE SUMMARY . . . xii

CHAPTER 1: THE PROJECT IN PERSPECTIVE . . . 1
1.1 Introduction . . . 1
1.2 Objectives and terms of reference . . . 2

PART 1: A NEW APPROACH, "*Give me a theory...*

CHAPTER 2: THE FRAMEWORK . . . 3
2.1 A Synoptic theory . . . 3
2.2 The ICT composite . . . 5

CHAPTER 3: THE MODEL . . . 6
3.1 Refinements and practical considerations . . . 6
3.2 The structure . . . 7
3.3 Technical specifications . . . 9

CHAPTER 4: RELATED ISSUES . . . 11
4.1 Internal divides . . . 11
4.2 Complementary information . . . 11
4.3 Content . . . 11

PART 2: AN EMPIRICAL APPLICATION, ...*and I can measure anything*"

CHAPTER 5: INDICATORS . . . 13
5.1 General uses and properties . . . 13
5.2 Data gaps . . . 14
5.3 Indicators used . . . 15
5.3.1 Definitions, data sources and notes . . . 15
5.4 Qualifications and caveats . . . 17

CHAPTER 6: ANALYSIS OF THE FINDINGS . . . 20
6.1 How big is the Digital Divide? . . . 20
6.2 How are infostates evolving? . . . 21
6.3 Is the Digital Divide widening or closing? . . . 23
6.4 Component analysis . . . 24
6.5 At the level of individual indicators . . . 26

CHAPTER 7: WHAT NEXT . . . 30

BIBLIOGRAPHICAL REFERENCES . . . 31

ACKNOWLEDGEMENTS . . . 32
REMERCIEMENTS . . . 33

ORBICOM . . . 34
ORBICOM . . . 35

PREFACE

When we were both approached a year ago by the Vice-Rector of UQÀM and Secretary General of Orbicom, Dr. Claude-Yves Charron, to co-chair Orbicom's Consultative Committee on the Digital Divide Monitoring project, we immediately answered positively. We were, and still are, convinced that information and communications technologies (ICTs) are key components for the sustainable development of economies, North and South. "Creating digital opportunities is not something that happens after addressing the 'core' development challenges; it is a key component of addressing those challenges in the 21st century".[1]

The project report presented in this monograph is a pilot sponsored by the Canadian International Development Agency (CIDA) that focused on the development of a conceptual framework, a methodology and an application model to measure the digital divide. The "Orbicom–CIDA Digital Divide Monitoring Project", was tested for 9 countries, albeit with a limited set of data, with very promising results. It constitutes the first phase of a more global project.

"Monitoring the Digital Divide" is Orbicom's response to the lack of adequate approaches to quantify and monitor ICT-related gaps between info-poor and info-rich countries. The overall objective of the project is to design, build, test, maintain and publish periodically a report of a system for monitoring and forecasting the digital and knowledge divides. To the extent that ICTs (old and emerging) and knowledge are increasingly becoming instruments of sustainable development, such a system will help to focus discussions by identifying trends, gaps and asymmetries (divides) both across countries and intertemporally.

It will provide a ready gauge of the access to and use of ICTs by individual countries and consequently help establish the extent of the divide affecting a particular country at any given time. As the system, and refinements to be introduced, make it capable to do so not only at a macro level but also at the micro level by identifying several important components of relative strengths and weaknesses, it can be used as a tool to monitor and assess progress. For instance, by monitoring the divide at periodic intervals, it will track over time the trend of the divide: whether it is narrowing, widening or remaining constant, as well as identify what individual factors account for that.

This research monograph, published with the assistance of the National Research Council Canada (NRC), provides the robust methodology, model and application that are needed to advance the research agenda. It is a tool that will evolve over time through the continued contribution of interested experts. With increased interest and participation, the model can be improved and the scope of the project expanded. It can seamlessly incorporate analyses of internal country divides, as well as linkages to outside intelligence that can turn it into a performance-monitoring tool.

In the process of the exercise, both the availability and reliability of the information were identified as problematic, particularly for ICT skills. The report echoes calls for a concerted international effort to address the gap, which would increase the value of the model as a tool to monitor the divide.

Jacques Lyrette
Vice-President
National Research Council Canada

Tony Zeitoun
Senior Advisor
Knowledge and Development Initiatives, CIDA

[1] G8, 2001. Creating Opportunities for All: Meeting the Challenges.

PRÉFACE

Il y a un an, lorsque le vice-recteur de l'UQÀM et secrétaire général d'Orbicom, le professeur Claude-Yves Charron, nous a demandé de coprésider le Comité consultatif du projet sur la fracture numérique, nous avons immédiatement répondu par l'affirmative. Nous étions alors convaincus, et nous le sommes encore, que les technologies de l'information et des communications (TIC) sont des éléments clés du développement durable des économies du Nord comme du Sud. « La création d'opportunités numériques ne survient pas après s'être occupé des défis majeurs du développement; il s'agit d'un élément nécessaire pour s'attaquer aux défis du 21ème siècle ».[1]

Le rapport présenté dans ce monogramme, dans la langue de l'auteur, présente un projet pilote parrainé par l'Agence canadienne de développement international (ACDI) qui porte sur le développement d'un cadre théorique et d'une approche méthodologique de même que sur l'application d'un modèle pour mesurer la fracture numérique. Le projet « Orbicom–ACDI / Observatoire de la fracture numérique » a fait l'objet d'un test dans neuf pays. Bien qu'effectué avec des données limitées, ce projet s'est avéré très prometteur. Il s'agit en fait de la première phase d'un projet plus global

L'observatoire de la fracture numérique est la réponse d'Orbicom aux approches inadéquates pour quantifier et observer l'évolution des fossés dans le domaine des TIC entre les pays info-pauvres et les pays info-riches. L'objectif ultime du projet est de conceptualiser, construire, tester, maintenir à jour et de publier un rapport pour observer et prévoir l'évolution des fractures numériques et du savoir. Dans la mesure où les TIC (anciennes et émergeantes) et le savoir s'imposent de plus en plus comme des instruments de développement durable, ce système permettra d'orienter les débats sur l'identification des tendances, des écarts, des assymétries (des fractures) entre pays et à travers le temps.

Il constitue un instrument de mesure de l'accès aux TIC et de leur utilisation par les différents pays et, par conséquent, il aidera à établir l'amplitude de la fracture de tout pays à n'importe quel moment dans le temps. Comme ce système peut mesurer la fracture, non seulement au niveau macro, mais aussi au niveau micro, en identifiant les éléments importants des forces et des faiblesses relatives, il peut également être un outil d'observation et d'évaluation du progrès des sociétés. Par exemple, l'observation de la fracture numérique à différents moments, permettra de déterminer si celle-ci s'élargie ou demeure constante et d'identifier les facteurs qui l'influencent.

Ce monogramme, publié avec le concours du Conseil national de Recherches Canada (CNRC), développe une méthodologie étoffée, un modèle et son application qui sont nécessaires à l'avancement de la recherche dans ce domaine. Il s'agit d'un instrument qui devrait évoluer avec le temps grâce aux contributions d'autres experts intéressés à cette problématique. Avec cet intérêt croissant et une plus grande participation, le modèle peut être amélioré et l'envergure du projet accrue. Le modèle peut aisément inclure des analyses de la fracture numérique à l'intérieur même des pays touchés par ce phénomène. Par ailleurs, en intégrant d'autres sources d'information (notamment d'autres indicateurs économiques et techniques), ce modèle peut devenir un réel instrument d'évaluation de la performance.

Enfin, le rapport du projet pilote a mis en évidence des lacunes quant à la disponibilité et la fiabilité de l'information en rapport avec les habiletés en TIC. Le rapport se veut donc un appel pour qu'un effort international concerté voit le jour afin de remédier à celles-ci, ce qui peut contribuer à en faire un modèle plus performant pour mesurer la fracture numérique.

Jacques Lyrette
Vice-président
National Research Council Canada

Tony Zeitoun
Conseiller sénior
Initiatives pour le savoir et le développement ACDI

[1] G8. 2001. Creating Opportunities for All: Meeting the Challenges.

FOREWORD

For Orbicom, monitoring the digital divide was a preoccupation first expressed by members of its network from the South. This initiative was conceived and presented to Orbicom's Executive Committee at the Mexico meeting of July 2000, convened by UNESCO, by Mr. Chin Saik Yoon, President of Orbicom's Research Committee and Editor, from Penang, Malaysia.

At the time, Orbicom's Executive Committee agreed on a plan of action which was subsequently approved by the general membership and that focuses on information and communication technologies (ICTs) for development. The Orbicom–CIDA Digital Divide Index Project (DDI) now called "Monitoring the Digital Divide" is one of several projects of the Orbicom network; they address access, impact and trust aspects of ICTs.

Sponsored by CIDA, Phase I of the DDI project is now completed. The pilot (framework, methodology and the model) has been tested for application with 9 countries and is published with the courtesy of the National Research Council of Canada. Organizations and individuals, a total of 25, from several regions of the world, took part in the consultative group which designed the terms of reference for the current phase and identified areas of focus for the second phase.

Dr. George Sciadas, Author of this report and Scientific Director for the project, presented the project's methodological design at the IAMCR/ICA Symposium on the Digital Divide held in Austin, Texas, USA in November 2001. The presentation was made at a roundtable organized by Orbicom. Prof. Jose Carreno Carlon, the Mexican UNESCO Chair, and Dr. Subhash Joshi, an Orbicom Board Member associated with the Indian Space Research Organization also made country and regional presentations at the roundtable which was chaired by Mr. Pierre Giguère, Ambassador-in-Residence at Orbicom and Université du Québec à Montréal (UQÀM). The project's Co-director, Mr. Chin Saik Yoon, who initiated this research, outlined its genesis and purposes.

The innovative methodology attracted much interest among the participants, many of whom are engaged in different initiatives to measure various elements of the asymetric/unequal diffusion of ICTs.

The DDI approach sets out to overcome inadequacies of past initiatives at cross-country comparisons. The earlier attempts had been restrained by a number of limitations: the choice of useful but disparate indicators; comparisons of interesting but ad-hoc groupings of data with no underlying framework; and frameworks which focus excessively on connectivity.

In closing these remarks, I want to attract the attention on another Orbicom initiative, complementary to this one, also initiated in the South in partnership with the APDIP program of UNDP, IDRC, and Pan Asia Networking. It is called the "Digital Review of Asia Pacific" and covers the region. The purpose is to produce facts, figures, data and analysis of the state-of-the-art of ICT and Internet diffusion, adoption and application in 29 countries.

In concluding, I want to express my sincere appreciation to all who helped Phase I of the DDI project to come to fruition.

Claude-Yves Charron
Vice-Rector of UQÀM
Secretary General of Orbicom

AVANT-PROPOS

Pour Orbicom, l'évolution de la fracture numérique est une préoccupation qui a d'abord été identifiée par les membres de son réseau de l'hémisphère Sud. À l'invitation de l'UNESCO, en juillet 2000 à Mexico, le Comité des recherches sous la présidence de monsieur Chin Saik Yoon, éditeur à Penang en Malaisie, a présenté au Comité exécutif d'Orbicom l'initiative sur la fracture numérique aux membres du réseau Orbicom.

À cette époque, le Comité exécutif d'Orbicom a défini un plan d'action approuvé ultérieurement par l'ensemble des membres. Il porte sur les technologies de l'information et des communications pour le développement international. Le projet Orbicom-ACDI « Index de la fracture numérique » (DDI), devenu « l'Observatoire de la fracture numérique » est un des projets du réseau Orbicom qui portent sur l'accès, l'impact et la confiance en rapport avec les TIC.

Parrainé par l'Agence canadienne de développement international (ACDI), le projet pilote dont il est question dans ces pages, a été effectué sous la direction de George Sciadas Ph.D. auteur du rapport et directeur scientifique du projet et testé pour 9 pays. Il fait l'objet de la présente publication, une courtoisie de Conseil national de Recherches Canada. Diverses organisations et personnes, 25 au total, de plusieurs régions du monde, ont été impliquées dans le processus de consultation qui a établi les paramètres de la phase I et qui a identifié les pistes de recherche de la phase II.

L' auteur et directeur scientifique du projet, George Sciadas, a présenté l'architecture méthodologique du projet au symposium IAMCR/ICA sur la fracture numérique qui s'est tenu à Austin, Texas, en novembre 2001. Cette présentation a été faite lors d'une table ronde organisée par Orbicom. Le titulaire de la chaire UNESCO au Mexique, le professeur José Carreno Carlon, et monsieur Subhash Joshi Ph.D., membre du Conseil d'administration d'Orbicom et associé au "Indian Space Research Centre" ont traité du sujet selon des perspectives nationales et régionales à cette table ronde présidée par Pierre Giguère, ambassadeur-en-résidence à Orbicom et à l'Université du Québec à Montréal (UQÀM). Le codirecteur du projet, Monsieur Chin Saik Yoon, qui a été à l'origine de celui-ci, en a expliqué la genèse et les objectifs.

Cette méthodologie novatrice a généré un grand intérêt parmi les participants dont un bon nombre est engagé dans différentes initiatives visant à mesurer certains éléments de la diffusion inégale et assymétrique des nouvelles technologies de l'information et de la communication (TIC).

Le concept DDI vise à dépasser les approches inadéquates des autres initiatives qui comparent l'état des TIC dans différents pays. Les tentatives précédentes ont été limitées par certaines contraintes: le choix d'indicateurs utiles mais disparates; des comparaisons de regroupements ad-hoc de données mais sans cadre de référence; et des cadres de références qui ciblent la connectivité de façon excessive.

Je veux aussi attirer l'attention des lecteurs sur une autre initiative d'Orbicom, en complémentarité avec celle-ci, qui provient elle aussi de l'hémisphère Sud et menée en partenariat avec le programme APDIP du PNUD, le CRDI et le "Pan Asia Networking": le "Digital Review of Asia Pacific". Cette initiative couvre toute la région. Son but est de produire des informations, des chiffres, des données et des analyses sur la diffusion, l'appropriation par les populations et l'application des plus récentes technologies et d'Internet dans 29 pays.

En concluant cet avant-propos, je désire exprimer mes remerciements sincères à tous ceux et celles qui ont contribué à mener à bonne fin cette première phase du projet DDI.

Claude-Yves Charron
Vice-recteur de l'UQÀM
Secrétaire général d'Orbicom

ABSTRACT

Monitoring the DIGITAL DIVIDE

Creating digital opportunities is not something that happens after addressing the 'core' development challenges; it is a key component of addressing those challenges in the 21st century. (G8, Creating Opportunities for All: Meeting the Challenge, 2001).

The context

The role of ICTs in development has generated enormous interest in the Digital Divide, which now occupies a prominent place in the agendas of national and international organizations. This elevated level of activity has come with the realization of the importance of adequate measurement. There is a need for an instrument to quantify the Digital Divide and monitor comparative performances across countries and over time.

The objective

This Orbicom–CIDA project aims to make a contribution by developing a framework and a methodological approach whose empirical application will make it possible to quantify the Digital Divide and

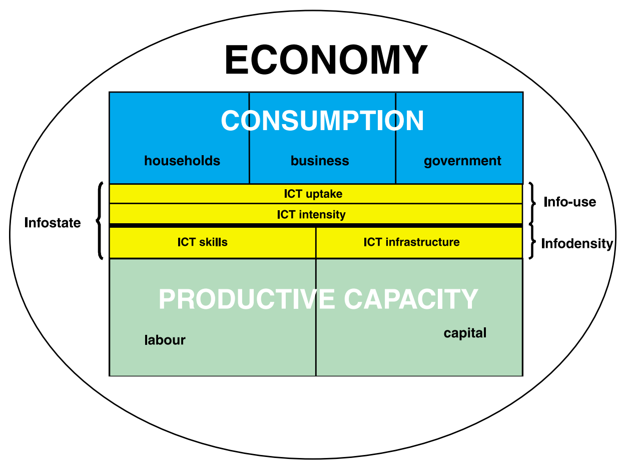
- compare across countries at a given point in time
- compare within countries over time.

The project is guided by the following ***terms of reference*:**

- Place emphasis on developing countries;
- Rely on an approach that yields policy-relevant results;
- Be broader in scope than pure connectivity measures.

The new approach

Rather than relying on ad-hoc indicators, a framework is developed based on strong theoretical underpinnings. It arrives at the degree of a country's "ICT-ization", or ***infostate***, as the combination of 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, machinery and equipment, as well as ICT skills, indispensable for the functioning of information, knowledge-oriented societies. ***Info-use*** refers to the uptake of various ICTs by households, businesses and governments and the intensity of their actual use. Then ***the Digital Divide is defined as the difference between countries' infostates.*** Since infostates are dynamic, unbounded and ever-evolving, the relative nature of the Digital Divide is explicitly recognized. Any progress made by developing countries can be measured and, at the same time, it can be compared against the progress made by developed countries.



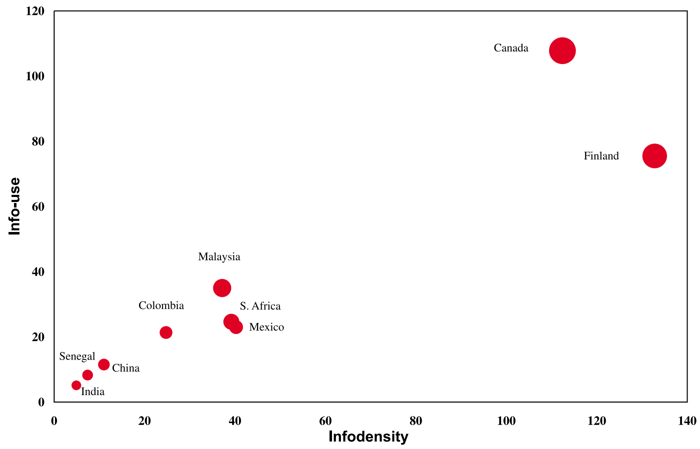
An empirical application

The model that results from the framework was then tested with a sample of nine countries for the 1995–2000 period. Existing data from known sources were collected and indicators were compiled for each thematic component. The intent of this pilot application is to demonstrate the analytical insights that the model can offer, the questions it can answer, as well as to assess the plausibility of the results that it yields. They prove revealing:

How big is the Digital Divide?

The magnitude of the gap between developed and developing countries is enormous. Developed countries (Canada and Finland in our sample) are in a league of their own. However, interesting sub-clusters are formed among the less-developed countries, indicative of different stages of development.

Chart 1. Digital Divide 2000



(Canada	Infodensity		Info-use		Infostate	
1999=100)	1995	2000	1995	2000	1995	2000
Canada	61.4	112.4	64.9	107.8	63.1	110.1
China	2.6	11.0	4.1	11.5	3.3	11.3
Colombia	8.0	24.7	10.3	21.4	9.1	23.0
Finland	89.1	132.8	58.7	75.5	72.3	100.1
India	1.1	4.9	2.7	5.1	1.7	5.0
Malaysia	15.2	37.2	16.5	35.0	15.9	36.1
Mexico	10.7	40.2	10.5	23.0	10.6	30.4
Senegal	1.0	7.4	3.4	8.3	1.8	7.8
South Africa	19.7	39.2	13.1	24.6	16.1	31.1

How is the Digital Divide evolving?

Infodensity and info-use are rising in all countries, mostly due to ICT networks and uptake associated with the newer technologies - the Internet and mobile phones. Growth is generally higher for those at the low end, but differs across countries and specific technologies. The Digital Divide is closing, but at a very slow pace. Without further action, it could persist for generations.

The model permits intra-country analyses and cross-country comparisons at various levels of detail. Relative strengths, weaknesses and progress can be identified for ICT networks, skills, uptake and intensity, as well as the level of individual indicators.

Genesis of the project

For Orbicom, monitoring the digital divide was a preoccupation first expressed by members of its network from the South. This initiative was conceived and presented to Orbicom's Executive Committee at the Mexico meeting convened by UNESCO in July 2000, by Mr. Chin Saik Yoon, Chair of Orbicom's Research Committee, and Editor from Penang, Malaysia.

At the time, Orbicom's Executive Committee agreed on a plan of action, which was subsequently approved by the general membership and which focuses on information and communication technologies (ICTs) for development. The Orbicom–CIDA Digital Divide Index Project (DDI), now called **"Monitoring the Digital Divide"**, is one of several projects of the Orbicom network; they address access, impact and trust aspects of ICTs.

Sponsored by CIDA, Phase I of the DDI project has now been completed under the direction of **Dr. George Sciadas**, author of this report and Scientific Director for the project. Organizations and individuals, a total of 25, from several regions of the world, took part in the consultative process which designed the terms of reference for the current phase and identified areas of focus for the second phase.

Phase II

With increased interest and participation, the model can be improved and the scope of the project expanded. It can seamlessly incorporate analyses of internal country divides, as well as linkages to outside intelligence that can turn it into a performance-monitoring tool.

In the process of the exercise, severe informational gaps were identified, particularly for ICT skills. The report echoes calls for a concerted international effort to address them.

The full report is available by Orbicom at **http://www.orbicom.uqam.ca**

RÉSUMÉ

OBSERVATOIRE DE LA FRACTURE NUMÉRIQUE

La création d'opportunités numériques ne survient pas après s'être occupé des défis majeurs du développement ; il s'agit d'un élément nécessaire pour s'attaquer aux défis du 21ème siècle. (G8, Creating Opportunities for All: Meeting the Challenge, 2001)

Le contexte

Le rôle joué par les technologies de l'information et des communications (TIC) dans le développement international a généré un grand intérêt pour le phénomène de la fracture numérique qui occupe désormais une place importante à l'ordre du jour des organisations nationales et internationales. Cet intérêt conduit à mesurer adéquatement l'importance de la fracture numérique. Il est donc nécessaire d'avoir un outil méthodologique pour quantifier ce phénomène et pour établir des comparaisons entre les performances des différents pays à un moment donné dans le temps.

L'objectif

Le projet d'Orbicom et de l'ACDI cherche à développer un cadre théorique et une approche méthodologique dont l'application empirique permettra de quantifier la fracture numérique afin :

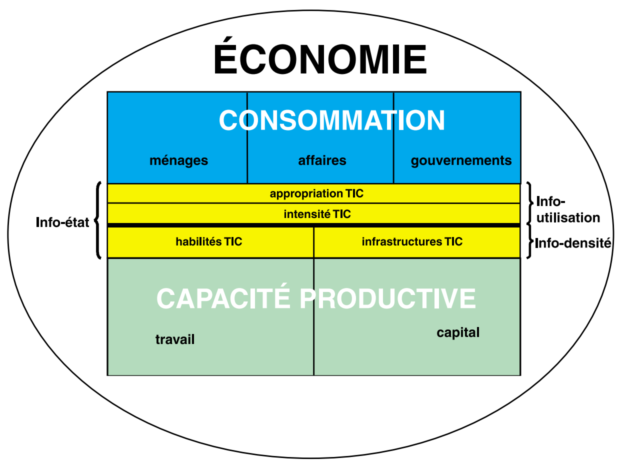
- d'établir des comparaisons entre les différents pays à un moment précis dans le temps ;
- d'établir des comparaisons à l'intérieur de ces mêmes pays à différentes périodes de temps.

Les critères de référence du projet de l'Observatoire de la fracture numérique sont :

- l'emphase doit être mise sur les pays en développement ;
- l'approche doit fournir des résultats devant mener à l'adoption de politiques pertinentes ;
- l'objectif est d'aller au-delà des seuls critères de connectivité.

Une nouvelle approche

Plutôt que de se fier aux indicateurs économiques et techniques ad hoc, la recherche est développée à partir d'un cadre théorique fiable permettant de déterminer le niveau de « TICisation » d'un pays ou son « info-état ». L'info-état résulte de la combinaison de l'info-densité et de l'info-utilisation.



L'info-densité se définit par le capital en TIC par rapport au capital travail et à leur impact dans la capacité productive d'un pays. L'info-densité inclut les réseaux de télécommunications, la machinerie et l'équipement ainsi que les habilités indispensables au fonctionnement des sociétés de l'information et du savoir.

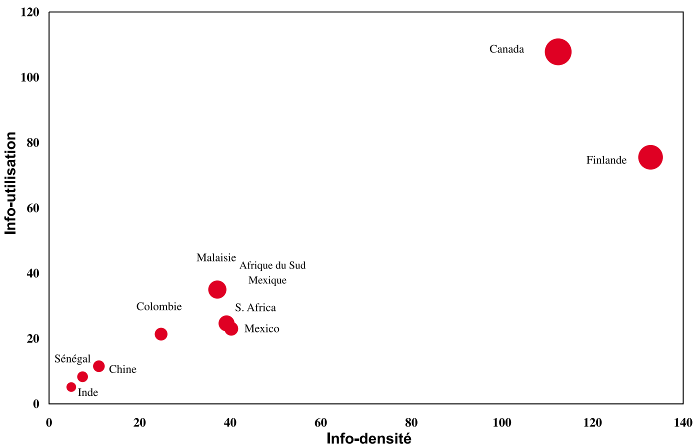
L'info-utilisation fait référence à l'appropriation des TIC par les foyers, les milieux d'affaires et les gouvernements ainsi qu'à l'intensité de leur utilisation réelle.

La fracture numérique est alors définie par la différence de l'info-état, soit la différence entre l'info-densité et l'info-utilisation entre les pays. Étant donné que les info-états sont dynamiques, sans limites et en constante évolution, la nature de la fracture numérique est explicitement relative. Tout progrès réalisé par les pays en développement est mesurable et, à tout moment, il peut être comparé aux progrès réalisés dans les pays développés.

Une application empirique

Le modèle théorique de la fracture numérique a été testé sur un échantillon de neuf pays durant la période 1995–2000. Les données, les principaux indicateurs économiques et techniques, provenant de sources connues sont colligées et compilées pour chaque partie thématique. L'objectif du projet pilote est de démontrer la validité du modèle en regard des aperçus analytiques, des questions auxquelles il répond et de la plausibilité des résultats. Le projet pilote a déjà révélé l'ampleur de la fracture numérique et de quelles manières elle évolue.

Graphique 1. Fracture numérique 2000



(Canada 1999=100)	Info-densité 1995	Info-densité 2000	Info-utilisation 1995	Info-utilisation 2000	Info-état 1995	Info-état 2000
Canada	61,4	112,4	64,9	107,8	63,1	110,1
Chine	2,6	11,0	4,1	11,5	3,3	11,3
Colombie	8,0	24,7	10,3	21,4	9,1	23,0
Finlande	89,1	132,8	58,7	75,5	72,3	100,1
Inde	1,1	4,9	2,7	5,1	1,7	5,0
Malaisie	15,2	37,2	16,5	35,0	15,9	36,1
Mexique	10,7	40,2	10,5	23,0	10,6	30,4
Sénégal	1,0	7,4	3,4	8,3	1,8	7,8
Afrique du Sud	19,7	39,2	13,1	24,6	16,1	31,1

Quelle est l'ampleur de la fracture numérique ?

Le fossé entre les pays développés et les pays en développement est énorme. Des pays comme le Canada et la Finlande sont dans une catégorie à part, tandis que les pays les moins développés sont regroupés en d'intéressantes sous-grappes qui attestent de différents stades de développement.

Comment la fracture numérique évolue-t-elle ?

L'info-densité et l'info-utilisation augmentent dans tous les pays en raison du développement des TIC et de l'appropriation plus récente de certaines d'entre elles comme Internet et les téléphones mobiles. Pour les pays en bas de l'échelle, la croissance est généralement plus importante, mais elle diffère selon les pays et les technologies. La fracture numérique se résorbe très lentement. Sans actions supplémentaires, elle pourrait persister pendant plusieurs générations.

Le modèle théorique et méthodologique permet de faire des analyses intra-pays et des comparaisons entre les pays à différents niveaux de précision. Les forces, les faiblesses, les progrès relatifs et le niveau des différents indicateurs peuvent être identifiés pour les réseaux des TIC, l'appropriation des TIC, les habiletés et l'intensité.

L'historique du projet

Pour Orbicom, l'évolution de la fracture numérique est une préoccupation majeure qui a d'abord été identifiée par les membres de son réseau de l'hémisphère sud. À l'invitation de l'UNESCO, en juillet 2000 à Mexico, le Comité des recherches sous la présidence de monsieur Chin Saik Yoon, éditeur à Penang en Malaisie, a présenté l'initiative sur la fracture numérique aux membres du réseau Orbicom.

À cette époque, le Comité exécutif d'Orbicom a défini un plan d'action approuvé ultérieurement par l'ensemble des membres. Il porte sur les technologies de l'information et des communications pour le développement international. Le projet Orbicom-ACDI « Index de la fracture numérique » (DDI), devenu « l'Observatoire de la fracture numérique » est un des projets du réseau Orbicom qui étudient l'accès, l'impact et la confiance en rapport avec le développement des TIC.

Parrainé par l'Agence canadienne de développement international (ACDI), la première phase, dont il est question dans ces pages, a été effectuée sous la direction de George Sciadas Ph.D. auteur du rapport et directeur scientifique du projet. Diverses organisations et personnes, 25 au total, de plusieurs régions du monde, ont été impliquées dans le processus de consultation qui a établi les paramètres de la phase I et qui a identifié les pistes de recherche de la phase II.

Une phase II de l'Observatoire de la fracture numérique

Avec une participation plus importante des pays et des organisations intéressés, le modèle peut être amélioré et son envergure augmenté. Le modèle peut aisément inclure des analyses de la fracture numérique à l'intérieur même des pays touchés par ce phénomène. Par ailleurs, en intégrant des expertises externes (notamment d'autres indicateurs économiques et techniques), ce modèle peut devenir un réel instrument d'évaluation de la performance.

Enfin, le rapport du projet pilote a mis en évidence de sérieuses lacunes en ce qui concerne la disponibilité de statistiques en rappport avec les habiletés et les connaissances pratiques des TIC. Le rapport se veut donc un appel pour qu'un effort international concerté voit le jour afin de remédier à celles-ci.

Le rapport complet est disponible sur le site d'Orbicom http://www.orbicom.uqam.ca

EXECUTIVE SUMMARY

The increasing belief that ICTs, appropriately integrated with overall efforts, are conducive to sustainable development has come with the realization that it is economically and socially undesirable to leave substantial population masses behind. The elevated interest and heightened level of activity by all stakeholders to address the Digital Divide have highlighted the importance of information and exposed the lack of adequate measurement approaches necessary for informed choices. There is need for an instrument to assist in the identification of relative states across and within countries, as well as to monitor progress. This is the area where the project to monitor the Digital Divide sets out to contribute.

Rather than relying on ad-hoc approaches, Part 1 of the study develops a framework based on solid theoretical underpinnings. It arrives at the degree of a country's ICT-ization, or infostate, as the combination of infodensity and info-use. Infodensity refers to the role of ICT capital and labour stocks in the productive capacity of the economy. It includes ICT networks, machinery and equipment, as well as ICT labour skills indispensable for the functioning of information, knowledge-oriented societies. Info-use refers to the uptake of various ICTs by households, businesses and governments and the intensity of their actual use. The Digital Divide is defined then as the difference among countries' infostates. Since infostates are dynamic, unbounded and ever-evolving, the relative nature of the Digital Divide is explicitly recognized. Any progress made by developing countries is examined in conjunction with the progress made by developed countries.

With appropriate modifications, the framework then serves as the basis for the building of a model that makes it possible to measure and compare both across countries at a given time and within countries over time. A pilot application of the model is implemented in Part 2. It demonstrates the richness of the analytical insights that it can yield, as well as provides a test for the plausibility of the results. The results are illuminating.

- The magnitude of the Digital Divide between developed and developing countries is huge. They are separated by decades.
- Infostates are increasing across countries, principally due to new technologies.
- The Digital Divide is closing, but at a very slow pace. Without further intervention, the gap could persist literally for generations.

The model permits cross-country and intra-country analyses and comparisons at various levels of desired detail to identify relative strengths, weaknesses and progress. It is also capable of incorporating analyses of internal country divides, as well as linkages to outside intelligence that can turn it into a performance-monitoring tool.

In the process of the exercise, severe informational gaps were identified. A concerted international effort to address them would be very beneficial.

CHAPTER 1. THE PROJECT IN PERSPECTIVE

1.1 Introduction

Information and communications technologies (ICTs) have catapulted into our lives and absorb a substantial amount of brain power to:

- conceive, design and produce ICT goods and services (supply);
- devise ways to integrate them efficiently in production and consumption (demand), and;
- understand what it all means (socio-economic research).

The first two create new industries, occupations and wealth and, at the same time, alter existing economic and social arrangements. Research spans across every discipline and is multi-faceted. A key area of investigation concerns the role of ICTs in sustainable economic growth and the magnitude of their contribution to the recent stellar economic performance of several developed countries by improving productivity everywhere in the economy and not just in the ICT sector. While there is healthy skepticism (e.g. Gordon 2000), the scale of the findings is tipping the other way (e.g. Jorgenson and Stiroh 2000). In parallel, sociological research is also taking place, examining such aspects as the impact of ICTs on social cohesion. From early on, researchers, policy makers and businesses got interested in the Digital Divide, the gap between ICT "haves" and "have-nots". While the first attempts (e.g. US 1995, Canada 1996) focused on various divides within individual countries, the interest soon escalated to cross-country comparisons with emphasis on the divide between developed and developing countries.

To a good extent, arguments in the debate concerning the international divide mirror those for domestic divides. In essence, it is deemed economically and socially undesirable to see ICTs elevating the lot of some, while leaving a substantial proportion of the population behind — thus, accentuating already existing gaps. There is a rising belief that ICTs can accelerate the outcomes of ongoing development efforts. Voices of caution are also heard ('computers versus tractors'). While there is no denying that such debates ought to take place in order to identify potential dangers and pitfalls, "ICTs for development" is now a recognized and influential phrase. The recent report of the G-8 DOT Force "Creating Opportunities for All: Meeting the Challenge" admits that much, says that the contribution of ICTs to development is not automatic and refers to their appropriate application, effective use and suitable implementation. However, it proceeds to unequivocally state that: "Creating digital opportunities is not something that happens after addressing the 'core' development challenges; it is a key component of addressing those challenges in the 21st century" (2001, p.7).

The belief that ICTs are conducive to development comes with the recognition that their diffusion, use and benefits are not going to happen automatically but, instead, require the concerted efforts of all in the international community. Without being a panacea for all the planet's woes, ICTs confront us with a critical juncture to an historic opportunity (Orbicom 1999, OECD/UN/UNDP/World Bank 2001). Thus, bridging the Digital Divide is a worthy undertaking.

It is in this vein that a series of parallel initiatives have been launched across international organizations and fora, such as the UN ICT Task Force, the World Bank's InfoDev program, the OECD and the G-8. Work undertaken under these initiatives entails a plethora of challenges, both substantive and practical. They encompass the identification of priority areas, our understanding of the tasks involved and the non-trivial coordination that must take place for their implementation. This burst of activity is accompanied by the heightened realization of the importance of reliable measurements, indispensable to assess the magnitude of the problem, as well as to monitor progress. However, the dearth of satisfactory approaches exposes the need for an instrument that will provide the international community with an adequate mechanism applicable towards:

- the identification of relative needs among countries;
- the allocation of investments to their most appropriate uses, and;
- the monitoring of performance.

This is where this project hopes to contribute.

1.2 Objectives and terms of reference

The objective of the Digital Divide project is to develop a model, grounded on a firm methodological framework, the empirical application of which will make possible systematic measurements and comparisons:

- across countries at a given point in time;
- within countries over time.

In conjunction with these objectives, the stakeholders of the project stipulated that it will be guided by the following terms of reference:

- Place emphasis on developing countries;
- Rely on a modeling approach that yields policy-relevant results;
- Focus on ICTs but be broader in scope than pure connectivity measures.

Several implications stem from the above, which will be addressed during the development of the framework.

As this is a new area of investigation, it is generally characterized by selective application of concepts and lack of acceptable terminology, definitions and overall nomenclature. Therefore, such work is subject to many complexities and can amount to a tall order. At another level, though, it is quite simple. It must provide a yardstick for the obvious. Anyone who visits Helsinki and Abidjan in consecutive days cannot but notice a difference. Finland has and uses ICTs much more than Côte d'Ivoire. In a nutshell, this is the requirement. Operationalizing it, though, requires a cogent framework.

The enormous chasms in the stage of development and the standard of living between developed and developing countries hardly need repeating. This is the Big Divide, against which all kinds of other divides can be identified and examined. Our era of rapid change has stimulated high, yet unsettled, intellectual curiosity. Widespread references to terms like the new economy, the knowledge economy or the information society, have in turn precipitated research on the knowledge divide (e.g. Malaysia 2001), the information divide, the technological gap and the like. While there is substantial overlap between such investigations, much can be learned from all. Our focus is on the Digital Divide, which is ICT-centric. The generation, capture, storage and transmission of information and knowledge, although greatly facilitated by ICTs, are not constrained by them. Technology is much broader in scope than ICTs.

While 'divide' is generally understood, the word 'digital' is a misnomer. Digitization is undoubtedly at the center of the recent technological advances, but our domain of interest encompasses more conventional, non-digital ICTs. Rather than adding unnecessary confusion by changing the term, it is preferable to clarify this. Telecommunications networks based on analogue technologies, for instance, are part of our investigation. Digitization of such networks matters, as it allows the delivery of value-added services in addition to voice telephony, but is not by itself a defining feature of ICTs.

Related research to date on cross-country comparisons has had a focus different than ours. Work by the OECD (2000, 2002) comes mainly in the form of a series of useful but rather disparate indicators. The McConnell International Report (2001) compares interesting but ad hoc groupings of qualitative indicators with no underlying framework. The Connectedness Index (Conference Board of Canada 2001) does offer a framework, but it focuses exclusively on connectivity and does not address factors important to the divide.

Although a discretionary approach to the construction of a measurement tool, whereby indicators of perceived interest are grouped together indiscriminately, could yield useful insights, we shall rely on a holistic approach. The conceptual framework will culminate in a model that will provide the underpinnings for the index's components, as well as provide the linkages between these components and all that could explain their movement. The technical specifications will then be developed, the rationale for the choice of specific indicators will be discussed and an empirical application will demonstrate the feasibility — and plausibility — of the approach.

PART 1: A NEW APPROACH
"*Give me a theory...*

CHAPTER 2. THE FRAMEWORK

As the issue of the Digital Divide immediately invokes comparisons, we must define what is that that divides. When referring to the cross-country income divide, for example, researchers typically define income as GDP and then compare — in absolute terms, per capita or some other measure. If the literacy divide is at issue, one must arrive at a reasonable definition of what constitutes literacy, apply it in consistent measurements across countries, and then look at the differences. In the case of the Digital Divide, the inability to define what it is has frustrated research efforts. Brainstorming sessions can be sometimes reduced to stimulating but endlessly vague discussions, where the beginning and the end are not separated by the between, and which invariably leave the participants with a pessimistic taste of 'smallness'. It is a daunting task to arrive at something that will embody every possible detail of interest and incorporate everyone's personal experiences and anecdotes, considering that every known economic, social and cultural dimension is affected by ICTs. However, arriving at an operational definition of the Digital Divide is inescapable in this project, as there is no other systematic way to proceed. To do so, we shall adapt existing knowledge and combine it with analytical observations and practicality. It may be that several alternative formulations are admissible, with their relative pros and cons. If that is the case, we stand to profit from a plurality of designs and diverse explorations.

2.1 A synoptic theory

For the purposes of this project, we shall develop a framework that allows us to define the degree of a country's 'ICT-ization' or **infostate** as the aggregation of its **infodensity** and **info-use**. Infodensity will refer to a country's productive capacity in relation to ICTs, and info-use to its consumption of ICTs. This categorization will not be done arbitrarily, but will rely on a theoretical construction. Once this is accomplished, the Digital Divide will be defined as the relative difference in infostates among countries.

The conceptualization phase begins with the basics. The overriding issue of a society concerns the quality of life of its people. While this relates to all kinds of intangibles, including matters of social and cultural relationships, spirituality and the like, its biggest component is the economy. Consistent with the developmental efforts over many decades, we do not set out to measure people's inner peace and happiness, but their economic well-being, current and potential. Undoubtedly, one can devise any number of illuminating measures that go well beyond economic boundaries per se, such as the UNDP's work on human development with its 'quality of life' index (2000). Moreover, studies to this date still shed light on the impacts of television in our lives, more than half a century after its introduction and when virtually everyone who wants to have one does have one in the developed countries. This is precisely the point we want to reach with ICTs — to continue to have analogous impact studies when the Digital Divide is bridged. For now, we shall see ICTs primarily as an economic reality.

The economy is situated within the broader socio-economic, geopolitical and cultural environment of a country, with its present, history, institutions, traditions, customs, language(s), religion(s), pride and other attributes. Thus, although the economy occupies the central place in this setting, it is immediately recognized that it does not exist in isolation from the broader environment, including its global dimension. If a war is raging, it becomes an abomination to talk about ICTs for development — other priorities exist, such as people trying to stay alive.

Next, a distinction is made between consumptive and productive functions. The standard of living of the people depends largely on their consumption of goods and services. Other than picking more wild berries, increased consumption must be met by increased production. Thus, our examination must deal with the intermediate problem of expanding the production capabilities of a country in a sustainable way, something that brings us to the whole issue of economic growth and, by extension, to economic development where growth is a prerequisite. Therefore, we care about two things: people's consumption, for economic well-being today; and the country's productive capacity for economic well-being in the future — the latter should not be confused with actual production, as shall become clear.

Current consumption is determined by current production, adjusted for foreign trade and society's preferences regarding intertemporal allocation — foregone consumption now (investment) for increased consumption tomorrow. The productive capacity of a country is determined by the factors of production, labour, land and capital (derived from the first two) and the way with which they are combined and used ('technology'). (Entrepreneurship is seen as a quality characteristic of labour). At a given point in time, the productive capacity is fixed because the factor stocks and the (endogenous) technology are fixed, but over time they are all expandable. Factor growth, technological improvements and productivity gains are instrumental. ICTs affect them all.

Furthermore, the economy is viewed as a collection of sectors; households/individuals, business, government (and foreign). These sectors are closely interlinked through the flow of people, goods and services. Each sector plays an integral role in the numerous supply and demand functions that characterize such an economic system, market or not. Households supply the labour in their capacity as employees or managers in the business and government sectors, which in turn combine it with capital and know-how to produce goods and services. At the same time, households, businesses and governments consume goods and services (from potatoes to high-tech labour skills). Whereas the household sector is seen as purely consumptive, the others use goods and services as intermediate inputs in their production processes. The above can easily accommodate trade through the foreign sector — imports and exports.

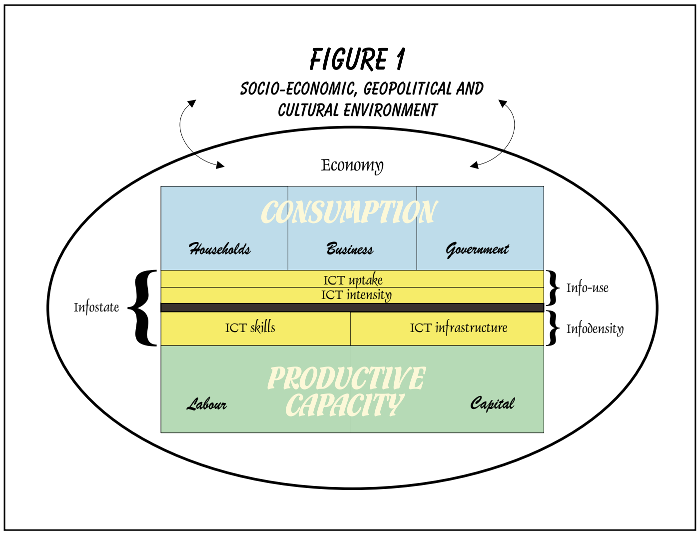
Now we introduce a composite commodity and call it ICT. Then we take a slice off each of the labour and capital stocks and refer to them as ICT labour and ICT capital. (We do not do that for land. Unlike natural resources, in dealing with ICTs it will be subsumed under the capital factor — despite that sand is the main ingredient for fiber optic cables. Landscape esthetics aside, for instance, a wireline telecommunications network will be part of ICT capital). ICT capital comprises network infrastructure, as well as machinery and equipment. ICT labour can be perceived not so much as a collection of individuals, but as the stock of the ICT skills of those in the labour force (more details later). In this formulation, produced output will be an increasing function of these ICT stocks, as it is for all other forms of capital and labour.

Then we follow economic theory. Consumption and production are co-determined by the functions of supply and demand. Numerous such functions are at work simultaneously, either in market or non-market settings. Goods markets, labour markets, asset markets and many others are at work. Each is affected, to varying degrees, by a great number of influences in the economy and the broader environment. Supply is affected by the prices of goods and services, the quality and prices of capital and labour inputs, expected profitability in the case of business or desired social outcomes in the case of governments, policy and regulatory regimes (competition in telecommunications vs. monopolies) and many more. Demand is affected by tastes and preferences, prices, incomes, income distributions, expected benefits, cultural traits and numerous other factors. The relative influence of such determinants may well differ among countries and over time. Jointly, demands and supplies determine the produced and consumed quantities, prices and attributes of consumable and capital goods, services and labour. These quantities should be seen as the objectively observed and measured ones ('equilibrium'), without any normative connotations. That is, at the end of a production and consumption cycle, there may well be dissatisfaction among people and the outcomes may be deemed socially undesirable.

What is important here is that in the beginning of the process, ICT and non-ICT factor inputs are combined to produce ICT and non-ICT goods and services, without a one-to-one correspondence. For instance, computers together with relatively unskilled labour are used to produce telecommunications services, and simple tools are used together with skilled ICT labour in the processing of agricultural output. What matters is that at the end of the process, part of the overall production will be in the form of the composite ICT commodity. Then, part of this will be absorbed as consumable (final demand) and part will be added back to the capital stock (gross investment — replenishing the used-up ICT capital and labour stocks and augmenting them). The same holds true for labour skills, produced and consumed. Attrition, obsolescence, training, movements in and out of the labour force, brain drain, all affect the skills stock.

Whether the production cycle takes place in discrete or continuous time, at any given point the observed and measured quantities of ICT stocks will reflect the incremental additions up to that time. Analogously, the consumption per time period can be measured. In this context, consistently with our starting point, it is consumption and productive capacity that matter. Thus, infodensity and info-use will be defined as follows:

Infodensity = sum of all ICT stocks (capital and labour)
Info-use = consumption flows of ICTs/period



Aggregating the two, in index form, we can arrive at a country's infostate. Then the digital divide will reflect the relative differences in infostates across countries. Figure 1 provides a schematic of the framework. (Some items contained there are discussed in more detail in Chapter 3).

2.2 The ICT composite

Time now to define the ICT commodity. It is perceived as a composite of ICT goods, services and skills. It is used in the production processes in combination with other factors, as well as serving as a consumable. In its productive function, it augments the productive capacity of a country in a dual way: as more capital and labour, and as embodied technology. Its capital component includes all necessary infrastructure, machinery and equipment, while its labour component refers to the ICT skills involved. Machinery and equipment, in addition to their 'stand-alone' use, combine to create networks, which are a key part of the overall infrastructure. They include, wireline and wireless telecommunications networks, broadcasting networks, satellites, LANS, WANS and the like.

Moreover, the ICT commodity encompasses explicitly both information and communications. ICTs are the product of technological convergence between new and older networks and technologies. The newer ones are mainly associated with two-way interactivity rather than one-way information provision. Frequently, in work involving developed countries, the information component of ICTs is either ignored or downplayed. This is so because the older technologies have achieved such a widespread penetration in these countries that it makes them uninteresting in comparative analyses. An example would be the television. While this may make sense in that context, inclusion of the information component of ICTs is indispensable when the emphasis is on developing countries. Therefore, although the comparison among developed countries may be neutralized with respect to those components, they will be included here. That it is possible for such media to turn interactive, upon digitization, is even more fitting. Information and communication extend beyond ICTs. So, we shall exclude non-ICT, print media. (What we include is sometimes referred to as electronic. We treat it as a loose link, though, since in the future the underlying technology may well be photonic, molecular or something else).

Although no complete ICT commodity classification as such exists yet, we do not need an exhaustive list of goods and services, such as computer peripherals, coaxial wiring, Web hosting services and the like for our purposes. But, when it comes to practical measurements through indicators, we do need to comprehend and endeavour to make use of the hierarchical nature of ICTs. For instance, Internet cannot be had without the telecommunications networks, e-commerce cannot take place before businesses have computers, network them, connect to the Internet and establish a Web presence.

Considering the intuitive and inextricable link of ICTs with the overall factor stocks (Internet cannot be had in the absence of electricity), ICTs are clearly not bounded upwards but are expandable over time. Even as consumables, achieving complete uptake today means nothing for tomorrow. For instance, if every available ICT had achieved 100% penetration and use rates prior to the arrival of the Internet, the ceiling would have moved upwards immediately after. The same holds true for skills, with obvious implications for productivity. Consequently, there is no pre-set, absolute upper limit of infostate that can be achieved over time.

CHAPTER 3. THE MODEL

So far, we have arrived at a workable definition that can enable the measurement of a country's infostate and subsequently of the Digital Divide across countries. More importantly, the approach stems from a cohesive framework that allows analytical linkages, economic or otherwise. However, in order to operationalize the framework in the form of a model, several more detailed issues remain to be clarified and more practical refinements are warranted. To this we now proceed.

3.1 Refinements and practical considerations

(i) *Networks*: ICT capital comprises all kinds of material goods, from wires and cables, to keyboards, printers, sophisticated routers, switches and connectors. They combine to form machinery and networks. Compared with conventional analyses of goods and services, networks come with their own idiosyncratic nature. One of their major features concerns the well-known externalities. Simply put, the value of a network and the benefits accruing to its users, increase with the number of users. Moreover, major infrastructure build-ups are accompanied by small marginal costs of connections. The same networks are used for consumption and production of many services. Telecommunications networks are used for residential and business use, as well as for a variety of services, such as transmission of voice or data, or long distance and local telephony. An implication of this is that it is practically artificial to apportion networks to categories of use, such as between consumption and productive capacity — although possible with creative accounting. Networks will therefore be treated as part of the ICT capital stock.

(ii) *Household ICT assets*: Consumption is not normally associated with infrastructure, capital or skills on the part of the individual/household — although such literature does exist. Clearly, although households are seen as a consumptive sector, transformations of a productive nature involving raw materials do take place for consumption to happen and satisfy ultimate needs. In addition to the networks discussed above, ICT consumption involves the use of capital and skills, both of which are becoming increasingly complex as consumption expands from staples to complex technological goods and services. Fetishism aside, ICT goods of varying durability are indispensable for the consumption of ICT services and can be considered parts of the assets associated with the household's 'consumptive capacity' — which determines current and future consumption. (Examples would include the telephone set that makes telephone calls possible, and the computer that allows the consumption of Internet services). However, this is more of an accounting than a conceptual problem. Although the consumption of durables can be apportioned over their expected lifetimes, we prefer to see them as household assets. (The national accounts measure household spending rather than household consumption in a given time period). Therefore, such ICT capital at home will be practically treated as part of consumption rather than the country's productive capacity.

(iii) *Skills*: Conceptually similar is the case of skills, which clearly are necessary in consumption. When someone buys meat and potatoes we assume that they know what to do with them, as they know how to drive (or can learn) when they purchase an automobile. While watching television is easy and making a telephone call requires the knowledge to obtain a dial tone before dialing, using computers and Internet services is less trivial. Consumption-related skills do not enter directly into the productive capacity of the country, but there is substantial overlap with production-related ICT skills since a very large number of the same individuals are involved as both employees and consumers. Such skills are transferable back and forth between the productive and consumptive functions, i.e. skills acquired on the job can be used for individual consumption too or the other way around.

The ICT labour stock is really a set of skills, as opposed to ICT versus non-ICT occupations or employment in ICT sector industries. As the use of ICTs becomes more pervasive, such skills are used by people whose primary occupation is a computer programmer, but also a secretary, a waiter or a car mechanic. While the labour stock includes those of labour force age, there are also those below and above the limits who consume ICTs — students and seniors. They obtain skills at school or through some other formal or informal training and consume ICT goods and services, but they are not part of their production. However, although there is a distinction between ICT skills necessary for production and consumption, they are subject to many commonalities and it is not unreasonable to assume that they move in parallel. So, practically we shall measure ICT skills on the productive capacity side.

(iv) *ICT consumption*: According to the framework, what matters in a society is overall consumption, not just consumption of ICTs. As more ICTs are consumed, substitutions take place. They can come either in the form of opportunity costs (spending on a cell phone by prolonging the life of clothing) or displacement (substituting a broadband Internet connection for dial-up service). In the very least, they will be substitutions in consumption due to the inescapable 24-hour-day constraint. Using the Internet will lead to reduced time of watching television or playing with the kids. When a new ICT enters the consumption basket, the relative proportions of ICT and non-ICT consumables will change. Although continuously higher relative proportions of ICTs in consumption is not the objective, these substitutions do not represent force-feeding. They will be regarded as reflective of consumer choices and therefore positive. What balance will be found over time, cannot be known a priori. This reinforces the point made in connection with household ICT assets necessary for the consumption of ICT services and points to the need for a further refinement in measuring ICT consumption that would encompass both stock and flow metrics.

ICT use is divided into ICT **uptake** and **ICT intensity of use.** The former refers to the consumptive capacity, as defined above, and the latter to the actual quantities consumed. (Roughly, uptake corresponds to ICT goods and intensity of use to ICT services). For instance, the proportion of households with a telephone may reach 100%, but then the actual use will always be a fraction of consumption and can be monitored in absolute terms. (The more traditional distinction of ICT access is collapsed in infrastructure that indicates the extent of the networks).

In addition to the intensity of use (how much), it matters to know how "smart" use is. This relates to the derived satisfaction, in the case of individuals, and to the issue of productivity in businesses (organizational innovations accompanying technological innovations). That is, it is one thing to know that a business is equipped with 1,000 PCs and another to know how they have been integrated in the production process. Such examinations are outside our purview and can be dealt with more appropriately with case or impact studies.

(v) *Sectoral ICT Use*: It is evident from the framework that domestic production of ICTs is not crucial. The issues are infodensity and info–use. Capitalized and consumed ICT goods and skills can come from imports. Alternatively, a developing country may manufacture ICT goods, which will not be seen in domestic consumption (exports). Thus, the supply-side ICT sector, although important for all the spillovers entailed, is not prominent. The framework shows that:

domestic production – net exports = household spending + net investment (business and government) + business spending + current government spending

An analogous relationship can be specified for labour skills.

While net investment will be captured as the incremental change in the capital and labour stocks at any given point in time (infodensity), to capture use we must include the business and government components, in addition to household consumption. (Our aim here is not to deal with value-added considerations, but to take into account the roundaboutness of production). So, info-use will extend to all sectors.

As well, what really matters for development is the utilization of the productive stocks rather than their availability. Having underutilized roads, abandoned factories and rusted telecommunications networks does not increase productive capacity. The same holds true for unemployed or underutilized labour and its skills. The supply-side refers clearly to the productive capacity of the country, but it is differentiated from actual production both because of capacity underutilization and trade.

3.2 The structure

The above culminate in a model whose basic steps are described below:

Infostate = infodensity + info-use
    Infodensity = sum of ICT stocks = ICT capital + ICT labour
        ICT capital = ICT infrastructure/networks + ICT capital goods
        ICT labour = ICT skills
    Info-use = consumption flows of ICT/period
        = ICT uptake + ICT intensity of use

Clearly, the building blocks of the model are the notions of infodensity and info-use. Each can be measured and examined separately, as can their constituent components: ICT infrastructure/networks, ICT skills, ICT uptake and ICT intensity of use. Technically, though, they can all be linked and aggregated — in index form.

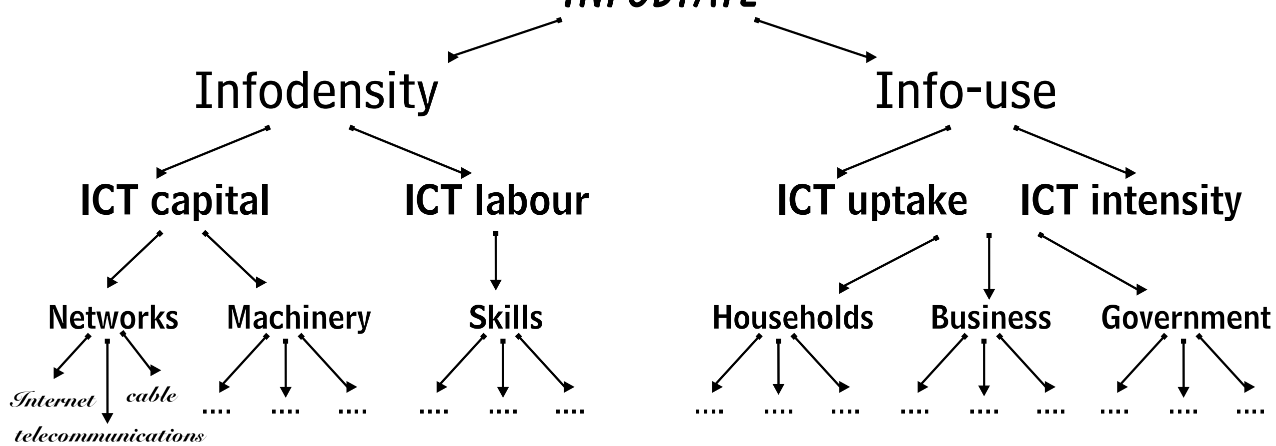
In applying the model, we must be cognizant of its tree-like structure, something that can be exploited and provide latitude and depth in actual investigations. A common example of such a structure is provided by the Consumer Price Index (CPI). The all-item CPI, like an umbrella, covers several main components: food, housing, clothing, entertainment etc. In turn, each of them contains further items of interest. For instance, food is an aggregation of meat and fish products, vegetables etc. In meat, we can further distinguish among beef, pork, veal, poultry etc. In beef we can separately identify different kinds of cuts and so on. However, the main components provide robustness in comparability, substitutions at the bottom notwithstanding.

This structure offers considerable flexibility and can be adapted to accommodate detailed examinations (see schema in Figure 2). Depending on the application at hand, it is constrained only by practical, data limitations. ICT capital can assume the form of networks, machinery and equipment. Networks can be broadcasting, telecommunications, cable and Internet. Telecommunications networks can in turn be itemized to wireline and wireless, terrestrial and satellite, digital or analog. Equipment can contain television and telephone sets, computers and the like.

Uptake and intensity also permit any level of desired detailed disaggregation. For instance, sectoral measurements and analyses can be accommodated. Furthermore, groups of households/individuals can be differentiated by gender, urban and rural locations, income, level of education and other characteristics important for the understanding of digital divides internal to a country. Businesses can be split by size or industry sector, and governments by level (national, regional, local) and type of institution (public administration, schools, health).

The association of labour with ICT skills is an area which is not much advanced. Surely, there are professionals in ICT occupations whose ICT skills are prominent among their asset sets. But, as discussed, ICT skills can be found among all employees — as well as consumers. ICT skills are not independent of the overall continuum of people's skills, which starts with basic literacy. As work continues in this area, perhaps in the future we will be able to distinguish between basic skills necessary to use ICTs and advanced skills needed for value-adding programs and applications or even more detailed sets of skills.

FIGURE 2
INFOSTATE



Practically, each component of the model will be populated by suitable indicators. (A full discussion follows in Chapter 5). The exercise will be carried out from the bottom up, as shall be explained in the technical specifications.

Consistent with the need for policy relevance of the model, as opposed to its business usefulness, the size of a country is important and will lead to a relativistic approach. So, we shall express the infostates of countries in relative terms. Thus, a small country like Luxembourg can have a higher level of infostate than a much larger one, say, India. In absolute terms something like that is unlikely to happen and this matters for businesses with an eye on market size.

3.3 Technical specifications

In order to be able to trace analytically the explanations of the findings back to their origin, the application of the model will follow a bottom-up approach, that is, starting from the individual indicators. This will also permit meaningful linkages with explanatory information originating beyond the indicators used.

Initially, each collected indicator will be converted to an index regardless of its original unit of measurement. During such a conversion, a point of reference must be specified. Since in our case the interest is to compare across countries but also within countries over time, both a reference country and a reference (base) year must be specified. (The exact choices will not distort the rankings). Base values will be assigned a value equal to 100. This will be done at the level of each and every indicator.

Thus, for the reference country (c) we get:

$$I_t^{i,c} = (V_t^{i,c} / V_{t_o}^{i,c}) \times 100$$

where I stands for the value of the index, i refers to individual indicators, V to raw values of indicators, t_o refers to the reference year and t to any other year.

Using the notation j for all other countries we have:

$$I_t^{i,j} = (V_t^{i,j} / V_{t_o}^{i,c}) \times 100$$

This normalization allows immediate comparisons of other countries with the reference country. Once every indicator has been expressed in index form, we shall proceed to the first layer of aggregation. For instance, in info-use that level will be households, business and governments for each one of ICT uptake and ICT intensity of use. Continuing with the notation introduced above, such aggregation will be given by:

$$\hat{I}_t^{i,j}(c) = \sqrt[n]{\prod_{i-1}^{n} I_{n,t}^{i,j\,(c)}} ,$$

where Î stands for the aggregate indicators, Π is the algebraic notation for product, and there are n aggregate indicators.

Clearly, this is an unweighted average, indifferent to each individual good or service, as we have no knowledge basis to do otherwise. The choice of a geometric rather than an arithmetic mean is made in order to smoothen the resultant series from the presence of extreme 'outlier' values — expected in this exercise due to the presence of developing countries with low degrees of ICT-ization.

Then, we continue likewise for subsequent levels of aggregation. The main components of interest, infrastructure, skills and use and, subsequently, the levels of infodensity and info-use will be arrived at as follows:

$$\text{Infodensity} = \sqrt[k]{\prod_{i-1}^{k} \hat{I}_{k,t}^{i,j}(c)} ,$$

$$\text{Info-use} = \sqrt[z]{\prod_{i-1}^{z} \hat{I}_{z,t}^{i,j}(c)}$$

with k and z being the components of each, respectively.

Finally, when we have both infodensity and info-use, we can aggregate and arrive at a country's infostate simply as:

$$\text{Infostate} = \sqrt[2]{(\text{infodensity} \times \text{info-use})}$$

Again, simple average index relatives with no weights will be used. Obviously, the overall aggregation will convey a broad picture, but much serious analysis can be performed by looking separately at its constituent components.

It is clear from this methodology that the reference country will have a value of 100 for the base year throughout the exercise — for each and every indicator, each component and the infostate. All other countries' indicators will assume their corresponding values. It may well be that for some countries individual indicators will have values below 100, while others will exceed 100. The same holds true for the aggregates.

Then, each country can be compared with the reference country. But the reference country's score is not static. It will be moving over time. It is only the base year that has a uniform value. So, consistent with the terms of reference, two-fold comparisons can be made: cross-country at any given point in time; and the infostates of a country over time. In a sense, for specific indicators, aggregate components of interest or the overall index, different countries will effectively reflect the reference country's time line. For instance, if that country had 40% Internet penetration in 1999 while another country achieves that in 2001, it will be at the level of the reference country two years before.

A key point to bear in mind is that, again consistent with the framework, there is no set maximum infostate value that can be achieved over time. This is especially true in infodensity, as ICT capital and labour stocks can expand continuously. A case can be made that ICT uptake, at a given point in time, has a ceiling that can be achieved when every inhabitant of a country uses every available ICT. However, the formulation of the model allows for differentiation in intensity of use (which cannot reach 100%) and 'technology shocks' that will realistically happen. For instance, even if a situation of perfect penetration had occurred prior to the arrival of the Internet, the ceiling would have moved upwards immediately after. This is so because of the expansion of the composite ICT commodity, which would now require the consumption of one more service and thus the addition of yet another indicator, in a cumulative sense. One way to deal with such a case (not used in the empirical application of Part 2) is to re-compute the index for all the previous periods, as the values until that time would not be comparable with the new values. However, this will be anchored again on the initial base year. A simple example illustrates:

Assuming that Canada sees the introduction of a major new ICT in 2000 while another country does not, or it starts to build a brand new network that the other country does not, Canada will have one more indicator, to reflect the reality of a higher ICT ceiling. If no adjustment for this takes place we would not be able to capture Canada's progress between 1999 and 2000, as well as the fact that the divide between Canada and the other country has just widened. Therefore, the following computation could take place after the initial conversion of indicators to indexes:

$$\hat{I}_t^{\,i,j\,(c)} = \sqrt[n]{\prod_{i-1}^{n} \left(\sum_{i-1}^{n} I_{n,t}^{\,i,j\,(c)} \Big/ \sum_{i-1}^{n+1} I_{n,\,t_o}^{\,i,c}\right)},$$

This would link, in effect, Canada's base-year situation before and after the introduction of the new ICT, while explicitly addressing its absence from the other country. That way, both the increase in Canada's infostate will be captured, as well as the fact that the difference between Canada and the other country has grown.

While something like this is unlikely to happen on the info-use side, it is quite possible on the infodensity side (e.g. the absence of a coaxial cable network). Notwithstanding the ICT uptake and intensity of use of a service, the fact that alternative delivery channels exist does have a value in the model, which must be reflected in the measurements.

A final note concerns the issue of the relative importance among ICTs. So far in the technical specifications, no weighting has been admitted. Anything else would be based on highly subjective judgement at this point. It is conceivable, that as our knowledge expands, meaningful ways of weighting can be devised. For instance, we can introduce a modification, based on the following premise: the difference between a country with a telecommunications network and a country without, is bigger than the difference between a country with a digital telecommunications network and another with an analogue one. Although, value-added services cannot be had in the latter, voice telephony is at least possible. In that sense, the degree of digitization of the networks will be treated more as a quality attribute of the network ('weight') rather than as an independent platform. Thus, each year's infrastructure indicator will be adjusted for the degree of the countries' respective degree of digitization and will be treated as one index. That way, although digitization will be taken into account, it will not produce as dramatic an effect as the introduction of a totally new network. Leapfrogging to wireless networks raises some similar issues, but our approach to infodensity necessitates the treatment of wireline and wireless networks as additives rather than substitutes.

CHAPTER 4. RELATED ISSUES

The project to monitor the Digital Divide is broader than the measurement of the infostates through infodensities and info-use. It extends to investigate areas of interest that do not necessarily fit within the confines of a framework.

4.1 Internal divides

In addition to the gaps among countries, a great deal of interest exists with regards to the gaps between have and have-not groups within countries. Such divides can come in the form of unequal access to and use of ICTs by gender, income, geographical location and a host of other variables. Clearly, the framework developed under this project is compatible with such investigations. It permits detailed analyses of digital divides internal to each country, with the added advantage that these can be linked to the international comparisons since the data sets can be linked at the national level.

While, for the purposes of the model, only indicators at the national level are needed, nothing prevents the decomposition of data sets in a way that is conducive to the detailed examination of the infostate of each country. In fact, this can be performed for any aggregate component or particular variable of interest. For example, network coverage and extent can be measured by region, province or other locality. Use of ICTs can be disaggregated by gender, age, income level, urban or rural location and the like. The ensuing analyses will then reveal the differences among the various groups. The same holds true for businesses, where analysis can be done by firm size, sector of activity and other pertinent characteristics.

Considering that this can be seamlessly accommodated in the framework, the only constraints would be purely practical, associated with the availability of data on a country basis. Such studies can then proceed to utilize analytical techniques, such as Lorenz curves, Gini coefficients and others to illuminate the issues.

4.2 Complementary information

The model to measure the Digital Divide can prove an effective instrument to analyze comparative infostates across countries and over time. Moreover, depending on the breadth and depth of the indicators that can be used in specific applications, it can be adapted to shed light on the movements of important components and even individual indicators at a detailed level. Rich as such analytical insights can be, they can be enhanced significantly if complemented with outside intelligence. As explained early in the development of the framework, each infostate component is affected by numerous factors, which may well be extraneous to ICTs or even the economy. The more we know about them, the richer the exploration, including the identification of causes and effects.

A clear implication of this concerns information collection. It will be desirable to compile information beyond the needs of the model itself. ICT prices, the state of ICT competitiveness, government policies, major business initiatives, and training programs would be a few examples. In principle, this will improve the performance-monitoring aspect of the model, as it should be possible to link measured inputs (being they government policies, strategic business initiatives of some scale or international aid projects) to measurable outcomes.

4.3 Content

The project in its totality can also accommodate the measurement and examination of thematic or horizontal issues of interest. One such issue that keeps surfacing in discussions concerning ICTs and the digital divide is content. Although it has not been possible to define it — at least in a way that enough people would ascribe to — content is broadly understood to refer to what is actually delivered to users and therefore relevant to their reality (national, regional, local) and accessible in their language. In the final analysis, consistent with the approach taken here, it is neither the networks that matter nor the vast range of peripheral gadgetry attached to them. All these are mere conduits. What really matters is what they deliver and the way that this improves a country's productive capacity and people's lives. Seen in this context, content becomes extremely important to the extent that the long-term deployment, absorption and use of ICTs ultimately depend on it.

It is undeniable that today, with the predominance of English on the Internet, people with other languages and low literacy skills lose out. It is in this vein that encouragement of local content can directly help uptake of ICTs, especially in poorer countries. Echoing previous discussions, content may be identified as a key argument in the demand and supply of ICT goods and services. As it became evident in the early days of the Internet, its uptake and use are part and parcel of its usefulness (applications and content available), which in turn depend on uptake and use. So, developments on both sides take place in parallel.

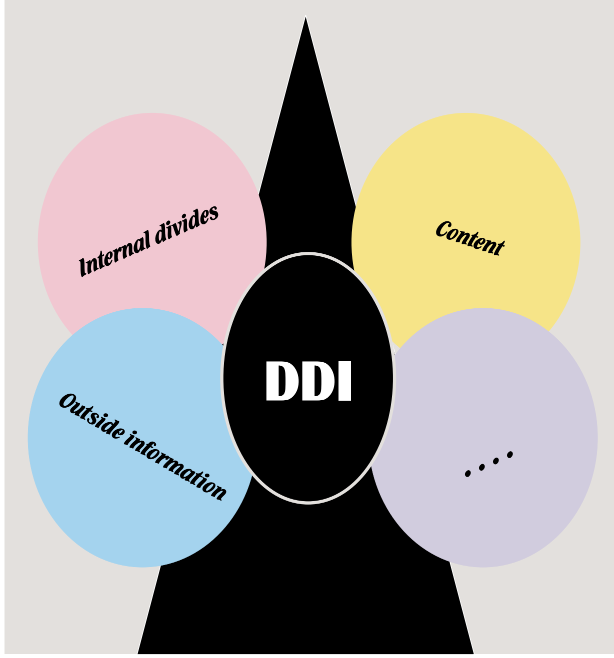
There are, however, serious reservations — if not counter arguments — in measuring content the way we do ICTs. First, a distinction must be made between domestically-produced and domestically-consumed content and explicitly recognize that it is the latter that is of particular interest. Even then, things can be fussy. People in Ghana can get local news from a server based in Canada. (This is linked to the spatial dimension of content — national, regional, local and very local — which assumes additional importance in multi-racial countries with many religions and languages).

Second, individual tastes must weigh in, something that brings up several complications. Most people would agree that a world with diversity and pluralism of languages, culture, music and food is preferable to one with dull uniformity. But given the choice, what is wrong if people in Zambia choose to watch an American soap opera or take a virtual tour of Le Louvre on the Internet? What is wrong with people in other countries consuming Zambian content? Are these not prime examples of cultural exchange and cross-fertilization that have characterized the history of civilization? The above are especially true in a world with increasingly mixed populations and mobility, as well as "anarchic" technologies.

A fundamental difference exists between content and what the model purports to measure. While increased Internet penetration is "good" as it improves a country's infostate, continuously increased consumption of domestic content as a proportion of total content cannot be the objective — some 'balance' may be appropriate. Thus, an indicator of consumption of local content would not be 'well-behaved' (in the jargon of Chapter 5), as it would not lead to unambiguous directional movement of the underlying phenomenon without resort to subjective value judgments. Therefore, content can be studied independently, outside the purview of the model.

Finally, technical and dry as it may sound, the above notion of content is network/medium-specific. Content of television programming can be easily understood and differentiated, as does content on the Internet. But content on telephone networks (e.g. people's conversations) is hardly exciting as a policy issue — outside spy circles. Therefore, more work on specificity would be helpful.

FIGURE 3
DDI PROJECT



PART 2: AN EMPIRICAL APPLICATION
...and I can measure anything"

CHAPTER 5. INDICATORS

In this Part we proceed to a practical implementation of the methodology and the model. The main objective of this exercise is to demonstrate the feasibility of the proposed approach and its potential for rich analyses. The application had to cope with the pragmatic data constraints that practitioners in the area are familiar with. Thus, **the running of the model and the ensuing analysis are intended solely for demonstration purposes.**

5.1 General uses and properties

As the model is populated by indicators, a general discussion is in order. When the actual indicators used are concerned, a more specific discussion of caveats and potential biases will follow in section 5.4.

Indicators are extremely useful to focus the discussions of complex issues on their important components, and to illustrate the direction of their movement and the order of magnitude of change. Indicators come in any kind, shape or form. They can be simple or complex, quantitative or qualitative, and can be expressed in various units of measurement. Invariably, the value of individual indicators depends on the context within which they are used.

For example, the GDP is an indicator commonly used for the amount of overall economic activity. But when the quality of life is at issue, additional indicators must enter the picture and address non-economic dimensions. One could contemplate the quality of housing, as we spend so much time there, the quality of our mattress, for the same reason, the relationship with our family members and neighbours, our social outings and an endless array of things. Practically, researchers seek indicators that would embody information on several attributes of interest ('nested' indicators). One such indicator is life expectancy at birth. It can be argued that it encompasses information on many dimensions, such as the health care system, the hygienic conditions of the country, the eating habits of its people, even the quality of the road infrastructure. Obviously, it does not mean that everyone in a country with a higher number lives longer than everyone else in the country with the lower number, neither does it contain information about numerous other things known to extend or curtail life expectancy.

Indicators, useful as they are, are not substitutes for detailed analyses of specific issues. The messages conveyed by their use must not be confused with detailed findings from case studies. Discovering, for example, that in a country with generally low life expectancy, members of a group of people in a mountain live longer than anyone on the planet because of a local concoction, does not invalidate the indicator.

Indicators are generally more useful when differences of some scale are concerned. In the previous example, for instance, it would be quite revealing to see that two countries are separated by 20 years of life expectancy. But marginal differences in longevity are not as informative, as the significance of such differences in the ultimate objective diminishes. So, once confronted with a 'choice' of 76.8 vs.77.5 years, an obvious question would be how were/will these years be spent — sweating on a factory floor, or vacationing in the Greek islands?

Furthermore, indicators are generally more suitable when comparing across countries with rather similar structures. Frequently, indicators of ICT use refer to the household unit. This does not fit well with the social structures of many developing countries with more communal attitudes (telecentres etc.). Therefore, to the extent possible, emphasis will be placed on individuals. This has its own drawbacks, as family sizes differ.

Not only the context but the specific intended use of indicators is also of paramount significance. Knowing the penetration of computers equipped with modems may be useful in formulating policies on access, but inadequate for a bank that contemplates the offering of Internet banking — it needs to know type/age of computers and modem speed to decide whether or not it will proceed and what would be an appropriate design for the technical specifications of the application.

In conjunction with all the above, one must have knowledge of what indicators purport to indicate. This requires knowledge of the subject matter around them, including as much 'metadata' information related to their construction as possible. When penetration rates change, for instance, one must know that likely both the numerators and the denominators have changed. Thus, growth rates can be computed meaningfully only on the basis of the absolute figures used in their construction.

In short, every indicator has its strengths and limitations. The quest for perfection will be futile and can only lead to inactivity and paralysis. Simplicity is a virtue in this case. Indicators are practically selected by a combination of reasonableness and availability. Over the longer term, areas of interest and statistical gaps can be identified for investment in the production of more and better indicators. In principle, we do not gain by merely adding indicators. It is more productive to find more suitable ones to substitute.

Choosing indicators is thus somewhat of an art. However, it does require broad knowledge and experience, in conjunction with practical considerations concerning data availability. Ideally, chosen indicators should be 'well-behaved', that is, the direction of their movement should be unambiguously linked to whether or not we are moving towards, or away from, a desired state. In addition, they should be unbiased and, in the case of ICTs, 'technology-neutral'. This is meant to neutralize different technological platforms among countries, so that comparisons will be fairer. For instance, a country with extensive cable infrastructure through which multiple television channels are delivered, should not be placed at a comparative advantage to one that accomplishes the same through satellites — when the availability of multiple channels is the issue. In other words, the model should not pick technology winners.

5.2 Data gaps

The pilot exercise relied exclusively on existing data from known sources — chiefly international organizations. The main reason for this choice was to take advantage of the considerable work that is carried out for many years and which, in principle, achieves basic harmonization among the underlying national sources, concepts and methods. Using data from a singular source maximizes cross-country and time-series comparability.

However, there are measurement gaps everywhere. From statistics on networks, to statistics on intensity of ICT use and uptake — although, admittedly, the latter are in comparatively better shape. There is lack of sectoral data too, something that would substantially enrich the analysis, as it would make possible the study of issues such as business competitiveness and governments online. But the biggest gap of all exists in the area of skills. Precious little exists internationally even for more conventional skills than the ones associated with ICTs. (Albeit at the stage of infancy, efforts are underway to address the issue of ICT literacy).

Among the data limitations that introduce biases are:

- lack of enough indicators,
- lack of adequacy of fit of indicators,
- insufficient quality of some indicators.

In addition, research involving international comparisons is typically confronted with the additional problem that the country with the less available data dictates the pace — the lowest common denominator. This is particularly the case when the choice of data is a common source.

Considering the state of affairs touched upon in the preceding paragraphs, perhaps a preferred and viable alternative for the near future would be to resort to the compilation and use of data on the basis of each individual country and minimize the reliance on generic sources. This will take some 'digging', but it should provide some relief by making it possible to maximize the information that can be compiled and used.

Clearly, there is ample room for a concerted international effort to develop ongoing information concerning matters of information and knowledge-based societies with a development angle. Undoubtedly, such an undertaking would be significant and can only be accomplished under the co-ordination of an appropriate international organization that could generate interest and mobilize resources. Even so, realistically, it could take years. However, it would represent an investment which, over and above the direct benefits, is guaranteed to produce substantial side-benefits through its diffusion of knowledge and expertise. The ability to produce information, store it, manipulate it, analyze it in order to distill knowledge from it and then apply it, is paramount and more than ever indispensable to economic development and growth. One of several thorny issues involved, and which could consume substantial time and energy, is the identification of the information gaps and their prioritization since, realistically, progress can be achieved only incrementally. If the present framework, in conjunction with its information requirements and identification of data gaps, proves helpful towards such a mission, it will have made a modest contribution.

5.3 Indicators used

For the purposes of the pilot, the thematic components of the model were populated by the list of indicators shown in the Table below. What follows describes in some detail the data used, their definitions and sources. In the interest of transparency, it also offers a discussion of their appropriateness, caveats and potential biases introduced in the results.

INFOSTATE

Infodensity

Networks

- Teledensity
  - main telephone lines per 1,000 inhabitants
  - cellular subscribers per 1,000 inhabitants
- Internet hosts per 1,000 inhabitants

Skills

- Educational attainment index
  - adult literacy rates
  - gross enrollment ratios

Info-use

Uptake

- Radios per 1,000 inhabitants
- Proportion of households with television
- Proportion of households with cable or satellite connections
- Computers per 1,000 inhabitants
- Internet users per 1,000 inhabitants

Intensity

- International outgoing telephone traffic per inhabitant
- ICT spending as % of GDP

5.3.1 Definitions, data sources and notes

This section describes briefly the indicators used and credits their original sources (in parenthesis). Some indicators are used as published, while others were derived on the basis of the existing data. The database used for the pilot application was compiled for the years 1995–2000 and for the nine countries chosen. Missing values were estimated by the authors.

Network indicators

Main telephone lines per 1,000 inhabitants (ITU).

The ITU (2000) defines main telephone lines as "The number of telephone lines connecting the subscriber's terminal equipment to the public switched network and which have a dedicated port in the telephone exchange equipment…It may not be the same as an access line or a subscriber". The indicator is based on data referring to the absolute number of main telephone lines, which includes lines used for professional purposes (business and government), residential lines and public telephones.

Cellular subscribers per 1,000 inhabitants (ITU).
The ITU defines cellular mobile telephone subscribers as "…users of portable telephones subscribing to an automatic public mobile telephone service which provides access to the Public Switched Telephone network (PSTN) using cellular technology. This can include analogue and digital cellular systems…Subscribers to fixed wireless…public mobile data services are not included".

Internet hosts per 1,000 inhabitants (Internet Software Consortium).
Internet hosts, also a widely used indicator, refer to the number of computers directly linked to the worldwide Internet network. Data come from the Internet Domain Survey which, in principle, queries the domain system for the name assigned to every possible IP address. (In practice, corners are cut out of practical necessity). The statistic is based on the country code in the host address and thus does not necessarily correspond to the actual physical location of the host computer. (Generic codes are assigned to the US). Moreover, methodological improvements to the survey introduced in 1998 further inhibit the comparability of the results from previous years. Complete methodological details can be found at www.isc.org (2002).

Skills
Educational attainment index (UNDP).
Based on the combined primary, secondary and tertiary gross enrollment ratio and the adult literacy rate. UNDP (2000) combines the two into the education attainment index — 2/3 of literacy and 1/3 enrollment. The indicator is one of the three used in the construction of the human development index.

Adult literacy rates (UNESCO).
The definition of the adult literacy rate is "The percentage of people aged 15 and above who can, with understanding, both read and write a short, simple statement on their everyday life" (2000). Adult literacy shows the accumulated achievement of primary education in combination with literacy programmes in imparting basic skills to the population.

Gross enrollment ratios (UNESCO).
The indicator refers to gross enrollment in primary, secondary and tertiary education. It is defined as "the number of students at all these levels as a percentage of the population of official school age for these levels" (2000). Education has been categorized as primary, secondary and tertiary in accordance with the International Standard Classification of Education (ISCED). Primary education "provides the basic elements of education at such establishments as primary or elementary schools". Secondary education is based on "…at least four years of previous instruction at the first level and provides general or specialized instruction, or both, at such institutions as middle school, secondary school, high school, teacher training school at this level and vocational or technical school". Tertiary education "…refers to education at such institutions as universities, teachers colleges and higher-level professional schools — requiring as a minimum condition of admission the successful completion of education at the second level or evidence of the attainment of an equivalent level of knowledge".

Uptake
Radios per 1,000 individuals (UNESCO).
The indicator refers to radio receivers in use for broadcast to the general public. Radios are widespread and cannot be associated with households. Thus, the indicator is expressed by population.

Proportion of households with television (ITU).
Television receivers represent the estimated total number of television sets in use. In addition, the ITU provides information for television equipped households. This is not the same as the number of television receivers, since households may have more than one receiver and other entities, such as hotels, also have television sets. According to the ITU (2000), some countries require registration and issue licenses. To the extent that license statistics from such sources are used as proxies, "Since households may not register, the number of licenses may underestimate the number of television households".

Proportion of households with cable or satellite connections (ITU).
Cable television subscribers refers to "…households which subscribe to a multichannel television service delivered by a fixed line connection. However some countries report subscribers to a pay television using wireless technology (e.g., Microwave Multi-point Distribution systems (MMDS)). Other countries include the number of households that are cabled to community antenna systems even though the antennas are simply rebroadcasting free-to-air channels because of poor reception".

Home satellite antennas refers to "…the number of households with access to a multichannel television service delivered by satellite. This figure includes both Direct-to-the-home (DTH) service and Satellite Master Antenna Television (SMATV) which serves several households in the same building".

Computers per 1,000 inhabitants (ITU).
The indicator refers to estimates of "The number of personal computers (i.e. designated to be operated by a single user at a time) in use in the country".

Internet users per 1,000 inhabitants (ITU - various sources).
The indicator is self-explanatory and refers to the number of individuals accessing and using the Internet.

Intensity of Use
International outgoing telephone traffic per inhabitant (ITU).
The indicator measures minutes and "…covers the effective (completed) traffic originating in a given country to destinations outside that country. Many countries have now shifted to reporting international traffic volumes based on point of billing. This means that the data refers to traffic billed in the country", i.e. collect calls.

ICT spending as % of GDP (IDC - WITSA).
The indicator covers "external" spending, "internal" spending and spending on telecommunications and other office equipment. External spending refers to spending on tangible "…information technology products purchased by businesses, households, governments, and education institutions from vendors or organizations outside the purchasing entity…"; internal spending refers to spending on intangibles, such as internally customized software and capital depreciation.

The World Information Technology and Services Alliance (WITSA 2000) uses data from the International Data Corporation (IDC) — reproduced by the World Bank (2001).

5.4 Qualifications and caveats

The choice of indicators, necessitated by availability, requires qualifications and identification of potential biases introduced. These are discussed next.

ICT Networks: The model calls for indicators of network extent and availability. These could come in the form of the geographical coverage of a country or territory, or preferably they would refer to the proportion of the population that has access to each network. Such indicators would account for the asymmetric distribution of populations within the geographical boundaries of countries (urbanization). In addition, they should cover all existing networks, from wireline and wireless telecommunications networks, to broadcasting, cable, satellite networks and others. Although indicators of that kind do exist for some countries, especially developed (e.g. households passed by cable — European Audiovisual Observatory 1999) they are not collected in any systematic way for developing countries and are not used much in research. Thus, we resort to the use of telephone main lines and cellular mobile subscribers that have come to be used extensively as indicators of network extent. In fact, we follow the ITU practice of combining them to indicate total teledensity. The implication of this is that these indicators will not be used in the uptake part. It may be possible in future treatments to improve on this, particularly if individual country data outside generic sources can be tapped.

Common as such usage is, it is not free of problems. Strictly speaking, in the conceptual framework on which our model is based, these indicators would be more appropriate to measure info-use — specifically, ICT uptake. The model clearly distinguishes between infodensity and info-use, as the analytical treatment afforded to each is quite different. A similar differentiation is made between supply and (sectoral) demand. What is observed and measured in practice, though, is the equilibrium of the two (known as the identification problem). Furthermore, statistics on telephone main lines and cellular mobile subscribers do not account for substitutions and they are prone to double-counting, as far as usage is concerned. For example, if a lifetime wireline subscriber switches to wireless only, it does not diminish the extent and coverage of the wireline network — even though if enough customers do so it can lead to the expansion of the wireless network. Measuring the two networks separately can also shed light on the issue of technological leapfrogging in developing countries (without, again, negating the reality of the lack of an adequate wireline network — consistent with the discussion in section 3.3).

On the other hand, an argument can be advanced that in developing countries the observed equilibrium quantities (main telephone lines and cellular mobile subscriptions) are good indicators for both ICT uptake and network extent. This is so because there is no evidence of slack network capacity, unlike countries with highly developed wireline networks where capacity may well exceed current demand. On the contrary, existing statistics show that there is unsatisfied demand (waiting lines) in all countries in our sample, with the exception of Canada and Finland.

Other refinements would be desirable too, in future applications. For instance, the theoretical concept of infodensity in the model would require adjustments for network capacity and quality, such as the degree of digitization and the extent of broadband capacity (however defined). Again, while such statistics exist for some countries they do not exist for all countries in our sample.

ICT Skills: The model calls for ICT-related skills. Such information does not exist and efforts to develop some are at a rather embryonic stage. This is a severe limitation, not likely to be overcome soon. For the purposes of the pilot there is no alternative but to approximate the stocks of such skills through generic ones linked to education. The underlying assumption is that ICT skills will not be radically out of line with generic skills and they will be moving more on less in tandem. In other words, a country with high levels of illiteracy is not likely to have a huge proportion of the population with computer engineering skills. Such an assumption, however, is far from being unchallenged. In any event, the best way to approach this issue for now is through the realization that ICT skills are not independent of other skill sets, basic or more advanced, and perceive people's skills as a continuum, the low end of which measures the very basics and then it becomes increasingly more sophisticated. This is where we find ourselves at. Thus, skills early in the continuum will be dealt with on the basis of the education index compiled by the UNDP, which is based on weighting adult literacy rates and enrollment ratios. More advanced skills can be approximated with data measuring the numbers of tertiary students, students in science, scientists and engineers in R&D and the like. However, they do not exist annually nor do they exist for all countries in our sample.

To the extent that some countries with good basic literacy skills and reasonably high enrollment have low ICT skills, the above choice would bias the results in favour of developing countries ("shrink" the Digital Divide) by underestimating the gap from developed countries.

ICT Uptake: One of the issues here concerns whether or not the indicators should be expressed in terms of individuals or households. Experience from measurements in this area strongly suggests that the household is the appropriate unit when issues of access are concerned (more akin to uptake), whereas the individual is the appropriate unit when actual usage is at issue (more like intensity). It has been argued that because of the more communal attitudes prevalent in developing countries (i.e. usage of facilities such as telecentres rather than basement solitude), expressing penetration in terms of households would bias the results against developing countries. This is so because in reality more people access and use, say the Internet, than household statistics would show. This is a valid argument that warrants more attention.

While the argument is fundamentally sound, when it comes to its statistical application it really is an argument for showing statistics by household whenever possible rather than by population (i.e. per 1,000 individuals). The main reason relates to the demographic situation, which is such that the household/family size is, on average, larger in developing countries (i.e. 9.8 in Senegal vs. 2.2 in Finland). In measuring ICT uptake, using the number of households as the denominator presents a more realistic situation of access, penetration and use. If we divide by population we would bias the results against the have-not countries (augment the Digital Divide). To demonstrate with a simple example: in a country with a population of 1,000, average household size of 10 and 100 TV sets, expressing TV uptake in terms of the population yields a penetration rate of 10%, meaning that 1 in 10 people have access to a TV. However, the truth may be that all citizens have access to a TV. Indeed if the TV sets are more or less equally distributed across the population (i.e. they are not all concentrated in a few households) expressing them in terms of households (averaging 100 in the example) would show a household penetration rate of 100%.

This rationale carries even more weight when uptake of largely household items is concerned, such as TV sets. So we use households as the denominator in television households, as well as cable/satellite indicators. When it comes to items used broadly by all sectors, including businesses and government, expressing them per 1,000 people is more appropriate — if they cannot be de-composed by sector, which would have been closer to what the model calls for. This is the case for computers.

ICT Intensity of Use: The information gap in this component is also serious, although not new. Typically, development of such indicators comes after basic measurements of uptake and is more demanding. Ideally, we could use information on intensity of use for a wide range of ICTs.

The way intensity is perceived in the model is free of normative or value judgments. Measurements that look into hours spent on the Internet, for instance, while indicative of intensity of use are not indicative of benefit, as they could bring up talk about pornography and the like and practically lead to an impasse. Such issues of quantity versus quality time are best dealt with through case studies.

In measuring intensity of use with regards to the telephone network, ideally all traffic should be counted, including national traffic. However, data are not available for all countries in our sample. (There are also issues of comparability, as some countries report pulses as opposed to minutes etc.) In using minutes of outgoing international telephone traffic, a bias is introduced — for instance, Canada, a country with many immigrants, has proportionately more outgoing calls. Another issue for discussion should be whether or not incoming calls should also be counted, as they too indicate intensity of use in both countries — not to mention the usage of the networks in all countries through which the call may be routed.

Due to the lack of other indicators, relative ICT spending among countries is utilized. The rationale is provided by the fact that all ICT use must be paid for — save for free services. Thus, the spending on ICTs as a percentage of overall spending would be a good neutralizer to compare much diverse use. Once again, among like countries it would be more appropriate. But then consider the following caveat: unlike non-tradable haircuts, whose prices tend to reflect national economic norms, internationally competitive goods (computers) tend to have equal prices in absolute terms. Then, the country with the lower income would spend a much higher proportion of its income for equal or even lesser penetration than a country with higher income. This would represent much higher 'use', but in reality it would only reflect differences in relative prices. Thus, it will understate the extent of the Digital Divide. (This seems to be the case with Colombia, for instance, as can be seen in Chapter 6).

With the above discussion on potential biases, all in all, statistical instincts say that the empirical application underestimates the true extent of the Digital Divide.

CHAPTER 6. ANALYSIS OF THE FINDINGS

The results are illuminating and provide a first flavour of the kinds of analyses that can be supported from the ongoing application of this approach. Such analyses can be broad in scope and deep in their compositional detail. Both cross-country and intertemporal comparisons are possible, and they can be performed at any level of aggregation.

Meeting the project's terms of reference, the model can answer major questions of the type:

- How big is the Digital Divide?
- How are infostates evolving and what is the relative contribution of individual factors?
- Is the Digital Divide widening or closing and at what pace?

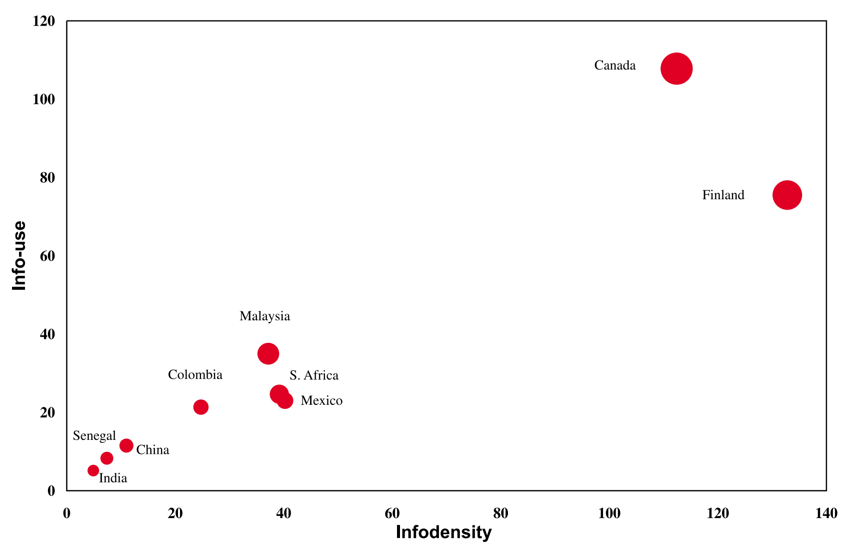
What follows represents only a top-level analysis, which merely scratches the surface of what is feasible. With data availability, sectoral analyses could also be performed that would shed light on issues such as e-government or ICTs in education. Moreover, it should be remembered that much richer analysis can be produced when the data used in the model are combined with data external to the model (but not to the framework). These would include the simultaneous examination of internal divides, whether by gender, income, geographical location and any other variable of interest, as well as factors that would shed light on causalities. Then, the analysis can uncover outcomes associated with specific business and policy initiatives by linking this knowledge with the measured individual indicators. Thus, the model can serve as an assessment and monitoring tool. Such an endeavour can be undertaken when the statistical basis for the application of the model is solidified.

Despite the data limitations, the indicators used are not fictional; on the contrary, they have been applied in research for years. In this vein, we hope that in addition to demonstrating the model's analytical capabilities, the results of the model will provide another important test — plausibility. Is what comes out plausible or counter-intuitive? We let the readers draw their conclusions. (Bear in mind that in calculating indexes Canada serves as the reference country with a value of 100 for base year 1999.) The analysis proceeds from the general to the specific.

6.1 How big is the Digital Divide?

The results make it immediately evident that, among the list of nine countries selected for the pilot, huge differences exist in both infodensities and info-use, and consequently their infostates. As suspected, the magnitude of the Digital Divide between developed and developing countries is enormous. Specifically, Canada and Finland are neck-to-neck in a league of their own, whereas all other countries lag very far behind. Within this last group, however, Malaysia, S. Africa and Mexico form a subcluster and appear to be in a better state than the others. Colombia trails but is ahead of China, Senegal and India, which are clustered further behind. Chart 1 demonstrates.

Chart 1. Digital Divide 2000



In addition to defining and quantifying the Digital Divide, the model can provide answers to two related and fundamental questions: first, how are infostates (and their constituent component indicators) evolving over time; and second, how is the Digital Divide evolving? These two questions are analytically separate. The first is consistent with the framework that sets no upper limit to the evolution of a country's infostate. The second underscores once again that studying and measuring the Digital Divide is an exercise in relative changes (hopefully, relative progress). From a policy perspective, whether the divide is widening or closing and at what speed is a more important question than how big it is.

6.2 How are infostates evolving?

The developmental chasm is evident regardless of which of the two main composite indicators is examined, infodensity or info-use. Generally, though, the gap appears somewhat smaller in info-use, suggesting that once developing countries have the technologies they do use them. The two composites for each country, together with the overall infostate indexes, and for each year of the study period, are contained in Table 1. Charts 2 and 3 show the relative country rankings for infodensity and info-use, respectively, and compare their evolution from 1995 to 2000.

Table 1. Composite indexes

	1995	1996	1997	1998	1999	2000
			INFOSTATE			
Canada	63.1	72.6	81.9	93.1	100.0	110.1
China	3.3	5.1	5.8	7.0	9.9	11.3
Colombia	9.1	12.7	15.3	18.2	21.2	23.0
Finland	72.3	77.9	89.2	94.4	97.0	100.1
India	1.7	2.4	3.0	3.5	4.3	5.0
Malaysia	15.9	23.8	27.1	29.7	32.7	36.1
Mexico	10.6	13.0	15.6	19.7	24.9	30.4
Senegal	1.8	2.8	3.5	4.5	5.7	7.8
South Africa	16.1	20.4	23.2	25.7	28.8	31.1
			Infodensity			
Canada	61.4	71.4	79.6	88.0	100.0	112.4
China	2.6	5.2	5.6	6.3	9.9	11.0
Colombia	8.0	12.9	15.5	18.5	23.4	24.7
Finland	89.1	97.3	119.5	124.7	126.8	132.8
India	1.1	1.8	2.6	3.2	4.0	4.9
Malaysia	15.2	25.1	28.0	31.3	34.5	37.2
Mexico	10.7	13.5	15.8	22.3	30.7	40.2
Senegal	1.0	1.6	2.3	3.1	4.1	7.4
South Africa	19.7	25.5	29.2	32.6	36.7	39.2
			Info-use			
Canada	64.9	73.9	84.3	98.4	100.0	107.8
China	4.1	5.0	6.1	7.8	9.8	11.5
Colombia	10.3	12.5	15.0	17.9	19.2	21.4
Finland	58.7	62.3	66.5	71.5	74.1	75.5
India	2.7	3.1	3.4	3.9	4.5	5.1
Malaysia	16.5	22.5	26.2	28.1	30.9	35.0
Mexico	10.5	12.6	15.3	17.3	20.2	23.0
Senegal	3.4	4.9	5.5	6.6	7.9	8.3
South Africa	13.1	16.3	18.4	20.3	22.6	24.6

Chart 2. Infodensity

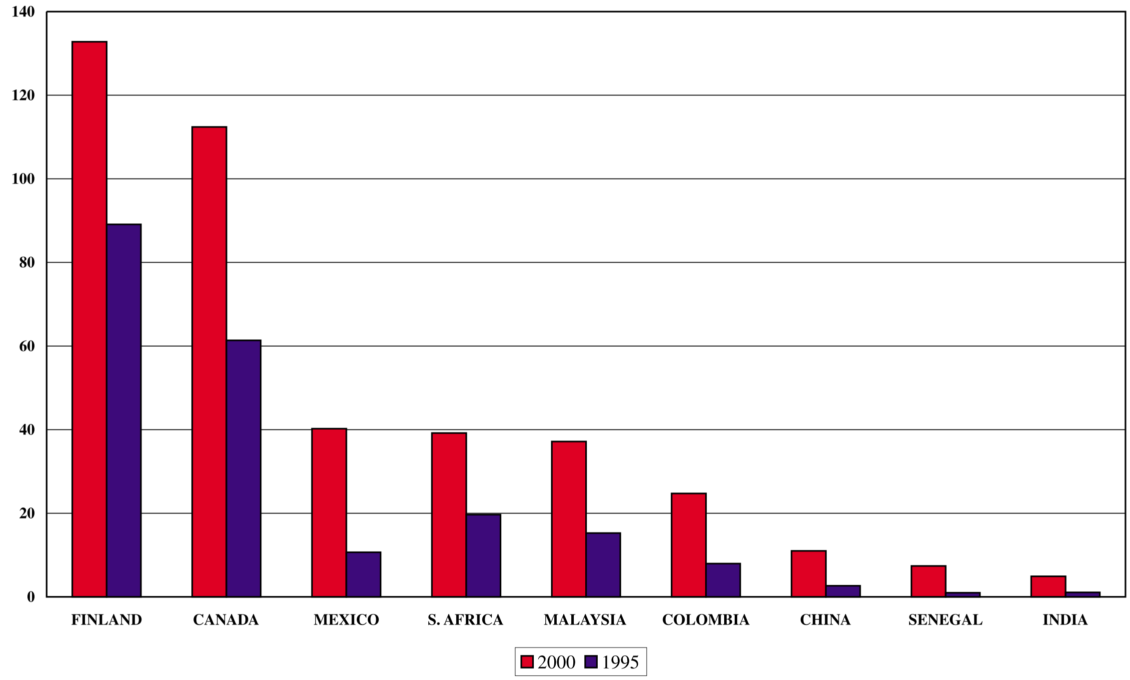
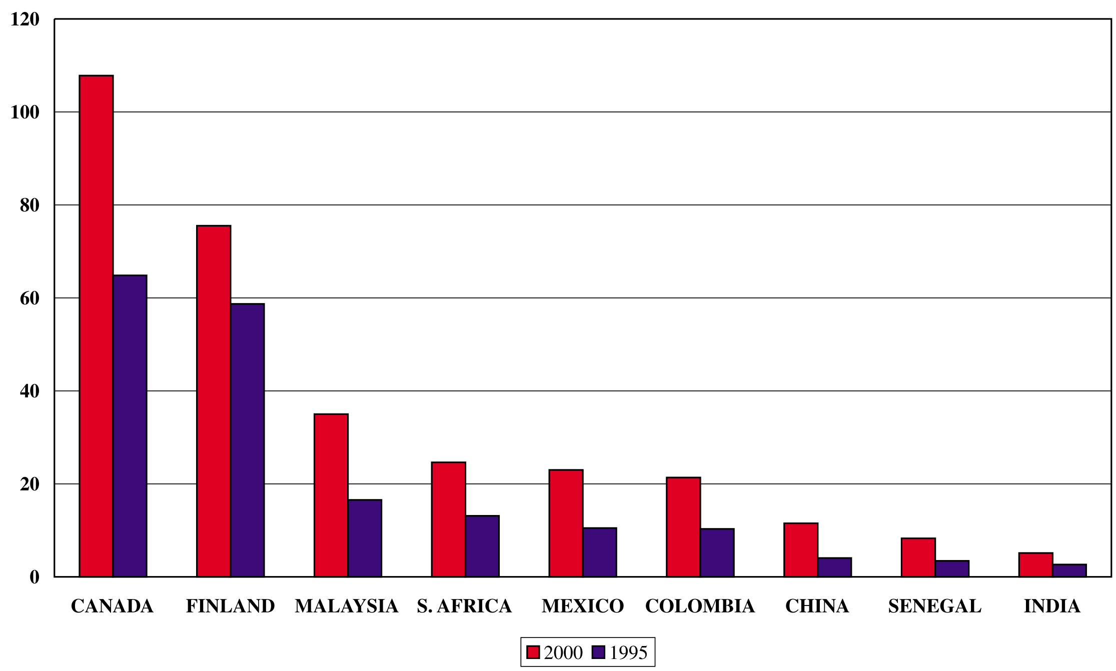


Chart 3. Info-use



Progress is being made every year in every country, including the countries with highly advanced infostates (Canada and Finland in our country group). Within the period under consideration, the rankings of the countries did not change much, except that in infodensity Mexico overtook S. Africa. Overall, in infostate, S. Africa was displaced from third place by Malaysia and is approached closely by Mexico, indicative of S. Africa's slower progress than these countries over the 1995–2000 period.

Growth has been generally higher in countries with very low infostates and lower in countries with advanced infostates. This is a pattern familiar in diffusion of new technologies. Thus, starting from very low, Senegal's infostate almost quadrupled, whereas Finland and Canada experienced slower rates of growth. As well, the countries with the lowest infodensity, China, Senegal and India, experienced sizeable growth compared to others, while info-use roughly doubled for developing countries between 1995 and 2000. Networks and uptake account for most of the growth. These results are shown in Table 2.

Table 2. Infostate growth: 1995-2000 (%)

	networks	skills	Infodensity	uptake	intensity	Info-use	INFOSTATE
Canada	3.4	1.0	1.8	1.8	1.5	1.7	1.7
China	16.5	1.1	4.2	5.5	1.5	2.8	3.4
Colombia	8.2	1.2	3.1	3.3	1.3	2.1	2.5
Finland	2.2	1.0	1.5	1.5	1.1	1.3	1.4
India	19.7	1.1	4.6	2.8	1.3	1.9	3.0
Malaysia	5.6	1.1	2.4	3.9	1.1	2.1	2.3
Mexico	13.9	1.0	3.8	2.6	1.8	2.2	2.9
Senegal	53.1	1.1	7.6	4.6	1.3	2.4	4.3
South Africa	3.7	1.1	2.0	3.0	1.2	1.9	1.9

6.3 Is the Digital Divide widening or closing?

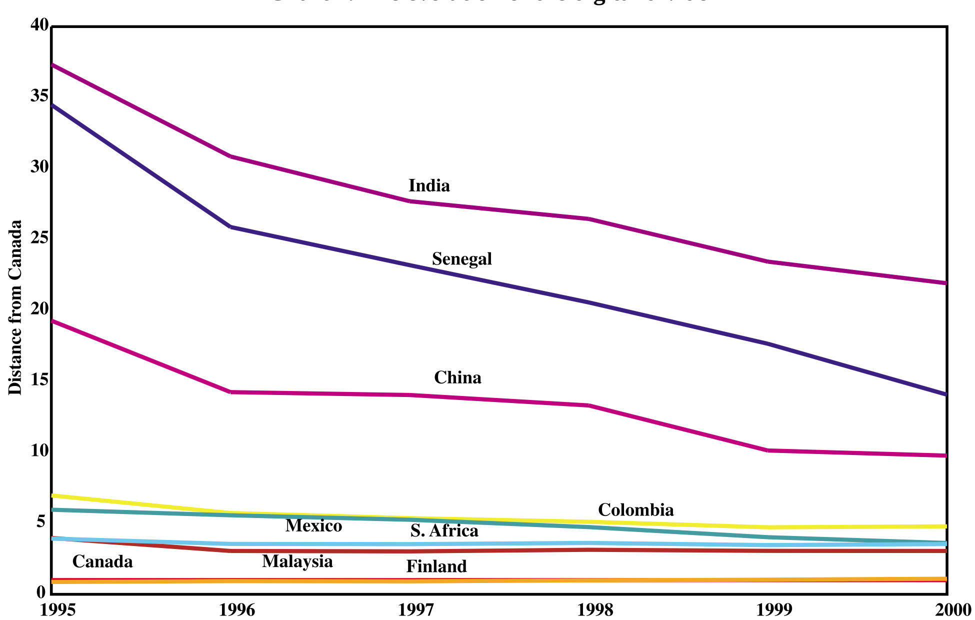
One way to tackle this issue analytically, is to use Canada as an anchor and compare the relative evolution of the other countries against Canada. This was done and the results are presented in Table 3.

Table 3. The evolution of the digital divide

	1995	1996	1997	1998	1999	2000
Canada	100.0	100.0	100.0	100.0	100.0	100.0
China	5.2	7.0	7.1	7.5	9.9	10.2
Colombia	14.4	17.5	18.6	19.6	21.2	20.9
Finland	114.7	107.3	108.8	101.5	97.0	91.0
India	2.7	3.2	3.6	3.8	4.3	4.6
Malaysia	25.2	32.8	33.0	31.9	32.7	32.8
Mexico	16.8	18.0	19.0	21.1	24.9	27.6
Senegal	2.9	3.9	4.3	4.9	5.7	7.1
South Africa	25.5	28.1	28.3	27.7	28.8	28.2

Over the period of examination, the digital divide appears to be closing for all developing countries. On average, it does so very slowly but there are noticeable differences in the speed among countries. A better idea of that speed can be obtained by calculating the ratios of Canada over the other countries' infostates (or among each other in comparative analyses) and tracing them over the six-year period of the study. This was done and displayed in Chart 4. Progress could be characterized as unsatisfactory and, considering the gaps involved, it could literally take generations before a substantial narrowing of the Digital Divide takes place without further intervention.

Chart 4. The evolution of the digital divide



6.4 Component analysis

More detailed analysis can identify what extent of this growth came from network infrastructure, skills, uptake or intensity of use, as well as individual indicators. Some striking observations include the tremendous lag of: India, Senegal and China in infrastructure; India and Senegal in uptake; India and China in intensity of use, and; Senegal in skills.

A key observation is that generally the gap is much less severe in skills and then in intensity of use compared to networks and uptake. This helps dampen the overall magnitude of the Digital Divide presented earlier. However, to a good extent this reflects the limitations of the indicators used. As explained in Chapter 5, measuring skills with the education index and its relatively low skill requirements, likely under-estimates the skills gap between developing and developed countries. (Moreover, for this sort of skills, developed countries have reached a saturation level). The scenario would probably be much worse for developing countries, if superior indicators of ICT skills were used. Another example comes from the use of relative ICT spending which, as has also been explained in Chapter 5, biases the measures in favour of developing countries due to the influence of relative prices. The results are summarized in Table 4.

Charts 5 and 6 reveal how a country more advanced in each of these four components can envelop another or how asymmetric performances can be identified between countries (when the lines cross). As well, the relative differences can be identified and examined. For instance, Malaysia outperforms Senegal in all four components, but does more so in skills and uptake than in networks and intensity of use. Or, the extent to which Malaysia outperforms Mexico in uptake and intensity of use exceeds the extent to which Mexico does better than Malaysia in networks and skills.

Chart 5. Cross-country comparisons I, 2000

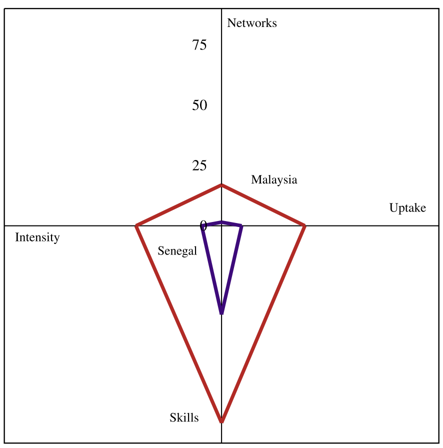


Chart 6. Cross-country comparisons II, 2000

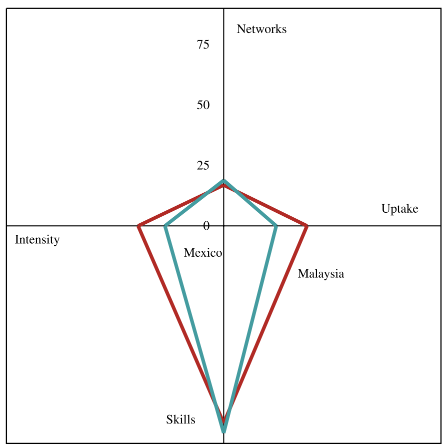
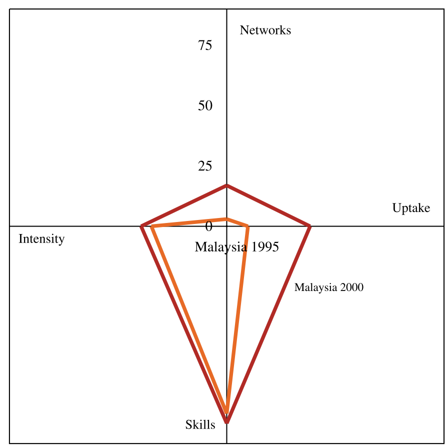


Chart 7. Intertemporal comparisons



Analogously, we can examine the relative progress of a country over time on a component-by-component basis. For instance, between 1995 and 2000, Malaysia improved significantly on all four, but did so proportionately more in uptake and networks, whereas the progress in skills and intensity of use were marginal (Chart 7).

In the process, we can identify and analyze specific sub-components responsible for the change, such as the teledensity part of networks. Of course, the analysis can be traced all the way to individual indicators. A sample is provided below.

Table 4. Component indexes

	1995	1996	1997	1998	1999	2000
			Networks			
Canada	37.3	50.4	62.8	76.7	100.0	126.3
China	0.1	0.3	0.4	0.5	1.2	1.5
Colombia	0.9	2.1	2.8	3.9	6.3	7.0
Finland	79.4	94.2	141.4	153.9	159.2	174.5
India	0.0	0.1	0.1	0.2	0.3	0.4
Malaysia	3.0	8.0	9.7	12.2	14.6	16.9
Mexico	1.4	2.2	3.0	5.8	11.0	18.9
Senegal	0.0	0.1	0.1	0.3	0.5	1.5
South Africa	4.6	7.6	9.6	11.8	15.2	17.3
			Skills			
Canada	101.0	101.0	101.0	101.0	100.0	100.0
China	77.6	78.6	79.6	80.6	81.6	81.6
Colombia	73.5	79.6	85.7	86.7	86.7	86.7
Finland	100.0	100.5	101.0	101.0	101.0	101.0
India	54.1	54.6	55.1	56.1	57.1	57.1
Malaysia	77.6	79.1	80.6	80.6	81.6	81.6
Mexico	83.7	84.2	84.7	85.7	85.7	85.7
Senegal	33.7	34.7	35.7	36.7	36.7	36.7
South Africa	83.7	86.2	88.8	89.8	88.8	88.8
			Uptake			
Canada	57.6	65.5	78.9	91.7	100.0	104.7
China	3.1	4.5	6.0	9.3	13.6	17.4
Colombia	7.3	9.8	13.2	17.2	20.8	24.4
Finland	69.2	75.5	83.4	91.1	95.6	100.7
India	2.7	3.4	3.8	4.8	6.2	7.5
Malaysia	8.8	13.4	18.2	24.7	28.7	34.5
Mexico	8.3	10.5	13.5	16.2	19.0	21.8
Senegal	1.8	3.4	4.3	5.6	7.6	8.3
South Africa	8.6	12.3	15.1	19.0	22.5	25.8
			Intensity			
Canada	73.0	83.3	90.1	105.6	100.0	111.0
China	5.2	5.6	6.2	6.5	7.1	7.6
Colombia	14.5	15.9	17.0	18.7	17.6	18.7
Finland	49.8	51.5	53.1	56.2	57.5	56.6
India	2.6	2.9	3.1	3.1	3.3	3.5
Malaysia	31.2	37.7	37.7	31.9	33.3	35.5
Mexico	13.3	15.1	17.5	18.5	21.3	24.3
Senegal	6.5	6.9	7.0	7.6	8.1	8.2
South Africa	20.2	21.7	22.4	21.8	22.8	23.5

6.5 At the level of individual indicators

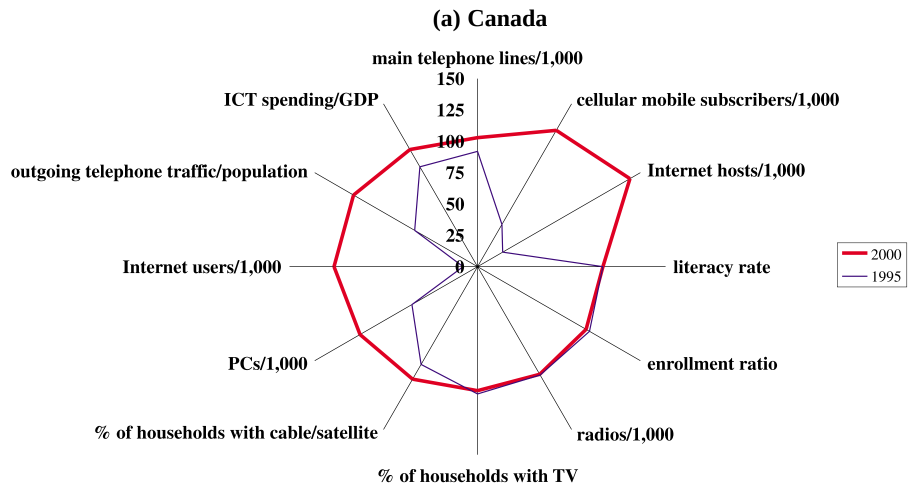
At this level of analysis, the differences across countries are more pronounced, indicative of their "personalized" development experience. Knowledge of each and every indicator comes to bear and, combined with outside information and knowledge, can be revealing.

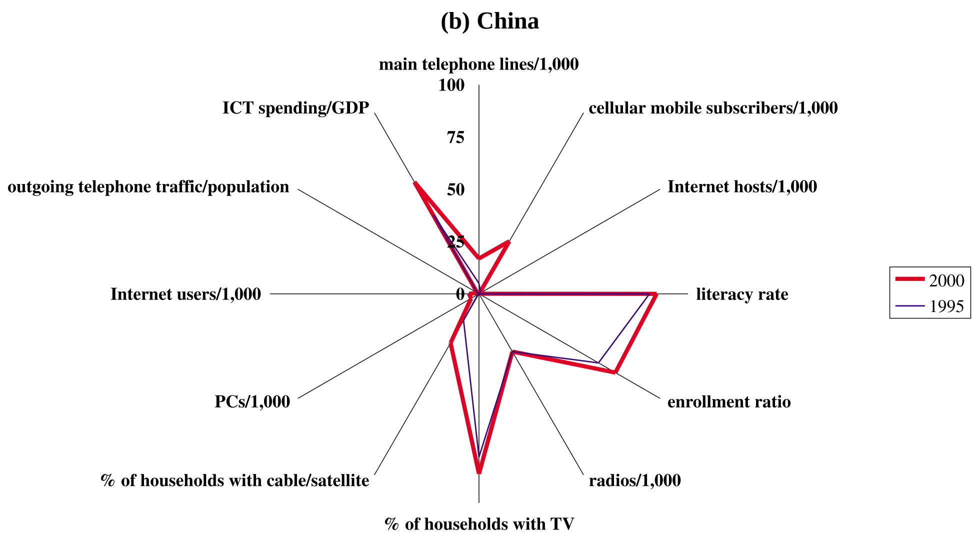
Comparing the situation of individual countries, several things stand out as noteworthy (see Charts 8a – 8i). For instance, from a 'skewed' situation in 1995, by 2000 Canada made significant progress in the areas of new technologies, i.e. Internet users, Internet hosts and cellular mobile subscribers. Finland's already high uptake of cellular telephony has had an exceptional acceleration.

The situation of developing countries, on the other hand, is different. The emerging patterns are quite lopsided. Although it is evident that growth comes mainly from the diffusion of newer technologies, progress in other areas, such as skills, is barely detectible. Not only do they have a great distance to cover before they start to look like the developed countries, but they also have a long way to go before they achieve more balance within their countries.

This level of detail is also the most appropriate to identify issues related to the data.

Chart 8. Country indicators





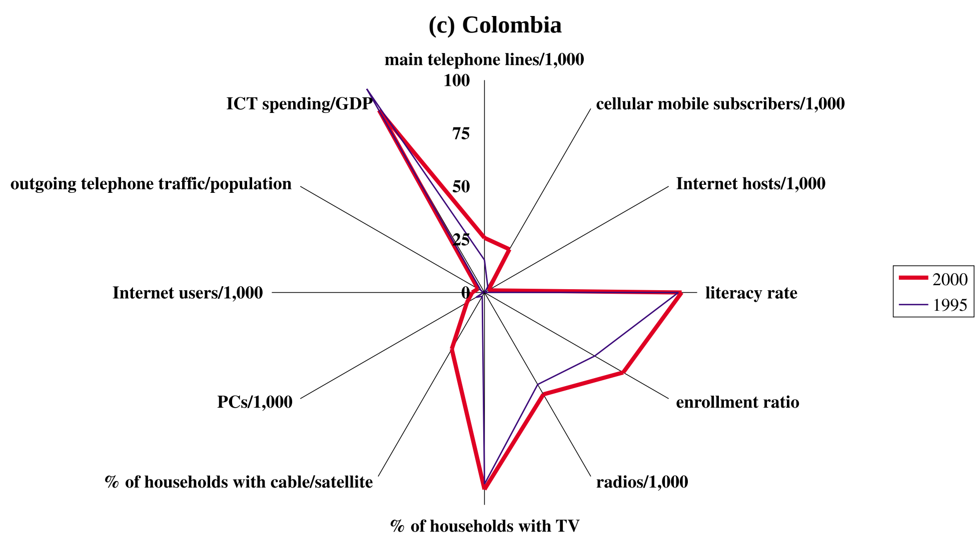
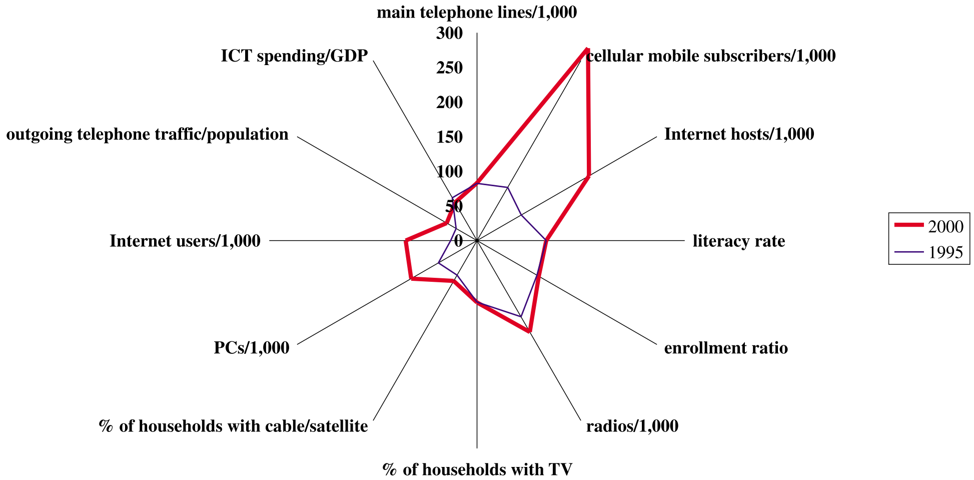
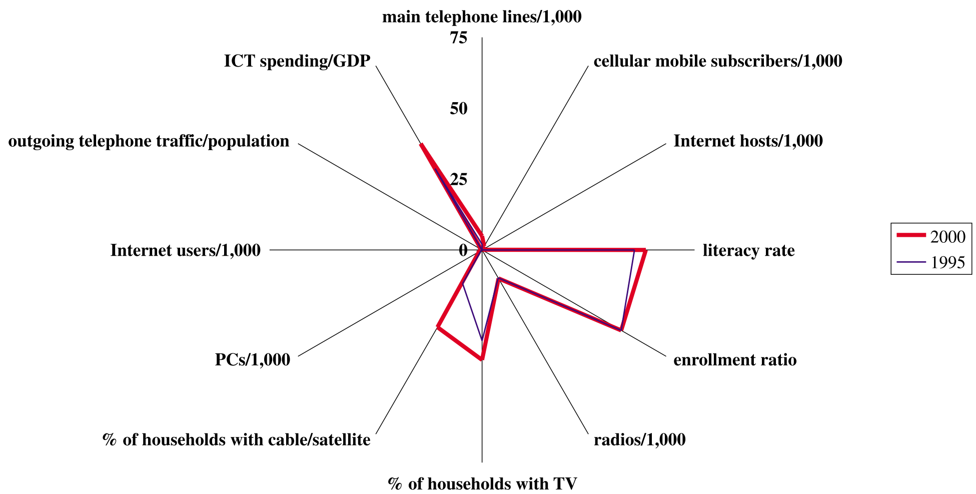


Chart 8. Country indicators (cont'd)

(d) Finland



(e) India



(f) Malaysia

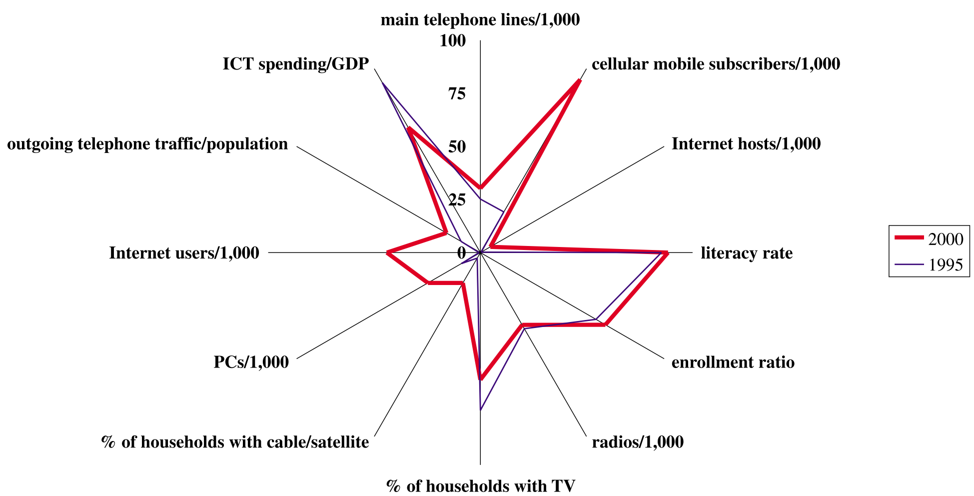
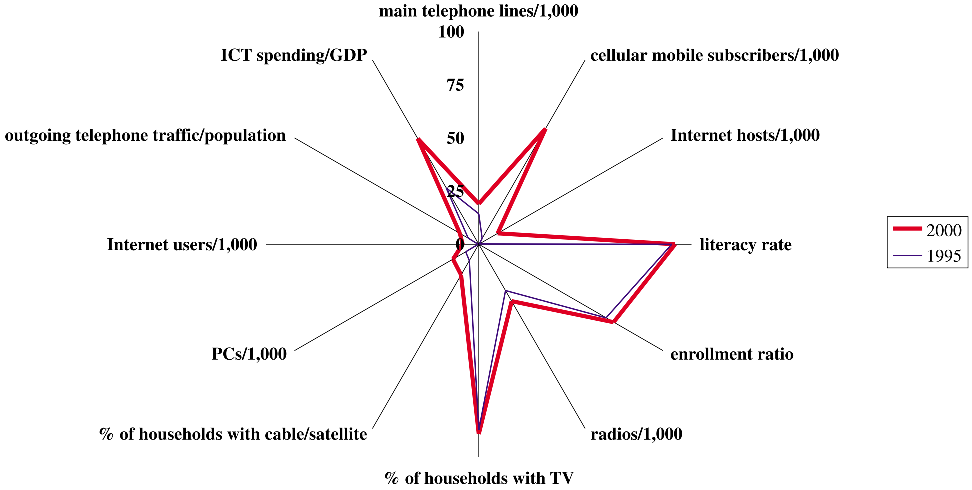
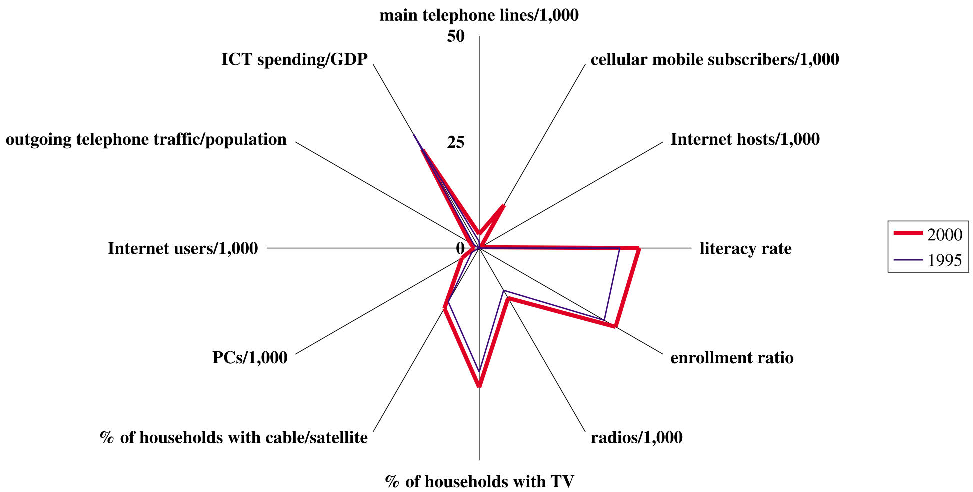


Chart 8. Country indicators (cont'd)

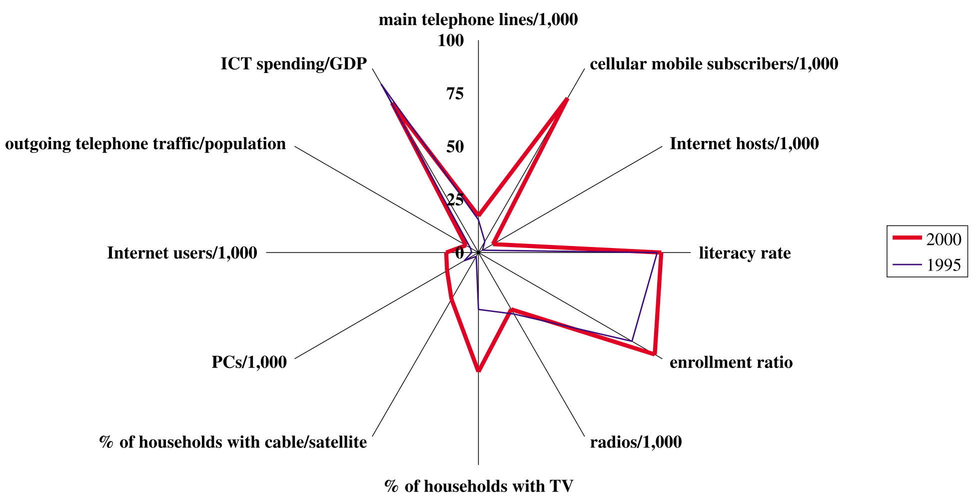
(g) Mexico



(h) Senegal



(i) S. Africa



CHAPTER 7. WHAT NEXT

This report concludes Phase I of the project to monitor the Digital Divide. It proposes a new approach, and puts it to the test. It also offers a sample of the analytical output that can be produced so that its worth can be assessed.

As in every new effort, during the work and the process associated with this phase, valuable lessons have been learned and experiences accumulated. These can now be leveraged as the project moves on to Phase II and beyond.

Starting with this publication, one of the first next steps involves the broad dissemination of the outputs of Phase I. They will be made accessible to all with an interest in this subject matter area, whether in the international community or at a national level. This will be accomplished through a variety of means, including consultations and events. It is envisaged that new stakeholders will join the core group. Such collaboration will contribute both to the improvement and the expansion of the project.

Refinements would start to be introduced to the methodology, as necessary. These can come in the form of value-added modifications, appropriate adaptations, or fine-tuning in order to accommodate additional layers of desired detail. During Phase II, considering the data limitations discussed in this report, emphasis can be placed on tapping individual country sources, in addition to the generic ones. This will provide further insights into specific ICT-related gaps and their evolution. Applications of the model in regional contexts could also prove revealing.

The full potential of the project can be realized by probing beyond the core challenge of measurement. Pertinent outside intelligence can be solicited, something that promises to add explanatory power to the analysis. In parallel, much can be gained by undertaking cross-cutting thematic studies, outside country lines. Studying, for example, ICTs in education or tele-health would complement well work done under the framework. The above activities will be most fruitful if done with the participation and active involvement of the countries themselves, who would help shape the identity of the project.

Lastly, an effort will start to go beyond the Digital Divide and gain more of an understanding of the broader knowledge divide, as so much depends on it for the functioning of societies of the future.

BIBLIOGRAPHICAL REFERENCES

Canada (1996) Dickinson, Paul and Sciadas, George "Access to the Information Highway", Canadian Economic Observer, Cat. No. 11-010-XPB, December.

Conference Board of Canada (2001) "Connectedness and the Economy: Measuring Our Performance", January.

European Audiovisual Observatory (1999) "Statistical Yearbook".

G8 (2001) "Digital Opportunities for All: Meeting the Challenge", Report of the Digital Opportunity Task Force (DOT Force), including a proposal for a Genoa Plan of Action.

Gordon, Robert J (1999) "Does the 'New Economy' Measure Up to the Great Inventions of the Past?" Journal of Economic Perspectives, 14 (4), Fall.

ITU (2001) "World Telecommunication Indicators", Geneva.

Jorgenson, Dale W and Stiroh, Kevin J (2000) "Raising the Speed Limit: U.S. Economic Growth in the Information Age", Brookings Papers on Economic Activity, 1.

Malaysia (2001) "K-Measures: Towards a Knowledge Society", http://www.infosoc.nitc.org.my.

McConnell International (2001), "Ready? Net. Go! Partnerships Leading the Global Economy", May.

OCED (2001) "Understanding The Digital Divide", Paris.

OECD/UN/UNDP/World Bank Global Forum, "Exploiting the Digital Opportunities for Poverty Reduction", Paris, March,. http://www.oecd.org.

Orbicom (1999) "New Partnerships in Communications for the 21st Century", Conference Proceedings.

UNDP (2000) "Human Development Report", Technical and Statistical Notes, http://www.undp.org/hdr2000/english/HDR2000.html.

US (1995) "Falling through the Net: A Survey of the 'Have Nots' in Rural and Urban America", Washington.

ACKNOWLEDGEMENTS

This research was made possible thanks to Orbicom and the dedication of its Secretary General, Vice-Rector Claude-Yves Charron, and the financial contributions of the Canadian International Development Agency (CIDA) and the National Research Council Canada (NRC).

Orbicom is also thankful to Dr. George Sciadas who conducted this research in his capacity of Scientific Director of the project. Dr. Sciadas is currently Chief of Information Society Research and Analysis in the Science, Innovation and Electronic Information Division and Editor of "Connectedness Series" at Statistics Canada. Thanks also to Mr Chin Saik Yoon, Chair, Research and Publications Committee for Orbicom and Editor and Managing Director of Southbound, Penang, Malaysia, who developed the concept of the digital divide index and contributed to this research in his capacity of Co-director of the project.

A number of people and organizations served on the project's Consultative Committee or participated in the Roundtable of Experts at the Digital Divide Symposium of Austin, TX. Some contributed to determine the terms of references and benchmarks. The same core group with others, who got involved at a later stage, assisted in shaping the design of Phase II which should be launched in April 2002 with wider contributions.

In addition to the Co-chairs, Dr. Jacques Lyrette and Mr. Tony Zeitoun, and to Dr. George Sciadas and Mr. Chin Saik Yoon, Orbicom wishes to extends its deep appreciation to following people involved in the Consultative Committee and/or the Roundtable of Experts:

Richard Bourassa, Director, International Affairs, Electronic Commerce Branch, Industry Canada
José Carreno Carlon, UNESCO Chair Holder in Communication, Universidad Iberoamericana, Mexico
Chu Shiu-Kee, Programme Specialist, UNESCO Institute for Statistics
Yves Courrier, Senior Program Officer, Information and Informatics Division, UNESCO
Carl Dahlman, World Bank Institute
Richard Fuchs, Director, Information and Communication Technologies for Development, IDRC
Concetta Gasbarro, Statistician, UNESCO Institute for Statistics
Bo Goransson, Research Policy Institute, Lund University, Sweden
Suhbash Joshi, Group Director, Social Research, Indian Space Research Organization
Denise Lievesley, Director, UNESCO Institute for Statistics
Beverly Mahony, International Affairs, Industry Canada
Ramasamy Ramachandran, Statistician, Mimos, Malaysia
Miguel Sales, Senior Program Officer, Communication and Information, UNESCO
Martha Stone, Senior Advisor, Orbicom, and Senior Partner, Moenston Associates
Diane Stukel, Statistician, UNESCO Institute for Statistics
Yves Théorêt, Associate Researcher, Orbicom and Professor at UQÀM
My von Euler, Consultant, UNESCO Institute fo Statistics
Ellen Wartella, UNESCO Chair Holder in Communications, University of Texas at Austin
Nalan Yuksel, Knowledge and Development Initiatives, CIDA

This research would not have been possible without the involvement and active support of Pierre Giguère, seconded until the Fall of 2001 to the Orbicom International Secretariat and UQÀM as Ambassador-in Residence by Canada's Department of Foreign Affairs and International Trade. Mr. Giguère has continued his involvement until the completion of the research as the project's Special Coordinator.

REMERCIEMENTS

Cette recherche a été possible grâce à Orbicom et au dévouement de son secrétaire général, le vice-recteur Claude-Yves Charron, et aux contributions financières de l'Agence canadienne de développement international (ACDI) et au Conseil national de Recherches Canada (CNRC).

Orbicom est également redevable au Dr. George Sciadas qui a dirigé la recherche en qualité de directeur scientifique du projet. Le Dr. Sciadas est présentement Chef, Recherche et analyse sur la société de l'information, Division des sciences, de l'innovation et de l'information électronique, et éditeur de la série de publications sur la connectivité, à Statistique Canada; et à monsieur Chin Saik Yoon, président du Comité des recherches et des publications d'Orbicom, et éditeur et directeur exécutif de la maison d'édition Southbound à Pénang, en Malaisie, qui a développé l'idée de construire un index de la fracture numérique et qui a contribué à la recherche en qualité de co-directeur du projet.

Bon nombre de personnes et organisations ont participé aux délibérations du Comité aviseur du projet et/ou à la table ronde d'experts au symposium d'Austin sur la fracture numérique. Quelques-unes ont participé à la définition des paramètres .Ce même groupe, auquel se sont ajoutées d'autres personnes qui sont intervenues plus tardivement, a contribué à bâtir l'architecture de la phase II qui devrait débuter en Avril 2002 avec de plus larges contributions.

En plus des coprésidents, Messieurs Jacques Lyrette et Tony Zeitoun, et des codirecteurs du projet, messieurs George Sciadas et Chin Saik Yoon, Orbicom tient à remercier bien sincèrement les personnes suivantes pour leur implication au sein du Comité aviseur et/ou de la table ronde d'experts:

Richard Bourassa, directeur, Affaires internationales, Direction générale du commerce électronique, Industrie Canada
José Carreno Carlon, titulaire de la chaire UNESCO en communication, Universidad Iberoamericana, Mexico
Chiu Shiu-Kee, spécialiste de programme, Institut de Statistique de l'UNESCO
Yves Courrier, gestionnaire sénior de programme, Division de l'information et de l'informatique, UNESCO
Carl Dahlman, World Bank Institute
Richard Fuchs, directeur, Technologies de l'information et des communications, CRDI;Concetta Gasbarro, statisticienne Institut de Statistique de l'UNESCO
Bo Goransson, Research Policy Institute, Lund University, Sweden
Subhash Joshi, Group Director, Social Research, Indian Space Research Organization
Denise Lievesly, directrice, Institut de Statistique de l'UNESCO
Beverly Mahony, Affaires internationales, Industrie Canada
Ramasamy Ramachandran, statisticien , Mimos, Malaisie
Miguel Sales, gestionnaire sénior de programme, Communication et Information, UNESCO
Martha Stone, conseillère sénior, Orbicom et partenaire sénior de Moenston Associates
Diane Stukel, statisticienne, Institut de statistique de l'UNESCO
Yves Théorêt, chercheur associé, Orbicom, et professeur à l'UQÀM
My von Euler, consultante pour l'Institut de Statistique de l'UNESCO
Ellen Wartella, titulaire de la chaire UNESCO en communication, University of Texas at Austin
Nalan Yuksel, Initiatives pour le savoir et le développement, ACDI

Cette recherche n'aurait pas été possible sans l'implication active et le soutien de monsieur Pierre Giguère, détaché à Orbicom et à l'UQÀM jusqu'à l'automne 2001, en qualité d'ambassadeur-en-résidence, par le ministère des Affaires étrangères et du Commerce international. Monsieur Giguère a poursuivi sa collaboration jusqu'à la fin du projet à titre de coordonnateur spécial.

ORBICOM

THE INTERNATIONAL NETWORK OF UNESCO CHAIRS IN COMMUNICATIONS

Since its inception in 1994, the Orbicom Network 's unique contribution lies in its determination to bring academics, industry professionals, and public sector actors in communications together to participate in shared research and action projects. Too often these domains remain separate and the need to share information, best practices,and resources is ever more crucial in the converging global information economy.

The Network unites 25 Chairs in Communications throughout the world: in Western Europe (Denmark, France, Germany, Spain and the United Kingdom); Eastern Europe (Bulgaria, Hungary, Lithuania, Russia); Central Asia (Kazakhstan); Asia/Pacific (Australia, Japan, Philippines); Africa (Côte d'Ivoire and Morocco); Latin America (Mexico, Uruguay, Brazil, Columbia); and North America (Canada and the United States).

Orbicom brings together over 250 individual members in 60 countries, with representation from communications research, journalism, multimedia, public relations, communications law, international development, and more. Ten representatives of UN Agencies including UNDP, UNOPS, UNFPA, and UNESCO are also key members. The Network achieved full accreditation with consultative status at the Economic and Social Council of the UN in 1997.

At the heart of Orbicom is a commitment to a policy of convergence — of ideas, of disciplines, of languages, of sectors, and of regions and nations. The Network shares with UNESCO a commitment to promoting freedom of expression, pluralism, development of infrastructures, and democratization.

Orbicom seeks to develop all disciplines of communications through research programmes, missions of intervention, student/teacher exchanges, professional development, courses abroad for young professionals, seminars, symposia and congresses, all of which facilitate transcultural relations, technology transfer, and the valuation and exchange of different forms of knowledge.

The Network is trilingual (French, Spanish, and English) and its International Secretariat is located at the Université du Québec à Montréal. Orbicom supports the Internet as a dynamic tool for global communication and maintains a trilingual website which is updated regularly (http://www.orbicom.uqam.ca).

Two notable current activities include the distribution of New Partnerships in Communications for the 21st Century: Strategies for Governance, Technology, Employment and Lifelong Learning (1999), the proceedings from the Connecting Knowledge: Bridging the Gap Between Training and Employment in Communications which was held in Montreal on April 14-17 1999; and the book Freedom of Expression and New Communication Technologies (1998). Publication of a research on Trust in Ecommerce entitled Generating Trust in Online Business (2002) and the current publication on the Digital Divide (2002).

ORBICOM

ORBICOM — LE RÉSEAU INTERNATIONAL DES CHAIRES UNESCO EN COMMUNICATION

Le réseau international des Chaires UNESCO en communication Orbicom a pour mandat de travailler au développement de toutes les disciplines de la communication dans le monde. Par le biais de plusieurs programmes d'activité mis en place par le réseau des Chaires UNESCO en communication et grâce à l'action convergente de ses associés répartis dans 60 pays, Orbicom devient l'un des principaux regroupements de spécialistes de la communication basés sur le partenariat multinational et multidisciplinaire.

Le réseau des Chaires UNESCO en communication regroupe 25 chaires réparties sur tous les continents : Europe de l'Ouest (Allemagne, Angleterre, Danemark, Espagne, France), Europe de l'Est (Bulgarie, Hongrie, Lituanie, Russie), Asie centrale (Kazakhstan), Asie pacifique (Australie, Japon, Philippines), Afrique (Côte d'Ivoire, Maroc), Amérique latine (Mexique, Uruguay, Brésil, Colombie) et Amérique du Nord (Canada, États-Unis).

Orbicom rassemble plus de 250 membres associés de 60 pays. La moitié de ces associés est composée de chercheurs, d'intervenants et de professeurs, et l'autre, de professionnels des communications de l'entreprise, des médias et du multimédia, du journalisme, des relations publiques et du droit des communications. Dix représentants d'agences de l'ONU, telles que le PNUD, l'UNOPS, l'UNFPA, l'UNESCO et le Secrétariat de l'ONU, à New York font aussi partie du réseau. Orbicom a obtenu son accréditation avec statut consultatif au Conseil Économique et Social de l'ONU (ECOSOC) au printemps 1997.

L'action du réseau s'appuie sur une politique de la convergence de visions, d'approches multidisciplinaires, multilinguistiques, multisectorielles et transnationales. Le réseau adhère à la stratégie des communications mise de l'avant par l'UNESCO, qui promeut la liberté d'expression, la circulation libre de l'information, des infrastructures, le pluralisme et les processus de démocratisation : chacune de ces réalités contribue au renforcement des sociétés civiles.

Les échanges et les stages des professeurs-chercheurs et des professionnels de l'entreprise privée, spécialisée en communication, les recherches appliquées et les publications, les colloques et les conférences, les groupes de discussion sur le site Internet, voilà autant d'activités conjointes qui encouragent l'action multilatérale et multidisciplinaire en info/communication.

Les langues utilisées pour les publications, la correspondance et le Web sont l'anglais, le français et l'espagnol. Le Secrétariat international du réseau Orbicom est situé à Montréal. Il est hébergé par l'Université du Québec à Montréal (l'UQÀM). Le site Web d'Orbicom, accessible à l'adresse www.orbicom.uqam.ca, est mis à jour régulièrement. Il constitue un outil dynamique de communication pour les membres répartis dans plusieurs pays du monde.

Entre autres activités du réseau se trouve la mise en place d'un programme de suivi dans le contexte du Plan d'action adopté au cours de la conférence internationale « Les connexions du savoir : combler l 'écart entre la formation et l'emploi en communication » tenue en avril 1999 à Montréal ; la publication des actes de la conférence, intitulés Les nouveaux partenariats de la communication à l'aube du 21 e siècle : stratégies de gouvernance, de technologie, d'emploi et d'apprentissage à long terme (1999) ; le livre Liberté d'expression et nouvelles technologies (1998). Isabelle Quentin éditeur, le livre sur le commerce électronique, comment créer la confiance (2002) et le présent ouvrage.

ORBICOM—THE INTERNATIONAL NETWORK OF UNESCO CHAIRS IN COMMUNICATIONS

Université du Québec à Montréal
P.O. Box 8888 Downtown Station
Montreal, Quebec
Canada H3C 3P8

Phone: (1 514) 987 8743
Fax: (1 514) 987 0249
E-mail: orbicom@uquam.ca
http://www.orbicom.uqam.ca

MONITORING THE DIGITAL DIVIDE
OBSERVATOIRE DE LA FRACTURE NUMÉRIQUE